LATE QUATERNARY VOLCANIC STRATIGRAPHY OF THE SOUTHEASTERN SECTOR OF THE MOUNT RUAPEHU RING PLAIN NEW ZEALAND

A thesis presented as partial fulfilment of the requirements
for the degree of

Doctor of Philosophy in Soil Science

by

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TABLE OF CONTENTS

VOLUME I

PREFACE . . . . . *i*
CHAPTER 1 Introduction 1
CHAPTER 2 Identification and Correlation of Rhyolitic Tephras, Tongariro Volcanic Centre 14
CHAPTER 3 Andesitic Tephrostratigraphy and Tephrochronology, Tongariro Volcanic Centre 84
CHAPTER 4 Mineralogy and Chemistry of Tongariro Volcanic Centre Tephras 154
CHAPTER 5 Stratigraphy and Chronology of Laharic Deposits on the Southeastern Mt Ruapehu Ring Plain 243
CHAPTER 6 Volcanic Hazard 290
CHAPTER 7 Summary 307
BIBLIOGRAPHY 321

VOLUME II

APPENDIX I
METHODOLOGIES

Ia Similarity Coefficient/Coefficient of Variation *A2*
Ib Tephra Volume Calculation *A3*
Ic Thin Section Polishing *A15*

APPENDIX II
STRATIGRAHIC SECTION DESCRIPTIONS

IIa Stratigraphic Section Descriptions *A16*

APPENDIX III
ELECTRON MICROPROBE AND X-RAY FLUORESCENCE ANALYSES

IIIa Rhyolitic Glass *A176*
IIIb Clinopyroxene *A194*
IIIc Orthopyroxene *A225*
IIId Olivine *A256*
IIIe Hornblende *A264*
IIIf Titanomagnetite/Ilmenite *A275*
IIIg Glass *A282*
IIIh Bulk Rock Pumice Lapilli *A293*

APPENDIX IV
MISCELLANEOUS

IVa Lithic:Pumiceous:Scoriaceous Lapilli Ratios *A295*
IVb Palynological Results *A296*

APPENDIX I

METHODOLOGIES

Ia	Similarity Coefficient Coefficient of Variation	*p. A2*
Ib	Tephra Volume Calculation	*p. A3*
Ic	Thin Section Polishing	*p. A15*

Appendix Ia: Similarity Coefficient and Coefficient of Variation

Similarity Coefficient and Coefficient of Variation calculations (after Borchardt *et al.* 1971).

$$Similarity\ Coefficient = \frac{\sum \left(\frac{a_1}{b_1} \cdots \frac{a_n}{b_n} \right)}{n}$$

Where:
- *a* and *b* are the normalised weight % values for each element pair being compared
- *n* = the number of element pairs being compared
- the values of *a* and *b* are arranged so that the value *a/b* is ≤1.0

Eight oxides have been used in the calculation (SiO_2, Al_2O_3, TiO_2, FeO, MgO, CaO, Na_2O, K_2O). Riehle *et al.* (1990) excludes from the calculation oxides with weight percent values of <0.40.

$$Coefficient\ of\ Variation = 100 * S * \sqrt{\bar{x}}$$

Where:
- the mean, $\bar{x} = \frac{\sum \left(\frac{a_1}{b_1} \cdots \frac{a_n}{b_n} \right)}{n}$, and $S = \sqrt{\frac{\sum \left(\frac{a_1}{b_1} - \bar{x} \cdots \frac{a_n}{b_n} - \bar{x} \right)^2}{n-1}}$
- *a* and *b* are the normalised weight % values for each element pair being compared
- *n* = the number of element pairs being compared
- the values of *a* and *b* are arranged so that the value *a/b* is ≤1.0

Appendix Ib: Calculation of Tephra and Lahar Volumes

Tephra Volumes

For most tephras only partial tephra distributions can be prepared from thickness data within the study area. A mathematical model assuming a constant isopach shape and exponential decay away from the point of maximum thickness is favoured for tephra volume estimates in such circumstances. Both Froggatt (1982b) and Pyle (1989) provide variations of a formula based on concentric circular and ellipse-shaped isopachs, which can be written:

$$\text{Tephra Volume} = 2\pi T_0 \sigma \overline{k_s^{\frac{1}{2}}} = 13.08\, T_0 \sigma a_{1/2}^2$$

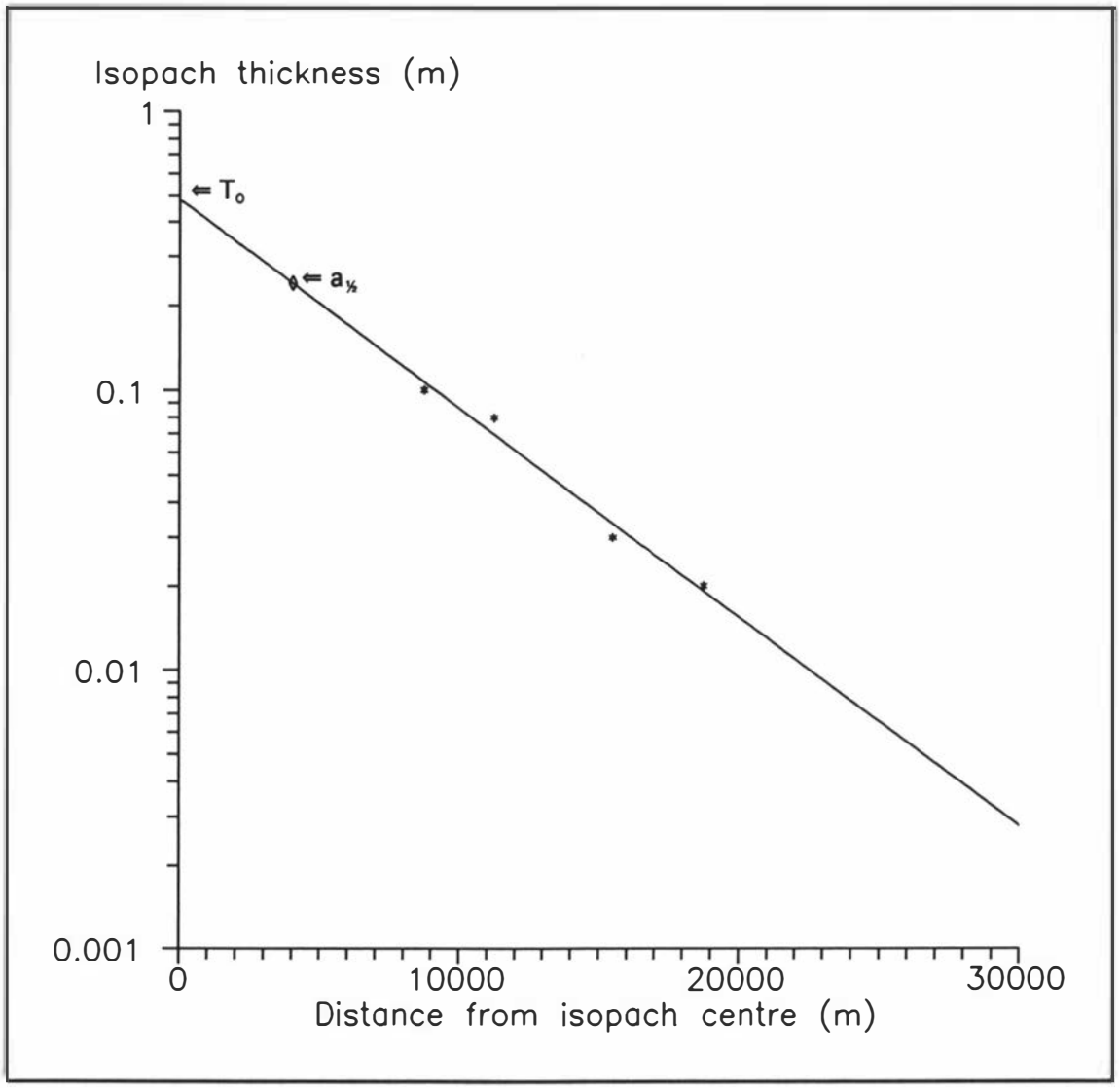
Where:

- T_0 = extrapolated thickness of tephra at isopach centre (assumed point of maximum thickness and source);
- $a_{1/2}$ = half thickness distance along major axis;
- σ = isopach "ellipticity" (minor axis/major axis) [for a circle $\sigma = 1$];
- k_s = thickness decay constant along major axis (slope on log(thickness)-distance plot).

In elliptical calculations the point of maximum tephra thickness (tephra source) is assumed to be at ellipse centre and not at a focus.

Estimates calculated on the basis of both circular isopach assumption and elliptical isopach assumption are presented where practicable. Partial distributions prepared suggest that the study area lies along the axis of dispersal for many tephra (also supported by the wind pattern in the area), and that isopach shape often closely resembles a deformed ellipse with the point of maximum thickness at the distant focus and minor axis width greatest at closer focus. The use of an assumed circular isopach pattern based on the partial distribution in the study area leads to a considerable over-estimation of tephra volume. A standard elliptical isopach pattern provides a better, but still conservatively large, estimate.

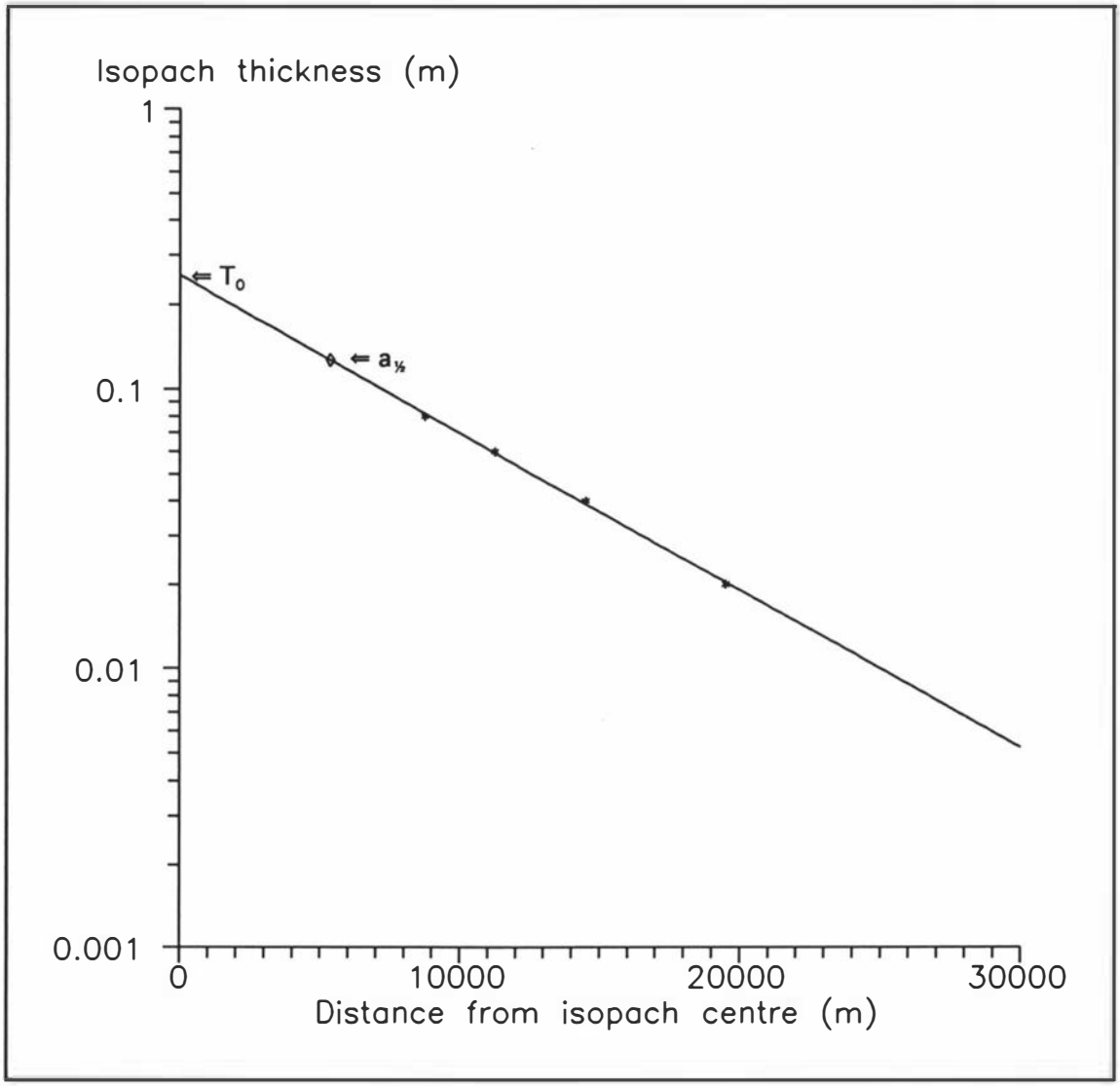
Member Tf8, Tufa Trig Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[*a*]	[k_a]
0.10	8750	4375	0.500	0.000180
0.08	11250	6000	0.533	0.000159
0.03	15500	7875	0.508	0.000179
0.02	18750	8750	0.467	0.000170
		Average	0.502	0.000172

Best fit line formula	$y = exp(-0.000171798x) * 0.481087$
Thickness at isopach centre [T_0]	0.481 m
Decay constant [k_a] (best fit)	0.000172
Distance from centre to half thickness [$a_{½}$]	4037 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	103 x10^6 m^3
Volume [ellipse: $V = 2\pi T_0 a/(k_a)^2$]	51 x10^6 m^3

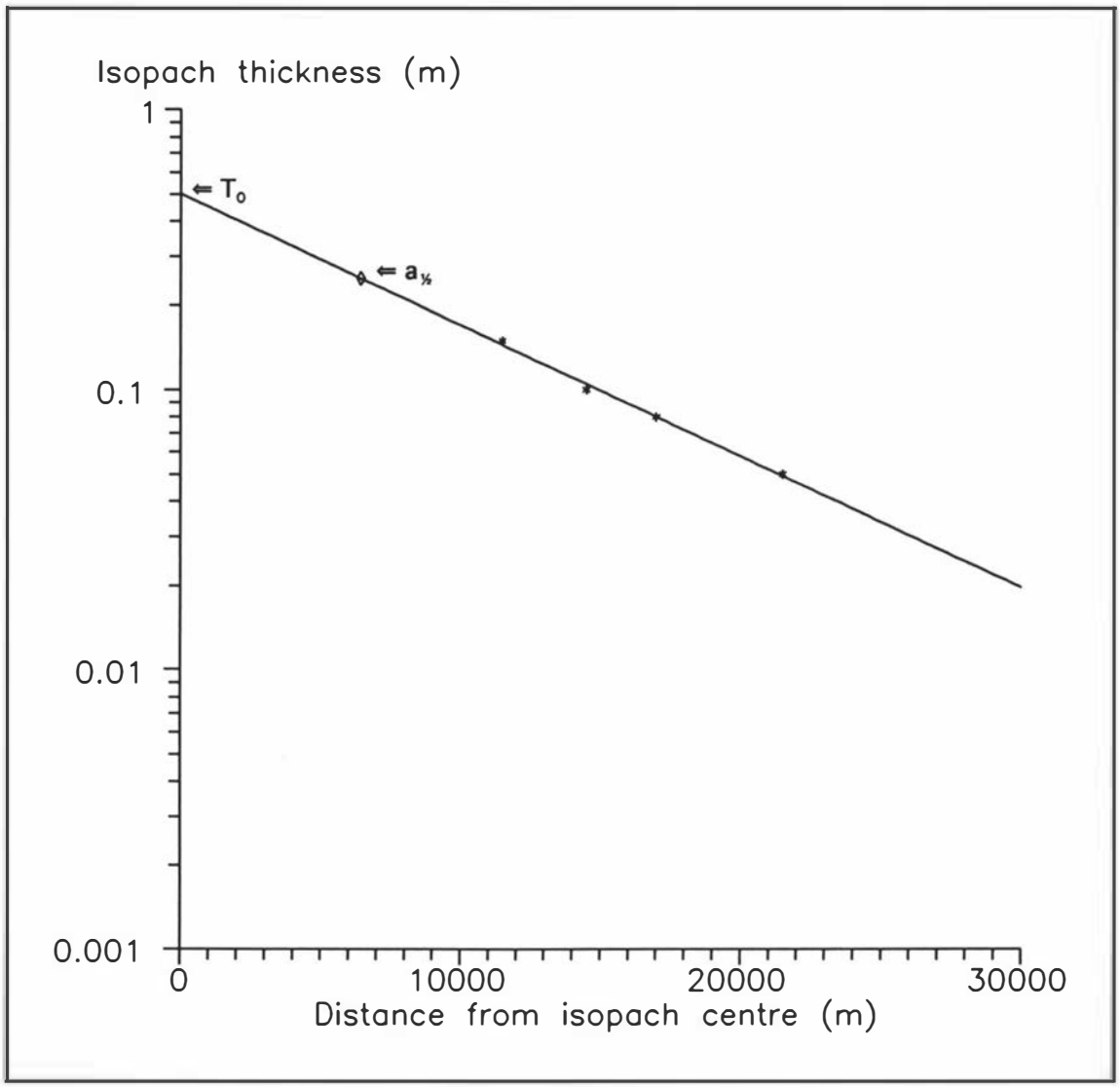
Member Tf6, Tufa Trig Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[σ]	[k_e]
0.08	8750	2375	0.271	0.000132
0.06	11250	4000	0.356	0.000128
0.04	14500	5250	0.362	0.000127
0.02	19500	7625	0.391	0.000130
		Average	0.345	0.000130

Best fit line formula	$y = exp(-0.000129418x) * 0.254013$
Thickness at isopach centre [T_0]	0.254 m
Decay constant [k_e] (best fit)	0.000129
Distance from centre to half thickness [$a_{½}$]	5357 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	95 x10^6 m^3
Volume [ellipse: $V = 2\pi T_0 a/(k_e)^2$]	33 x10^6 m^3

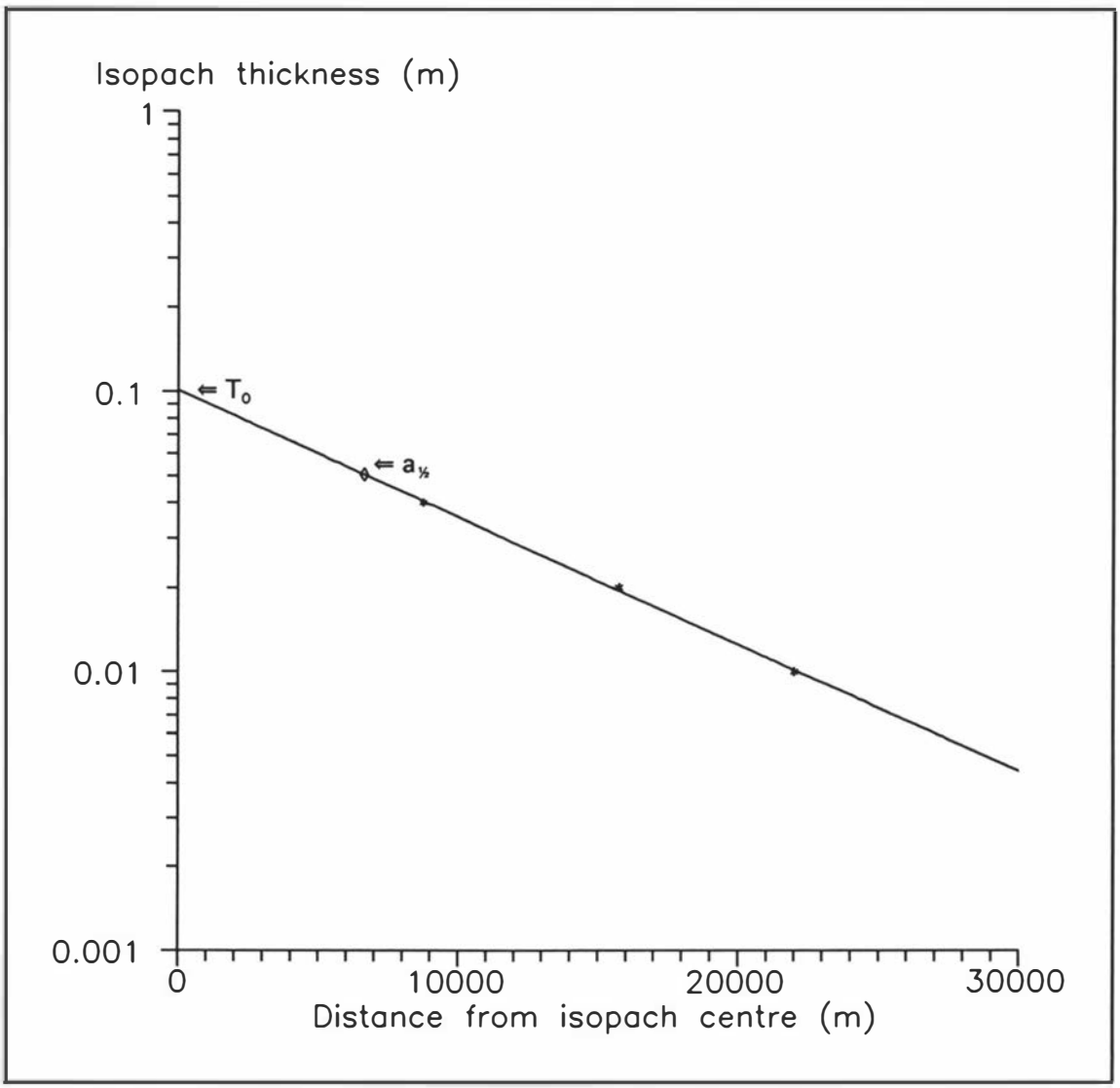
Member Tf5, Tufa Trig Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[*a*]	[k_e]
0.15	11500	2750	0.239	0.000105
0.10	14500	4500	0.310	0.000111
0.08	17000	6125	0.360	0.000108
0.05	21500	8375	0.390	0.000107
		Average	0.325	0.000108

Best fit line formula	$y = exp(-0.000107962x) * 0.501872$
Thickness at isopach centre [T_0]	0.502 m
Decay constant [k_e] (best fit)	0.000108
Distance from centre to half thickness [$a_{½}$]	6424 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	270 x10^6 m^3
Volume [ellipse: $V = 2\pi T_0 a/(k_e)^2$]	88 x10^6 m^3

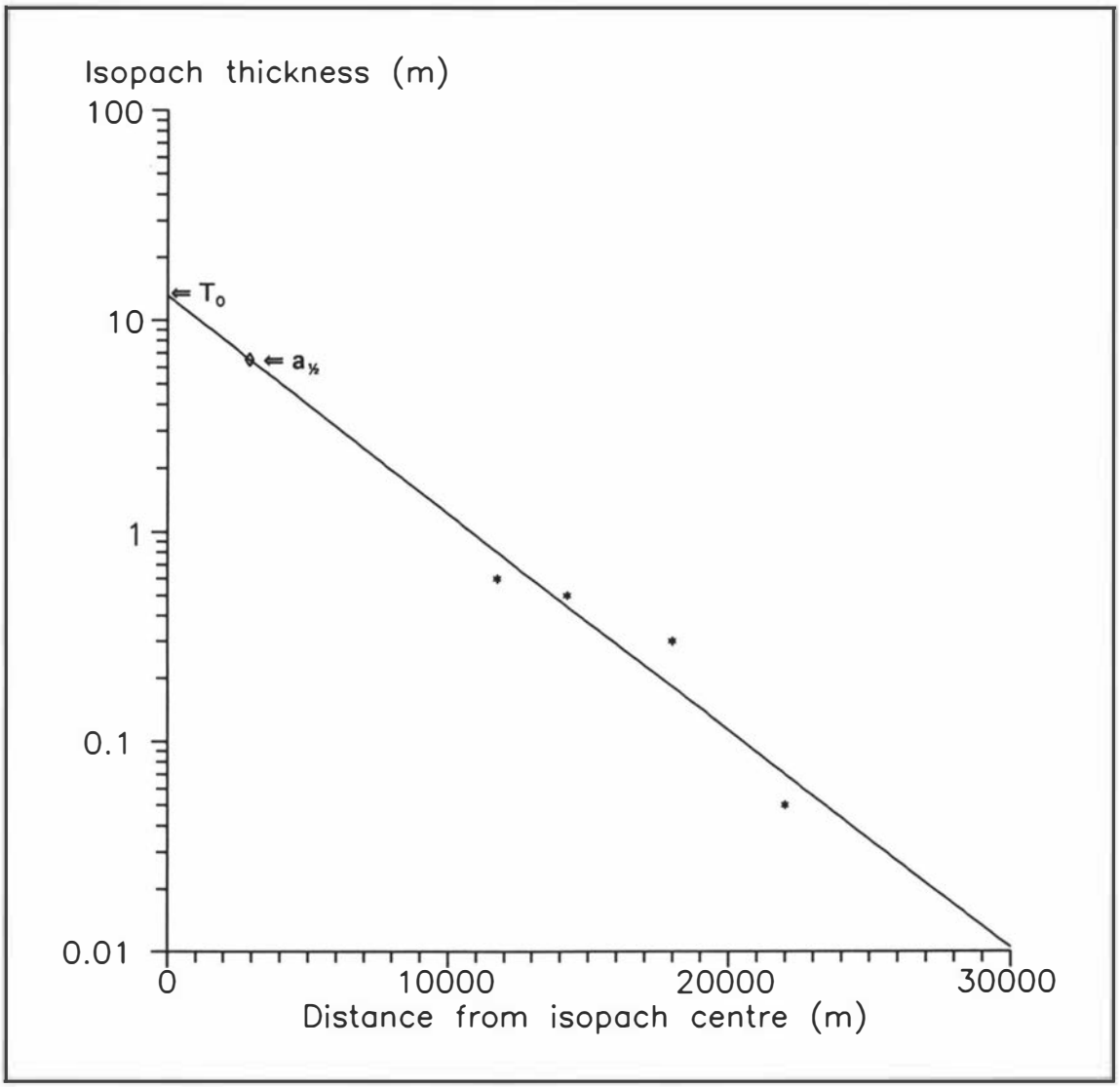
Member Tf4, Tufa Trig Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[σ]	[k_e]
0.04	8750	2000	0.229	0.000106
0.02	15750	5500	0.349	0.000103
0.01	22000	8625	0.392	0.000105
		Average	0.323	0.000105

Best fit line formula	$y = exp(-0.000104514x) * 0.101059$	
Thickness at isopach centre [T_0]		0.101 m
Decay constant [k_e] (best fit)		0.000105
Distance from centre to half thickness [$a_{½}$]		6633 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]		58 x10^6 m^3
Volume [ellipse: $V = 2\pi T_0\sigma/(k_e)^2$]		19 x10^6 m^3

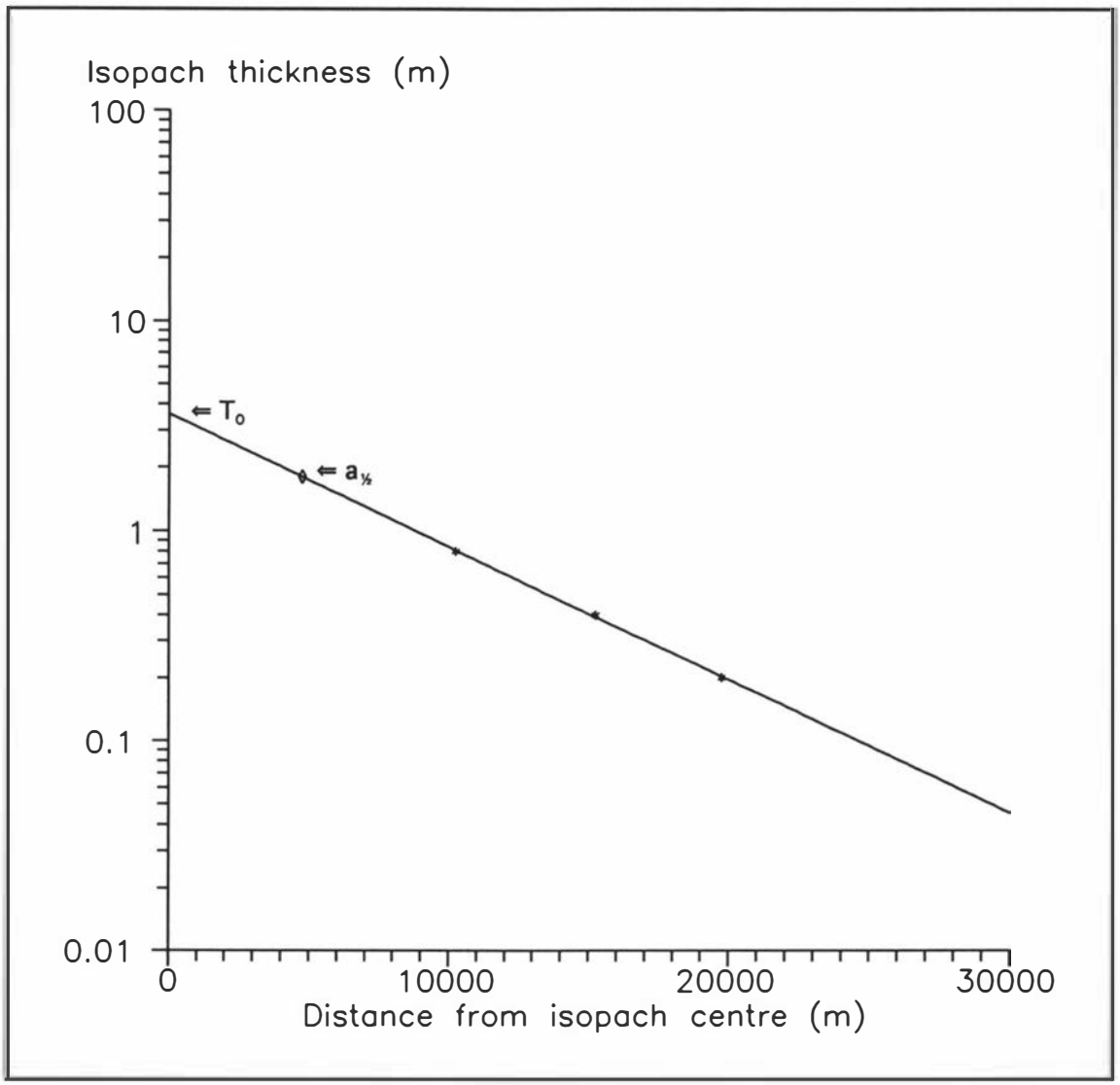
Mangatawai Tephra



Thickness (m) [T]	Max. *x* radius (m) [a]			
0.60	11750			
0.50	14250			
0.30	18000			
0.05	22000			

Best fit line formula	$y = exp(-0.000237779x) * 13.0977$
Thickness at isopach centre [T_0]	13.10 m
Decay constant [k_e] (best fit)	0.000238
Distance from centre to half thickness [$a_{½}$]	6.549 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	1.45×10^9 m^3

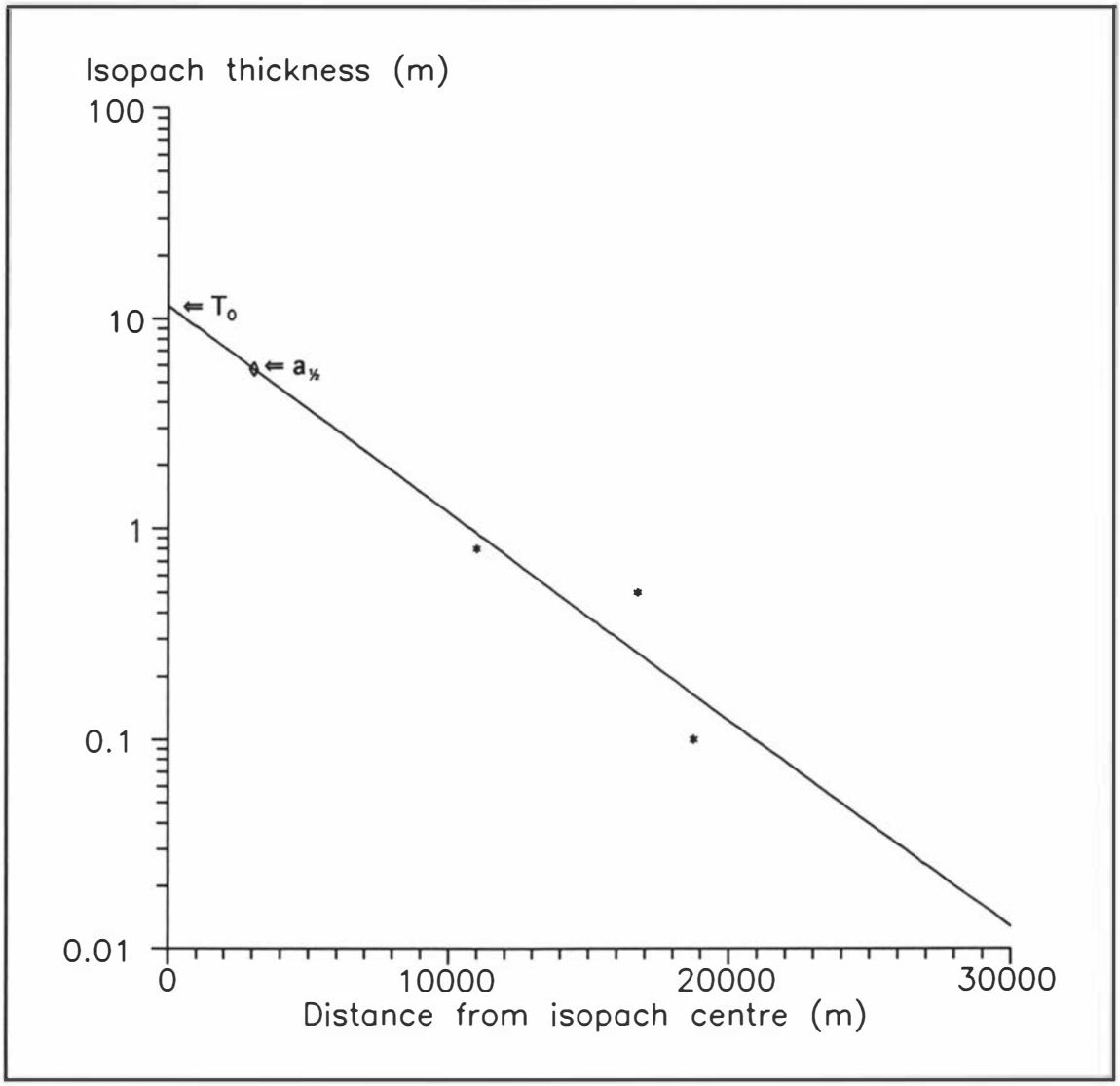
Poutu Lapilli, Mangamate Formation



Thickness (m) [T]	Max. *x* radius (m) [a]			
0.80	10250			
0.40	15250			
0.20	19750			

Best fit line formula	$y = exp(-0.000145791x) * 3.60645$
Thickness at isopach centre [T_0]	3.606 m
Decay constant [k_a] (best fit)	0.000146
Distance from centre to half thickness [$a_{½}$]	4757 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	1.07×10^9 m^3

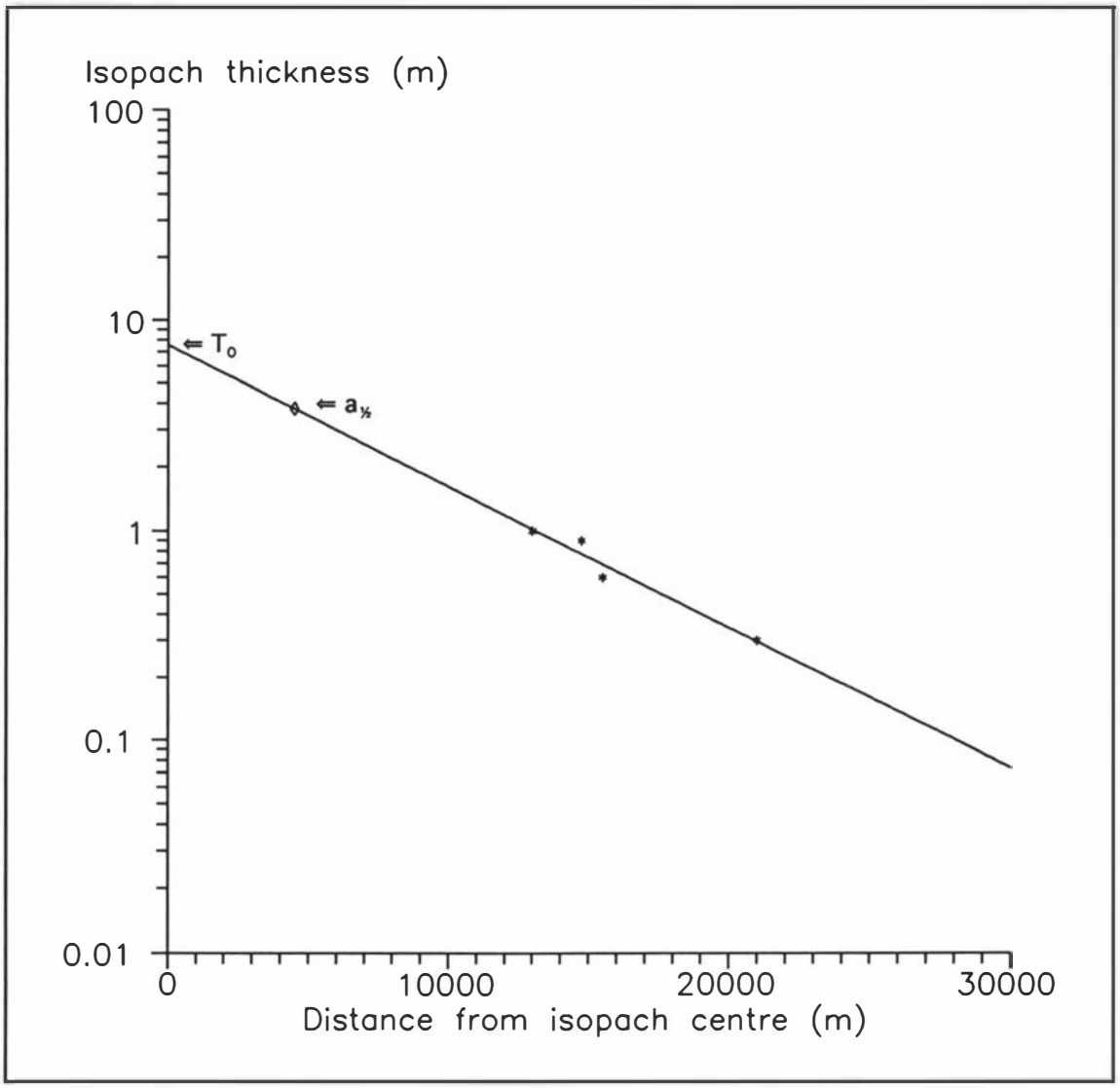
Wharepu Tephra, Mangamate Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[σ]	[k_e]
0.80	11000	2000	0.182	0.000242
0.50	16750	4250	0.254	0.000187
0.10	18750	6500	0.347	0.000253
		Average	0.261	0.000228

Best fit line formula	$y = exp(-0.000226894x) * 11.5178$
Thickness at isopach centre [T_0]	11.518 m
Decay constant [k_e] (best fit)	0.000227
Distance from centre to half thickness [$a_{½}$]	3056 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	1.41 x10^9 m^3
Volume [ellipse: $V = 2\pi T_0 \sigma/(k_e)^2$]	0.36 x10^9 m^3

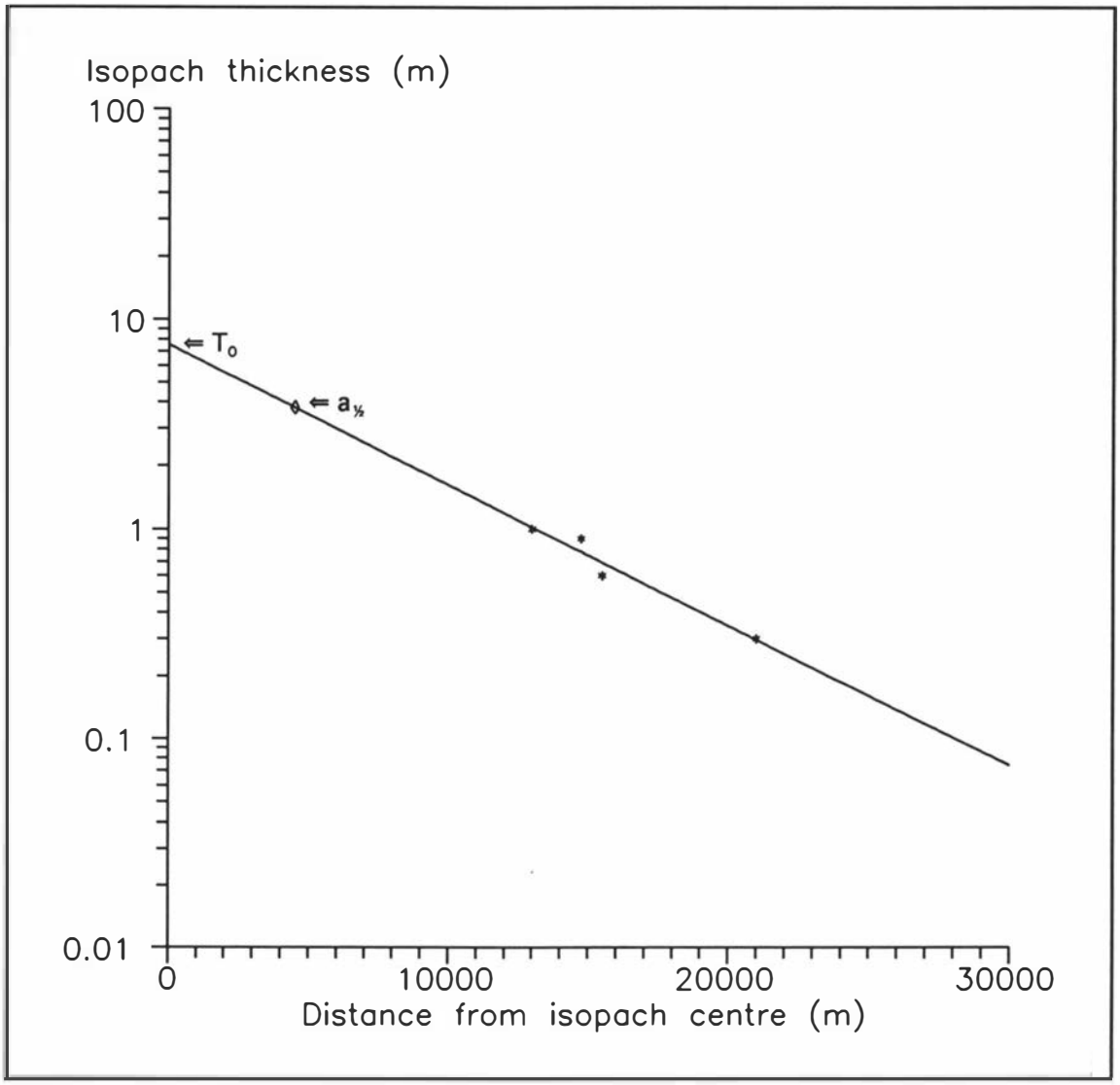
Waihohonu Lapilli, Mangamate Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[*a*/*b*]	[k_e]
1.00	13000	2250	0.173	0.000155
0.90	14750	3000	0.203	0.000144
0.60	15500	4875	0.315	0.000163
0.30	21000	6125	0.292	0.000154
		Average	0.246	0.000154

Best fit line formula	$y = exp(-0.000154175x) * 7.54888$
Thickness at isopach centre [T_0]	7.549 m
Decay constant [k_e] (best fit)	0.000154
Distance from centre to half thickness [$a_{½}$]	4498 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	2.00×10^9 m^3
Volume [ellipse: $V = 2\pi T_0 a/(k_e)^2$]	0.49×10^9 m^3

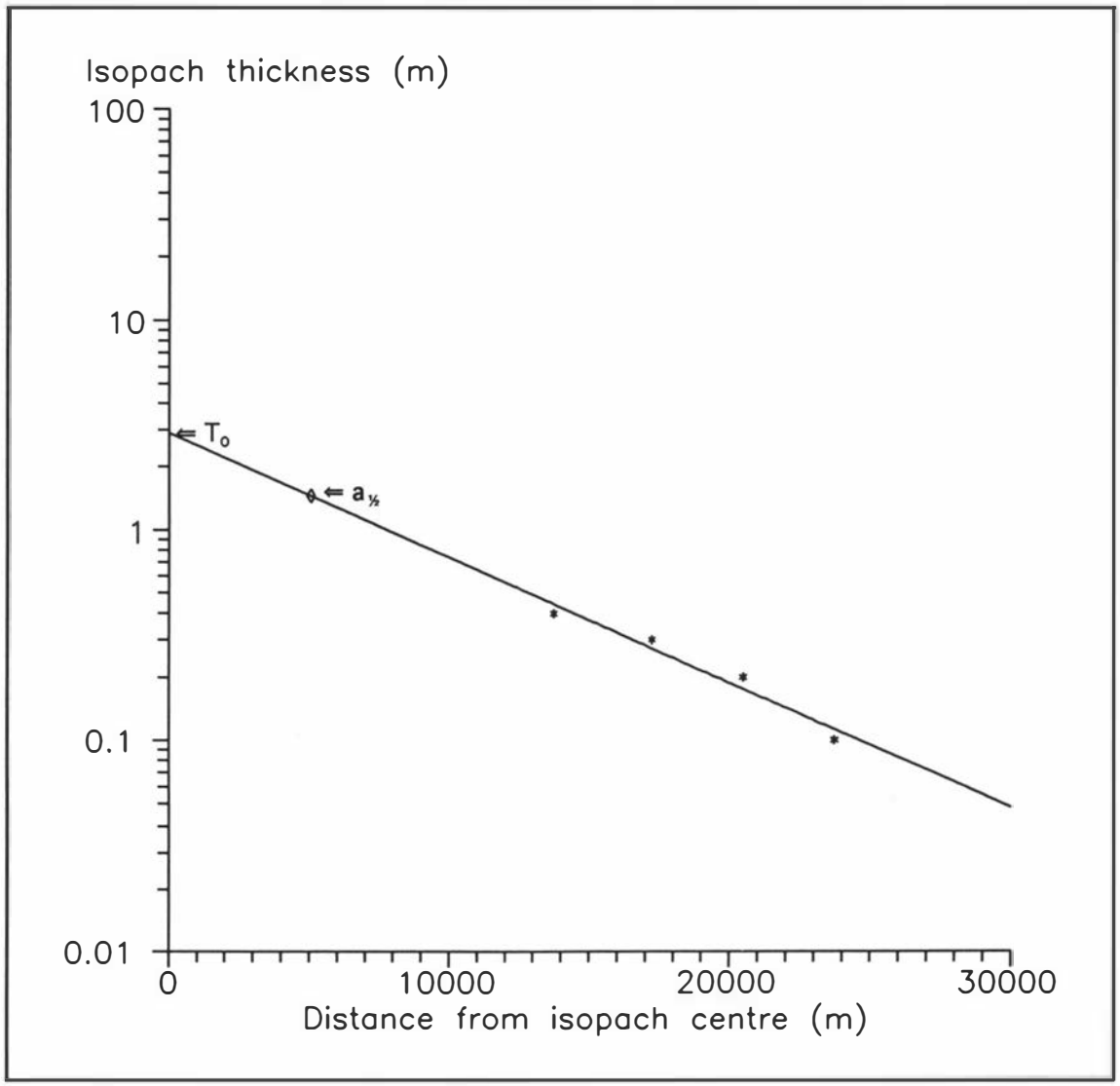
Oturere Lapilli, Mangamate Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[σ]	[k_s]
0.70	12250	1750	0.143	0.000111
0.50	15500	3625	0.234	0.000110
0.40	19750	5500	0.278	0.000097
0.20	23000	8125	0.353	0.000114
		Average	0.252	0.000108

Best fit line formula	$y = exp(-0.000107881x) * 2.73877$
Thickness at isopach centre [T_0]	2.739 m
Decay constant [k_s] (best fit)	0.000108
Distance from centre to half thickness [$a_{½}$]	6430 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	1.48×10^9 m^3
Volume [ellipse: $V = 2\pi T_0 \sigma / (k_s)^2$]	0.37×10^9 m^3

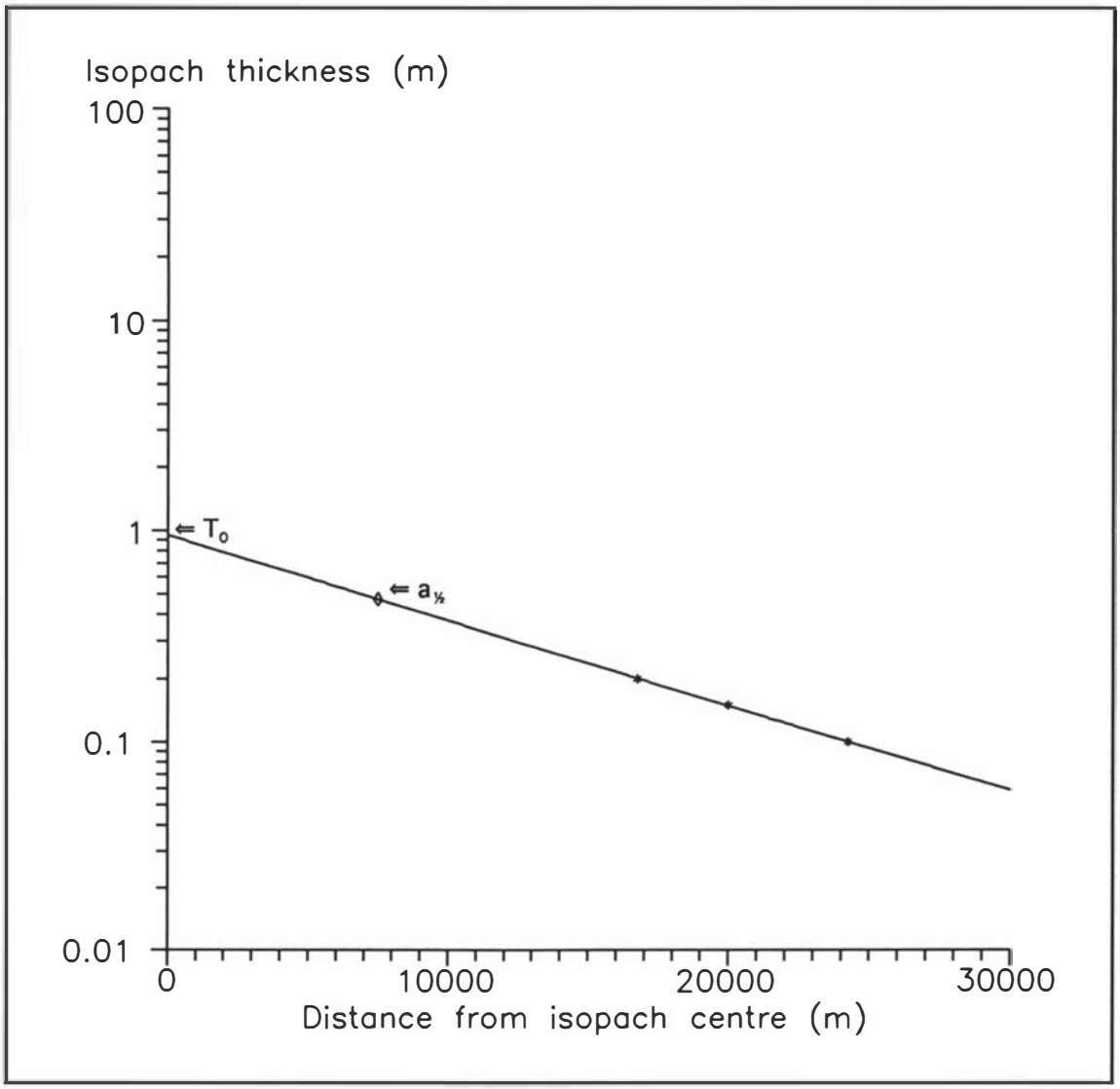
Pahoka Tephra



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[σ]	[k_e]
0.40	13750	1375	0.100	0.000144
0.30	17250	4500	0.261	0.000132
0.20	20500	6125	0.299	0.000130
0.10	23750	8625	0.363	0.000142
		Average	0.256	0.000137

Best fit line formula	$y = exp(-0.000136807x) * 2.90262$
Thickness at isopach centre [T_0]	2.903 m
Decay constant [k_e] (best fit)	0.000137
Distance from centre to half thickness [$a_{½}$]	5067 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	0.97 x10^9 m^3
Volume [ellipse: $V = 2\pi T_0\sigma/(k_e)^2$]	0.25 x10^9 m^3

Pourahu Member [tephra unit], Bullot Formation



Thickness (m) [T]	Max. *x* radius (m) [a]	Max. *y* radius (m) [b]	[σ]	[k_e]
0.20	16750	875	0.052	0.000093
0.15	20000	2500	0.125	0.000092
0.10	24250	4875	0.201	0.000093
		Average	0.126	0.000093

Best fit line formula	$y = exp(-0.000092569x) * 0.947296$
Thickness at isopach centre [T_0]	0.947 m
Decay constant [k_e] (best fit)	0.000093
Distance from centre to half thickness [$a_{½}$]	7493 m
Volume [circle: $V = 13.08T_0(a_{½})^2$]	0.70 x10^9 m^3
Volume [ellipse: $V = 2\pi T_0 \sigma/(k_e)^2$]	0.09 x10^9 m^3

Appendix Ic: Preparation of Polished Thin Sections: Polishing Procedure

Equipment Buehler Minimet Polisher and polishing plates (capacity for one section only)
Polish Hyprez diamond compound (paste); 6 μm, 3 μm and 1 μm grades. Jeweller's rouge.
Lubricant Hyprez fluid.

Recommended procedure:

Sections are polished with progressively finer diamond pastes (6 μm, 3 μm, 1 μm) and increasing polishing times between grades. Sections and the slide holder must be washed thoroughly before changing to the next paste grade to avoid contaminating finer with coarser grade pastes. Similarly, separate polishing pads must be used for each grade of paste. Prolonged polishing at any grade may promote peeling of the resin around the edges of the mount. When checking for purity of surface polish Sections should be cleaned with alcohol to remove oily paste residues.

Paste grade	Lap speed	Lap pressure	Time
6 μm	Full	3/4	10 minutes
3 μm	Full	3/4	15 minutes
1 μm	Full	3/4	20 minutes
Rouge	Full	1/2	optional*

* A final buffing with jeweller's rouge is recommended, although an adequate polish is achieved with the 1μm paste.

APPENDIX II

STRATIGRAPHIC SECTION DESCRIPTIONS

Appendix II: Section Descriptions

Stratigraphic descriptions are given for all type and reference sections defined for rhyolitic and andesitic tephras and lahars. Descriptions are also given for all other named sections appearing on Map 1 (identified by map code). Stratigraphic columns in Charts 1 – 4 illustrate type, reference, and some information sections.

Colours used in descriptions are taken from the Munsell Soil Color Charts. Unit measurements are given in millimetres, with cumulative measurements in metres. Grid references are based on NZMS 260 topographical maps (sheets T19,T20,T21,S20). Units marked with asterisks are not included in the overlying formation. Most of these units are medial deposits or paleosols.

A listing of type, reference, and information sections is given on pages *A18 – A24*.

RHYOLITIC TEPHRAS				
Formation	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Kaharoa Tephra	Ref.	S20/271074	Ohakune Mountain Road [OMR]	*A91*
	Info.	T20/403072	unnamed section	
Taupo Pumice	Ref.	T20/375046	Tufa Trig S.2 [TT2]	*A118*
		T20/464092	Desert Road S.11 [DR11]	*A58*
	Info.	T20/462135	Desert Road S.15 [DR15]	*A64*
		T20/464091	Desert Road S.10 [DR10]	*A55*
		T20/464173	unnamed section	
		T20/399954	Whangaehu River S.1 [WR1]	*A154*
		T20/435057	Scorpion Gully [SG]	*A104*
		T20/438033	Whangaehu River S.6 [WR6]	*A161*
		T20/418982	Aqueduct S.1 [AQ1]	*A28*
		T21/413874	Ngamatea Swamp S.1 [NS1]	*A89*
		S20/271074	Ohakune Mountain Road [OMR]	*A91*
Mapara Tephra	Ref.	T20/375046	Tufa Trig S.2 [TT2]	*A118*
	Info.	T21/413874	Ngamatea Swamp S.1 [NS1]	*A89*
Waimihia Tephra	Ref.	T19/481325	Poutu [PT]	*A97*
		T20/481186	Desert Road S.16 [DR16]	*A67*
		T20/375046	Tufa Trig S.2 [TT2]	*A118*
		T20/408047	Death Valley S.2 [DV2]	*A45*
	Info.	T21/413874	Ngamatea Swamp S.1 [NS1]	*A89*
		T20/435990	Wahianoa Aqueduct [WA]	*A129*
		T20/391986	Wahianoa Road S.1 [W1]	*A137*
		T20/409042	Death Valley S.3 [DV3]	*A47*
		T20/464092	Desert Road S.11 [DR11]	*A58*
Hinemaiaia Tephra	Ref.	T20/464092	Desert Road S.11 [DR11]	*A58*
		T20/462135	Desert Road S.15 [DR15]	*A64*
		T20/408047	Death Valley S.2 [DV2]	*A45*
	Info.	T19/481325	Poutu [PT]	*A97*
		T21/413874	Ngamatea Swamp S.1 [NS1]	*A89*
Whakatane Tephra	Ref.	T20/409045	Death Valley S.5 [DV5]	*A52*
	Info.	T20/408045	unnamed section	
		T20/408047	Death Valley S.2 [DV2]	*A45*
Motutere Tephra	Ref.	T19/482199	Desert Road S.17 [DR17]	*A70*
		T20/462135	Desert Road S.15 [DR15]	*A64*
		T20/410041	Death Valley S.4 [DV4]	*A50*
	Info.	T20/425984	Whangaehu Ford [WF]	*A147*
		T20/409042	Death Valley S.3 [DV3]	*A47*
Poronui Tephra	Ref.	T20/462135	Desert Road S.15 [DR15]	*A64*
		T20/464092	Desert Road S.11 [DR11]	*A58*

continued ...

RHYOLITIC TEPHRAS				
Formation	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Poronui Tephra	Info.	T20/443045	Whangaehu River S.5 [WR5]	*A156*
		T20/481186	Desert Road S.16 [DR16]	*A67*
		T20/458119	Desert Road S.12 [DR12]	*A62*
		T20/493184	unnamed section	
		T20/467102	Waikato Stream S.1 [WS1]	*A141*
		T19/481325	Poutu [PT]	*A97*
		T19/536270	Access 10 [A10]	*A25*
		T19/488213	Oturere Trig S.1 [OT]	*A93*
Karapiti Tephra	Ref.	T20/459153	Mangatoetoenui Quarry [MQ]	*A85*
	Info.	T19/524283	unnamed section	
Waiohau Tephra	Ref.	T20/435990	Wahianoa Aqueduct [WA]	*A129*
		T20/399954	Whangaehu River S.1 [WR1]	*A154*
	Info.	T20/443043	unnamed section	
		T20/443045	Whangaehu River S.5 [WR5]	*A156*
		T20/411966	Whangaehu River S.9 [WR9]	*A165*
		T20/397951	Whangaehu River S.8 [WR8]	*A163*
		T20/445069	Whangaehu Junction [WJ]	*A150*
		T20/385937	Shawcroft Road [SR]	*A107*
		T19/488213	Oturere Trig S.1 [OT]	*A93*
		T20/375046	Tufa Trig S.2 [TT2]	*A118*
		T20/398063	Missile Ridge	*A88*
		T20/401048	Upper Seagull Gully [USG]	*A127*
		T21/413874	Ngamatea Swamp S.2	*A90*
		T20/408925	unnamed section	
?Rotorua Tephra	Info.	T19/488213	Oturere Trig S.1 [OT]	*A93*
Rerewhakaaitu Tephra	Ref.	T20/412108	Bullot Track S.1 [BT1]	*A33*
		T20/443045	Whangaehu River S.5 [WR5]	*A156*
		T20/464091	Desert Road S.10 [DR10]	*A55*
	Info.	T20/375046	Tufa Trig S.2 [TT2]	*A118*
		T20/445069	Whangaehu Junction [WJ]	*A150*
		T20/435990	Wahianoa Aqueduct [WA]	*A129*
		T20/399954	Whangaehu River S.1 [WR1]	*A154*
Okareka Tephra	Ref.	T20/412108	Bullot Track S.1 [BT1]	*A33*
Kawakawa Tephra Formation	Ref.	T20/464091	Desert Road S.10 [DR10]	*A55*
		T20/469102	Waikato Stream S.2 [WS2]	*A145*
	Info.	T20/412108	Bullot Track S.1 [BT1]	*A33*
		T21/404818	unnamed section	
		T21/407811	unnamed section	

ANDESITIC TEPHRAS					
Formation	**Member(s)**	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Ngauruhoe Formation		Type	T19/489238	Mangatawai [MS] *	*A82*
Tufa Trig Formation		Type	T20/378045	Tufa Trig S.1 [TT1]	*A116*
		Ref.	T20/375046	Tufa Trig S.2 [TT2]	*A118*
		Info.	T20/459153	Mangatoetoenui Quarry [MQ]	*A85*
			T20/418982	Aqueduct S.1 [AQ1]	*A28*
			T20/445069	Whangaehu Junction [WJ]	*A150*
			T20/467102	Waikato Stream S.1 [WS1]	*A141*
			T20/481186	Desert Road S.16 [DR16]	*A67*
			T20/464092	Desert Road S.11 [DR11]	*A58*
			T20/443045	Whangaehu River S.5 [WR5]	*A156*
			T20/438033	Whangaehu River S.6 [WR6]	*A161*
			T20/398062	Missile Ridge Dune [MRD]	*A88*
			T20/385020	unnamed section	
			T20/326994	Top Road [TR]	*A115*
			T20/376036	Doubtful Road [DF]	*A71*
			T21/413874	Ngamatea Swamp S.1 [NS1]	*A89*
			T20/369027	Wahianoa River S.1 [WRS1]	*A133*
			T20/371016	Wahianoa River S.2 [WRS2]	*A135*
			T20/385020	Main Road	*A81*
			S20/271074	Ohakune Mountain Road [OMR]	*A91*
Mangatawai Tephra		Type	T19/489238	Mangatawai [MS] *	*A82*
		Ref.	T20/481186	Desert Road S.16 [DR16]	*A67*
			T20/459153	Mangatoetoenui Quarry [MQ]	*A85*
			T20/462135	Desert Road S.15 [DR15]	*A64*
			T20/375046	Tufa Trig S.2 [TT2]	*A118*
		Info.	T20/464092	Desert Road S.11 [DR11]	*A58*
			T20/408047	Death Valley S.2 [DV2]	*A45*
Papakai Formation		Type	T20/462135	Desert Road S.15 [DR15]	*A64*
		Ref.	T20/467102	Waikato Stream S.1 [WS1]	*A141*
			T20/464092	Desert Road S.11 [DR11]	*A58*
		Info.	T20/458119	Desert Road S.12 [DR12]	*A62*
			T20/322941	Rock Road [RR]	*A103*
			T20/494046	Paradise Valley Road [PR]	*A96*
	ba-2, ba-1, or-2, or-1	Ref.	T20/375046	Tufa Trig S.2 [TT2]	*A118*
	ba-2, ba-1	Ref.	T20/408047	Death Valley S.2 [DV2]	*A45*
Mangamate Tephra		Ref.	T19/536270	Access 10 [A10]	*A25*
			T19/377351	unnamed section	
			T20/481186	Desert Road S.16 [DR16]	*A67*
			T20/459153	Mangatoetoenui Quarry [MQ]	*A85*

continued ...

ANDESITIC TEPHRAS					
Formation	**Member(s)**	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Mangamate Tephre		Ref.	T20/462135	Desert Road S.15 [DR15]	*A64*
		Info.	T20/467102	Waikato Stream S.1 [WS1]	*A141*
			T20/465099	unnamed section	
			T20/463101	unnamed section	
			T19/488213	Oturere Trig S.1 [OT]	*A93*
			T20/464173	unnamed section	
			T20/464092	Desert Road S.11 [DR11]	*A58*
			T20/458119	Desert Road S.12 [DR12]	*A62*
			T20/494046	Paradise Valley Road [PR]	*A96*
			T20/435990	Wahianoa Aqueduct [WA]	*A129*
			T19/524283	unnamed section	
	Pt	Type	T19/481325	Poutu [PT] *	*A97*
	Wp, Oh	Type	T20/462135	Desert Road S.15 [DR15]	*A64*
	Wa	Type	T20/481186	Desert Road S.16 [DR16]	*A67*
	Ot	Type	T20/459153	Mangatoetoenui Quarry [MQ]	*A85*
Pahoka Tephra		Type	T20/481186	Desert Road S.16 [DR16]	*A67*
		Ref.	T20/459153	Mangatoetoenui Quarry [MQ]	*A85*
		Info.	T19/481325	Poutu [PT] *	*A97*
			T19/524283	unnamed section	
			T19/489238	Mangatawai [MS] *	*A82*
			T20/462135	Desert Road S.15 [DR15]	*A64*
			T20/464092	Desert Road S.11 [DR11]	*A58*
Bullot Formation		Type	T20/412108	Bullot Track S.1 [BT1]	*A33*
		Info.	T20/463101	unnamed section	
			T20/469102	Waikato Stream S.2 [WS2]	*A145*
			T20/464091	Desert Road S.10 [DR10]	*A55*
			T20/459153	Mangatoetoenui Quarry [MQ]	*A85*
			T20/445069	Whangaehu Junction [WJ]	*A150*
			T20/410966	Whangaehu River S.9 [WR9]	*A165*
			T20/399954	Whangaehu River S.1 [WR1]	*A154*
			T20/420110	Bullot Track S.2 [BT2]	*A38*
			T20/375046	Tufa Trig S.2 [TT2]	*A118*
			T20/322941	Rock Road [RR]	*A103*
			T20/333983	Duncan Road [DCN]	*A72*
			T20/437045	The Chute S.3	*A44*
			T20/385937	Shawcroft Road [SR]	*A107*
			T20/401048	Upper Seagull Gully [USG]	*A127*
			T20/407028	Lower Seagull Gully S.2 [LSG2]	*A79*
			T20/377987	Aqueduct Road [AR]	*A26*

continued ...

ANDESITIC TEPHRAS					
Formation	**Member(s)**	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Bullot Formation		Info.	T20/417979	Aqueduct S.2 [AQ2]	*A29*
			T20/386898	unnamed section	*A125*
	Nt-1, Nt-2	Ref.	T20/391986	Wahianoa Road S.1 [W1]	*A137*
			T20/407917	Helwan S.2 [H2]	*A75*
			T20/408921	Helwan Quarry [HQ]	*A73*
	Ph [T]	Type	T20/481186	Desert Road S.16 [DR16]	*A67*
		Ref.	T20/467102	Waikato Stream S.1 [WS1]	*A141*
			T20/464092	Desert Road S.11 [DR11]	*A58*
			T20/412108	Bullot Track S.1 [BT1]	*A33*
	Ph [lg]	Type	Locality	The Chute	
	Sh	Type	T20/435990	Wahianoa Aqueduct [WA]	*A129*
		Ref.	T20/399954	Whangaehu River S.1 [WR1]	*A154*
			T20/408921	Helwan Quarry [HQ]	*A73*

* Sections defined by Topping (1973).

LAHARIC FORMATIONS				
Formation	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Onetapu Formation	Type	T20/319906	Tangiwai Swamp [TS]	*A112*
		Locality	Tangiwai Swamp	
	Info.	T20/319905	unnamed section	
		T20/441049	unnamed section	*A123*
		T20/319903	Tangiwai Swamp S.3 [TS3]	*A110*
		T20/442054	Scorpion Gully S.1 [SG1]	*A105*
		T20/432062	Scorpion Gully S.2 [SG2]	*A106*
		T20/438033	Whangaehu River S.6 [WR6]	*A161*
		T20/418982	Aqueduct S.1 [AQ1]	*A28*
		T20/425984	Whangaehu Ford [WF]	*A147*
		T20/417984	Aqueduct S.3 [AQ3]	*A31*
Mangaio Formation	Type	T20/408047	Death Valley S.2 [DV2]	*A45*
	Ref.	Locality	Scorpion Gully	
		Locality	Death Valley	
	Info.	T20/445069	Whangaehu Junction [WJ]	*A150*
		T20/445072	unnamed section	
		T20/410035	Rangipo S.1 [R1]	*A98*
		T20/425984	Whangaehu Ford [WF]	*A147*
		T20/319904	Tangiwai Swamp S.3 [TS3]	*A110*
Manutahi Formation	Type	T20/410035	Rangipo S.1 [R1]	*A98*
	Ref.	T20/409045	Death Valley S.5 [DV5]	*A52*
		T20/425984	Whangaehu Ford [WF]	*A147*
	Info.	T20/420110	Bullot Track S.2 [BT2]	*A38*
		T20/432062	Lower Seagull Gully S.2 [LSG2]	*A79*
		T20/401048	Upper Seagull Gully [USG]	*A127*
		Locality	Missile Ridge	
Tangatu Formation	Type	T20/409045	Death Valley S.5 [DV5]	*A52*
	Ref.	T20/407917	Helwan S.2 [H2]	*A75*
		T20/408921	Helwan Quarry [HQ]	*A73*
	Info.	T20/425984	Whangaehu Ford [WF]	*A147*
		T20/417981	Rangipo S.2 [R2]	*A100*
		Locality	The Chute (S.1 – S.3)	
		T20/407028	Lower Seagull Gully S.2 [LSG2]	*A79*
		T20/406918	unnamed section	*A122*
		T20/397957	unnamed section	*A126*
		T20/417935	Waiouru Tip [WT]	*A146*
		Locality	Death Valley	
		T20/398912	unnamed section	
		T20/397951	Whangaehu River S.8 [WR8]	*A163*

continued ...

LAHARIC FORMATIONS				
Formation	**Section**	**Grid Ref.**	**Section Name and Map Code**	**Page**
Te Heuheu Formation	Type	T20/443045	Whangaehu River S.5 [WR5]	*A156*
	Ref.	T20/399954	Whangaehu River S.1 [WR1]	*A154*
		T20/435990	Wahianoa Aqueduct [WA]	*A129*
	Info.	T20/399954	Whangaehu River S.1 [WR1]	*A154*
		T20/410966	Whangaehu River S.9 [WR9]	*A165*

Section Name and Map Code: Access 10 [A10]

Grid Reference: T19/536270 [N112/301844]

Locality: A large cutting on the crest of a hill 2.5 km from the Waiouru – Turangi Road (Desert Road) on Hydro Access Road No. 10. Description taken from Topping (1973) with modifications (this study) given in italics

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		50+	0.050	Black fine ash
Taupo Pumice		600	0.650	Pale yellow rhyolitic ash, lapilli and blocks
Mangatawai Tephra		430	1.080	Dark yellowish brown to black ash
Papakai Formation & Waimihia Tephra & Hinemaiaia Tephra		580	1.660	Yellowish brown fine ash with interspersed pale yellow rhyolitic ash
Papakai Formation		400	2.060	Dark brown fine ash; paleosol; erosion break
Mangamate Tephra	Poutu Lapilli	360	2.420	Yellowish red stained lapilli
	Wharepu Tephra	40	2.460	Grey to yellowish brown ash
Poronui Tephra		10	2.470	Yellow fine rhyolitic ash
Mangamate Tephra	Ohinepango Tephra	140	2.610	30 mm Strong brown medium ash 40 mm Grey black medium ash 40 mm Strong brown and black medium ash 30 mm Grey black medium ash
	Waihohonu Lapilli	70	2.680	Yellowish red and grey fine lapilli
	unnamed tephra	40	2.720	Dark yellowish brown coarse ash
	Oturere Lapilli	200	2.920	100 mm Yellowish red coarse lapilli 20 mm Yellowish red coarse ash 30 m Yellowish red coarse lapilli 20 m Yellowish red coarse ash 30 m Yellowish red coarse lapilli
	Te Rato Lapilli	10	2.930	Grey coarse ash
***	***	50	2.980	Yellowish brown ash
Karapiti Tephra		20	3.000	Light yellowish brown rhyolitic ash
***	***	*30*	3.030	Andesitic tephra
Pahoka Tephra		*220*	3.250	*Dark grey, and colour-banded grey and pale yellow dominantly fine pumiceous lapilli, and coarse ash; with coarse ash base*
?Bullot Formation (upper)	*unnamed*	1050	4.300	*Andesitic ash*
?Waiohau Tephra		30	4.330	Pale yellow fine rhyolitic ash
?Bullot Formation (upper)	*unnamed*	1200	5.530	*Andesitic ash*
Rotoaira Lapilli		270	5.800	120 mm Strong brown pumiceous lapilli 20 mm Very dark grey fine ash, grading into 80 mm Strong brown and black coarse ash 20 mm Very dark grey ash, grading into 30 mm Olive yellow lapilli and ash
?Bullot Formation	*unnamed*	1100	6.900	Andesitic tephra
***	***	4500	11.400	Alluvium or laharic debris, on
		1400+	12.800	Purplish grey ignimbrite; planar upper surface

Section Name and Map Code: Aqueduct Road [AR]

Grid Reference: T20/377987

Locality: A cutting on Aqueduct Road, located approx. 50 m south of a ford over Wahianoa River, Karioi Forest.

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	150	0.150	White poorly sorted ash and fine pumice lapilli, with charcoal
Papakai Formation & Waimihia Tephra		750	0.900	Fine sandy loam textured ash, with interbedded pale brown fine ash 'cream cakes' with intermixed brown very fine andesitic ash (Waimihia Tephra), and two lapllli beds interbedded at half depth (orange lapilli-2 and orange lapilli-1 members)
Papakai Formation	unnamed	60	0.960	Medium and fine pumice and lithic lapilli in sandy loam textured ash, greasy, with dark coated root channels; paleosol
		140	1.100	Fine sandy loam textured ash, greasy, with scattered fine yellowish brown pumice lapilli, and dark brown coated root channels; paleosol
Bullot Formation (upper)	Ngamatea lapilli-2	50	1.150	Strong brown (7.5YR5/8) fine pumice lapilli, soft; with a sandy loam textured ash matrix; ungraded tephra
	unnamed	30	1.180	Medium sandy loam textured ash, with many very fine lithic and pumice lapilli
		20	1.200	Grey coarse ash and very fine lithic lapilli, firm, gravelly texture
		50	1.250	Coarse sandy loam textured ash, with many very fine lithic and pumice lapilli
	Ngamatea lapilli-1	100	1.350	Strong brown fine and medium pumice lapilli, and very dark grey fine lithic lapilli; loose lapilli; slight reverse grading
***	***	100	1.450	Yellowish brown coarse sandy loam textured medial unit, with scattered pumice and lithic lapilli
	unnamed	20	1.470	Grey ash, firm, and fine brown pumice lapilli at contacts
***	***	40	1.510	Medium sandy clay loam textured medial unit, with many scattered fine pumice and lithic lapilli
	unnamed	170	1.680	Medium and coarse pumice and lithic lapilli; with basal 60 mm lithic dominant coarse ash; reversely graded tephra
		10	1.690	Grey coarse ash, firm
		60	1.750	Lithic dominant coarse ash
***	***	160	1.910	Medium sandy clay loam textured medial unit, very greasy, with scattered fine lapilli
	unnamed	230	2.140	210 mm Greyish brown dominantly fine pumice and lithic lapilli; very vesicular firm pumice; some sandy loam textured ash matrix; reverse graded bed 20 mm Coarse pumice and lithic lapilli, loose
		180	2.320	Colour-banded grey and brown coarse sandy loam textured ash
		40	2.360	Brown fine and medium pumice lapilli, and grey fine and medium lithic lapilli; ungraded tephra
		5	2.365	Grey ash
		20	2.385	Strong brown very fine angular, platy pumice fragments
***	***	40	2.425	Grey medium sandy loam textured medial unit, showing paleosol development, very greasy, with brown coated root channels
	unnamed	30	2.455	Yellowish brown dominantly medium pumice and lithic lapilli; angular lapilli; no matrix; ungraded tephra
***	***	70	2.525	Coarse sandy loam textured medial unit, showing paleosol development, greasy, with many dark brown coated root channels and scattered fine and very fine pumice lapilli
?Tangatu Formation	unnamed	110	2.635	Medium and fine dominantly black andesitic pebbles and granules; ungraded

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	Shawcroft Tephra	310	2.945	Bedded lapilli: 50 mm Very dark grey fine lithic lapilli, and some strong brown fine pumice lapilli, and coarse ash; weakly bedded 220 mm Strong brown (7.5YR5/6) fine and very fine pumice lapilli, with yellow (2.5Y8/6) interiors, and some black fine and very fine lithic lapilli; soft pumice 40 mm Strong brown fine and very fine pumice dominant basal bed, with some very dark grey lithic lapilli
***	***	30	2.975	Fine sandy clay loam textured medial unit, with scattered fine pumice lapilli
Waiohau Tephra		20	2.995	White very fine ash, pocketing; irregular distinct contacts
Bullot Formation	unnamed	20	3.015	Black coarse ash and very fine lithic lapilli
		40	3.055	Purplish black coarse ash with scattered yellow fine pumice lapilli; distinctive tephra
***	***	80	3.135	Grey medium to fine sandy clay loam textured medial unit, very greasy, with interbedded fine pumice lapilli
	unnamed	50	3.185	Yellow fine and medium pumice lapilli, soft; with medium and fine lithic lapilli; gradational contacts
***	***	100	3.285	Yellowish grey medium sandy clay textured medial unit, very greasy
	unnamed	90	3.375	Yellowish brown medium and fine pumice lapilli, very soft, and grey lithic lapilli
***	***	80	3.455	Grey sandy loam textured medial unit, with scattered fine pumice and lithic lapilli
	unnamed	60	3.515	Pale yellow coarse pumiceous and lithic ash; with some very fine lapilli
***	***	70	3.585	Medium to coarse sandy clay loam textured medial unit, greasy; with some fine and very fine pumice and lithic lapilli
	unnamed	110	3.695	Yellowish brown fine pumice lapilli, some black and grey fine lithic lapilli, and coarse pumiceous and lithic ash; soft very vesicular pumice; reversely graded tephra, with a lithic dominant base
		80	3.775	Grey medium loamy ash
		40	3.775	Brown medium and few coarse pumice lapilli; irregular basal contact
Te Heuheu Formation	unnamed	100+	3.815	Coarse sandy loam textured matrix, with matrix-supported andesitic pebbles and cobbles; on andesitic diamictons

Section Name and Map Code: Aqueduct Section 1 [AQ1]

Grid Reference: T20/418982

Locality: A cutting within an unnamed stream channel at the southern end of Rangipo Desert, approx. 300 m south of Wahianoa Aqueduct (see Plate 2.5)

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		170	0.170	Greyish brown coarse loamy sand textured unit
Tufa Trig Formation	unnamed	15	0.185	Black medium ash with streaky grey and black fine ash base and top
Onetapu Formation	unnamed	100	0.285	Greyish brown medium loamy sand textured matrix, with many fine and medium andesitic pebbles and granules; debris flow deposit
		10	0.295	Brown coarse loamy sand
	Ond	680	0.975	Brownish grey granule and loamy sand textured matrix; poorly sorted sand; with many matrix-supported fine andesitic pebbles, dominantly black (2.5Y2/0) fine scoria pebbles, some brown medium pumice pebbles, and occasional hydrothermally altered pebbles; with pockets of fine pebbles, cobbles and boulders; maximum clast 280 mm (boulder) subrounded pebbles; slight reverse grading with clasts fining and becoming fewer toward top of unit
	unnamed	15	0.990	Brown coarse loamy sand and lithic granules
Tufa Trig Formation	member Tf5	45	1.035	Black coarse ash, with 40 mm thick grey fine ash base; pocketing ash; distinctive tephra
Makahikatoa Sands		30	1.065	Brown fine sandy loam
Tufa Trig Formation	member Tf4	10	1.075	Black medium ash with grey fine ash base; pocketing tephra
***	***	80	1.155	Brown sandy loam textured medial unit with common scattered fine lithic and minor pumice lapilli
***	***	20	1.175	Brown fine sandy loam textured unit
Onetapu Formation	unnamed	210	1.385	Yellowish brown (10YR5/6 – 5/8) sandy loam textured matrix; with matrix-supported dominantly coarse grey and red andesitic pebbles, and common fine hydrothermally altered pebbles; occasional cobble; ungraded unit; sharp contacts; debris flow deposit
Taupo Pumice	Taupo Ignimbrite	3000+	4.385	White to grey poorly sorted ash and fine pumice lapilli; base of formation is not exposed

Section Name and Map Code: Aqueduct Section 2 [AQ2]

Grid Reference: T20/417979

Locality: A cutting within an unnamed stream channel at the southern end of Rangipo Desert, approx. 600 m south of Aqueduct Road

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed		0.000	Grey hyperconcentrated flood flow deposits overlying reworked Taupo Pumice; sharp basal contact
reworked Taupo Pumice		610	0.610	White bedded fine and medium pumice lapilli, and coarse ash; sharp smooth erosional lower contact
?Mangatawai Tephra & Papakai Formation		170	0.780	Dark greyish brown (10YR4/2) sandy clay loam textured ash; with cracked exterior
Waimihia Tephra		10	0.790	Scattered pale brown fine ash 'cream cakes', with intermixed brown fine andesitic ash
Papakai Formation & Hinemaiaia Tephra		180	0.970	Olive brown (2.5Y5/4) medium sandy loam textured ash, with cracked exterior; and interbedded white coarse pumiceous ash
	unnamed	10	0.980	Brown fine pumice lapilli and pale grey lithic lapilli; indistinct
Papakai Formation		280	1.260	Dark brown (10YR4/3) to dark yellowish brown (10YR4/4) medium sandy clay loam textured ash; cracked exterior; many iron-stained root channels; with bluish grey fine lapilli dispersed through base of unit
***	***	90	1.350	Yellowish brown (10YR5/6) coarse sandy loam textured medial unit, with abundant very fine lithics
		130	1.480	Dark grey and brown coarse ash
		70	1.550	10 mm Grey coarse ash, firm 60 mm Olive coarse sandy loam textured ash
Bullot Formation (upper)	unnamed	40	1.590	Brown fine, and few medium pumice lapilli and fine lithic lapilli; some medium sandy loam textured ash matrix; sharp contacts
***	***	190	1.780	Coarse sandy loam textured medial unit, showing paleosol development; with common very fine lithic and pumice lapilli
	Ngamatea lapilli-1	70	1.850	Yellowish brown fine pumice lapilli, with pale yellow interiors, and few dark grey lithic lapilli; soft pumice; loose lapilli; ungraded unit; distinctive tephra
	unnamed	70	1.920	Light yellowish brown (2.5Y6/4) medium sandy loam textured ash, with dark brown coated root channels
		80	2.000	Dominantly very fine pumice and lithic lapilli, with minor sandy loam textured matrix
***	***	120	2.120	Dark brown coarse sandy loam textured medial unit, showing paleosol development; with brown coated root channels and scattered fine lapilli; indistinct contact with lower unit; scattered black scoria pebbles at base
Tangatu Formation	unnamed	560	2.680	Brownish grey coarse sand and granule matrix; with matrix-supported dominantly pale yellow medium pumice pebbles, and andesitic pebbles; maximum clast 170 mm (cobble); with occasional purplish black andesitic bombs, and pumice blocks; ungraded unit; dilute debris flow deposit
		730	3.410	Coarse sand and granule matrix; with matrix-supported dominantly coarse black, red, and grey andesitic pebbles, black scoria, and white pumice pebbles; blocky angular clasts protruding from matrix; normally graded deposit becoming weakly stratified towards top of unit; debris flow deposit grading to hyperconcentrated flood flow deposit
		290	3.700	Grey sand and granule matrix; poorly sorted sand; with matrix-supported dominantly medium and fine andesitic pebbles, and many white and brown pumice pebbles; soft pumice; ungraded unit; sharp basal contact; debris flow deposit

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangautu Formation	unnamed	300 +	4.000	Sand and granule matrix; poorly sorted sand; with matrix-supported grey andesitic cobbles, and pebbles; clasts concentrated in centre of unit; ungraded; debris flow deposit; base of unit not exposed

Section Name and Map Code: Aqueduct Section 3 [AQ3]

Grid Reference: T20/417984

Locality: An exposure within a small channel, on the south side of Aqueduct Road, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	470	0.470	Greyish brown medium loamy sand and granule matrix, poorly sorted and weakly bedded; with some medium andesitic pebbles concentrated in 20 mm thick beds near base of deposit; Basal 10 mm comprises medium sand; hyperconcentrated flood flow deposit
		80	0.550	Grey granules and sand, poorly sorted, and common very coarse andesitic pebbles and fine pumice lapllll (including reworked Taupo Pumice lapilli) in top of deposit; basal 30 mm comprises well sorted laminated sands; iron-stained sharp basal contact; hyperconcentrated flood flow deposit
		280	0.830	Pale grey sand, poorly sorted, and weakly bedded, with lenses of lithic granules and few fine to medium andesitic pebbles; with a loamy sand textured base; hyperconcentrated flood flow deposit
		280	1.110	Black coarse and medium sand, moderately well sorted, with pockets of fine and few medium andesitic pebbles and granules; basal half of deposit is more bedded and comprises sand and granule dominant beds and fine pebble dominant beds; sharp contacts; hyperconcentrated flood flow deposit
		20	1.130	Brown silt
	?Ond	360	1.490	Dark grey coarse sand and granule matrix, with matrix-supported grey, red and hydrothermally altered medium and coarse andesitic pebbles, dominantly black scoria, and brown and grey pumice pebbles; with pockets of andesitic cobbles and pebbles; top 60 mm and basal 70 mm comprise only sand and granules; debris flow deposit
Makahikatoa Sands		10	1.500	Brown fine sandy ash
Tufa Trig Formation	member Tf6	20	1.520	Black coarse ash; distinct
Makahikatoa Sands		10	1.530	Grey fine loamy sand textured unit
Tufa Trig Formation	member Tf5	40	1.570	Black coarse ash and some very fine lapilll
Makahikatoa Sands		70	1.640	Dark greyish brown (10YR4/2) medium sandy loam textured unit, with scattered very fine and fine lapilli
Onetapu Formation	unnamed	140	1.780	Grey coarse sand and granules, poorly sorted, and red, grey and hydrothermally altered dominantly medium andesitic pebbles and brown rounded pumice pebbles; maximum clast 20 mm (coarse pebble); basal 40 mm comprises bedded coarse and medium sand; hyperconcentrated flood flow deposit
		80	1.860	Greyish brown granules and fine sand, poorly sorted, and common yellowish brown medium and some coarse rounded pumice pebbles, red, grey and hydrothermally altered andesitic pebbles; maximum clast 20 mm (coarse pebble); basal 20 mm comprises sand and granule, no pebbles; wavy basal contact; hyperconcentrated flood flow deposit
		80	1.940	Greyish brown sand and granules, and common dominantly medium pumice, and fewer andesitic pebbles; pebbles concentrated in top half of deposit; basal half comprises dominantly granules; hyperconcentrated flood flow deposit
***	***	60	2.000	Brown medium sandy loam textured medial unit, with root channels; paleosol
***	***	40	2.040	Brown medium sandy loam textured medial unit, with common fine lapilli
***	***	260	2.300	Pale brown granule-rich sandy loam textured medial unit
***	***	70	2.370	Grey coarse sandy loam textured ash, firm
Bullot Formation (upper)	Ngamatea lapilli-1	60	2.430	Strong brown fine and few medium pumice lapilli; loose lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	70	2.500	Yellowish brown sandy loam textured ash
***	***	120	2.620	Yellowish brown coarse sandy loam textured ash, with root channels; paleosol
	unnamed	180	2.800	Coarse sandy loam textured ash, and scattered fine lithic and pumice lapilli
Tangatu Formation	unnamed	320	3.120	Olive coarse sand and granules, poorly sorted, and fine andesitic pebbles, and pumice pebbles; basal 110 mm coarse sand; hyperconcentrated flood flow deposit
Bullot Formation (upper)	unnamed	120	3.240	Yellowish red fine and medium pumice lapilli, very vesicular; ungraded tephra
Tangatu Formation	unnamed	80	3.320	Grey coarse sand
Bullot Formation (upper)	unnamed	110+	3.430	Brown sandy loam textured ash, greasy, and many brown fine pumice lapilli with grey interiors

Section Name and Map Code: Bullot Track Section 1 [BT1]

Grid Reference: T20/412108

Locality: An exposure within an ephemeral stream channel, approx. 200 m south of Bullot Track; the stratigraphy of deposits found overlying a 2 m thick fluvial deposit at 5.26 m is taken from an adjacent gully where the Holocene tephra stratigraphy is preserved

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	100	0.100	Bedded pebbles and sand, with sandy loam textured interbeds; rounded pumice and lithic pebbles; sharp wavy boundary
***	***	240	0.340	Dark greyish brown (10YR4/2) grading down to dark greyish brown (2.5Y4/2) medium sandy loam textured unit, greasy, with common brown coated root channels; sharp iron-stained lower contact; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	670	1.010	White fine to coarse pumice lapilli over poorly sorted ash and lapilli, with charcoalised branches
Mangatawai Tephra		480	1.490	250 mm Dark greyish brown (10YR4/2) fine sandy clay loam textured ash, slightly greasy; with many root channels; sharp contacts; paleosol 40 mm Very dark grey medium ash, firm, pocketing 80 mm Light olive brown to olive brown (2.5Y5/4 – 4/4) fine sandy loam textured ash, with iron-stained root channels; paleosol 110 mm Purplish black bedded fine sandy ash; discontinuous beds with wavy distinct contacts
Papakai Formation		90	1.580	Light olive brown (2.5Y5/4) fine sandy clay loam textured ash, greasy; with many brown coated root channels
Waimihia Tephra		30	1.610	Very pale brown (10YR7/3) fine ash 'cream cakes'
Papakai Formation		170	1.780	Light olive brown (2.5Y5/4) fine sandy loam textured ash, greasy; with many dark brown coated root channels; paleosol
	black ash-2	10	1.790	Very dark grey (5Y3/1) fine ash, pocketing, with interbedded beech leaves
		300	2.090	Yellowish brown (10YR5/6) fine sandy clay loam textured ash, greasy; with many dark brown coated root channels; paleosol; with indistinct lower contact, and a central 40 mm thick bed of brown and grey bedded coarse ash, pocketing;
Hinemaiaia Tephra		60	2.150	White and yellow coarse pumiceous ash interbedded within yellowish brown, greasy sandy loam textured Papakai Formation
Papakai Formation		170	2.320	Yellowish brown (10YR5/6) medium sandy loam textured ash, with many dark brown coated root channels
	orange lapilli-2?	40	2.360	Yellow (10YR7/6) fine pumice lapilli and grey fine lithic lapilli, with sandy loam textured ash matrix; discontinuous unit
		190	2.550	Yellowish brown (10YR5/6) fine sandy loam textured ash, with cracked exterior and many dark coated root channels; with scattered fine lithic lapilli
reworked Mangamate Tephra		80	2.630	Bedded very fine and fine brown and grey lithic lapilli
Mangamate Tephra	unnamed	180	2.810	Grey and brown very fine and fine lithic lapilli, non-vesicular and clast-supported lapilli; weakly bedded at top
Tangatu Formation	unnamed	70	2.880	Grey laminae of fine to coarse sand; ?fluvial sands
***	***	120	3.000	Pale brown fine and medium pumice lapilli, with pale yellow interiors

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Pahoka Tephra		60	3.060	20 mm Grey very fine angular, platy pumiceous fragments 40 mm Grey fine lapilli with matrix of grey and brown very fine angular, platy pumice fragments
***	***	200	3.260	Brown silty loam to silty clay loam textured medial unit, showing paleosol development; with cracked exterior and scattered fine pumice and lithic lapilli
***	***	2000	5.260	Weakly bedded pale yellow, pale brown, and grey pumice lapilli, and lithic lapilli with very fine sand and silt interbeds; fluvial deposit
		1000	6.260	Alternating beds of very fine compacted sand, and reverse graded pebble-rich beds with cobbles; fluvial deposit
Bullot Formation (upper)	unnamed	50	6.310	Pale orange and brown fine and medium pumice lapilli, angular, with few black fine lithic lapilli and sandy loam textured ash matrix
***	***	110	6.420	Light olive brown (2.5Y5/4) sandy loam textured ash, with interbedded laminae of coarse ash; common coated root channels; paleosol
	unnamed	30	6.450	Black coarse ash with very fine pumice and lithic lapilli
***	***	100	6.550	Dark yellowish brown to yellowish brown (10YR4/4 – 5/4) sandy clay loam textured medial unit, showing paleosol development, with many very fine lithic lapilli; few root channels
	Pourahu member [tephra unit]	140	6.690	White (10YR8/2) and pink (5YR7/3), with pale yellow medium and coarse pumice lapilli, firm, and few lithic lapilli; with coarse ash matrix; reversely graded unit, grading from a very fine lapilli and coarse ash base, to a dominantly medium lapilli top
	M_1	40	6.730	20 mm Grey ash, firm and prominent, with scattered fine strong yellow lapilli 20 mm Yellow ash, firm and prominent
	unnamed	90	6.820	Black fine lithic lapilli and fewer white and very pale yellow fine pumice lapilli
	member L18	90	6.910	Black, and some red angular lithic lapilli, and dark brown to dark yellowish brown (10YR4/3 – 4/4) dominantly fine pumice lapilli; ungraded unit
	unnamed	130	7.040	40 mm Purplish black coarse ash 30 mm Brown very fine angular, platy pumice fragments 60 mm Black coarse ash with many scattered fine lithic lapilli and pale yellow fine and medium pumice lapilli, soft
	member L17	250	7.290	Black fine lithic lapilli, angular, and dark brown (10YR3/3) fine and some medium pumice lapilli; ungraded unit
	M_2	130	7.420	40 mm Brownish grey pumice lapilli and coarse ash 10 mm Brown fine ash 20 mm Black and brown coarse ash 30 mm Yellow to olive coarse ash 30 mm Black coarse ash
	member L16	140	7.560	Strong brown (7.5YR5/8) medium and fine, with few coarse pumice lapilli, with olive brown (2.5Y4/4) interiors, and dark grey with few red fine to coarse lithic lapilli; angular pumice and lithic lapilli; coarse ash matrix; weak normal grading
	M_3	70	7.630	30 mm Grey loamy textured ash with scattered lapilli 20 mm Yellow loamy textured ash with very fine pumice lapilli and very fine angular, platy, pumice fragments 20 mm Dark grey coarse loamy textured ash with scattered lapilli
	member L15	250	7.880	Strong brown (7.5YR5/8) and very dark greyish brown (10YR3/2) very fine and fine pumice lapilli, with olive interiors; angular, hard pumice; and grey, very dark grey and occasional red lithic lapilli; minor coarse ash matrix; normally graded unit
	unnamed	80	7.960	Greyish brown medium ash with dark greyish brown lithic lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	member L14	90	8.050	Black fine and very fine lithic lapilli, and strong brown fine and very fine pumice lapilli; ungraded unit
	unnamed	30	8.080	Yellowish brown sandy loam textured ash with scattered lapilli
		70	8.150	Purplish black ash with many black very fine lithic lapilli
	member L13	190	8.340	Black, and occasional red, fine lithic lapilli, and strong brown fine and common medium pumice lapilli, with olive brown interiors
	unnamed	50	8.390	Purplish black medium ash with few fine lithic lapilli
	member L12	90	8.480	Black fine lithic lapilli and very dark greyish brown (10YR3/2) fine pumice lapilli, with black interiors; minor black coarse ash matrix
	unnamed	80	8.560	Brown coarse ash
		30	8.590	Pale grey medium ash with fine lapilli
		30	8.620	Brown sandy loam textured ash
		110	8.730	Brown fine pumice lapilli
		190	8.920	Black lithic lapilli in black coarse ash; with interbedded thin greyish brown ash laminae, and a purplish black coarse lithic-rich ash
		180	9.100	Black, and fewer grey and red very fine and fine lithic lapilli, and brown pumice lapilli; normally graded from very fine and fine lapilli base to a coarse ash top
		20	9.120	Purplish black fine sandy loam textured ash, with many very fine black lithic lapilli
		50	9.170	Dark olive grey coarse ash with yellow very fine pumice lapilli and black very fine lithic lapilli
		20	9.190	Purplish black coarse sandy ash with few black fine lithic lapilli
	member L11	110	9.300	Very dark greyish brown (10YR3/2) fine and medium pumice lapilli, with very dark greyish brown (2.5Y3/2) interiors, and black and common red fine and very fine lithic lapilli; hard subangular pumice, and lithic lapilli; with grey coarse ash matrix, grading up to a black coarse ash matrix near top of unit
	unnamed	120	9.420	Greyish brown coarse loamy textured ash, with many fine lithic lapilli
	member L10	120	9.540	Light olive brown (2.5Y5/4) dominantly fine pumice lapilli and black lithic lapilli, with a coarse ash matrix; hard subrounded pumice, and angular lithic lapilli; ungraded unit, with indistinct lower contact
	member L9	180	9.720	Light olive brown (2.5Y5/4) coarse pumiceous ash, fine pumice lapilli, and fewer black fine and very fine lithic lapilli; indistinct contacts
	member L8	180	9.900	Light olive brown (2.5Y5/4) fine and few medium-coarse pumice lapilli, and black dominantly fine lithic lapilli; subangular, soft pumice; distinct lower contact
	unnamed	200	10.100	Greyish brown loamy textured ash, and very fine to fine lithic lapilli
		40	10.140	Brown pumice lapilli and some black coarse lithic lapilli
		40	10.180	Light brownish yellow sandy loam textured ash, with fine pumice and lithic lapilli
		120	10.300	Black and brown coarse loam textured ash, with many fine lithic lapilli
		110	10.410	Brown fine and medium pumice lapilli with a central bed of yellow very fine, angular, platy pumice fragments; distinctive unit
		50	10.460	Black coarse sandy ash
Bullot Formation and Rerewhakaaitu Tephra		30	10.490	Pale brown ash with interbedded white very fine white rhyolitic ash
Bullot Formation (middle)	unnamed	170	10.660	Very dark grey coarse ash and very fine lithic lapilli; gravelly texture
		50	10.710	Yellow medium and fine pumice lapilli, and black medium and fine lithic lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (middle)	unnamed	40	10.750	Brown coarse ash and medium pumice lapilli, with some black lithic lapilli
		30	10.780	Brown coarse loamy sand textured ash
		30	10.810	Black sandy ash
		20	10.830	Grey fine ash and very fine lithic lapilli
		270	11.100	Alternating beds of brown, and very dark grey, loamy textured ash and fine to very fine lapilli
	member L7	180	11.280	Black lithic lapilli, and light yellowish brown (10YR6/4) fine and very fine pumice lapilli, with yellowish brown (10YR5/4) interiors; angular lithics and pumice; normally graded unit
	unnamed	10	11.290	Black to dark grey coarse ash
	member L6 (pink lapilli)	140	11.430	60 mm Pale brown (10YR6/3) to pinkish grey (7.5YR6/2) fine and very fine pumice lapilli, with same coloured interiors, and sandy loam textured ash matrix 80 mm Pale yellow fine pumice lapilli and coarse ash; with bed of black very fine lithic lapilli at base
	unnamed	150	11.580	Very fine pumice and lithic lapilli, and coarse ash
		50	11.630	Black lithic lapilli and yellowish brown pumice lapilli
		20	11.650	Dark greyish brown fine pumice lapilli and black fine lithic lapilli
		90	11.740	20 mm Pinkish brown sandy loam textured ash with scattered fine lithic lapilli 70 mm Brownish yellow to yellow (10YR6/6 – 7/6) and dark yellowish brown (10YR4/4) pumice lapilli, with olive brown interiors, and black with occasional red lithic lapilli, angular; some ash matrix
		40	11.780	Loamy textured ash
	member L5	100	11.880	Brown (10YR5/3) to dark brown (10YR4/3) fine pumice lapilli, with same coloured interiors, and black fine and medium lithic lapilli and scoria; some sandy loam textured ash matrix
	unnamed	130	12.010	Pale yellow and pink very fine pumice lapilli, with grey interiors, and black very fine lithic lapilli; with brown coarse ash matrix; normally graded unit
	member L4	290	12.300	Pale brown (10YR6/3) and light yellowish brown (2.5Y6/4) dominantly fine pumice lapilli, with light grey to light yellowish brown interiors; some medium and coarse pumice lapilli and occasional pumice bombs; very vesicular, hard pumice; and black and grey very fine lithic lapilli and some scoria; weak normal grading; sharp contacts
	unnamed	230	12.530	Greyish brown to olive brown coarse ash and fine lapilli beds
		150	12.680	Brown very fine and fine pumice lapilli, and black, red and grey lithic lapilli, with a sandy loam textured ash matrix; normally graded and prominent unit
***	***	1800	14.480	Strongly bedded unit comprising poorly sorted dominantly sand-rich, and granule-rich and pebble-rich beds, mostly <50 mm depth; with interbedded silt laminae and pockets of pumice, and lithic lapilli; with scattered very coarse pebbles, cobbles and boulders; weak cross bedding; unit wedges and pinches out at southern end of exposure; fluvial deposit
	unnamed	40	14.520	Brown medium ash and scattered fine pumice and lithic lapilli; sharp contacts
Okareka Tephra		10	14.530	White very fine ash, pocketing, with intermixed very fine black and brown andesitic ash
Bullot Formation (lower)	unnamed	20	14.550	Olive brown fine sandy loam textured ash; distinct contacts
		70	14.620	Black coarse ash; distinct contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (lower)	member L3 (hokey pokey lapilli)	230	14.850	Yellowish brown (10YR5/8 – 5/6), yellowish red (5YR5/8) and few very dark greyish brown (2.5Y3/2 – 2/2) medium, and some coarse pumice lapilli, and some olive grey pumice blocks with dark greyish brown interiors; very vesicular pumice lapilli; some black fine and medium scoria, angular and very few fine hydrothermally altered lithic clasts; ungraded unit
***	***	330	15.180	?Reworked andesitic pumice lapilli and ash; comprising alternating dark grey poorly sorted coarse sandy ash beds with fine lithic lapilli, and pale yellow dominantly fine pumice lapilli beds; sharp contacts
***	***	630	15.810	?Reworked andesitic lapilli and ash; comprising alternating poorly sorted grey sandy ash beds, and pebble-rich beds comprising pale brown to brown (10YR6/3 – 5/3) fine pumice and black and red fine lithic pebbles
	unnamed	30	15.840	Black fine sandy ash
	member L2	270	16.110	Light olive brown (2.5Y5/4) to brown (7.5YR5/4, moist colour) and pale yellow (dry colour)dominantly fine pumice lapilli, very vesicular and hard; and few black blocky-shaped lithic lapilli; some coarse ash matrix; reversely graded unit, grading from a dominantly fine lapilli base to a medium, with some coarse lapilli top
	member L1 (green ash)	220	16.330	Well bedded and well sorted, thin (< 10 mm) coarse pumiceous ash beds, and pale yellow very fine pumice and greenish grey lithic lapilli beds; distinctive colouring
	unnamed	50	16.380	Coarse ash and fine lapilli
		70	16.450	5 mm Coarse ash 65 mm Olive grey to brownish grey medium and fine lapilli, hard angular lapilli; normally graded
		10	16.460	Purplish grey medium ash
		150	16.610	Bedded lapilli and ash, comprising alternating fine and very fine lithic dominant lapilli beds, and poorly sorted coarse ash beds; beds 30 – 40 mm thick with distinct contacts; sharp upper and lower contacts
		20	16.630	Brown fine sandy loam textured ash; sharp contacts
		180	16.810	Bedded ash and lapilli, comprising alternating dark olive grey moderately well sorted coarse lithic and pumiceous ash beds, and pale brown (10YR6/3) to light yellowish brown (2.5Y6/4) fine pumice lapilli and black medium lithic lapilli beds; angular lithics and soft pumice; distinctly bedded unit
Kawakawa Tephra Formation	Oruanui Ignimbrite	40	16.850	30 mm Pinkish grey (7.5YR7/2) ash, firm, and fine pumice lapilli
	?Aokautere Ash			10 mm White fine ash
***	***	40	16.890	Brown sandy loam textured ash
Te Heuheu Formation	unnamed	110	17.000	Strong brown (7.5YR5/8) sandy clay loam textured matrix, with brown very fine and fine pumice pebbles and grey andesitic pebbles; ungraded; debris flow deposit
***	***	30	17.030	Greyish brown sand with scattered pebbles; moderately well sorted sand
***	***	100	17.130	Yellowish red (5YR5/8) fine and medium pumice lapilli, with same coloured interiors, soft and firm pumice; and fewer dark grey fine lithic lapilli, angular; some ash matrix; weak normal grading
***	***	520	17.650	150 mm Weakly bedded yellowish red (5YR5/6) very fine and some fine pumice lapilli, with olive brown interiors; angular, hard pumice lapilli; and grey very fine lithic lapilli; prominent unit; indistinct contacts 370 mm As above but dominantly fine pumice lapilli
		140	17.790	Coarse sandy loam textured matrix, poorly sorted, with fine andesitic pebbles and reddish yellow fine pumice pebbles, soft, and scattered andesitic cobbles at upper contact

Section Name and Map Code: Bullot Track Section 2 [BT2]

Grid Reference: T20/420110

Locality: A large cutting within an ephemeral stream channel, approx. 400 m northeast of Bullot Track, and 600 m south of Hyde Trig

Description is taken from an exposure immediately adjacent to a thick sequence of Manutahi Formation sands and gravels which infill a former channel cut into tephras older than Hinemaiaia Tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed		0.000	Lag deposit of grey sand, pebbles, cobbles and boulders
***	***	260	0.260	Dark greyish brown (10YR4/2) and dark greyish brown (2.5Y4/2) fine sandy loam textured ash, non-greasy; with mottled root channels and contacts; paleosol
Taupo Pumice	Taupo Ignimbrite	570	0.830	White fine to coarse pumice lapilli and coarse ash, poorly sorted, with charcoal; with a 40 mm thick very coarse crystal-rich deposit at base of the ignimbrite
Mangatawai Tephra		520	1.350	150 mm Olive brown (2.5Y4/4) sandy clay loam textured ash, greasy; with many iron-stained and imogolite-coated root channels; paleosol 50 mm Black medium sandy ash, pocketing 130 mm Olive brown (2.5Y4/4) to dark greyish brown (2.5Y4/2) sand clay loam textured ash, slightly greasy, grading downwards to fine sandy loam; with imogolite-coated root channels 190 mm Bedded black and purplish black coarse and fine ash, pocketing; with profuse iron-stained beech leaves; wavy distinct bed contacts, with brown sandy loam textured ash interbeds
Papakai Formation		80	1.430	Dark yellowish brown (10YR4/4) sandy loam to sandy clay loam textured ash, with patches of gleyed dark grey (5Y4/1) to olive grey (5Y4/2) sandy loam; slightly sticky;; with distinctive dark reddish brown (2.5YR3/4) iron-stained root channels and contacts
		110	1.540	Dark yellowish brown (10YR4/4) medium sandy clay loam textured ash, slightly greasy; with common very fine pumice and lithic lapilli; imogolite-coated root channels
Waimihia Tephra		30	1.570	Pale brown (10YR6/3) fine ash 'cream cakes' interbedded in Papakai Formation
Papakai Formation		240	1.810	Dark yellowish brown (10YR4/4) sandy clay loam textured ash, slightly greasy; distinct cracked exterior; weakly developed coarse nut and block structure; with scattered very fine orange pumice lapilli; paleosol
Manutahi Formation	unnamed	340	2.150	Grey bedded sands and lithic granules, with very coarse andesitic pebbles (maximum clast 60 mm) and pockets of clast-supported andesitic and pumice pebbles; discontinuous beds and some cross bedding; wavy contacts; 1st conformable unit seen above Manutahi Formation channel fill deposits in an adjacent section
		50	2.200	Grey bedded fine sandy clay
Papakai Formation		180	2.380	Yellowish brown (10YR5/6) and light olive brown (2.5Y5/4) medium sandy clay loam textured ash, greasy; with many dark brown coated root channels; indistinct basal contact
Hinemaiaia Tephra		120	2.500	Pale yellow (10YR5/6) and white coarse pumiceous ash dispersed within yellowish brown Papakai Formation
Papakai Formation		110	2.610	Yellowish brown coarse sandy clay loam, with interspersed Hinemaiaia Tephra at top, and fine andesitic lapilli
Manutahi Formation	unnamed	130	2.740	Bedded unit comprising well sorted and lithified coarse sand beds, granule-rich beds, and pebble-rich beds

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Manutahi Formation	unnamed	140	2.880	Clast-supported, subrounded fine and medium pumice and lithic pebbles, interbedded within sandy loam textured matrix
		60	2.940	Grey and brown, mottled fine and very fine sandy loam- and sandy clay loam textured beds; sharp contacts
***	***	20	2.960	Fine and very fine lithic lapilli, and fewer pumice lapilli, with minor sandy loam textured ash matrix
Papakai Formation		290	3.250	130 mm Yellowish brown (10YR5/6) fine sandy clay loam textured unit, with yellowish red (5YR4/8) mottles and coated root channels; distinct surface cracking 160 mm Greyish brown (2.5Y5/2) to light olive brown (2.5Y5/4) medium sandy loam, with yellowish red coated root channels; distinct surface cracking; paleosol
***	***	50	3.300	Olive brown fine sandy clay loam textured medial unit, slightly greasy; with abundant very fine lithic and pumice lapilli, and common yellow (10YR7/8) fine pumice lapilli; iron-stained root channels
***	***	60	3.360	Sandy clay textured medial unit, sticky, with common yellow fine and very fine pumice lapilli, and very fine lithic lapilli; many reddish brown coated root channels
***	***	240	3.600	Grey, weakly bedded sands and lithic granules, with interbedded lenses of brown, dominantly fine clast-supported pumice pebbles; discontinuous beds with wavy distinct contacts
***	***	170	3.770	Rounded fine to coarse pumice lapilli, and lithic lapilli interbedded within a sandy loam textured matrix; discontinuous unit
***	***	240	4.010	Greyish brown (2.5Y5/2) and purplish grey medium sandy clay loam textured unit, slightly greasy; coarse surface cracking; distinctive dark brown iron-stained contacts and coated root channels
reworked Mangamate Tephra		230	4.240	150 mm Very dark grey (5Y3/1) dominantly fine non-vesicular lapilli, with interbedded sandy laminae; weakly bedded and semi-lithified 80 mm Grey dominantly very fine non-vesicular lapilli; semi-lithified
Mangamate Tephra	Wharepu Tephra	150	4.390	Grey (5Y3/1) and dark greyish brown (10YR4/2) dominantly very fine non-vesicular lapilli; loose, gravelly texture; normally graded, with a brown firm sandy ash base
	Ohinepango Tephra	210	4.600	Black (2.5Y2/0), and yellowish red (5YR4/6) to strong brown (7.5YR5/6) bedded coarse ash; black beds are lithic dominant, and yellowish red to strong brown beds are pumice dominant; near base of unit are two distinct, coarse yellow ash beds, possibly representing Waihohonu Lapilli Member
***	***	150	4.750	Bedded black and olive sand, and granule-rich beds with fine pebbles; with black coarse sand at base
***	***	110	4.860	Yellowish brown (10YR5/6) sandy loam textured matrix, with interbedded discontinuous lenses of fine and medium pebbles
	?Oturere Lapilli	60	4.920	Dark grey (5Y4/1) dominantly medium lapilli; loose, gravelly texture
***	***	150	5.070	Yellowish brown (10YR5/6) and light olive brown (2.5Y5/4) fine sandy loam textured medial unit, showing paleosol development, greasy; with common fine yellow pumice lapilli and black coated root channels
	unnamed	90	5.160	Grey and black very fine andesitic pebbles interbedded in fine sandy loam textured matrix
Pahoka Tephra		50	5.210	Very dark grey (5Y3/1) to dark grey (5Y4/1) and yellowish brown (10YR5/6 – 5/8) fine lapilli, and distinctive very fine angular, platy pumiceous fragments
Bullot Formation (upper)	unnamed	90	5.300	Yellowish brown (10YR5/6) sandy loam textured ash, with some root channels and common fine lithic lapilli; indistinct basal contact on

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	1000+	6.300	Lapilli and ash beds A debris flow deposit of Tangatu Formation-age is found interbedded with Bullot Formation tephras at this site

Section Name and Map Code: The Chute Section 1

Grid Reference: T20/437045

Locality: An exposure near the southern end (approx. 500 m up channel) of The Chute, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Eroded surface with tephras younger than Bullot Formation member Ngamatea lapilli-1 eroded
Bullot Formation (upper)	Ngamatea lapilli-1	70	0.070	Strong brown fine and medium pumice lapilli, and grey fine lithic lapilli; loose, sub-angular, soft pumice lapilli; with minor sandy clay loam textured ash matrix; distinct contacts
***	***	90	0.160	Dark yellowish brown sandy clay loam textured medial unit, showing paleosol development, greasy, with cracked exterior and pale brown coated root channels; with scattered black fine lithic lapilli, and brown pumice lapilli; many lithic lapilli at base
	Pourahu Member [ignimbrite unit]	120	0.280	White and pinkish white dominantly medium pumice lapilli, and blocks, and minor black lithic lapilli and sandy clay loam textured ash matrix; very vesicular, hard phenocryst-rich pumice
	unnamed	20	0.300	Black very fine and fine lithic lapilli, loose, gravelly texture; grading laterally to grey sandy ash with fine lithic lapilli
	Pourahu Member [ignimbrite unit]	350	0.650	Pale yellow, white, and pinkish white dominantly medium pumice lapilli, and blocks; with some white and dark grey colour-banded pumiceous lapilli; very vesicular, hard, rounded and subrounded phenocryst-rich lapilli; some pale brown fine sandy loam textured ash matrix with pockets of black sand; finer grained basal 40 mm; sharp distinct contacts
Tangatu Formation	unnamed	620	1.270	Grey coarse sand and granule matrix, moderately well sorted, with matrix-supported black, grey, and red andesitic, and scoria pebbles, and small discontinuous lenses of white reworked Pourahu Member medium pumice pebbles; weakly bedded base comprising <100 mm thick pebble dominant and moderately well sorted sand dominant beds; distinctly reversely graded deposit with clasts concentrated toward the top of the unit; debris flow deposit
Bullot Formation (upper)	Pourahu Member [ignimbrite unit]	270	1.540	Pale yellow, white, and pinkish white dominantly coarse pumice lapilli, and many blocks; with fewer colour-banded pumiceous lapilli, and grey and red lithic clasts and some black scoria; some sandy loam textured ash matrix with interbedded lenses of grey fine sand; rounded, very vesicular, phenocryst-rich pumice; ungraded deposit; sharp basal contact
Tangatu Formation	unnamed	200	1.740	Grey coarse pumiceous and lithic sand matrix, moderately well sorted; with matrix-supported dominantly grey, and black and red andesitic pebbles and scoria, and many olive grey pumice pebbles and occasional jig-saw jointed white phenocryst-rich pumice bombs (>250 mm); poorly bedded deposit, with lateral changes in bedding development; debris flow deposit
		260	2.000	Grey coarse sand and granule matrix, semi-lithified; with common matrix-supported black and red andesitic pebbles and scoria, some scattered cobbles and boulders protruding at base of exposure, and rounded fine and medium pumice lapilli; deposit shows lateral changes in bedding development, grading from massive to very weakly bedded, with 50–100 mm pebble dominant and sand dominant beds

Section Name and Map Code: The Chute Section 2

Grid Reference: T20/437045

Locality: An exposure near the southern end (approx. 500 m up channel) of The Chute, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	Pourahu Member [ignimbrite unit]	500	0.500	White pumice lapilli, blocks, and occasional bombs; with a coarse ash matrix; some andesitic and scoria clasts; rounded pumice; pockets of clast-supported pumice
Tangatu Formation	unnamed	300	0.800	Pale grey coarse sand and granule matrix, semi-lithified; with matrix-supported dominantly black, and red and grey medium andesitic pebbles and scattered cobbles; wavy scoured basal contact; debris flow deposit
		140	0.940	Bedded grey sand and granule matrix, semi-lithified; with fine andesitic pebbles; bed thicknesses generally 50 – 60 mm; hyperconcentrated flood flow deposit
		120	1.060	Grey sand and granule matrix; with clast-supported red, grey and black fine and few medium andesitic pebbles; discontinuous lens-shaped deposit; scoured upper contact; hyperconcentrated flood flow deposit
		230	1.290	Grey very coarse sand and granule matrix; with many red, grey and black fine and medium andesitic pebbles and scoria, and many (>50%) olive brown pumice pebbles; maximum clast 110 mm (cobble); debris flow deposit
		60	1.350	Pale grey firm sand with lithic granules
		150	1.500	Grey coarse sand and granule matrix; with many matrix-supported fine and medium pumice pebbles, sub-rounded, and fewer pale yellowish brown, grey and red dominantly medium andesitic pebbles; debris flow deposit
		230	1.730	Grey poorly sorted very coarse sand and granule matrix; with heterolithologic red, black and grey dominantly coarse pebbles, distinct porphyritic clasts, angular and subangular, with common cobbles and boulders; with common pale brown fine andesitic pumice pebbles, subrounded, vesicular, hard; matrix to clast-supported lithic and pumice pebbles; pumice pebbles concentrated in top half of unit, and lithic pebbles in basal half; distinct sharp and scoured basal contact; debris flow deposit
		500	2.230	Pale brown poorly sorted medium sand dominant and granule matrix; with matrix-supported pale brown fine and medium subrounded pumice pebbles and fewer red, purplish red, grey and black dominantly medium andesitic pebbles and scattered cobbles (150 mm), and occasional conglomerate cobbles; with an interbedded 400 mm prismatically-jointed pumice bomb; ungraded deposit; distinct wavy basal contact; debris flow deposit
		90	2.320	Purplish brown medium sand dominant and granule matrix, poorly sorted; with some olive grey fine pumice pebbles and andesitic pebbles; wedging unit tapering to 20 mm depth; distinct contacts; hyperconcentrated flood flow deposit
		160	2.480	Grey granule dominant and coarse sand matrix, poorly sorted; with matrix-supported purplish red, grey and black fine and medium andesitic pebbles, and some cobbles and boulders at very base of unit; with pockets of clast-supported clasts; finer grained pebble-free basal 20 mm; debris flow deposit
		420	2.900	Grey medium to coarse sand dominant and granule matrix, poorly sorted; with many matrix-supported pale brown and white medium to coarse pumice pebbles and medium black, red and grey andesitic pebbles, scattered (200 – 300 mm) cobbles and boulders concentrated toward base of unit; subangular protruding clasts; slight normal grading; debris flow deposit

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	250+	3.150	Brown coarse sand dominant and granule matrix, poorly sorted; with matrix-supported grey and red andesitic pebbles and scattered cobbles, and some brown pumice pebbles; ungraded deposit; debris flow deposit

Section Name and Map Code: The Chute Section 3 [CT3]

Grid Reference: T20/437045

Locality: An exposure near the southern end (approx. 500 m up channel) of The Chute, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	500	0.500	Grey andesitic pebbles, cobbles and boulders and laharic sands, unconformably overlying Papakai Formation
Papakai Formation		280	0.780	Dark brown to reddish brown medium sandy clay loam textured ash, greasy, with cracked exterior, and many dark brown coated root channels; with scattered interspersed very fine strong brown pumice lapilli; erosional sharp laminar upper contact; paleosol
	?orange lapilli-2	40	0.820	Strong brown medium pumice lapilli and black to dark grey medium lithic lapilli; with sandy clay loam textured ash matrix; indistinct contacts
		80	0.900	Greyish brown medium sandy loam textured ash; with scattered fine lithic lapilli and streaks of ?imogolite; paleosol
	?orange lapilli-1	30	0.930	Strong brown medium to fine pumice lapilli, and some grey fine lithic lapilli; angular, soft pumice; discontinuous tephra
		150	1.080	Greyish brown medium sandy loam textured ash; with cracked exterior and many ?imogolite-coated root channels; with interbedded indistinct fine lithic and pumice lapilli; paleosol
Bullot Formation (upper)	Ngamatea lapilli-2	50	1.130	Strong brown fine and fewer medium pumice lapilli, and black very fine lithic lapilli; with some sandy loam textured ash matrix; ungraded, distinctive tephra; soft pumice
***	***	90	1.220	Brownish yellow coarse sandy loam textured medial unit, showing paleosol development, slightly greasy; with moderately well developed fine nut structure and many ?imogolite-coated root channels; prominent unit
	Ngamatea lapilli-1	90	1.310	Strong brown fine pumice lapilli and very fine dark grey lithic lapilli; loose lapilli, gravely texture; ungraded tephra; finer grain size than Ngamatea lapilli-2; distinctive tephra
***	***	70	1.380	Brown coarse sandy clay loam textured medial unit, greasy, with black and dark brown coated root channels, and many very fine scattered white pumice and grey lithic lapilli
***	***	90	1.470	Yellowish grey coarse sandy loam textured medial unit, showing paleosol development; with common ?imogolite-coated root channels, and many scattered black very fine lithic lapilli and some white pumice lapilli
	unnamed	60	1.530	Strong brown fine and medium pumice lapilli and grey fine lithic lapilli, with minor sandy loam textured ash matrix; hard pumice; sharp basal contact
	Pourahu Member (ignimbrite unit)	110	1.640	White fine pumice lapilli and blocks, with coarse sandy ash matrix; ungraded deposit; sharp basal contact
Tangatu Formation	unnamed	700	2.340	Dark grey coarse sand and granule matrix, moderately well sorted; with dominantly black, red and grey fine and medium andesitic pebbles, and few reworked Pourahu Member pumice blocks; discontinuous unit; scoured basal contact; debris flow deposit
Bullot Formation (upper)	Pourahu Member (ignimbrite unit)	1010	3.350	Very poorly sorted deposit comprising white and pinkish white pumice lapilli, blocks and bombs; colour-banded grey and white pumiceous lapilli and blocks; some black scoria; and pale pinkish brown crystal-rich coarse ash with pale brown sandy clay loam textured interbeds; very vesicular phenocryst-rich pumice; pyroclastic flow deposit
Tangatu Formation	unnamed	350+	3.700	Dark grey coarse sand and granule matrix, with black, red and grey dominantly coarse and very coarse andesitic pebbles and scoria; reversely graded deposit, with coarser clasts concentrated toward top of deposit; distinct upper contact; debris flow deposit

Section Name and Map Code: Death Valley Section 2 [DV2]

Grid Reference: T20/408047

Locality: Description is for deposits exposed along a *c.* 50 m stretch of channel within Death Valley.

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		40	0.040	Yellowish brown (10YR5/6) sandy loam textured unit
Tufa Trig Formation	unnamed	60	0.100	Dark grey coarse ash; distinct contacts
	member Tf8	15	0.115	Very dark grey sandy ash with very fine yellowish brown pumice lapilli at base
Makahikatoa Sands		30	0.145	Yellowish brown fine sandy loam textured unit
Tufa Trig Formation	unnamed (?member Tf7)	30	0.175	Black sandy ash
	member Tf6	60	0.235	Black coarse ash and very fine lapilli, with a grey fine ash base and top
Makahikatoa Sands		70	0.305	Yellowish brown sandy loam textured unit; paleosol
Tufa Trig Formation	member Tf5	90	0.395	Black very coarse black and dark grey ash and fine lapilli with a fine grey ash base
Makahikatoa Sands		25	0.420	Brown sandy loam textured unit
Tufa Trig Formation	member Tf4	5	0.425	Grey coarse ash, pocketing
Makahikatoa Sands		20	0.445	Brown sandy loam textured unit
Tufa Trig Formation	member Tf3	5	0.450	Dark grey coarse ash, pocketing
Makahikatoa Sands		65	0.515	Grey sandy loam textured unit, greasy, with strong brown mottles; paleosol
Tufa Trig Formation	member Tf2	55	0.570	Brown fine and medium pumice lapilli with iron-stained contacts
Makahikatoa Sands		170	0.740	Yellowish brown medium sandy loam textured unit, slightly greasy, with distinct iron-stained contacts; paleosol
Tufa Trig Formation	member Tf1	50	0.790	Pale yellow medium and fine pumice lapilli, with iron-stained contacts
***	***	130	0.920	Purplish grey sandy loam textured unit, greasy; with scattered fine reworked Taupo Pumice; 10 mm yellowish red iron-stained base; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	360	1.280	White poorly sorted coarse ash and lapilli, with charcoalised branches
Mangatawai Tephra		460	1.740	110 mm Dark purplish brown medium sandy clay textured ash, very greasy; with a 10 mm strong yellowish red iron-stained base; paleosol 130 mm Dark brown fine sandy clay textured ash, very greasy; paleosol 220 mm Dark grey and black coarse ash beds, discontinuous; with sandy clay loam textured ash interbeds
Papakai Formation		160	1.900	Dark yellowish brown (10YR4/4) medium sandy loam textured ash, slightly greasy
Waimihia Tephra		20	1.920	Pale brown to white fine ash 'cream cakes' interbedded with dark yellowish brown sandy loam textured ash
Papakai Formation		20	1.940	Dark yellowish brown (10YR4/4) sandy loam textured ash
	black ash-2	15	1.955	Black coarse ash, firm, pocketing
		210	2.165	Dark yellowish brown (10YR4/4) medium sandy loam textured ash, slightly greasy

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Mangaio Formation		2030	4.195	910 mm	Unit 1: strong brown (7.5YR5/6) and grey (2.5Y6/0) sandy loam to sandy clay loam textured matrix, sticky; with many white and iron-stained hydrothermally altered lithic pebbles and cobbles, soft clasts
				220 mm	Unit 2: as above but with stronger iron-staining of matrix materials; indistinct contacts
				900 mm	Unit 3: purplish grey, grey (2.5Y6/0) and strong brown (7.5YR5/6) sandy clay textured matrix; with many white and orange iron-stained hydrothermally altered andesitic pebbles and cobbles; greater concentration of clasts than in units 1 and 2; with common small branches, radiocarbon dated [NZ7729] at 4600 ± 110 years B.P.; sharp lower contact
		30	4.225	Dark brownish red peat, radiocarbon dated [NZ7532] at 4850 ± 90 years B.P.	
Papakai Formation		100	4.325	Purplish brown greasy sandy clay textured ash; paleosol	
	black ash-1	20	4.345	Black coarse ash, firm, pocketing, indistinct	
		30	4.375	Greyish brown sandy clay loam textured ash	
Hinemaiaia Tephra		30	4.405	Yellow and white coarse pumiceous ash dispersed within greasy andesitic ash of Papakai Formation	
Manutahi Formation	unnamed	90	4.495	Olive brown coarse loamy sand; ?hyperconcentrated flow or stream flow deposit	
Papakai Formation	orange lapilli-1	270	4.765	Strong brown iron-stained fine and very fine pumice lapilli, soft; with sandy loam textured ash matrix	
Manutahi Formation	unnamed	3500	8.265	Grey sands, bedded, with lenses of pumice pebbles and sandy loam textured interbeds	
		20	8.285	Black fine ash	
		10	8.295	Strong brown iron-stained greasy clay	
Whakatane Tephra		25	8.320	White very fine ash with pale grey very fine ash base	
Manutahi Formation	unnamed	20	8.340	Strong brown iron-stained greasy clay	
		20	8.360	Grey fine sand	
		230	8.590	Alternating beds of fine sand and sandy clay	
		240	8.830	Weakly bedded sands and medium to fine pumice, firm, and andesitic pebbles	
		220	9.050	Strong brown iron-stained greasy clay with dark coated root channels and root matter	
		120	9.170	Purplish brown greasy sandy clay, with very fine white pumice fragments and scattered coarse ash	
Motutere Tephra		20	9.190	Pale brown and pinkish brown fine and coarse ash 'cream cakes', and scattered white very fine pumice fragments, interbedded in greasy sandy clay	
Tangatu Formation	unnamed	150+	9.340	Greyish – brown – purplish brown greasy sandy clay	

Section Name and Map Code: Death Valley Section 3 [DV3]

Grid Reference: T20/409042

Locality: A large cutting (western exposure) near the southern end of Death Valley, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed		0.000	Veneer deposit of grey laharic and fluvial sands and gravels
Taupo Pumice	Taupo Ignimbrite	380	0.380	White poorly sorted coarse ash and lapilli, with charcoal fragments; sharp smooth contacts
Mangatawai Tephra		440	0.820	110 mm Dark greyish brown (10YR4/2) sandy clay to sandy clay loam textured ash, slightly greasy; cracked exterior; many iron-stained root channels; sharp upper contact; paleosol 30 mm Dark grey coarse ash, pocketing 130 mm Olive brown (2.5Y4/4) fine sandy loam textured ash, greasy; with dark brown coated root channels; paleosol 170 mm Alternately bedded dark grey to black coarse sandy ash beds, pocketing, and dark greyish brown coarse loamy sand textured ash beds
Papakai Formation		110	0.930	Yellowish brown (10YR5/6) to dark yellowish brown (10YR4/4) fine sandy loam textured ash, with weakly developed coarse blocky structure, and pale brown coated root channels; paleosol
Waimihia Tephra		20	0.950	Pale brown fine ash 'cream cakes', with intermixed brown fine andesitic ash
Papakai Formation		190	1.140	Yellowish red (5YR4/8) and yellowish brown (10YR5/6) mottled fine sandy loam textured ash, with moderately developed fine nut structure; many mottled root channels; paleosol
	black ash-2	20	1.160	Dark grey (5Y4/1) coarse ash, firm, with reddish brown iron-staining
		60	1.220	Dark yellowish brown (10YR4/4) sandy loam textured ash; indistinct contacts
Papakai Formation & Hinemaiaia Tephra		130	1.350	Yellowish brown (10YR5/6 – 5/8) sandy loam textured ash; with interspersed yellow coarse pumiceous ash; with dark reddish brown (5YR3/4) mottled root channels
Manutahi Formation	unnamed	1450	2.800	Bedded unit, comprising sand dominant, pebble dominant, and yellowish brown (2.5Y6/4) prominent sandy clay loam textured beds with dark brown coated root channels and interbedded grey fine sand laminae; sand dominant beds comprise grey well sorted sands, with cross beds and scour and fill structures; pebble-rich beds comprise fine rounded andesitic and brown pumice pebbles with sand and granule matrices, and are the dominant bed-type in the top 1 m; discontinuous beds; deposit transitional in character between fluvial and hyperconcentrated flood flow deposits
		50	2.850	Millimetre-bedded grey very fine sand and brown very fine silt beds; firm, prominent; with 5 mm iron-stained contacts
***	***	70	2.920	Grey (5Y5/1) to olive grey (5Y5/2) medium sandy clay loam textured medial unit, showing paleosol development, with yellowish red (5YR4/6) mottles; with common fine white pumice lapilli; many distinct dark brown coated root channels
***	***	220	3.140	Light olive brown (2.5Y5/4) sandy clay loam textured medial unit, with interbedded yellowish brown (10YR5/8) fine pumice lapilli with light olive brown (2.5Y5/4) interiors, and grey and black lithic lapilli; distinct contacts
***	***	170	3.310	Dark yellowish brown (10YR4/4) medium to fine sandy clay loam textured medial unit, showing paleosol development; with weakly developed blocky structure, and interbedded fine pumice lapilli and grey lithic lapilli; with brown coated root channels

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Papakai Formation	?orange lapilli-1	90	3.400	Yellowish brown (10YR5/8) dominantly fine pumice lapilll (<10 mm) and grey lithic lapilli; interbedded in dark yellowish brown (10YR4/4) sandy clay loam textured ash with distinct olive brown (2.5Y4/4) coated root channels and fibres; discontinuous tephra
Manutahi Formation	unnamed	180	3.580	Pockets of matrix and clast-supported coarse and medium brown rounded pumice pebbles, and red and black fine and medium andesitic pebbles; irregular contacts
reworked Motutere Tephra		20	3.580	Laminated pinkish brown coarse and fine ash
Manutahi Formation	unnamed	210	3.790	Bedded unit, comprising very fine and fine rounded pumice and andesitic pebble beds, normally graded, and sand dominant beds comprising well sorted sands with pockets of medium and coarse rounded pumice and andesitic pebbles; some cross beds and scour & fill structures; wavy sharp bed contacts; sharp basal contact; deposit transitional in character between fluvial and hyperconcentrated flood flow deposits
Motutere Tephra		20	3.810	Light grey (10YR7/2) to pinkish brown coarse and fine ash 'cream cakes', and pumice fragments; primary tephra; sharp discontinuous contacts
***	***	40	3.850	Pale yellow (2.5Y7/4) to light yellowish brown (2.5Y6/4) fine sandy loam textured ash, with cracked exterior and distinct black coated root channels; paleosol
Tangatu Formation	unnamed	430	4.280	Bedded unit, comprising pebble dominant and sand dominant beds; pebble dominant beds comprise distinctly rounded pale yellow (5Y7/3) and light brownish grey (2.5Y6/2) to greyish brown (2.5Y5/2) medium to fine pumice lapilli, with very pale brown (10YR7/4) interiors, and subrounded fine and medium andesitic pebbles; sand-rich beds comprise lenses of well sorted coarse or fine sand, and grade laterally to fine lapilli and granules; discontinuous beds; on 70 mm grey (5Y5/1) fine sand; deposit shows characteristics transitional between fluvial and hyperconcentrated flood flow deposits
***	***	320	4.600	Alternately bedded greyish brown (2.5Y5/2) fine sand, and yellowish brown (10YR5/6) slightly greasy fine sandy clay loam to clay loam textured beds with black coated root channels; laminar beds < 20 mm depth; sharp contacts; prominent unit
***	***	190	4.790	Dark greyish brown (2.5Y4/2) and dark grey (5Y4/1) to olive grey (5Y4/2) gleyed sandy clay loam to sandy clay textured medial unit, showing paleosol development, sticky; with yellowish red (5YR4/6) mottles and many fine lithic lapilli at base; distinct dark brown coated root channels
***	***	30	4.820	Dark yellowish brown (10YR4/4) fine sandy loam textured ash; sharp basal contact
***	***	20	4.840	Black coarse ash and very fine lithic lapilll; discontinuous
***	***	40	4.880	Pale greyish brown loamy sand; granule-rich; indistinct; discontinuous
?Papakai Formation		70	4.950	Yellowish brown (10YR5/6) fine sandy loam textured-ash, with cracked exterior and many black coated root channels; with scattered fine lithic lapllll; paleosol
Bullot Formation (upper)	Ngamatea lapilli-1	70	5.020	Strong brown iron-stained fine and very fine pumice lapilli, with few very fine and fine lithic lapilli; loose, gravelly texture; ungraded
Tangatu Formation	unnamed	240	5.280	Weakly bedded unit, comprising pebble dominant, granule dominant and sand dominant beds, and scattered acoria cobbles; pebble dominant beds comprise < 50 mm thick beds of fine subrounded pumice pebbles and andesitic pebbles, with sand and granule matrices; granule dominant beds comprise well <10 mm thick beds of well sorted andesitic and pumice granules; sand dominant beds comprise < 20 mm thick beds of dark grey, well sorted sand, and some cross beds; ?fluvial deposit

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	130	5.390	Greyish brown sand and granule matrix, lithified, with many clast-supported fine andesitic and pumice pebbles, angular; discontinuous unit; ?hyperconcentrated flood flow deposit
		40	5.430	Alternately bedded andesitic granule and sand beds; bed thicknesses <5 mm
		40	5.470	Weakly bedded black and strong brown coarse sand and granules
		320	5.790	Greyish brown loamy sand and granule matrix; with many matrix-supported fine to very coarse pumice pebbles, and black and red andesitic pebbles; common red and black cobbles in top 150 mm; subrounded clasts; debris flow deposit
		170	5.960	Pale grey coarse sand and granule matrix with clast-supported fine andesitic pebbles, and common black scoria, and some pumice pebbles; weakly bedded sandy base; hyperconcentrated flood flow deposit; sharp basal contact
***	***	280	6.240	Light yellowish brown (2.5Y6/4) very fine sandy loam textured medial unit, prominent; with interbedded small lenses of sand, granules, and pebbles; with ?imogolite-coated root channels
***	***	60	6.300	Fine and medium pumice and lithic lapilli, angular; with a light yellowish brown (2.5Y6/4) loamy sand textured ash matrix; ungraded tephra
		760	7.060	Weakly bedded unit comprising sand dominant, granule dominant, and pebble dominant beds; sand dominant beds comprise dominantly coarse sand; granule dominant beds comprise andesitic granules, some sand and few fine andesitic pebbles, poorly sorted; pebble dominant beds comprise clast-supported fine to coarse andesitic pebbles, and some sand; discontinuous lens-shaped beds, with wavy discontinuous bed contacts; ?fluvial deposits
		240	7.300	Black coarse to very coarse sand and granule matrix, moderately well sorted; with matrix-supported andesitic cobbles and some boulders at base, and many red andesitic pebbles; angular to subangular clasts; ungraded deposit

Section Name and Map Code: Death Valley Section 4 [DV4]

Grid Reference: T20/410041

Locality: A large cutting (western exposure) at the southernmost end of Death Valley, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Mangaio Formation		870	0.870	300 mm Grey and strong brown iron-stained sandy clay loam textured matrix, with matrix-supported andesitic pebbles and cobbles 570 mm Grey and strong brown iron-stained sandy clay textured matrix, sticky; with matrix-supported andesitic cobbles and boulders concentrated toward base of unit; sharp smooth contacts; Overlain by dark grey Onetapu Formation andesitic diamictons
***	***	60	0.930	Grey gleyed fine sandy loam textured unit, with strong brown mottles
Manutahi Formation	unnamed	270	1.200	Pale grey bedded pebble-rich and sand-rich beds, with loamy sand and sandy loam textured interbeds; all beds discontinuous; stream flow deposit
Papakai Formation		130	1.330	Dark yellowish brown (10YR4/4) fine to very fine sandy loam-sandy clay loam textured ash; with dark yellowish brown (10YR4/4) to yellowish brown (10YR5/6) coated root channels; paleosol
	black ash-1	20	1.350	Grey coarse ash, pocketing
Hinemaiaia Tephra		50	1.400	Yellow and white coarse pumiceous ash, dispersed within dark yellowish brown sandy clay loam textured ash
Papakai Formation		120	1.520	Yellowish brown (10YR5/6) fine sandy clay loam textured ash; with dark brown and black coated root channels; paleosol
***	***	130	1.650	Yellowish brown (10YR5/6) fine sandy clay loam textured unit, paleosol; with interbeds of rounded pumice pebbles and pockets of grey sand
Manutahi Formation	unnamed	3000	4.650	Weakly bedded deposit comprising pumice-rich beds with distinctly rounded pumice and lithic pebbles, sand-rich beds, and sandy loam textured interbeds; all beds discontinuous
Motutere Tephra		30	4.660	Pinkish brown fine and coarse ash; possibly reworked; with sharp contacts
Tangatu Formation	unnamed	240	4.920	Brown fine sandy clay, firm; with interbedded laminae of grey very fine sand; occasional iron-stained root channels
***	***	180	5.100	Brown greasy sandy clay, sticky, with scattered strong brown (7.5YR5/8) fine pumice lapilli; sharp contacts
Bullot Formation (upper)	uncorrelated (?Ngamatea lapilli-1)	50	5.150	Brown fine pumice lapilli
Tangatu Formation	unnamed	580	5.730	Greyish brown coarse sand and granule matrix; with matrix-supported grey and red, dominantly medium andesitic pebbles, and cobbles and boulders (maximum clast 570 mm); reverse graded with finer granule dominant weakly laminated base; sharp lower contact; debris flow deposit
		240	5.970	Grey sand matrix, indurated, with fine andesitic pebbles, and lenses of dominantly medium pebbles to cobbles; ?hyperconcentrated flood flow deposit
		30	6.000	Greyish brown fine sandy loam textured unit
		70	6.070	Strong brown and black bedded coarse ash with fine sandy loam textured interbeds and laminae
		30	6.100	Brown silt bed, firm

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	360	6.460	Grey medium to coarse sand and granule matrix, moderately well sorted and slightly indurated; with many matrix-supported red and black andesitic pebbles, rounded and subangular, and pockets of same; reverse graded with finer dominantly coarse sand and granule basal 100 mm; sharp wavy lower contact; debris flow deposit
		240	6.700	Brown fine sandy loam textured unit with grey sand laminae and discontinuous pebble-rich and sand-rich beds
		100+	6.800	Grey sand matrix with many matrix-supported fine pebbles and occasional cobbles; debris flow deposit

Section Name and Map Code: Death Valley Section 5 [DV5]

Grid Reference: T20/409045

Locality: A large cutting within Death Valley, eastern exposure

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed		0.000	Grey laharic sands and gravels
Makahikatoa Sands		100	0.100	Dark yellowish brown (10YR4/4) greasy fine sandy clay loam textured unit
		270	0.370	Yellowish brown fine sandy loam textured ash
Tufa Trig Formation	?member Tf14	30	0.400	Dark grey coarse ash
Makahikatoa Sands		220	0.620	Yellowish brown fine sandy loam textured unit
Tufa Trig Formation	?member Tf8	20	0.640	Dark grey medium and coarse ash, with very fine pumice lapilli
	member Tf6	40	0.680	Dark grey coarse ash
Makahikatoa Sands		50	0.730	Medium to coarse sandy loam textured unit
Tufa Trig Formation	member Tf5	80	0.810	Dark grey coarse ash and very fine lapilli, with finer grey ash base; distinctly reverse graded
Makahikatoa Sands		60	0.870	Dark greyish brown (10YR4/2) greasy medium sandy loam textured unit
Tufa Trig Formation	member Tf4	10	0.880	Grey coarse ash, pocketing
Makahikatoa Sands		140	1.020	Dark yellowish brown (10YR4/4) medium sandy loam grading down to dark greyish brown (10YR4/2) greasy medium sandy clay loam textured unit; with iron-stained root channels; paleosol
Tufa Trig Formation	?member Tf1	30	1.050	Fine pumice and lithic lapilli within a sandy loam textured ash matrix; ungraded unit, with iron-stained lower contact
***	***	170	1.220	Dark yellowish brown (10YR4/4) to yellowish brown (10YR5/6) sandy clay loam textured ash; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	590	1.810	Grey poorly sorted coarse ash and lapilli with carbonised branches
Mangatawai Tephra		390	2.200	130 mm Dark greyish brown (10YR4/2) very greasy medium sandy clay loam textured ash; with imogolite-coated and iron-stained root channels; paleosol 20 mm Black coarse sandy ash, firm, pocketing 90 mm Dark greyish brown (10YR4/2) slightly greasy medium sandy clay loam textured ash; friable; with few indistinct iron-stained root channels; sharp contacts 150 mm Bedded dark grey (5Y4/1) coarse ash beds, firm, pocketing, and brown sandy loam textured ash beds
Papakai Formation		90	2.290	Dark greyish brown (10YR4/4) fine sandy loam textured ash; with common iron-stained root channels
Papakai Formation & Waimihia Tephra		240	2.530	Yellowish brown (10YR5/6) fine sandy loam textured ash; with dark brown coated root channels; with 10 mm pale brown fine ash 'cream cakes' (Waimihia Tephra) interbedded near top
Papakai Formation	black ash-2	10	2.540	Dark grey coarse ash, firm, pocketing
Hinemaiaia Tephra		60	2.600	Yellow and white coarse pumiceous ash dispersed throughout yellowish brown (10YR5/6) medium sandy loam textured Papakai Formation
Papakai Formation		20	2.620	Yellowish brown (10YR5/6) fine sandy loam textured ash
Manutahi Formation	unnamed	210	2.830	Yellowish brown (10YR5/6) sandy loam textured unit, with brown coated root channels; and interbedded pebble-rich beds comprising fine rounded bluish grey andesitic pebbles, and distinctly rounded brown pumice pebbles; discontinuous pebble beds

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Manutahi Formation	unnamed	1260	4.090	Poorly bedded unit, comprising pebble-rich, granule-rich and few sand-rich beds; pebble-rich beds are ungraded and discontinuous, and comprise pale brown fine rounded pumice pebbles and fine subangular andesitic pebbles, with pockets of clast-supported pebbles. Sand-rich beds dominate in upper part of unit and comprise well sorted, semi-lithified sands, with some granules; bed contacts are wavy and distinct
Manutahi Formation & Whakatane Tephra		170	4.260	Dark yellowish brown (10YR4/4) very greasy fine silty clay loam textured unit, prominent; with interbedded laminae of pale grey very fine sand, and distinct 5 mm thick white very fine ash 'cream cakes' (Whakatane Tephra) near top of unit; sharp lower contact
***	***	210	4.470	Indistinct lapilli beds of dominantly fine pumice and fewer lithic lapilli; with sandy loam textured coarse ash matrix
***	***	180	4.650	Reddish brown (2.5YR4/4) greasy fine sandy clay loam textured medial unit, showing paleosol development; with scattered very fine lithic lapilll, and distinctive black coated root channels
Manutahi Formation	unnamed	230	4.880	Poorly bedded unit comprising yellowish brown (10YR5/6 – 5/8) sandy loam textured beds, grey sand, and fine pebble beds comprising rounded andesitic and pumice pebbles; discontinuous beds
		70	4.950	Bedded yellowish brown (10YR5/6) and grey very fine sand
		120	5.070	Discontinuous bed of distinctly rounded fine iron-stained pumices and andesitic pebbles; sharp contacts
		90	5.160	Light olive brown (2.5Y5/4) to olive brown (2.5Y4/4) very fine sandy loam textured unit with interbedded grey very fine sand laminae; common imogolite-coated root channels; sharp upper contact
?Papakai Formation		180	5.340	Greyish brown (2.5Y5/2) fine sandy clay textured unit; with grey mottles; strong brown (7.5YR5/6) iron-stained root channels and contacts; paleosol
Motutere Tephra		50	5.390	Pale pinkish brown fine and coarse ash 'cream cakes' with distinctive white pumice fragments
?Papakai Formation		90	5.480	Olive grey (5Y5/2) to greyish brown (2.5Y5/2) greasy medium sandy clay loam textured unit, with distinct yellowish red iron-stained root channels; paleosol
***	***	10	5.490	Yellowish red (5YR4/6 – 4/8) iron pan
***	***	70	5.560	Yellowish brown (10YR5/6 – 5/8) sandy loam textured unit, with abundant lithic granules; occasional root channels; sharp lower contact
Tangatu Formation	unnamed	120	5.680	Grey sand and granule dominant matrix, poorly sorted, indurated; weakly laminated; grading laterally to pebble-rich with clast and matrix-supported pebbles; fine pebbles only, maximum clast 15 mm (medium pebble), pumice poor; sharp contacts; hypeconcentrated flow deposit
		320	6.000	Grey to olive grey coarse sand, and granule dominant matrix, poorly sorted; weakly laminated; occasional cobble at base of unit; fine heterolithologic lithics and few pumice lapilli (pumice poor); with scattered small lenses of fine lithics and few pumices; sharp wavy contacts; hyperconcentrated flow deposit
***	***	70	6.070	Yellowish brown (10YR5/6) medium sandy loam textured medial unit, with cracked exterior, and fine crumb structure, friable, with black coated root channels and common scattered fine lithic lapilli
***	***	90	6.160	Sandy loam textured medial unit with abundant lithic granules and many fine lithic lapilli; indistinct lower contact
	unnamed	160	6.320	Pale grey coarse sand and granules, poorly sorted, and many fine and few coarse andesitic pebbles; few pale grey scoria cobbles, maximum clast 150 mm (cobble); sharp scoured basal contact; hyperconcentrated flood flow deposit

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
Tangatu Formation	unnamed	180	6.500	Pale grey coarse sand and granule s, and many black, grey, red, and orange fine andesitic pebbles; few cobbles at top of unit; reversely graded deposit; hyperconcentrated flood flow deposit
		160	6.660	Weakly stratified very coarse sand and granules, poorly sorted and semi-lithified; with many fine andesitic pebbles in top of unit, grading down to coarse sand and granules; reversely graded deposit, wedging to 40 mm; sharp wavy lower contact; hyperconcentrated flood flow deposit
		140	6.800	Grey coarse sand and granules, poorly sorted, with scattered red, orange, black and grey fine andesitic and pumice pebbles; reversely graded unit, grading upward from a granule dominant base to a fine pumice-rich top 40 mm; hyperconcentrated flood flow deposit; unit pinches out
		380	7.180	Grey coarse sand and granules, poorly sorted; with many fine andesitic pebbles, and pockets of clast-supported pebbles and cobbles; sharp boundaries; reversely graded deposit, grading upwards from a sand dominant base to a granule dominant top with pebbles; at top; sharp boundaries; hyperconcentrated flood flow deposit
		170	7.350	Very coarse sand and granules, with dominantly fine andesitic pebbles; maximum clast 20 mm (coarse pebble); reversely graded deposit, with finer grained basal 80 mm; hyperconcentrated flood flow deposit; unit pinches out
		80	7.430	Medium sand and granules, with fine and fewer coarse andesitic pebbles, maximum clast 20 mm (coarse pebble); discontinuous unit with sharp contacts; hyperconcentrated flood flow deposit
		340	7.770	Very coarse sand and granule matrix, poorly sorted, with matrix-supported red, black, grey, and brown, dominantly coarse andesitic pebbles, and common cobbles; slight normal grading; debris flow deposit
		230	8.000	Stratified coarse sand and granules, with many fine, dominantly black andesitic pebbles; reversely graded unit; hyperconcentrated flood flow deposit
		40	8.040	Grey very fine sandy loam textured unit
		50	8.090	Strong brown and black coarse sand, weakly bedded
		40	8.130	Grey very fine sandy loam textured unit, with central granule-rich interbed
		70	8.200	Coarse, poorly sorted sands
		620	8.820	Fine sand dominant and granule matrix, poorly sorted sands; with many scattered fine heterolithologic pebbles, red, grey, black, and scattered boulders and cobbles at base; pebble-rich unit with discontinuous, ungraded pebble-rich lenses and granule-rich lenses; debris flow deposit
		160	8.980	Grey very fine sandy loam textured unit, with interbedded grey fine sand laminae and rounded pumice pebbles

Section Name and Map Code: Desert Road Section 10 [DR10]

Grid Reference: T20/464091

Locality: A large cutting on the western side of the Desert Road, approx. 100 m north of the junction with Tukino Skifield Road (Bullot Track), and immediately south of Desert Road S.11

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	700	0.700	Pink and grey poorly sorted coarse ash and lapilli
Mangamate Tephra, Pahoka Tephra, Bullot Formation (upper)	unnamed	1300	2.000	Undescribed andesitic tephras, occurring between Taupo Pumice and Bullot Formation member L16
Bullot Formation (upper)	member L16	160	2.160	Yellowish red (5YR4/6 – 4/8) dominantly fine, and many medium and few coarse pumice lapilli, with strong brown (7.5YR5/8) interiors, and grey lithic lapilli; vesicular, blocky, angular, firm pumice lapilli and angular lithic lapilli
	?M_3	110	2.270	40 mm Olive coarse lithic and pumiceous ash; sharp upper contact 20 mm Pale brown coarse loamy textured ash, firm; with many fine lithic lapilli; discontinuous tephra, with wavy contacts 50 mm Dark purplish black coarse ash and fine lithic lapilli; loose; wavy contacts; distinctive tephra
	unnamed	20	2.290	Brownish yellow coarse ash and fine pumice lapilli; distinct contacts
		70	2.360	Dark grey coarse ash and very fine lithic lapilli; distinct upper contact
		30	2.390	Brown very fine pumice lapilli and grey lithic lapilli with some coarse ash matrix; distinct lower contact
		10	2.400	Brown coarse ash, firm
		60	2.460	Bedded dark purplish black coarse ash and very fine lithic lapilli
		40	2.500	Olive coarse ash and very fine lithic and pumice lapilli; wavy gradational contacts
		30	2.530	Pale grey coarse ash and dark brown (7.5YR4/4) pumice lapilli
	member L15	170	2.700	Dark brown (7.5YR4/4) and reddish yellow (7.5YR6/6) very fine and fine with fewer medium pumice lapilli; loose, gravelly texture; distinctive colouring
	unnamed	30	2.730	Grey coarse ash and very fine lithic lapilli
	member L14	60	2.790	Strong brown fine pumice lapilli with pale yellow interiors, few lithic lapilli, and black coarse ash matrix; vesicular, angular, hard pumice; ungraded unit
***	***	50	2.840	Pale purplish grey medium sandy loam textured medial unit, slightly greasy; with some scattered medium pumice lapilli; distinct contacts
	unnamed	40	2.880	20 mm Coarse ash 20 mm Strong brown fine and some medium pumice lapilli and some grey lithic lapilli; very vesicular pumice
		70	2.950	Black very fine lithic lapilli and coarse ash; loose, gravelly texture; with few fine pumice lapilli; distinct contacts
		10	2.960	Black coarse ash
		10	2.970	Pale brown coarse ash, firm; with scattered yellow fine pumice lapilli
		10	2.980	Brownish yellow very fine, angular, platy pumice fragments; loose, distinct contacts; strong colouring
		70	3.050	Black coarse ash
		70	3.120	Dark purplish black coarse ash and very fine and fine lithic, scoria and few pumice lapilli
		30	3.150	Olive grey coarse ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	70	3.220	20 mm Black coarse ash and lithic lapilll 50 mm Brown medium and fine pumice lapilll and coarse ash; with imogolite on lapilli faces; ungraded tephra
		50	3.270	Grey coarse lithic lapilli and few pumice lapilli
		40	3.310	Brown coarse sandy ash with few lapilli
		30	3.340	Grey sandy ash with scattered lapilli
		120	3.460	80 mm Coarse lithic ash with fine pale brown pumice lapilli 40 mm Coarse ash with yellow fine and few medium pumice lapilli, with olive to light grey interiors, and fine lithic lapilli
Rerewhakaaitu Tephra		100	3.560	Olive grey coarse ash with fine angular lithic lapilli; with 20 mm pale grey to white fine glassy rhyolitic ash (Rerewhakaaitu Tephra), pocketing, interbedded near base of unit
Bullot Formation (middle)	unnamed	30	3.590	Medium and fewer coarse strong brown pumice and black lithic lapilli
		30	3.620	Grey loamy coarse ash, firm
	?member L7b	80	3.680	Strong brown fine and medium pumice lapilli, with olive interiors, few grey angular lithic lapilli, and coarse sandy ash
	unnamed	20	3.700	Black and olive coarse loamy textured ash; sharp upper contact
		30	3.730	Yellowish brown loamy textured ash and few lapilli
	member L7	150	3.880	20 mm Strong brown very fine, angular, platy pumice fragments 110 mm Strong brown (7.5YR5/8) medium and fine pumice lapilli, with olive interiors, and very fine angular, platy pumice fragments and olive brown coarse ash; moderately soft pumice; reversely graded tephra; sharp basal contact 20 mm Black-olive coarse ash
Bullot Formation (?lower)	unnamed	40	3.920	Yellowish brown (10YR5/4) coarse ash and scattered lapilli
		90	4.010	Yellowish brown (10YR5/4) grading down to dark greyish brown (2.5Y4/2) coarse lithic ash; with fine lithic and pumice lapilli; ungraded tephra
		140	4.150	10 mm Andesitic pumice lapilli and interbedded reworked Kawakawa Tephra Formation 70 mm Strong brown (7.5YR5/8) very fine, fine and fewer medium pumice lapilli, with same coloured interiors, and coarse ash; reversely graded tephra, grading upward to dominantly medium lapilli; 80 mm Dominantly fine, and very fine pumice lapilli, firm and soft, and coarse ash
Te Heuheu Formation	unnamed	80	4.230	Coarse sand and lapilli, with reworked Kawakawa Tephra Formation; and scattered cobbles and pebbles; fluvial deposit
reworked Kawakawa Tephra Formation		70	4.300	20 mm Pink fine ash 50 mm Grey fine ash, pocketing; fluvially reworked tephra
Kawakawa Tephra Formation	Oruanui Ignimbrite	340	4.640	Pink fine ash with very fine and fine pumice lapilli; massive; with occasional chalazoidites; lower 50 mm mottled
	Aokautere Ash	50	4.690	30 mm Salmon-pink fine ash with many chalazoidites 20 mm Laminae of pink and grey fine ash with many chalazoidites
		85	4.775	10 mm Grey coarse crystal-rich ash and very fine pumice 30 mm Pale yellow coarse crystal-rich ash and very fine pumice 3 mm Grey fine ash 2 mm Pink fine ash 5 mm Grey fine ash 25 mm White coarse ash; with many bright orange mottles 10 mm Pale yellow coarse ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Te Heuheu Formation	unnamed	130	4.905	40 mm	Dark grey (10YR4/1) loamy sand; sharp contacts
				50 mm	Yellowish brown (10YR5/4) medium sandy loam textured unit; massive
				20 mm	Grey medium sandy loam textured unit, with scattered fine lapilli
				20 mm	Brown medium sandy loam textured unit, with scattered fine lapilli
		60	4.965	Coarse sand with fine scattered pumice lapilli and fine subrounded lithic pebbles; ?fluvial deposit	
		80	5.045	Coarse sand with many orange and black lithic pebbles; normally graded clasts	
		450	5.045	Yellowish brown (10YR5/8) clay matrix with matrix-supported medium and coarse heterolithologic lithic pebbles, many colours, soft, weatherad; with a brown firm clay band with scattered pebbles at base; wedging debris flow deposit	
		1000+	6.765	Yellowish brown (10YR5/8) coarse loamy sand and granule matrix, becoming sandier toward base; with many matrix-supported fine andesitic pebbles, many colours, and pale yellow fine pumice pebbles; soft pumice; debris flow deposit, with finer clasts than overlying deposit	

Section Name and Map Code: Desert Road Section 11 [DR11]

Grid Reference: T20/464092

Locality: A large cutting on the western side of the Desert Road, approx. 1 km north of the intersection with Tukino Skifield Road (Bullot Track)

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		170	0.170	Greyish brown fine sandy loam textured unit
Tufa Trig Formation	unnamed	15	0.185	Black fine sandy ash
Makahikatoa Sands		165	0.350	30 mm Greyish brown fine sandy loam textured bed 5 mm Grey and pale yellow to white fine sand 10 mm Greyish brown fine sandy loam textured bed 10 mm Paler grey fine loamy sand textured bed 110 mm Brown to black medium sandy loam textured unit with interbedded strong brown fibrous bed
Tufa Trig Formation	unnamed	10	0.360	Dark grey to black medium ash, pocketing
Makahikatoa Sands		65	0.425	50 mm Brown fine sandy loam textured unit, greasy 15 mm Greyish brown fine sandy loam textured unit
Tufa Trig Formation	?member Tf8	20	0.445	Dark grey medium ash, with a 5 mm thick pale grey to yellow fine ash top
Makahikatoa Sands		60	0.505	Greyish brown fine sandy loam textured unit
Tufa Trig Formation	unnamed	15	0.520	Black fine sandy ash
Makahikatoa Sands		10	0.530	Fine sandy loam textured unit, greasy
Tufa Trig Formation	unnamed	10	0.540	Black fine sandy ash
Makahikatoa Sands		50	0.590	Brownish grey medium loamy sand
Tufa Trig Formation	member Tf5	70	0.660	Coarse ash and very fine lithic and pumice lapilll
Makahikatoa Sands		30	0.690	Brownish grey medium sandy loam textured unit
Taupo Pumice	Taupo Ignimbrite	720	1.410	410 mm Pink ash and fine lapilli 310 mm Grey poorly sorted coarse ash and lapllll, distinct sharp basal contact
Mangatawai Tephra		430	1.840	310 mm Dark brown fine sandy clay loam textured ash, greasy, with root channels; iron-stained upper contact; paleosol 120 mm Bedded black coarse ash and brown sandy loam textured ash beds; iron-stained basal contact
Papakai Formation		110	1.950	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, very greasy; with reddish brown mottles and brown coated root channels
Waimihia Tephra		60	2.010	Pale brown fine ash 'cream cakes', up to 60 mm depth, with intermixed brown fine andesitic ash
Papakai Formation		30	2.040	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, greasy; with root channels; paleosol
***	***	380	2.420	80 mm Grey bedded sand; discontinuous, wedging unit 240 mm Brown andesitic ash, with interspersed reworked rhyolitic tephra and grey sand laminae 60 mm Bedded white clay, greasy, and grey ash; discontinuous unit with sharp contacts; fluvial deposits
Papakai Formation		150	2.570	Pale grey (gleyed) coarse sandy clay textured ash, very greasy; with strong brown coated root channels; indistinct basal contact
Hinemaiaia Tephra		70	2.640	White coarse pumiceous ash interspersed within dark yellowish brown (10YR4/4) fine sandy loam textured Papakai Formation
Papakai Formation & Motutere Tephra		170	2.810	Dark yellowish brown (10YR4/4) fine sandy clay textured ash, very greasy; cracked exterior; with many black and brown coated root channels and common scattered very fine lithic and pumice lapilli; scattered white very fine rhyolitic pumice (Motutere Tephra) near base; iron-stained lower contact

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
***	***	1640	4.450	Bedded orange and black, fine, coarse, and very coarse sand, and yellowish brown (10YR5/6) and brownish yellow (10YR6/8) fine rounded pumice pebbles and very dark grey (5Y3/1) andesitic pebbles; beds <100 mm; some cross beds
Papakai Formation		90	4.540	Medium sandy loam textured ash, greasy, firm; with common root channels; distinct contacts
?reworked Mangamate Tephra		70	4.610	60 mm Fine lapilli and coarse ash; normally graded 10 mm Grey coarse ash, firm
***	***	70	4.680	Fine lapilli and coarse ash; ungraded
Mangamate Tephra	?Poutu Lapilli	200	4.880	150 mm Yellowish brown (10YR5/8) dominantly fine pumice lapilli, with olive brown (2.5Y4/4) interiors, and very dark grey (5Y3/1) angular andesitic lapilll; slight normal grading; iron-stained basal lapilli
		50	4.930	Very dark grey (5Y3/1) fine ash
	Wharepu Tephra	540	5.470	500 mm Olive brown (2.5Y4/4), very dark grey (5Y3/1) and minor yellowish brown (10YR5/8) fine lithic and pumice lapilli over bedded medium and fine loose angular lapilli and very coarse ash with common fine rounded lapilll; bed thicknesses less than 100 mm 40 mm Strong brown (7.5YR5/6), and minor very dark grey (5Y3/1) fine lapilll and ash
		10	5.480	Yellowish brown (10YR5/6) fine sandy loam; firm
Poronui Tephra		3	5.483	White pocketing rhyolitic ash
Mangamate Tephra	?Ohinepango Tephra	20	5.503	Black coarse to fine ash
	Waihohonu Lapilli	210	5.713	Bedded, very dark grey (5Y3/1), olive brown (2.5Y4/4) and some strong brown (7.5YR5/6) fine lithic and pumice lapilli and coarse ash; loose, angular lapilli; beds <100 mm; Sharp upper contact
	unnamed tephra	40	5.753	Black coarse sandy ash and fine laplll, over Brown fine ash and lapilli, over Black ash and fine lapilli; distinct contacts
	Oturere Lapilli	180	5.933	Very dark grey (5Y3/1), strong brown (7.5YR5/6) and olive brown (2.5Y4/4) dominantly medium and fine lithic and few pumice lapilli; weakly bedded tephra; coarser grain size than overlying Mangamate Tephra; sharp distinct lower boundary
***	***	100	6.033	Yellowish brown (10YR5/6) fine sandy loam textured ash, greasy; with scattered fine and very fine lapilli; indistinct contacts
Pahoka Tephra		50	6.083	Dark grey (5Y4/1) fine pumiceous lapilli and very fine, angular, platy pumiceous fragments; discontinuous tephra
Bullot Formation (upper)	unnamed	70	6.153	Yellowish brown (10YR5/6) coarse loamy sand textured ash with some fine lapilli
	Pourahu Member [tephra unit]	110	6.263	Pale yellow coarse pumice lapilli, few dark grey coarse lithic lapilli, and coarse ash; very vesicular pumice lapilli and angular lithic lapilli; ungraded tephra
	unnamed	50	6.313	Dark grey medium and fine lithic and pumice laplll, and yellow very fine angular, platy pumice fragments
		30	6.343	Yellowish brown (10YR5/6) very fine angular, platy pumice fragments, soft
		50	6.393	Yellowish brown and grey very coarse lithic and pumiceous ash
		20	6.413	Yellowish brown fine to medium pumice lapilli and coarse ash
		40	6.453	Black (5Y2/1) coarse ash; distinct contacts
		50	6.503	Yellowish brown (10YR5/6) fine and medium pumice lapilli, and grey lithic lapilli; with a fine sandy loam textured ash matrix
		50	6.553	Yellowish brown and grey coarse ash, firm, prominent; with some lithic and pumice lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	55	6.608	10 mm Yellowish brown very fine angular, platy pumice fragments 45 mm Fine lithic and rounded pumice lapilli and coarse ash
		100	6.708	Yellowish brown fine to medium pumice lapilli and few grey lithic lapilli; with loamy textured ash matrix; ungraded tephra
		10	6.718	Yellowish grey coarse lithic and pumiceous ash, firm
		50	6.768	Black (5Y2/1) fine and very fine lithic lapilli with coarse ash matrix
		70	6.838	Strong brown (7.5YR5/6) fine to medium lithic lapilli; with coarse ash base
	M_1	25	6.863	10 mm Brown and grey bedded coarse and fine ash 10 mm Yellowish brown coarse pumiceous ash with central laminae of yellow pumice lapilli 5 mm Yellow coarse pumiceous ash with few scattered yellow fine and very fine pumice lapilli, firm lapilli
	unnamed	20	6.883	Black coarse ash and fine lithic lapilli, and grey rounded pumice lapilli
		45	6.928	Greyish brown coarse lithic and pumiceous ash with fine lithic and pumice lapilli
		60	6.988	Black fine lithic lapilli and coarse ash; reverse graded tephra; sharp contacts
		30	7.018	Light yellowish brown (2.5Y6/4) very fine angular, platy pumice fragments, and scattered light yellowish brown fine-medium pumice lapilli; distinctive tephra
		40	7.058	Black coarse lithic ash with very fine lithic lapilli at top
	member L17	150	7.208	Yellowish brown (10YR5/4) coarse pumice lapilli, with olive (5Y5/3) interiors, and grey coarse andesitic lapilli; normally graded tephra, with a finer 50 mm top
	unnamed	30	7.238	Yellowish brown very fine angular, platy pumice fragments, and fine pumice lapilli
		50	7.288	Yellowish brown fine to medium pumice lapilli, and grey, and few red lithic lapilli
		80	7.368	Olive coarse lithic ash
		60	7.428	Black very coarse ash
	member L16	160	7.588	Strong brown (7.5YR5/6) medium to fine pumice lapilli, with light olive brown (2.5Y5/4) interiors, and grey fine lithic lapilli
	unnamed	30	7.618	Grey coarse ash with some medium pumice lapilli
		10	7.628	Brownish yellow, fine loamy sand textured ash
		30	7.658	Black coarse ash with scattered fine lithic lapilli
		20	7.678	Strong brown very fine angular, platy pumice fragments, and fine pumice lapilli
		10	7.688	Black coarse ash
		50	7.738	20 mm fine pumice and lithic lapilli with black ash matrix; distinctive 30 mm Black to very dark grey coarse ash with fine lithic and pumice lapilli
		30	7.768	Black to purplish black coarse ash, well sorted
		50	7.818	Grey coarse ash
	member L15	130	7.948	30 mm Strong brown (7.5YR5/8) fine pumice lapilli, with same coloured interiors, grey and few red lithic lapilli, and minor coarse loamy textured ash 100 mm As above, with very little ash matrix; loose lapilli
	unnamed	5	7.953	Grey fine ash, firm, with few soft weathered grey lithic lapilli
		60	8.013	Grey ash, firm, with fine lithic lapilli
	member L14	70	8.083	Strong brown fine pumice lapilli and grey sandy ash matrix, indistinct unit
	unnamed	20	8.103	Medium and fine pumice lapilli; ungraded tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	45	8.148	Black and dark purplish black lithic ash and very fine black (5Y2/0) lithic lapilli
		30	8.178	Grey over yellowish brown coarse ash
		50	8.228	Yellowish brown (10YR5/4) very fine angular, platy pumice fragments, and scattered yellowish brown fine pumice lapilli
		50	8.278	40 mm Black to purplish black, coarse and very coarse ash and very fine black lithic lapilli 10 mm Purplish coarse ash
		30	8.308	Greyish brown, coarse ash and very fine lithic and pumice lapilli
		10	8.318	Black, coarse ash
		30	8.348	Yellowish brown dominantly fine pumice lapilli, few lithic lapilli, and matrix of very fine yellowish brown angular, platy pumice fragments; angular laplli
		70	8.418	Yellowish brown, coarse ash
		40	8.458	Grey coarse ash with scattered bright yellowish brown medium pumice lapilli
		80	8.538	Undescribed lapilli and ash beds
		40	8.578	Bright yellowish brown very fine angular, platy pumice fragments, and scattered pumice lapilli
		~ 250	8.578	Undescribed centimetre-bedded lapilli and ash beds to road level

Section Name and Map Code: Desert Road Section 12 [DR12]

Grid Reference: T20/458119

Locality: A cutting on the west side of the Desert Road, adjacent to Wharepu Stream

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	600	0.600	Pale grey poorly sorted ash and fine lapilli, with charcoal; sharp wavy lower boundary
Mangatawai Tephra & Papakai Formation & Waimihia Tephra		130	0.730	Dark brown sandy clay loam textured ash and very dark grey ash beds; irregular wavy lower contacts (Mangatawai Tephra) over Gleyed grey sandy clay loam textured ash with iron-stained root channels; paleosol (Papakai Formation), and interbedded pale brown fine ash 'cream cakes' (Waimihia Tephra); indistinct lower contact
Hinemaiaia Tephra		90	0.820	White coarse pumiceous ash interspersed in grey (gleyed) Papakai Formation; indistinct contacts
Papakai Formation & Motutere Tephra		360	1.180	Grey (gleyed) sandy clay loam textured ash, with root channels, and interspersed white to pale grey very fine and fine pumice fragments (Motutere Tephra); prominent unit; sharp smooth basal contact
reworked Mangamate Tephra		180	1.360	Brown and grey very fine angular, platy lithic and some pumice fragments; weakly cemented; distinctive fine grained unit; sharp contacts
Mangamate Tephra	Poutu Lapilli	50	1.410	Dark greyish brown (2.5Y4/2) and iron-stained strong brown dominantly fine lithic lapilli, and few strong brown pumice lapilli; angular, loose lapilli; ungraded tephra; cemented at surface of outcrop; wavy distinct lower contact
	Wharepu Tephra	540	1.950	Dark greyish brown dominantly fine lithic lapilli, and common brown lithic and pumice lapilli; angular, sharp, loose lapilli; base of unit is bedded, with a prominent strong brown lapilli base; sharp smooth contacts
Poronui Tephra		5	1.955	White very fine ash, pocketing
Mangamate Tephra	Ohinepango Tephra	40	1.995	Colour-banded tephra comprising thin alternating beds of black lithic dominant, and strong brown pumice dominant coarse ash; sharp contacts
	Waihohonu Lapilli	220	2.215	Grey and strong brown dominantly fine lithic lapilli, and few pumice lapilli; angular, sharp, loose lapilli; becoming bedded toward base; with two strong brown, distinctive, pumice dominant beds near base of unit; sharp distinct contacts
	unnamed tephra	120	2.335	Thin andesitic ash and lapilli beds; prominent; distinct contacts
	Oturere Lapilli	330	2.665	Dark greyish brown and very dark grey dominantly fine and common medium lithic, and some pumice lapilli; angular, sharp, loose lapilli; weakly bedded tephra; distinct wavy lower contact
***	***	240	2.905	Greyish brown sandy clay loam textured andesitic ash, greasy, with scattered fine lapilli; indistinct lower contact
Pahoka Tephra		95	3.000	Dark grey fine pumiceous lapilli, and very fine angular, platy pumiceous fragments; soft, angular lapilli; discontinuous tephra; indistinct irregular contacts
Bullot Formation (upper)	unnamed	290	3.290	Greyish brown sandy loam textured ash and fine lapilli
	Pourahu Member [tephra unit]	120	3.410	Bedded pale yellow to white dominantly medium lapilli, with common coarse lapilli, separated by 10 mm black coarse ash; upper bed ungraded, dominantly medium lapilli; lower bed dominantly medium lapilli and normally graded, grading upwards to a coarse ash top; distinct contacts
	unnamed	130	3.540	Andesitic ash and scattered lapilli
		150	3.690	Fine, and few medium pumice and lithic lapilli, and coarse ash; normally graded
	M_1	20	3.710	Grey ash, firm, over yellow ash, firm, with scattered fine lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	?member L18	130	3.840	Dominantly medium, and fine pumice and lithic lapilli, with a distinctive black coarse ash top
	unnamed	60	3.900	Black coarse ash
		20	3.920	Strong brown very fine angular, platy pumice fragments, and fine pumice lapilli
		30	3.950	Black coarse ash
		40	3.990	Fine and medium, and few coarse pumice and fewer lithic lapilli; ungraded tephra
	?member L17	210	4.200	Dominantly medium, fine and few coarse pumice and lithic lapilli, with a 20 mm dark grey coarse ash and lapilli top; sharp contacts
	unnamed	40	4.240	Grey ash
		20	4.260	Yellowish brown fine sandy loam textured ash
		20	4.280	Dark grey coarse ash
		30	4.310	Fine pumice and lithic lapilli, with a 10 mm firm black coarse ash base
		40	4.350	Dark grey coarse ash
	?member L16	160	4.510	Strong brown medium and coarse pumice lapilli and black lithic lapilli; ungraded; distinctive tephra
reworked Bullot Formation tephras		1000+	5.510	Centimetre- and millimetre-bedded orange and black tephric sands

Section Name and Map Code: Desert Road Section 15 [DR15]

Grid Reference: T20/462135

Locality: A large cutting on the eastern side of the Desert Road, immediately south of a crossing over a tributary of Te Piripiri Stream

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		160	0.160	Dark brown sandy loam textured unit; with an iron-stained basal contact
Tufa Trig Formation	member Tf5	10	0.170	Black coarse ash
***	***	30	0.200	Dark brown sandy loam textured ash; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	520	0.720	White poorly sorted coarse ash and lapilli; average depth 260 mm
Mangatawai Tephra		470	1.190	250 mm Very dark greyish brown (2.5Y3/2) fine sandy loam textured ash, greasy, with two interbedded black medium ash beds; with dark brown coated root channels; paleosol 220 mm Alternately bedded black coarse ash and greyish brown (2.5Y3/2) greasy fine sandy loam textured ash beds
Papakai Formation		180	1.370	Dark yellowish brown (10YR4/4) coarse sandy loam textured ash, greasy; with distinct root channels, and occasional scattered lapilli
Waimihia Tephra		20	1.390	Pale brown to white fine ash 'cream cakes', and intermixed brown fine andesitic ash; distinct tephra
Papakai Formation		270	1.660	Dark yellowish brown (10YR4/4) medium sandy clay loam textured ash, very greasy, with many distinct dark brown coated root channels; indistinct contacts
Hinemaiaia Tephra		90	1.750	Olive yellow (2.5Y6/6) and white coarse pumiceous ash dispersed throughout dark yellowish brown (10YR4/4) greasy sandy clay loam textured Papakai Formation; indistinct boundaries
Papakai Formation		410	2.160	Dark yellowish brown (10YR4/4) and dark brown (7.5YR4/4) sandy clay loam textured ash, very greasy, with moderately well developed nut structure, and cracked exterior; with many scattered bluish grey lithic lapilli interbedded nears base; distinct dark coated root channels; paleosol
Motutere Tephra		25	2.185	Pale pinkish brown coarse and fine ash 'cream cakes', grading laterally to scattered fine pumice fragments; indistinct lower contact
Papakai Formation		270	2.455	Dark yellowish brown (10YR4/4) and dark brown (7.5YR4/4) sandy clay loam, very greasy, with cracked exterior; some interbedded white pumice fragments; dark greyish brown coated root channels; paleosol
Mangamate Tephra	Poutu Lapilli	330	2.785	320 mm Strong brown (7.5YR5/6) iron-stained dominantly fine, and very fine lapilli, with dark greyish brown (2.5Y4/2) and strong brown (7.5YR5/6) interiors; firm, angular, non- and poorly vesicular lapilli; lithic lapilli dominant; weakly cemented at surface of outcrop; normally graded tephra
		10	2.795	Black coarse ash, firm; sharp distinct basal contact

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Mangamate Tephra	Wharepu Tephra	770	3.565	480 mm	Grey and strong brown (7.5YR5/6) non- and poorly vesicular lapilli; loose, angular lapilli; normally graded bed, grading upwards from fine and medium lapilli (<20 mm) to fine lapilli (<10 mm) and very fine lapilll; coarsest of the three beds; sharp grain size contrast at contact with overlying Poutu Lapilli
				210 mm	Olive, and strong brown non- and poorly vesicular lapilli; normally graded bed, grading upwards from fine and very fine lapilli to granule dominant top 80 mm
				2 mm	Brown fine ash, firm, distinct; sharp contacts
				110 mm	Strong brown (7.5YR5/6) non- and poorly vesicular lapilll, weakly cemented at surface of outcrop; reversely graded bed, grading upwards from very fine and fine laplll to dominantly fine lapilli
				30 mm	Brown fine silty textured ash with some scattered lapilli; sharp basal contact
Poronui Tephra		15	3.580	White fine rhyolitic ash, pocketing, discontinuous in outcrop	
Mangamate Tephra	Ohinepango Tephra	390	3.970	Colour-banded tephra comprising alternating 30 mm beds of strong brown (7.5YR5/8) very fine pumice lapilli and coarse ash dominant beds, and black (2.5Y2/0) very fine lithic lapilli dominant and coarse ash beds; sharp contacts	
	Waihohonu Lapilli	340	4.310	110 mm	Grey and strong brown laplll; reversely graded bed, grading upwards from dominantly fine to dominantly medium lapilll; loose, with 5 mm fine ash base
				130 mm	Dominantly fine grading upwards to dominantly medium lapilli; reversely graded bed
				100 mm	Well sorted very fine lapilli dominant bed; with two distinct 20 mm thick strong brown (7.5YR5/8) pumice dominant beds near base
				20 mm	Black lithic-rich coarse ash and very fine lapilli
	unnamed tephra	180	4.490	20 mm	Greyish brown very fine lapilll and minor coarse ash contact;
				10 mm	Grey coarse ash
				20 mm	Black coarse ash, well sorted; with occasional lithic lapilll
				60 mm	Alternating 10–15 mm beds of fine and very fine lithic dominant lapilll and ash
				10 mm	Brown greasy coarse sandy loam textured ash
				60 mm	Dark grey (2.5Y4/0) coarse ash
	Oturere Lapilli	390	4.880	Very dark grey (5Y3/1) and very dark greyish brown (2.5Y3/2) fine lithic lapilli, and minor light yellowish brown (2.5Y6/4) fine pumice lapilli; angular, loose lithic and pumice lapilli; weakly bedded unit with coarser central 60 mm comprising dominantly medium lapilli	
***	***	210	5.090	70 mm	Light grey (2.5Y7/0 to 2.5Y7/2) gleyed greasy sandy clay textured ash, sticky; with scattered fine and very fine pumice lapilll; with yellowish red iron-stained lower contact
				30 mm	Strong brown very fine pumice lapilli and black very fine lithic lapilli; compacted
				70 mm	Alternating beds of greasy coarse sandy clay loam textured ash, and very fine lithic and pumice lapilli; strong iron-stained lower contact
				40 mm	Olive sandy clay textured ash, sticky; with scattered fine brown pumice lapilli; iron-stained basal contact.
Pahoka Tephra		190	5.280	170 mm	Grey (2.5Y5/0 to 2.5Y6/0) and pale yellow colour-banded fine and very fine pumiceous lapilli, with very fine angular, platy pumiceous fragments concentrated in top 70 mm; normally graded lapilli unit;
				20 mm	Pale yellow pumiceous and black coarse lithic ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Bullot Formation (upper)	unnamed	190	5.470	90 mm	Very fine pumice and lithic lapilli in brown coarse ash
				100 mm	Dark yellowish brown (10YR4/4) greasy, sticky sandy clay textured ash
	Pourahu Member [tephra unit]	160+	5.630	Pale brown (10YR6/3) and yellowish brown (10YR5/6) very fine and fine pumice and lithic lapilli and coarse ash	

Section Name and Map Code: Desert Road Section 16 [DR16]

Grid Reference: T20/481186

Locality: On the eastern side of the Desert Road, approx. 0.2 km south of a turn off to Waihohonu substation

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	600	0.600	White, poorly sorted coarse ash and pumice lapilli, with sharp wavy contacts
Mangatawai Tephra		610	1.210	190 mm Dark brown fine sandy loam to sandy clay loam textured ash, greasy; distinct contacts; paleosol 420 mm Bedded black to dark purplish grey coarse sandy ash beds, discontinuous, with abundant yellow beech leaves; with dark yellowish brown (10YR4/4) greasy sandy loam textured ash interbeds
Papakai Formation		90	1.300	Dark yellowish brown medium sandy loam textured ash, greasy, with some dark brown coated root channels; paleosol
Waimihia Tephra		20	1.320	White coarse ash, and fine ash 'cream cakes' interbedded within dark yellowish brown greasy sandy loam textured Papakai Formation
Papakai Formation		180	1.500	Dark greyish brown (10YR4/2) medium sandy loam textured ash, with distinct black coated root channels; indistinct lower contact; paleosol
Hinemaiaia Tephra		110	1.610	Yellowish brown (10YR5/8) coarse pumiceous ash dispersed within dark yellowish brown (10YR4/4) sandy loam textured Papakai Formation
Papakai Formation		418	2.028	Dark yellowish brown (10YR4/4) slightly greasy fine sandy clay loam textured ash, with distinctive surface cracking and many bluish grey to dark grey (5Y4/1) and dark brown (7.5YR4/4) iron-stained fine lithic lapilli; paleosol
Motutere Tephra		50	2.078	Pinkish brown fine and coarse ash 'cream cakes', firm, distinct, and scattered very fine pumice fragments; interbedded within dark yellowish brown sandy clay loam textured Papakai Formation
Papakai Formation		120	2.198	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, slightly greasy, with distinctive surface cracking and many bluish grey and brown fine lithic lapilli dispersed throughout unit; with many brown coated root channels; paleosol
Mangamate Tephra	Poutu Lapilli	500	2.698	Dark grey (5Y4/1), olive grey (5Y4/2) and dark brown (7.5YR4/4) iron-stained fine lithic lapilli, and few orange iron-stained fine pumice lapilli; moderately well sorted; normally graded from a fine to medium lapilli base to a fine and very fine (<4 mm) lapilli top; Top 40 mm comprises very fine angular, platy lapilli; unit is weakly cemented by iron oxide; upper contact with Papakai Formation is marked by a discrete discontinuous line of andesitic pebbles
		10	2.708	Dark grey medium to fine sandy ash
	Wharepu Tephra	200	2.908	Bedded grey fine and very fine lapilli Upper bed: dark greyish brown (2.5Y4/2) and olive brown (2.5Y4/4) lithic and few yellowish brown pumice lapilli, normally graded from a fine lapilli base to a very fine lapilli and coarse ash top Lower bed: olive (5Y4/4), dark greyish brown (2.5Y4/2) and iron-stained yellowish brown (10YR5/8) lithic and few pumice lapilli, reverse grading from a coarse ash and very fine lapilli base to a fine lapilli top
		20	2.928	Olive brown (2.5Y4/4) silty textured ash
Poronui Tephra		5	2.933	Light yellowish brown (2.5Y6/4) fine ash
Mangamate Tephra	Ohinepango Tephra	100	3.033	Bedded black (lithic-rich) and strong brown (pumiceous-rich) coarse ash beds; well sorted; sharp smooth bed contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Mangamate Tephra	Waihohonu Lapilli	1180	4.213	355 mm	Weakly bedded dominantly very fine lithic lapilli; moderately well sorted
				5 mm	Dark brown (10YR4/3) fine silty textured ash
				820 mm	Weakly bedded very dark grey (5Y3/2) and black (5Y2/1) lithic, and light yellowish brown (2.5Y6/4) pumice lapilli; with a distinctive light yellowish brown pumice dominant bed in lower half of unit
	unnamed tephra	125	4.338	5 mm	Dark brown (10YR4/3) fine ash
				30 mm	Black well sorted coarse ash
				50 mm	Fine pumice and lithic lapilli in brown loamy textured ash
				40 mm	Grey coarse loamy textured ash with very fine lithic lapilli
	Oturere Lapilli	495	4.833	Very dark grey (5Y3/1) and black (2.5Y2/0) angular lithic lapilli, with few iron-stained pumice lapilll, poorly vesicular; weak normal grading from a medium and fine lapilll base to a dominantly fine lapilli top; sharp basal contact	
***	***	330	5.163	140 mm	Light yellowish brown (2.5Y6/4) to light olive brown (2.5Y5/4) coarse pumiceous and lithic ash; indistinct lower contact
				60 mm	Coarse loamy textured ash
				50 mm	Orange and grey coarse ash and fine lapilli
				80 mm	Light olive brown (2.5Y5/4) to olive brown (2.5Y4/4) coarse sandy clay loam textured ash, sticky; distinct basal contact
Pahoka Tephra		340	5.503	Bedded very dark grey (5Y3/1), olive grey (5Y4/2), pale olive (5Y6/3) and colour-banded grey and pale olive angular lithic and pumiceous lapilli Upper bed: dominantly fine, and medium lapilli, with colour-banded lapilli dominant Middle bed: fine and some medium lapilli, with colour-banded lapilli dominant and pale olive lapilli Lower bed: dominantly pale olive lapilli (5Y6/3) with light olive grey (5Y6/2) interiors and very dark grey fine and medium lapilli	
Bullot Formation (upper)	unnamed	10	5.513	Dark greyish brown (10YR4/2) coarse sandy clay textured ash, very greasy	
		70	5.583	Yellowish brown (10YR5/6) lapilli-rich loamy textured ash	
		50	5.633	Black fine lithic lapilli and coarse ash, with olive (5Y5/3) very fine pumice lapilli	
		70	5.703	Dark brown (10YR4/3) coarse sandy clay textured ash, sticky, greasy, with many fine lapilli	
		40	5.743	Brownish yellow (10YR6/6) fine lapilli and coarse ash with loamy ash textured matrix	
	Pourahu Member [tephra member]	220	5.963	Light yellowish brown (2.5Y6/4) and light olive brown (2.5Y5/4) medium and fine, subangular pumice lapilli, with pale olive (5Y6/3) and light grey (2.5Y7/2) interiors; soft pumice lapilli; weak normal grading with sharp wavy basal contact	
Tangatu Formation	unnamed	420	6.383	Andesitic diamicton; grey poorly sorted coarse sand and granule matrix, with matrix-supported fine, coarse and very coarse heterolithologic red, grey and black andesitic pebbles and boulders; debris flow deposit	
Bullot Formation (upper)	unnamed	110	6.493	50 mm	Grey and strong brown iron-stained very greasy coarse sandy clay textured ash, sticky; with root channels
				60 mm	Grey coarse sandy clay textured ash with many grey (2.5Y6/0) fine pumice lapilli; sharp basal contact
Tangatu Formation	unnamed	50	6.543	Lithified grey pebbly sand; hyperconcentrated flood flow deposit	
Bullot Formation (upper)	unnamed	80	6.623	Very greasy sandy clay loam textured ash with interbed of coarse pumiceous and lithic ash	

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	380	7.003	Grey sand and granule matrix with matrix-supported dominantly fine heterolithologic red, purplish red and grey fine to very coarse andesitic pebbles; debris flow deposit
		40	7.043	Olive coarse greasy sandy clay
Bullot Formation (upper)	unnamed	90	7.133	Light olive grey (5Y6/2) to pale olive (5Y6/3) fine and few medium pumice lapilli, with a greyish brown (2.5Y5/2) sandy clay textured matrix
		40+	7.173	Brown greasy coarse sandy clay

Section Name and Map Code: Desert Road Section 17 [DR17]

Grid Reference: T19/482199

Locality: A cutting on the east side of the Desert Road, and on the south side of an unnamed tributary of Pangarara Stream; description is for tephras older than Mangatawai Tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation & Taupo Pumice & Mangatawai Tephra			0.000	Tephras overlying Papakai Formation
Papakai Formation		410	0.410	Greyish brown sandy clay loam textured ash, greasy; with cracked exterior and dark brown coated root channels; with moderately well developed fine blocky structure; interbedded at 220 – 250 mm from top is a pocketing black coarse sandy ash; Contact with overlying Mangatawai Tephra is distinct and wavy; basal contact is indistinct; paleosol
Hinemaiaia Tephra		110	0.520	Yellow and white coarse pumiceous ash interspersed in yellowish brown sandy clay loam textured ash; indistinct contacts
Papakai Formation		320	0.840	Dark brown sandy clay loam textured ash, with cracked exterior, and blocky structure; with scattered very fine and fine lapilli; discontinuous lower contact
Motutere Tephra		60	0.900	Pale pinkish brown fine and coarse ash 'cream cakes', and common white fine pumice fragments; firm, almost continuous ash
Papakai Formation		120	1.020	Dark brown to reddish brown clay loam textured ash, greasy; with cracked exterior and common root channels; with many interspersed bluish grey and brown fine lapilli (reworked Poutu Lapilli); coarse andesitic pebbles occur at lower contact
Mangamate Tephra	Poutu Lapilli	500	1.520	Strong brown and very dark grey dominantly fine lapilli; angular; cemented at surface of outcrop on: Wharepu Tephra (120 mm), Ohinepango Tephra (120 mm) and Waihohonu Lapilli (1050 mm); older tephras not exposed

Section Name and Map Code: Doubtful Road [DF]

Grid Reference: T20/376036

Locality: A cutting on Doubtful Road (southern exposure), at the crest of a large hill, overlooking Main Road to the east (northern Karioi Forest)

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		100	0.100	Dark grey sand and overlying disturbed soil surface
Tufa Trig Formation	unnamed	40	0.140	Dark grey medium ash, with pale grey fine ash top and base; pocketing tephra
Makahikatoa Sands		10	0.150	Grey medium sand
Tufa Trig Formation	member Tf8	50	0.200	Dark grey medium to coarse ash, with fine and very fine olive pumice lapilli at base, with an underlying 10 mm black fine ash
Makahikatoa Sands		60	0.260	Greyish brown loamy sand textured unit, with interbedded sand laminae
Tufa Trig Formation	member Tf6	40	0.300	Dark grey coarse ash and very fine lapilli, with a 20 mm fine grey ash base
Makahikatoa Sands		80	0.380	Brown medium sandy loam textured unit, greasy, with few fine reworked Taupo Pumice lapilli; paleosol
Tufa Trig Formation	member Tf5	60	0.440	Black coarse ash and very fine lapilli, with fine grey ash base and some very fine olive pumice lapilli; distinctive tephra
Makahikatoa Sands		50	0.490	Brownish grey medium sandy loam to sandy clay loam textured unit; with reworked white Taupo pumice lapilli; and reddish brown organic matter; paleosol
Tufa Trig Formation	member Tf4	50	0.540	Dark grey medium ash with greyish brown slightly finer top; discontinuous tephra
Makahikatoa Sands		200	0.740	Brown medium sandy clay loam textured unit, greasy; with scattered reworked taupo Pumice lapilli; paleosol
Tufa Trig Formation	member Tf2	40	0.780	Discrete line of medium and fine lapilli
***	***	80	0.860	Dark yellowish brown fine sandy clay loam textured unit; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	370	1.230	White poorly sorted ash and fine pumice lapilli; distinct sharp contacts
Mangatawai Tephra & Mapara Tephra		210	1.440	Dark yellowish brown fine sandy loam textured ash, greasy; with root channels; paleosol; with interbedded white firm ash 'cream cakes' (Mapara Tephra)
		70	1.510	Black sandy ash beds; distinct contacts
Papakai Formation		140	1.650	Dark yellowish brown medium sandy clay loam textured ash; with common root channels
Waimihia Tephra		20	1.670	Pale brown fine ash 'cream cakes'
Papakai Formation		40	1.710	Dark yellowish brown medium sand loam textured ash
	black ash-2	10	1.720	Very dark grey medium ash, pocketing, firm
		120	1.840	Dark yellowish brown fine sandy loam textured ash; with root channels
		30	1.870	Medium pumice and few lithic lapilli interbedded in sandy loam textured ash
		40	1.910	Dark yellowish brown fine sandy loam textured ash
	black ash-1	10	1.920	Very dark grey medium ash, firm, pocketing
		90	2.010	Dark yellowish fine sandy loam textured ash
		40	2.050	Medium and few coarse lithic and pumice lapilli in sandy loam textured ash
		200	2.250	Dark yellowish brown to dark brown fine sandy loam to sandy clay loam textured ash; with root channels, becoming coarser with depth
?reworked Mangamate Tephra		600+	2.850	Bedded dark and pale grey, and brown very fine lapilli; firm

Section Name and Map Code: Duncan Road [DCN]

Grid Reference: T20/333983

Locality: At the crest of a hill (northern exposure) on Duncan Road, approx. 30 m east of a small road bridge over an unnamed tributary channel

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	150	0.150	White poorly sorted ash and pumice lapilli, with charcoal
Papakai Formation		1300	1.450	Yellowish brown fine sandy loam textured ash, with interspersed fine and medium pumice lapilli; massive
?Bullot Formation	unnamed	40	1.490	Yellowish brown fine pumice interbedded in sandy loam textured ash
***	***	110	1.600	Olive medium sand
	unnamed	30	1.630	Scattered medium pumice lapilli
		90	1.720	Black coarse ash and some brownish yellow pumice lapilli
Bullot Formation (upper)	?Ngamatea lapilli-1	190	1.910	Strong brown fine pumice lapilli and black lithic lapilli; loose, gravely texture
	unnamed	80	1.990	Olive medium sandy loam textured ash, greasy; with yellowish red iron-stained contacts
		30	2.020	Grey sandy ash
	ul_1	200	2.220	40 mm Yellowish brown fine angular, platy pumice fragments 60 mm Yellowish brown fine pumice lapilli and black lithic lapilli; gravelly texture; reversely graded tephra
***	***	100	2.320	Purplish grey coarse sandy loam textured medial unit, showing paleosol development; with dark brown coated root channels and some very fine pumice and lithic lapilli
	Shawcroft Tephra	220	2.540	Dark grey fine lithic lapilli and fewer strong brown pumice lapilli, with grey interiors; soft pumice
Bullot Formation (upper) & Waiohau Tephra	unnamed	80	2.620	Grey pumiceous fine ash, greasy; with interbedded white very fine rhyolitic ash
Bullot Formation (upper)	unnamed	20	2.640	Black coarse sandy ash
		30	2.670	Purplish black sandy loam textured ash
		50	2.720	Medium sandy loam textured ash and interbedded pumice and lithic lapilli
		40	2.760	Fine sandy loam textured ash, greasy; with yellowish red iron-stained basal contact
***	***	70	2.830	Medium sandy loam textured ash, with distinct root channels; paleosol; with iron-stained basal contact
	unnamed	70	2.900	Medium sandy loam textured ash and lapilli
		60	2.960	Black coarse ash and fine lapilli; pocketing
		70	3.030	Medium sandy loam textured ash and lapilli
***	***	110	3.140	Grey fine sandy loam to sandy clay loam textured ash, greasy; with distinct root channels; paleosol
?reworked Bullot Formation tephras		300+	3.440	Bedded very fine lithic and pumice lapilli; ?fluvial deposit; base not exposed. Older deposits overlie lava

Section Name and Map Code: Helwan Quarry [HQ]

Grid Reference: T20/408921

Locality: Northern exposure within a small quarry located immediately east of the Desert Road, on the south side of Waitangi Stream, and approx. 0.2 km north of Helwan S.2

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Disturbed soil surface
Taupo Pumice	Taupo Ignimbrite	500	0.500	White poorly sorted ash and fine lapilli, with charcoal
Mangatawai Tephra		230	0.730	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, greasy; with common dark brown coated root channels; indistinct lower contact; paleosol
Papakai Formation		520	1.250	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash; with cracked exterior, and dark brown coated root channels; bluish grey lithic lapilli and brown pumice lapilli interbedded near base of unit; paleosol
Mangamate Tephra	Poutu Lapilli	110	1.360	Yellowish brown (10YR5/6) very fine lapilli interspersed in fine sandy loam textured ash
Bullot Formation (upper)	unnamed	130	1.490	Very pale brown (10YR7/4) medium sandy loam textured ash; with moderately well developed medium nut structure and root channels; paleosol
	Ngamatea lapilli-2	70	1.560	Dark brown (7.5YR4/4) dominantly medium, and some fine pumice lapilli, with white (2.5Y8/2) interiors, and few grey lithic lapilli; some sandy loam textured ash matrix; ungraded tephra
	unnamed	30	1.590	Greyish brown medium sandy loam textured ash
	Ngamatea lapilli-1	110	1.700	Dark brown (7.5YR4/4) dominantly fine pumice lapilli, and dark grey lithic lapilli; loose lapilli
***	***	20	1.720	Pale brown sandy loam textured medial unit
		70	1.790	Dark grey very fine lithic lapilli and coarse ash
***	***	120	1.910	Yellowish brown (10YR5/4) medium sandy loam textured medial unit, with brown coated root channels, and common fine lapilli
	Helwan lapilli	80	1.990	Strong brown (7.5YR5/6) fine pumice lapilli, with pale grey interiors, and fewer dominantly very fine dark grey lithic lapilli; loose lapilli; moderately soft pumice; ungraded tephra; sharp basal contact
***	***	80	2.070	Brown medium sandy loam textured medial unit, with pale brown coated root channels, and strong brown fine pumice lapilli
	unnamed	80	2.150	Strong brown (7.5YR5/6) and dark brown (7.5YR4/4) dominantly medium pumice lapilli, and few coarse lapilli, and grey lithic lapilli; ungraded tephra
***	***	40	2.190	Fine sandy loam textured medial unit, with root channels and fine lapilli
	Shawcroft Tephra	90	2.280	Black (2.5Y2/0) fine and very fine lithic lapilli and fewer strong brown (7.5YR5/8) pumice lapilli, with a strong brown pumice dominant base; distinctive tephra
Medial unit & Waiohau Tephra		620	2.900	Yellowish brown (10YR5/4) fine sandy clay loam textured medial unit, greasy; with scattered fine, soft pumice lapilli in upper part of unit, and abundant very fine pale yellow pumice and grey lithic lapilli in lower; many dark brown coated root channels; interbedded near top of unit is a white very fine ash, discontinuous (Waiohau Tephra)
Bullot Formation (upper)	unnamed	40	2.940	Strong brown (7.5YR5/6) dominantly very fine pumice lapilli and black lithic lapilli; discontinuous tephra; distinct irregular contacts
***	***	80	3.020	Fine sandy loam textured medial unit, with many brown coated root channels and common very fine pale yellow pumice, and lithic lapilli, and some fine lapilli at base

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
***	***	110	3.130	Yellowish brown medium sandy loam textured medial unit, with root channels, and some fine and medium pumice and lithic lapilli; with scattered coarse andesitic pebbles at upper contact
Tangatu Formation	unnamed	550	3.680	Grey sand and granule matrix, poorly sorted; with matrix-supported dominantly fine andesitic and few pumice pebbles, grading downwards to coarse pebbles and cobbles near base of deposit; unit pinches out; debris flow deposit
		180	3.860	Greyish brown sand and granule matrix; with matrix-supported andesitic pebbles, grading upwards from dominantly fine pebbles to coarse and very coarse pebbles; some pumice pebbles; unit pinches out; debris flow deposit
		160	3.860	Grey granules and sand, with dominantly fine andesitic pebbles; upper 30 mm dominantly coarse sand; hyperconcentrated flood flow deposit
		160	3.860	Grey granules and sand, and few fine andesitic pebbles; semi-lithified; hyperconcentrated flood flow deposit
		170	3.860	Granules and minor sand, semi-lithified; with common fine andesitic pebbles and few medium pebbles; hyperconcentrated flood flow deposit
		1000	3.860	Granule and sand matrix, with matrix-supported dominantly medium andesitic pebbles, and some coarse pebbles and olive brown sandstone cobbles concentrated toward base of deposit; maximum clast 150 mm (cobble); wedging unit, thinning to 250 mm; debris flow deposit
		700	3.860	Fine sand and granule matrix, poorly sorted, with red and grey dominantly fine, and few coarse andesitic and hydrothermally altered pebbles, and some pumice pebbles; occasional sandstone cobbles; unit becomes bedded laterally, and comprises pebble dominant and poorly sorted sand dominant beds with bed thicknesses generally about 100 mm; debris flow grading to hyperconcentrated flood flow deposit
***	***	70	3.860	Dark greyish brown sandy clay loam textured medial unit, with common medium pebbles
	unnamed	750	3.860	Medium sand and granule matrix, with matrix-supported andesitic pebbles, cobbles and boulders, and some brownish grey sandstone clasts; dominant clast size is cobble (80 mm); maximum clast is 500 mm (boulder); with some pockets of clast-supported pebbles and cobbles; basal 20 mm bedded sand and granules; unit pinches out; erosional lower contact; debris flow deposit
		3700+	3.860	Alternately bedded pebble dominant and sand dominant beds; pebble dominant beds are commonly reverse graded, and comprise dominantly fine pumice and minor andesitic pebbles, granules, and some medium sand at base; sand dominant beds comprise fine to coarse sand, commonly reversely graded, and granules; Some lenticular beds and few andesitic cobbles; sharp bed contacts; overall the deposit appears reversely graded, grading upwards from predominantly sand beds in the lower half, to pebble beds; lower half of deposit is more massive; hyperconcentrated flood flow deposit; base of deposit is not exposed

Section Name and Map Code: Helwan Section 2 [HS2]

Grid Reference: T20/407917

Locality: A cutting in the face of a small hill on the east side of the Desert Road, approx. 1.5 km north of Waiouru

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		900	0.900	570 mm Present day soil surface, overlying dark brown fine sandy loam textured unit with few reworked Taupo Pumice lapilli 170 mm Very dark grey (10YR3/1) fine sandy loam textured unit, with interbedded pockets of grey sandy ash, and some reworked Taupo Pumice lapilli 160 mm Dark brown (10YR4/3) medium sandy loam, with some reworked charcoal fragments and fine Taupo Pumice lapilli
Taupo Pumice	Taupo Ignimbrite	470	1.370	White to pale grey poorly sorted ash and lapilli; with carbonised branches; at base of the ignimbrite is a thin crystal-rich coarse ash
Mangatawai Tephra		210	1.580	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, with some reddish brown mottles; indistinct lower contact
Papakai Formation		540	2.120	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, with cracked exterior and distinct dark brown coated root channels; with common bluish grey fine lithic lapilli interspersed within basal 100 mm, and some brown fine pumice lapilli; paleosol
Mangamate Tephra	Poutu Lapilli	120	2.240	Profuse brown very fine lapilli interspersed throughout pale brown fine sandy loam textured ash; indistinct tephra
Bullot Formation (upper)	unnamed	240	2.480	Yellowish brown (10YR5/6) fine sandy loam, grading downwards to fine sandy clay loam textured ash and scattered strong brown (7.5YR5/6) fine pumice lapilli and bluish grey lithic lapilli; some root channels; paleosol
	Ngamatea lapilli-2	70	2.550	Strong brown (7.5YR5/6) dominantly medium pumice lapilli and light grey (2.5Y7/0) lithic lapilli, with some brownish yellow (10YR6/6) fine sandy loam textured ash matrix; ungraded tephra; angular to subrounded, moderately soft pumice lapilli
	unnamed	30	2.580	Light olive grey (5Y6/2) medium ash, firm, and some very fine lapilli
	Ngamatea lapilli-1	100	2.680	Dark brown (7.5YR4/4) and strong brown (7.5YR5/6) fine and medium pumice lapilli, and fewer dark grey (2.5Y4/0) lithic lapilli, with basal 10 mm coarse ash; loose subrounded lapilli
	unnamed	30	2.710	Dark grey very fine lithic lapilli with a 5 mm strong brown iron-stained base; wavy distinct lower contact
Tangatu Formation	unnamed	140	2.850	Grey fine sand and granule matrix; with clast-supported red and grey andesitic pebbles, and pale yellow (2.5Y8/4) pumice pebbles; top 60 mm dominantly fine sand; sharp lower contact; hyperconcentrated flood flow deposit
***	***	60	2.910	Yellowish brown fine sandy loam textured medial unit with many very fine lapilli; prominent unit; sharp contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Tangatu Formation	unnamed	1820+	4.730	140 mm	Grey weakly bedded very fine sand coarsening downwards to medium sand with interbedded thin discontinuous lapilli beds; with pumice pebbles concentrated at base
				580 mm	Well bedded sands and pebbles; bed thicknesses generally 70 mm; comprising pumice dominant pebble beds, commonly reversely graded with sandy bases and fine pebbles grading upwards to medium pebbles, and sand dominant beds comprising reversely graded sands and few pebbles; no cobbles or boulders
				1100 mm	Weakly bedded unit, more massive and coarser than overlying unit; comprising pebble dominant with dominantly fine and some medium andesitic and pumice pebbles; and sand dominant beds comprising very coarse sand and granules; hyperconcentrated flood flow deposit

Section Name and Map Code: Lower Seagull Gully Section 1 [LSG1]

Grid Reference: T20/408026

Locality: An exposure within Lower Seagull Gully, approx. 50 m up-channel from its southern end where it broadens and opens out into the southern Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	440	0.440	Poorly bedded deposit comprising very coarse sand dominant, and pebble dominant beds; with some andesitic cobbles and boulders; very dark grey andesitic clasts, and brown and yellowish brown rounded pumice pebbles
Manutahi Formation	unnamed	500	0.940	Poorly bedded deposit comprising: Sand and granule dominant beds, with fine andesitic and pumice pebbles, moderately well sorted sands and some cross beds Pebble dominant beds comprising pale and dark grey and red andesitic dominantly coarse pebbles, and yellowish brown (10YR5/6), dark brown (10YR3/3) and very dark greyish brown (10YR3/2) medium and fine pumice pebbles, distinctly rounded: and yellowish brown fine sandy loam textured beds; discontinuous beds
Papakai Formation		60	1.000	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, with cracked exterior, and dark brown coated root channels; paleosol
	?orange lapilli-2	20	1.020	Strong brown (7.5YR5/6) dominantly fine, and some medium pumice lapilli, with same coloured interiors, and dark grey, pale grey and black dominantly very fine lithic lapilli, and coarse ash; very soft pumice
		50	1.070	Coarse sandy clay loam textured ash, greasy
	?orange lapilli-1	70	1.140	Strong brown (7.5YR5/6) fine and very fine pumice lapilli, grey and black lithic lapilli, and coarse ash; soft pumice; reversely graded tephra
Papakai Formation & Motutere Tephra		390	1.530	Dark yellowish brown (10YR4/4) medium sandy clay loam textured ash, very greasy, with cracked exterior; with common dark brown and black coated root channels and interspersed bluish grey lithic lapilli and yellowish brown pumice lapilli; with pale pinkish brown fine to coarse ash 'cream cakes' interbedded 90 mm from basal contact
?reworked Mangamate Tephra		50	1.580	Very dark grey to black (5Y3/1 – 2/1) and brown very coarse ash and very fine lapilli, firm, prominent, pocketing
Bullot Formation (upper)	unnamed	80	1.660	Strong brown (7.5YR5/6) medium and few coarse pumice lapilli and black (2.5Y2/0) lithic lapilli, interbedded in sandy clay loam textured ash
***	***	70	1.730	Coarse sandy clay loam textured ash, greasy; with many interspersed fine pumice and lithic lapilli; with dark brown root coatings; paleosol
Tangatu Formation	unnamed	110	1.840	Poorly bedded grey coarse sand and rounded medium pumice pebbles and fewer andesitic pebbles; scoured basal contact
		370	2.210	Bedded grey fine sand with strong brown beech leaves, and fine and medium pumice pebbles, and occasional andesitic pebbles; small scour and fill structures; lens-shaped deposit thinning to 20 mm; scoured basal contact; fluvial deposit
		90	2.300	interbedded brown fine sandy clay, hard, and grey very fine sand; with leaves
***	***	20	2.320	Black coarse ash and fine lithic lapilli; correlates with deposit at 1.8 – 1.94 m in Lower Seagull Gully S.2
	unnamed	80	2.400	Greyish brown (2.5Y5/2) very fine sand
		10	2.410	Yellowish brown clay
***	***	130	2.540	Bedded sandy loam, and very greasy sandy clay loam textured beds; medial unit; with iron-stained contacts and some root channels

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	750	3.290	Black and pale yellow bedded very coarse and medium lithic and pumiceous sand; with cross beds; fluvial deposit; correlates with deposit at 2.2 – 2.3 m in Lower Seagull Gully S.2
		130	3.420	Yellowish brown (10YR5/4 – 5/6) coarse and medium rounded pumice pebbles interbedded in greasy fine sand and greasy sandy clay loam textured matrix
		170	3.590	Poorly bedded yellowish brown (10YR5/4) fine pumice pebbles and lithic granules, and grey coarse sand
***	***	40	3.630	Greyish brown (2.5Y5/2) fine sandy loam, greasy; with iron-stained root channels; sharp contacts
	unnamed	200	3.830	Grey bedded coarse sand, loose; discontinuous deposit; scoured basal contact
Bullot Formation (upper)	unnamed	180	4.010	Light olive brown (2.5Y5/2) fine and medium pumice lapilli, and dark grey fine; gravelly texture; firm pumice; normally graded tephra
***	***	70+	4.080	Fine sandy clay loam textured unit, greasy, with distinct black coated root channels; paleosol; base not exposed

Section Name and Map Code: Lower Seagull Gully Section 2 [LSG2]

Grid Reference: T20/407028

Locality: An exposure near the southern end of Lower Seagull Gully, in a shallow meandering section of the channel

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation			0.000	Grey laharic sands and gravels unconformably overlying Papakai Formation
Papakai Formation		180	0.180	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, greasy; cracked exterior, with brown coated root channels
	?orange lapilli-2	20	0.200	Strong brown (7.5YR5/6) fine pumice lapilli, soft, with same coloured interiors, and dark grey, grey and black very fine lithic lapilli; some sandy clay loam textured ash matrix
		40	0.240	Dark yellowish brown fine sandy clay loam textured ash
	?orange lapilli-1	60	0.300	Strong brown (7.5YR5/6) medium and fine pumice lapilli and grey fine lithic lapilli; soft pumice
		70	0.370	Yellowish brown fine sandy clay loam textured ash, greasy, with root channels; paleosol
Manutahi Formation	unnamed	480	0.850	Poorly bedded dark grey and brown sands and pebbles; dominantly andesitic pebbles and common brown pumice pebbles, well rounded; discontinuous beds; some croas bedded sands
Papakai Formation & Motutere Tephra		420	1.270	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash; cracked exterior, with dark brown and black coated root channels; prominent unit; interbedded 90 mm from base of unit are pale pinkish brown fine and coarse ash 'cream cakes' (Motutere Tephra); erosional upper contact; prominent unit
Tangatu Formation	unnamed	450	1.720	Weakly bedded grey coarse sand and granules, moderately well sorted, with scattered fine to coarse andesitic pebbles, and occasional pockets of clast-supported medium and coarse pebbles; fine grained unit; sharp smooth contacts hyperconcentrated flood flow deposit
		60	1.780	Clast-supported pumice pebbles and sand
***	***	20	1.800	Dark grey coarse ash and fine lithic lapilli
	unnamed	140	1.940	Bedded grey fine sand, firm, and brown clay beds; sharp contacts
		40	1.980	Fine and very fine pumice pebbles and brown loamy sand
***	***	130	2.110	Greyish brown and grey (gleyed) sandy clay loam textured medial unit, showing paleosol development; greasy, with many brown coated root channels; some very fine lithic and pumice lapilli at contacts
Bullot Formation (upper)	unnamed	60	2.170	Dominantly fine pumice lapilli, and very fine lithic lapilli and coarse ash; ungraded
Tangatu Formation	unnamed	40	2.210	Grey sand, with common pale brown pumice granules; discontinuous unit
		90	2.300	Greyish brown fine sand
Bullot Formation (upper)	unnamed	110	2.410	Yellowish brown (10YR5/6) dominantly fine pumice lapilli, and grey lithic lapilli; normally graded unit, grading from lapilli base to coarse ash top; some sandy clay loam textured ash matrix; discontinuous unit
Tangatu Formation	unnamed	150	2.560	Olive grey granules and sand, poorly sorted; with very fine lithic lapilli; semi-lithified; with interbedded laminae of fine pumice pebbles; hyperconcentrated flood flow deposit
		60	2.620	Greyish brown (2.5Y5/2) stratified very fine sand; firm; sharp wavy contacts
Bullot Formation (upper)	unnamed	130	2.750	Fine pumice and lithic lapilli and greyish brown coarse ash
***	***	60	2.810	Grey (2.5Y6/0) sandy clay loam textured medial unit, showing paleosol development; with reddish brown coated root channels, and scattered fine lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	110	2.920	Yellowish brown (10YR5/6) dominantly fine pumice lapilli, with grey interiors, and black fine lithic lapilli; angular lapilli; slight normal grading to coarse ash dominant top 30 mm
		10	2.930	Grey coarse ash; firm
		70	3.000	Loamy sand textured coarse ash, and fine lapilli
		60	3.060	Brown and grey dominantly fine pumice lapilli, and black, with some red lithic lapilli, subangular; sharp contacts
		70	3.130	Grey (2.5Y5/0) coarse ash and fine lapilli
		10	3.140	Yellowish brown loamy textured ash and fine pumice and lithic lapilli
		50	3.190	Dark brown (10YR4/3) dominantly fine pumice lapilli, with common coarse, and some very coarse lapilli, and grey lithic lapilli; some loamy textured ash matrix; reversely graded unit
		10	3.200	Yellow loamy textured ash, firm
		130	3.330	Grey and red dominantly very fine lithic lapilli, and yellowish brown (10YR5/6) pumice lapilli; and few fine to medium pumice lapilli; normally graded unit, grading upwards to dominantly coarse ash
	M_1	30	3.360	10 mm Grey very fine ash, firm, prominent, with yellow very fine pumice lapilli 20 mm Yellow ash and fine yellow and greyish brown pumice lapilli
	unnamed	30	3.390	Black coarse ash and fine lithic and pumice lapilli
		60	3.450	Brown and greyish brown dominantly medium pumice lapilli, and black and red lithic lapilli, with common coarse lapilli; ungraded unit; very vesicular, subangular pumice; with some greyish brown loamy textured ash matrix
		30	3.480	Grey coarse ash and fine lapilli
		10	3.490	Black coarse ash and very fine lithic lapilli
		50	3.540	Grey coarse ash and scattered fine pumice and lithic lapilli
	member L17	120	3.660	Strong brown (7.5YR5/6) dominantly fine pumice lapilli, and dark grey, brown, and red lithic lapilli; some coarse ash matrix; angular lapilli; ungraded; distinct tephra
	unnamed	10	3.670	Very dark grey (2.5Y3/0) coarse ash; firm; prominent
	member L16	110	3.780	Strong brown (7.5YR5/6) dominantly fine pumice lapilli and grey lithic lapilli, with many very fine lapilli, and loamy textured ash matrix; subrounded pumice and angular lithics; ungraded; overall finer grain size than member L17
Tangatu Formation	unnamed	100+	3.880	Yellowish brown sand and granule matrix; with pockets of grey coarse sand, and many matrix-supported andesitic cobbles, and fewer coarse andesitic, and brown pumice pebbles; dominant clast size 80 mm (cobble); base of unit not exposed; debris flow deposit

Section Name and Map Code: Main Road [MR]

Grid Reference: T20/385020

Locality: A shallow ditch on the west side of Main Road, south of an intersection with an unnamed road, northern Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		70	0.070	Dark greyish brown sandy loam textured unit with pockets of greyer sandy loam
Tufa Trig Formation	unnamed	20	0.090	Dark grey medium ash, pocketing
Makahikatoa Sands		30	0.120	Brown medium sandy loam textured unit
Tufa Trig Formation	unnamed	20	0.140	Very dark grey medium ash, with a pale grey fine ash base
Makahikatoa Sands		20	0.160	Brown medium sandy loam textured unit
Tufa Trig Formation	unnamed	10	0.170	5 mm Very dark grey medium ash, over 5 mm grey fine ash base
Makahikatoa Sands		20	0.190	Brown medium sandy loam textured unit
Tufa Trig Formation	?member Tf10	20	0.210	Very dark grey medium ash with a grey fine ash base; pocketing tephra
Makahikatoa Sands		40	0.250	Brown coarse sandy loam textured unit
Tufa Trig Formation	member Tf8	60	0.310	50 mm Very dark grey coarse ash grading down to medium ash 10 mm Grey coarse ash base with olive and brown fine lapilli
Makahikatoa Sands		40	0.350	Brown medium sandy loam textured unit
Tufa Trig Formation	member Tf7/ member Tf6	30	0.380	20 mm Black medium ash 5 mm Yellowish brown sandy loam textured unit 35 mm Black coarse ash with finer grey ash base
Makahikatoa Sands		40	0.420	Brown coarse sandy loam textured unit
Tufa Trig Formation	member Tf5	70	0.490	Black coarse ash and fine lapilli; coarsest tephra in section; distinctive tephra
Makahikatoa Sands		40	0.530	Yellowish brown fine sandy loam textured unit, slightly greasy; paleosol
Tufa Trig Formation	member Tf4	20	0.550	Black medium sandy ash; pocketing
Makahikatoa Sands		75	0.625	Yellowish brown fine sandy loam textured unit, with interbedded 5 mm white fine ash, pocketing
Tufa Trig Formation	member Tf2	50	0.675	Olive grey medium and fine scoriaceous and lithic lapilli; glassy, very vesicular scoriaceous lapilli; interspersed in yellowish brown fine sandy loam
Makahikatoa Sands		40	0.715	Yellowish brown fine sandy loam textured unit, with common very fine lapilli
		60	0.775	Yellowish brown fine sandy loam textured unit, and many reworked fine Taupo Pumice lapilli
Taupo Pumice	Taupo Ignimbrite	660	1.435	White poorly sorted ash and fine pumice lapilli; with carbonised branches and charcoal fragments
Mangatawai Tephra		40+	1.475	Dark yellowish brown fine sandy loam textured ash, very greasy; with common yellowish brown fine lapilli, and root channels; paleosol; base of tephra not exposed

Section Name and Map Code: Mangatawai (Stream) [MS]

Grid Reference: T19/489238 [N112/250806]

Locality: A cutting on the Desert Road on the southern side of the bridge over Mangatawai Stream. Description taken from Topping (1973), with modifications (this study) given in italics

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		440	0.440	Very dark grey medium ash to dark brown fine ash
Taupo Pumice		200	0.640	Pale yellow coarse to fine rhyolitic ash, lapilli and small blocks (in pockets)
Mangatawai Tephra		790	1.430	290 mm Dark brown fine ash giving way to dark grey medium ash with interbedded dark grey ash containing yellow leaves
Papakai Formation & Waimihia Tephra & Hinemaiaia Tephra		240	1.670	Dark yellowish brown fine and medium ash with pale yellow medium rhyolitic ash, giving way to yellowish brown coarse rhyolitic ash
Papakai Formation		240	1.910	Yellowish brown fine ash with interspersed grey and strong brown stained fine and medium lapilli; buried soil
Mangamate Tephra	Poutu Lapilli	540	2.450	Strong brown fine and medium lapilli and grey lithics
	Wharepu Tephra	70	2.520	40 mm Grey to dark olive grey medium ash 30 mm Dark olive grey and olive brown medium ash with a few interspersed fine and medium lapilli
Poronui Tephra		2	2.522	Trace yellow fine rhyolitic ash
Mangamate Tephra	Ohinepango Tephra	190	2.712	50 mm Dark olive grey and olive brown medium ash 40 mm Very dark grey medium ash 60 mm Very dark grey and brownish yellow medium ash 40 mm Very dark grey medium ash
	Waihohonu Lapilli	360	3.072	10 mm Grey ash 70 mm Strong brown and dark to very dark grey fine to coarse lithic lapilli 280 mm Dark grey and strong brown fine and a few medium lithic lapilli
	unnamed tephra	50	3.122	20 mm Dark greyish brown medium ash with interspersed yellow coarse ash 10 mm Coarse yellow ash, fine and medium brownish lapilli 20 mm Dark yellowish brown ash
	Oturere Lapilli	420	3.542	Strong brown, yellowish brown and dark greyish brown fine to coarse lapilli
	Te Rato Lapilli	40	3.582	Olive grey and olive fine lapilli
Karapiti Tephra		2	3.584	Trace light yellowish brown fine rhyolitic ash
***	***	*50*	3.634	*Very fine lithic and pumice lapilli, with minor greasy sandy loam textured ash matrix*
		80	3.714	*Strong brown fine and very fine pumice, and lithic lapilli; with minor greasy sandy clay loam textured ash matrix*
Pahoka Tephra		470	4.184	*Olive brown (2.5Y4/4) dominantly fine pumiceous lapilli, with light olive brown (2.5Y5/4) interiors; angular, loose lapilli*
?Bullot Formation (upper)	*unnamed*	*30*	4.214	*Yellowish brown (10YR5/6) coarse sandy ash and fine to very fine lithic and pumice lapilli; sharp contacts; ungraded tephra*
***	***	*80*	4.294	*Dark yellowish brown (10YR4/4) very coarse sandy clay loam textured medial unit, showing paleosol development; with abundant very fine lithic and pumice lapilli, and dark brown coated root channels*
	unnamed	*120*	4.414	*Pale yellow and black coarse pumiceous and lithic ash; gravelly texture; sharp basal contact*

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
***	***	220	4.634	Dark yellowish brown (10YR4/4) coarse sandy clay loam textured medial unit, showing paleosol development, greasy ; with common black coated root channels and many interspersed fine and very fine lithic and yellowish brown (10YR5/8) pumice lapilli with olive (5Y5/3) interiors; with an 80 mm thick lapilli unit interbedded at 75–155 mm depth from top; wavy basal contact
	unnamed	100	4.734	Dark brown (7.5YR4/4) dominantly fine pumice lapilli, with olive interiors, and dark grey lithic lapilli, with minor loamy coarse ash matrix; very vesicular, firm to moderately soft pumice; sharp basal contact
***	***	50	4.784	Greyish brown medium sandy clay loam textured medial unit, very greasy
	unnamed	40	4.824	Brown coarse sandy ash
***	***	60	4.884	Dark greyish brown (10YR4/2) sandy loam textured medial unit, greasy; with few scattered fine lithic and pumice lapilli; wavy basal contact
	unnamed	70	4.954	Dark brown (7.5YR4/4) fine lapilli; loose ungraded lapilli; discontinuous tephra
***	***	110	5.064	Dark greyish brown (10YR4/2) coarse sandy clay loam textured medial unit, showing paleosol development, greasy; with brown coated root channels, few scattered yellowish brown pumice lapilli, and pockets of beech leaves
	unnamed	30	5.094	Yellowish brown fine and very fine lapilli; loose, gravelly texture; with a discontinuous 5 mm basal pale grey sandy ash
***	***	70	5.164	Dark greyish brown(10YR4/2) medium sandy clay loam textured medial unit, showing paleosol development; with common interspersed fine lapilli and root channels
	unnamed	110	5.274	Yellowish red (5YR4/8) fine and very fine pumice lapilli and very dark grey (5Y3/1)fine and very fine lithic lapilli; loosa lapilli; very vesicular, firm pumice; wavy basal contact
***	***	150	5.424	Yellowish brown coarse sandy loam textured medial unit, very greasy
	unnamed	90	5.514	Grey coarse sandy ash and fine lapilli
		190	5.704	Dark brown (7.5YR4/4) fine pumice lapilli and very dark grey (5Y3/1) fine lithic lapilli; weakly bedded tephra; angular, loose lapilli
***	***	80	5.784	Dark yellowish brown (10YR4/4) sandy clay loam textured medial unit, showing paleosol development, greasy; with interspersed fine grey lithic and brown pumice lapilli; common black coated root channels
?Waiohau Tephra		50	5.834	White fine ash, interbedded in dark yellowish brown sandy clay loam textured medial unit, greasy, with black coated root channels
?Bullot Formation (upper)	unnamed	60	5.894	Yellowish brown fine pumice lapilli and grey lithic lapilli; with sandy clay loam textured ash matrix
***	***	50	5.944	Dark yellowish brown (10YR4/4) sandy clay loam textured medial unit, with some interspersed yellowish brown fine lapilli
	unnamed	130	6.074	Strong brown (7.5YR5/8) coarse ash and fine pumice lapilli, and grey lithic lapilli
***	***	80	6.154	Olive grey coarse sandy loam textured medial unit, greasy, with root channels
***	***	120	6.274	Olive grey and yellowish brown loamy sand textured medial unit
	unnamed	110	6.384	Grey coarse sandy ash, with yellowish brown and grey fine lapilli
***	***	80	6.464	Dark yellowish brown (10YR4/4 – 5/8) sandy clay loam textured medial unit, greasy; with black coated root channels and interspersed fine and some medium lapilli
	unnamed	130	6.594	Strong brown (7.5YR5/8) very fine pumice lapilli and grey lithic lapilli, and coarse ash; weakly bedded

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
***	***	90	6.684	50 mm Grey sandy loam textured medial unit, greasy 40 mm Yellowish brown (10YR5/8) to dark yellowish brown (10YR4/4) coarse sandy clay loam textured medial unit, very greasy; with interspersed yellowish brown fine lapilli
***	***	190	6.874	Sandy clay loam textured medial unit, very greasy; with brown coated root channels and yellowish red iron-stained contacts
Medial unit & ?Rotorua Tephra		160	7.034	Greyish brown (2.5Y5/2) sandy clay loam textured medial unit, showing paleosol development; with brown coated root channels; with 5 mm white fine ash interbedded near top of unit (?Rotorua Tephra); with yellowish red (5YR4/6) iron-stained contacts
***	***	160	7.194	Dark yellowish brown (10YR4/4 – 4/8) sandy clay loam textured medial unit, sticky; with interbedded lapilli
?Rotoaira Lapilli		240	7.434	50 mm Dark grey ash 140 mm Brownish yellow fine to coarse lapilli and grey fine lithics 50 mm Dark and light grey medium to coarse ash
?Bullot Formation (upper)	unnamed	170	7.604	Yellowish brown and black coarse pumiceous and lithic ash
		70	7.674	Very dark grey coarse ash and fine lapilli
		170	7.844	Yellowish brown , white and olive fine and medium pumice lapilli and common coarse lapilli; with coarse ash matrix; ungraded tephra
		50	7.894	Yellowish grey coarse ash and fine lithic and pumice lapilli; with iron-stained base; ungraded tephra
***	***		7.894	on alluvium or laharic debris

Section Name and Map Code: Mangatoetoenui Quarry [MQ]

Grid Reference: T20/459153

Locality: A large exposure within a quarry on the east side of the Desert Road, immediately south of the road bridge over Mangatoetoenui Stream

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands & Tufa Trig Formation		200	0.200	Grey sand over brown fine sandy loam textured unit, and dark grey medium ash
Tufa Trig Formation	unnamed	25	0.225	Black coarse ash with fine grey ash base and top
Makahikatoa Sands		30	0.255	Grey coarse loamy sand textured unit
Tufa Trig Formation	member Tf6	25	0.280	Reversely graded dark grey coarse ash, on 20 mm fine grey ash
Makahikatoa Sands		40	0.320	Brownish grey medium sandy loam textured unit, slightly greasy
Tufa Trig Formation	member Tf5	60	0.380	40 mm Bedded black coarse ash 20 mm Grey fine ash base
Makahikatoa Sands		40	0.420	Dark yellowish brown (10YR4/4) medium sandy loam textured unit, slightly greasy
Tufa Trig Formation	member Tf4	15	0.435	Very dark grey coarse ash with pale grey fine ash top
***	***	340	0.775	Dark yellowish brown (10YR4/4) sandy clay loam textured ash; with dark coated root channels; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	750	1.525	White poorly sorted coarse ash and lapilli, with charcoalised branches.
Mangatawai Tephra		650	2.175	140 mm Dark brown fine sandy clay loam textured ash, sticky; with interbeds of black coarse ash, pocketing; and many iron-stained root channels; sharp lower contact; paleosol 510 mm Alternately bedded black and dark purplish black coarse ash beds, with abundant yellowish brown and orange beech leaves, and dark yellowish brown (10YR4/4) fine sandy loam textured ash beds; bed thicknesses < 100 mm; upper beds discontinuous, lower beds continuous; wavy bed contacts
Papakai Formation		120	2.295	Dark yellowish brown (10YR4/4) coarse sandy clay loam textured ash, very greasy; with many scattered fine lapilli and iron-stained root channels; sharp wavy contacts
Papakai Formation & Waimihia Tephra		100	2.395	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, with 40 mm thick interbedded pale olive (5Y6/3) fine ash 'cream cakes'
Papakai Formation		280	2.675	Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash, sticky; with many dark coated root channels; indistinct contacts
Hinemaiaia Tephra		100	2.775	Yellow coarse pumiceous ash dispersed throughout dark yellowish brown sand clay loam textured Papakai Formation; distinctive tephra
Papakai Formation		300	3.075	Yellowish brown (10YR5/6) and strong brown (7.5YR5/6) fine sandy clay loam textured ash, strongly cracked exterior; with many bluish grey fine lithic lapilli concentrated at base, and many dark brown coated root channels
Motutere Tephra		10	3.085	Pale brown to pinkish brown coarse and fine ash 'cream cakes'
Papakai Formation		310	3.395	Yellowish brown and strong brown fine sandy clay loam textured ash, with many coated root channels, and interspersed fine lapilli; cracked exterior
reworked Mangamate Tephra		340	3.735	Brown and grey very fine angular, platy lithic fragments; normally graded deposit; weakly cemented; sharp smooth basal contact

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Mangamate Tephra	Poutu Lapilli	240	3.975	Dark greyish brown (2.5Y4/2) fine and fewer medium lithic lapilli, and strong brown (7.5YR5/6) fine and medium pumice lapilli, with yellowish brown (10YR5/6) interiors; non- and poorly vesicular lapilli, moderately soft; slight normal grading; weakly cemented at surface of outcrop
		20	3.995	Black coarse sandy ash
	Wharepu Tephra	670	4.665	Bedded lapilli and ash: 110 mm Very fine lapilll and coarse ash; slight normal grading 160 mm Dark greyish brown (2.5Y4/2 and 5Y3/1) and common dark brown (7.5YR4/4) fine and very fine lapilli 100 mm Dark brown fine and very fine lapilli; sharp contacts
		40	4.705	Dark yellowish brown (10YR4/4) fine sandy loam textured ash; prominent
	Waihohonu Lapilli	700	5.405	Bedded lapilli and ash: 330 mm Very dark grey (5Y3/1) dominantly medium angular lithic lapilli, and few yellowish brown (10YR5/8) pumice lapilli 50 mm Bright yellowish brown (10YR5/6) fine pumice lapilli and coarse pumiceous ash 190 mm Dark grey medium and fine angular lithic lapilli, and few strong brown pumice lapilli 20 mm Yellowish brown fine pumice lapilli and few black lithic lapilli, and coarse pumiceous and lithic ash 20 mm Coarse black ash
	unnamed tephra	90	5.495	80 mm Brown coarse loamy coarse ash; with many very fine lithic lapilli; sharp contacts 10 mm Coarse sandy clay loam textured ash, very greasy
	Oturere Lapilli	480	5.975	470 mm Weakly bedded dominantly very fine and fine, very dark grey (5Y3/1) and fewer dark greyish brown (2.5Y4/2) lithic lapilli, and some yellowish brown (10YR5/6) pumice lapilli, poorly vesicular, moderately soft; slight normal grading 10 mm Bluish grey very fine and fine lithic lapilli, soft; in greasy sandy clay loam textured ash
***	***	15	5.990	Grey (2.5Y6/0) to light brownish grey (2.5Y6/2) sandy clay textured ash; greasy; with iron-stained upper contact
Karapiti Tephra		5	5.995	Pale grey fine ash 'cream cakes', few, indistinct
***	***	20	6.015	Grey (2.5Y6/0) to light brownish grey (2.5Y6/2) sandy clay textured ash; greasy; with iron-stained lower contact
		100	6.115	20 mm Brown coarse sandy clay loam textured ash, greasy 40 mm Yellowish brown (10YR5/6) dominantly fine and very fine pumice lapilli, soft, weathered; ungraded tephra 30 mm Black coarse ash and fine lithic lapilll 10 mm Greyish brown coarse loamy ash
Pahoka Tephra		240	6.355	Grey (2.5Y5/0 – 6/0), light olive grey (5Y6/2), and olive (5Y6/3) colour-banded fine and medium, and few coarse pumiceous lapilli; light grey (2.5Y7/0), and olive (5Y6/3) non-banded pumiceous lapilli; and few olive and very dark grey lithic lapilli; blocky, angular, moderately hard pumiceous lapilli; slight normal grading with upper 50 mm comprising very fine angular, platy pumiceous lapilli; basal 20 mm comprises coarse pumiceous and lithic ash; distinctive tephra
Tangatu Formation	unnamed	340	7.115	Medium sand and granule matrix, moderately well sorted; with matrix-supported very fine, and fine andesitic and pumice pebbles, and many grey aphanitic cobbles (150 mm) and boulders; ungraded deposit; debris flow deposit
Bullot Formation (upper)	unnamed	140	7.115	30 mm Coarse sandy loam 110 mm Yellowish brown (10YR5/6) fine pumice lapilli; discontinuous tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	150	7.115	Coarse sand and granule matrix, moderately well sorted; with black and red dominantly medium andesitic pebbles, and brown and olive pumice pebbles; maximum clast 30 mm (coarse pebble); finer basal 30 mm without pebbles; debris flow deposit
Bullot Formation (upper)	unnamed	30	7.115	Coarse ash with some fine and few medium black lithic lapilli and yellowish brown pumice lapilli; normally graded
Tangatu Formation	unnamed	70	7.115	Very greasy fine sandy loam textured matrix, with occasional pebbles and cobbles, and dark coated root channels
Bullot Formation (upper)	unnamed	30	7.115	Greyish yellow coarse loamy ash
	Pourahu Member (ignimbrite unit)	490	7.605	190 mm Upper bed: pale yellow and pinkish brown dominantly medium pumice lapilll, with fine lapilli to blocks up to 150 mm; highly vesicular pumice; some grey sandy loam textured matrix; coarsest of the three beds 170 mm Middle bed: pale yellow and pinkish yellow dominantly medium pumice lapilli, with many fine lapilli, and common coarse lapilll and blocks 130 mm Basal bed: pale yellow and pinkish yellow fine and some coarse pumice lapilli with coarse pumiceous ash
Tangatu Formation	unnamed	6000+	13.605	Total thickness 6+ m; nine possible units, with predominantly yellowish grey matrices of sand to sandy loam; with many matrix-supported andesitic and pumice pebbles, cobbles, and some boulders; debris flow deposits

Section Name and Map Code: Missile Ridge Dune [MRD]

Grid Reference: T20/398062

Locality: An exposure in the face of a large dune located adjacent to Missile Ridge, near a large beech stand, in the northwestern Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands	Makahikatoa Sands	400	0.400	Dark greyish brown loamy sand textured unit
Tufa Trig Formation	unnamed	30	0.430	Dark grey medium ash; discontinuous
Makahikatoa Sands		1400	1.830	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf14	70	1.900	Very dark grey medium ash; with intermixed dark brown sandy loam; streaky ash; irregular contacts
Makahikatoa Sands		230	2.130	Dark brown medium sandy loam textured unit
Tufa Trig Formation	member Tf13	30	2.160	Very dark grey medium ash; discontinuous
Makahikatoa Sands		130	2.290	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf11	50	2.340	Very dark grey medium ash; discontinuous
Makahikatoa Sands		100	2.440	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf10	25	2.465	Dark grey fine and medium ash; indistinct, discontinuous tephra
Makahikatoa Sands		310	2.775	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf8	65	2.840	40 mm Dark grey medium ash 15 mm Pale grey fine ash base
Makahikatoa Sands		20	2.860	Greyish brown sandy loam textured unit
Tufa Trig Formation	member Tf6	60	2.920	Black medium to coarse ash; distinct reversely graded tephra; laterally continuous; distinct contacts
Makahikatoa Sands		60	2.980	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf5	120	3.100	Black coarse ash and some very fine lapilli; distinctive tephra; laterally continuous; coarsest member present in section; distinct contacts
Makahikatoa Sands		60	3.160	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf4	40	3.200	Very dark grey medium ash; discontinuous
Makahikatoa Sands		40	3.240	Dark brown sandy loam textured unit
Tufa Trig Formation	member Tf3	10	3.250	Very dark grey medium ash; pocketing; indistinct tephra
Makahikatoa Sands		90	3.340	Dark yellowish brown sandy loam textured unit; paleosol
Tufa Trig Formation	member Tf2	60	3.400	Brown fine pumice lapilli, with pale yellow interiors, grey and some hydrothermally altered fine lithic lapilli, and coarse ash; angular lapilli
Makahikatoa Sands		150	3.550	Dark yellowish brown sandy loam textured unit; paleosol
Tufa Trig Formation	member Tf1	70	3.620	Greyish brown fine and medium pumice lapilli, and coarse ash, interbedded in dark yellowish brown sandy loam
***	***	150	3.770	Dark yellowish brown sandy loam textured unit, greasy; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	450	4.220	White poorly sorted ash and fine lapilli, with charcoal and carbonised branches
			4.220	on Mangatawai Tephra

Section Name and Map Code: Ngamatea Swamp Section 1 [NS1]

Grid Reference: T21/413874

Locality: Western face of a NE–SW trending drainage channel located within Ngamatea Swamp, near a small rise, and approx. 400 m along channel from the northeastern margin of the swamp

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
		200	0.200	Dark brown fibrous peat
Tufa Trig Formation	member Tf6	10	0.210	Fine sandy ash within peat. Stratigraphic position of ash determined by texture
•••	•••	50	0.260	Dark brown peaty loam with traces of Tufa Trig Formation member Tf5
	member Tf5	30	0.290	Dark grey coarse ash within peat. Stratigraphic position of ash determined by texture and colour
•••	•••	150	0.440	Dark brown peaty loam
Taupo Pumice	Taupo Ignimbrite	280	0.720	White coarse ash and fine lapilli, with grey organic-rich basal 30mm
•••	•••	160	0.880	Dark brown fibrous peat
Mapara Tephra		10	0.890	Pale brown to white fine ash, pocketing, distinct contacts
•••	•••	350	1.240	Dark greyish brown (10YR4/2) fibrous peat
Waimihia Tephra		30	1.270	Pale brown to white fine ash, pocketing
•••	•••	250	1.520	Dark greyish brown (10YR4/2) fibrous peat
Hinemaiaia Tephra		110	1.630	White coarse pumiceous ash dispersed within peat; indistinct contacts
•••	•••	290	1.920	Yellowish brown (10YR5/4) fibrous peaty loam with interbedded sandy ash
•••	•••	60	1.980	Brown (10YR5/3) peaty loam with very fine pumice and lithic lapilli
•••	•••	130+	2.110	Yellowish brown peaty loam

Section Name and Map Code: Ngamatea Swamp S.2 [NS2]

Grid Reference: T21/413874

Locality: Western face of a NW–SE trending drainage channel located within Ngamatea Swamp, approx. 10 m south along channel from Ngamatea Swamp S.1 [NS1]; at this site tephras older than Taupo Pumice are not found interbedded with peat

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	250	0.250	White poorly sorted ash and fine pumice lapilli, with charcoal
Papakai Formation		320	0.570	Yellowish brown fine sandy clay loam textured ash, with strong brown (7.5YR5/6) coated root channels; cracked exterior
Hinemaiaia Tephra		100	0.670	White coarse pumiceous ash dispersed within yellowish brown Papakai Formation
Papakai Formation		260	0.930	Yellowish brown sandy clay loam textured ash, with interspersed bluish grey fine lapilli; cracked exterior
Bullot Formation (upper)	Ngamatea lapilli-2	70	1.000	Yellowish brown medium and fine pumice lapilli and pale grey lithic lapilli, with some sandy loam textured ash matrix; moderately soft pumice; ungraded unit
		30	1.030	Olive brown fine sandy loam textured ash
	Ngamatea lapilli-1	60	1.090	Strong brown dominantly fine pumice lapilli, and grey lithic lapilli; minor sandy loam textured ash; ungraded unit
***	***	30	1.120	Olive brown sandy loam textured medial unit, with common fine grey lithic lapilli
	unnamed	70	1.190	Yellowish brown dominantly fine, with some very fine and medium pumice lapilli, and grey lithic lapilli; minor sandy loam textured ash matrix; slight reverse grading
***	***	70	1.260	Olive grey sandy loam textured medial unit, with dark brown (7.5YR4/6) coated root channels
***	***	50	1.310	Grey coarse ash, normally graded, and scattered brown, soft pumice lapilli
***	***	50	1.360	Olive brown fine sandy clay loam textured medial unit with common fine lapilli and brown coated root channels
	unnamed	60	1.420	Brown fine, and few medium pumice lapilli, with olive interiors, and grey lithic lapilli; some sandy loam textured ash matrix
***	***	180	1.600	Dark grey loamy textured ash with common dark brown (7.5YR4/4) mottles about root channels
	unnamed	30	1.630	Olive very fine pumice lapilli in sandy clay loam textured ash matrix
		30	1.660	Grey very coarse ash
?Waiohau Tephra		5	1.665	White fine ash, pocketing
***	***	50	1.715	Olive brown medium sandy clay loam textured medial unit, with scattered brown pumice lapilli and common brown coated root channels
Te Heuheu Formation	unnamed	500+	2.215	Loamy sand textured matrix, grading downwards to coarse sand; strongly iron-stained, semi-lithified sands, with grey, black and red andesitic pebbles, and some pumice pebbles

Section Name and Map Code: Ohakune Mountain Road [OMR]

Grid Reference: S20/271074

Locality: A cutting on the east side of Ohakune Mountain Road, approx. 500 m south of the Turoa Skifield car park

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands			0.000	Brownish grey loamy sand textured unit and overlying present day soil surface
Tufa Trig Formation	unnamed	40	0.040	Black coarse ash; discontinuous tephra
Makahikatoa Sands		90	0.130	Brown fine sandy loam textured unit, greasy, with root channels, containing many pale green leaves near base; paleosol
Tufa Trig Formation	unnamed	30	0.160	Black coarse ash with basal laminae of very fine lithic lapilli
Makahikatoa Sands		50	0.210	Brown fine sandy loam textured unit, greasy, with root channels; paleosol
Kaharoa Tephra		10	0.220	White to pale grey very fine ash; discontinuous tephra; sharp irregular contacts
Makahikatoa Sands		90	0.310	Brown medium to fine sandy loam textured unit, with interbedded black coarse ash laminae, discontinuous, and common pale green leaves
Tufa Trig Formation	unnamed	60	0.370	Black coarse ash, discontinuous; distinct irregular contacts
Makahikatoa Sands		290	0.660	Brown fine sandy loam textured unit, slightly greasy; with two black coarse ash interbeds (20 – 30 mm thick), and common root channels
Tufa Trig Formation	unnamed	30	0.690	Grey to black coarse ash and few very fine pumice lapilli; discontinuous tephra
Makahikatoa Sands		10	0.700	Fine sandy loam textured unit
Tufa Trig Formation	unnamed	80	0.780	Black coarse ash beds; indistinct contacts
Makahikatoa Sands & Tufa Trig Formation		210	0.990	Brown fine sandy loam textured unit, greasy; with root channels and blackened root casts; Interbedded at 110 mm depth - black ash with a fine grey ash base, pocketing (Tufa Trig Formation tephra)
Tufa Trig Formation	?member Tf6	30	1.020	Black coarse ash, with fine grey ash at top, and strong brown scattered very fine and fine pumice lapilli at base; discontinuous tephra
Makahikatoa Sands		100	1.120	Brown fine sandy loam textured unit, slightly greasy with interbedded discontinuous grey ash laminae (?Tufa Trig Formation tephras)
Tufa Trig Formation	?member Tf5	120	1.240	Black coarse ash; distinct, irregular contacts
***	***	80	1.320	Brown fine sandy clay loam textured unit, very greasy, with white ?imogolite-coated greasy twigs; strong brown iron-stained basal contact; paleosol
***	***	230	1.550	Greyish brown fine sandy clay loam textured unit, very greasy, with many strong brown coated root channels; cracked exterior; paleosol
Taupo Pumice		40	1.590	Bed of scattered fine white pumice lapilli in brown ash (paleosol)
?Papakai Formation		340	1.930	Greyish brown fine sandy clay loam textured ash, very greasy, with few scattered fine pumice lapilli; many strong brown coated root channels; cracked exterior
***	***	80	2.010	Weakly bedded black coarse loamy sand, with protruding cream orange-coloured, greasy ?imogolite-coated twigs
***	***	170	2.180	Pale brown to cream fine sandy clay, very greasy; with small pockets of grey coarse ash? and orange greasy ?imogolite-coated twigs; paleosol
	unnamed	60	2.240	Yellowish grey and black fine lithic lapilli, and strong brown pumice lapilli, soft, interbedded in sandy clay textured ash matrix, greasy, with ?imogolite-coated twigs

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
***	***	920	3.160	280 mm	Grey sandy clay loam, very greasy, paleosol, over
				190 mm	Orange iron-stained sandy clay loam, very greasy; paleosol, over
				450 mm	Purplish grey sandy clay loam, very greasy, paleosol, with ?imogolite-coated twigs and protruding small branches; paleosol

Section Name and Map Code: Oturere Trig Section 1 [OT]

Grid Reference: T19/488213

Locality: A large exposure of the west side of the Desert Road, approx. 0.5 km north of the road bridge crossing Oturere Stream

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	130	0.130	White poorly sorted ash and fine lapilli, with carbonised branches; sharp lower contact
Mangatawai Tephra		480	0.610	230 mm Very dark greyish brown (2.5Y3/2) fine sandy loam textured ash, greasy, with dark brown coated root channels; paleosol 250 mm Alternately bedded black coarse ash and brown fine sandy loam textured ash beds
Papakai Formation & Waimihia Tephra		320	0.930	Dark yellowish brown (10YR4/4) sandy loam textured ash, greasy, with cracked exterior and brown coated root channels; with interbedded pale brown fine ash 'cream cakes'; paleosol
Hinemaiaia Tephra		140	1.070	Yellow and white coarse pumiceous ash, interspersed in yellowish brown sandy loam textured ash
Papakai Formation & Motutere Tephra		740	1.810	Dark yellowish brown (10YR4/4) sandy clay loam textured ash, with cracked exterior and dark brown coated root channels; with interspersed bluish grey and brown fine lapilli in base, and pale pinkish brown fine and coarse ash 'cream cakes' (Motutere Tephra) interbedded about 90 mm from base; paleosol
Mangamate Tephra	Poutu Lapilli	390	2.200	Strong brown fine and medium pumice lapilli, and iron-stained lithic lapilli; weakly cemented at surface of outcrop; angular poorly vesicular lapilli; basal 90 mm dominantly fine (10 mm) lapilli; sharp basal contact
	Wharepu Tephra	160	2.360	50 mm Black very fine lapilli and coarse ash, firm 110 mm Strong brown dominantly fine lapilli, cemented at surface of outcrop; sharp contacts
Poronui Tephra		5	2.365	White very fine ash, pocketing
Mangamate Tephra	Ohinepango Tephra	170	2.535	Colour-banded tephra comprising alternating beds of black lithic dominant, and strong brown (7.5YR5/8) pumice dominant coarse ash; sharp beds contacts; distinctive tephra
	Waihohonu Lapilli	750	3.285	Bedded grey (5Y3/1), strong brown (7.5YR5/6), yellowish red (5YR4/8) and some dark reddish brown (5YR3/4) dominantly fine, and medium lapilli; angular, sharp, loose lapilli; with a strong brown dominant bed at base; reversely graded tephra
	unnamed tephra	90	3.375	50 mm Olive grey very coarse loamy ash 40 mm Grey coarse sandy clay loam textured ash, greasy, with common fine lapilli; indistinct lower contact
	Oturere Lapilli	710	4.085	Bedded strong brown (7.5YR5/8 – 5/6) and very dark grey (5Y3/1) dominantly fine, and medium and very fine lapilli; normally graded tephra grading upwards from very fine to medium lapilli; loose, angular lapilli; distinct contacts
	?Te Rato Lapilli	30	4.115	Bluish grey very fine lapilli and coarse ash; colour contrast with overlying Oturere Lapilli
***	***	50	4.165	Coarse sandy clay loam textured ash, greasy
	unnamed	60	4.225	Coarse sandy clay loam textured ash with common yellow pumice and grey lithic lapilli
		50	4.275	Yellow sandy clay loam textured ash, greasy, with common very fine lapilli
		40	4.315	Strong brown iron-stained very fine lapilli, interbedded in sandy clay loam textured ash
		110	4.425	Very fine grey lapilli and coarse ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Pahoka Tephra		670	5.095	Grey and reddish brown (5YR5/4) iron-stained dominantly very fine lapilli, with very dark grey (5Y3/1) interiors; with pale yellow coarse ash base; soft lapilli
Builot Formation (upper)	unnamed	120	5.215	Very fine lapilli and sandy loam textured ash
		230	5.445	Black very fine lithic lapilli and light olive brown (2.5Y5/4) pumice lapilli, and coarse ash
	Pourahu Member [tephra unit]	130	5.575	Pale yellow and iron-stained dark brown (7.5YR4/4) dominantly fine medium pumice lapiili, and dominantly very fine lithic lapilli, and coarse ash; very vesicular pumice; some brown sandy clay loam textured ash
	unnamed	90	5.665	Olive brown (2.5Y4/4) fine lithic lapilli, and strong brown pumice lapilli, and sandy clay loam textured ash, with dark brown coated root channels
		110	5.775	Yellow coarse ash and scattered light olive brown (2.5Y5/4) fine lapilli
		70	5.845	Very dark grey (2.5Y3/0) medium sandy clay loam textured ash, greasy, and scattered strong brown fine pumice lapiiii, and grey lithic lapilli
		90	5.935	Dark greyish brown (2.5Y4/2) coarse loamy ash with some brown coated root channels; sharp lower boundary
		60	5.995	Yellowish brown fine pumice lapiili, grey lithic lapilli and coarse ash
***	***	140	6.135	Dark yellowish brown (10YR4/4) coarse sandy clay loam textured medial unit, greasy, with distinct black coated root channels, and many very fine lapilli
	unnamed	100	6.235	Strong brown (7.5YR5/6) and dark brown (7.5YR4/4) dominantly fine pumice lapilli, and grey lithic lapilli; moderately soft pumice; loose lapilli; ungraded tephra
		110	6.345	Yellowish brown (10YR5/8) very fine pumice lapilli, and lithic lapilli, with minor sandy clay loam textured ash matrix; with a 30 mm discontinuous black sandy ash interbedded 30 mm from top of unit
		80	6.425	Very dark grey (5Y3/1) to black (5Y2/1) very fine lithic lapilli and coarse ash; slight normal grading
		40	6.465	Very dark grey very fine lithic lapilli and yellowish brown pumice lapilli
		5	6.470	Dark grey coarse sandy ash
		50	6.520	Very dark grey (5Y3/1) very fine lithic lapilii and strong brown (7.5YR5/6) very fine pumice lapilli, and coarse ash; discontinuous tephra
		5	6.525	Grey coarse sandy ash
Waiohau Tephra		50	6.575	White very fine ash, discontinuous
?Bullot Formation (upper)	unnamed	20	6.595	Purplish black coarse sandy ash; distinctive
***	***	150	6.745	Brown sandy loam textured medial unit, greasy, with scattered yellowish brown, and white pumice lapilli, and grey very fine lithic lapiiii
***	***	60	6.805	Dark greyish brown coarse sandy loam textured medial unit, showing paleosol development
	unnamed	90	6.895	Yellowish brown and black very fine lapiili and coarse ash
		100	6.995	Yellowish brown fine and medium pumice lapilli, with brown interiors, and black, dominantly medium lithic lapilli, angular, and coarse ash; angular lapilli; ungraded tephra
		70	7.065	Yellowish brown and grey very fine pumice and lithic lapilli, and coarse ash; ungraded tephra
		70	7.135	Yellowish red (5YR5/8) dominantly fine, and very fine pumice lapilli, and black very fine lithic lapilli; soft very vesicular pumice lapiiii; distinctive colouring; ungraded tephra
		30	7.165	Colour-banded black, and yellowish red coarse ash and very fine lapiili beds
		90	7.255	Yellowish red (5YR5/8) dominantly fine (5 – 10 mm) pumice lapiiii and black very fine lithic lapilli; soft pumice; slight normal grading; sharp basal contact

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	90	7.345	Very dark grey and strong brown very fine lapIIII and coarse ash; sharp contacts
Medial unit & ?Rotorua Tephra		60	7.405	Pale grey sandy clay loam textured medial unit, showing paleosol development; greasy, with root channels; and interbedded white fine ash 'cream cakes' (?Rotorua Tephra); with reddish brown iron-stained contacts
?Bullot Formation	unnamed	50	7.455	Very dark grey and yellowish brown dominantly fine lapilli and coarse ash; reversely graded tephra
		90	7.545	Light purplish grey coarse ash, and grey lithic and yellowish brown pumice lapIII
		160	7.705	Brownish red coarse ash and fine lapilli; sharp contacts
		80	7.785	Black sandy ash and yellowish brown fine lapilli, firm
		140	7.925	Dark olive, and some white fine to coarse pumice lapIII, and coarse ash; brittle pumice; distinct contacts
		60	7.985	Yellow and dark grey coarse ash and very fine lapilli; sharp wavy lower contact, on
***	***	30	8.015	Andesitic diamictons, with sandy clay loam textured matrices and boulders (> 1 m)

Section Name and Map Code: Paradise Valley Road [PR]

Grid Reference: T20/494046

Locality: Shallow cutting on the south side of Paradise Valley Road, beside a disused railway track south of the junction with Burma Road

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		250	0.250	Present day soil overlying brown sandy loam textured unit
Tufa Trig Formation	member Tf5	40	0.290	Black coarse ash; distinctive tephra
Ngauruhoe Formation		50	0.340	Dark greyish brown sandy loam to sandy clay loam textured unit; paleosol
Tufa Trig Formation	member Tf2	15	0.355	Fine scoriaceous lapilli interbedded in sandy loam textured ash
Ngauruhoe Formation		40	0.395	Dark greyish brown sandy clay loam textured unit; paleosol
Tufa Trig Formation	member Tf1	25	0.420	Fine lapilli interbedded in sandy clay loam textured ash
***	***	120	0.540	Dark greyish brown fine sandy clay loam textured unit; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	430	0.970	White poorly sorted ash and fine lapilli, with charcoal; sharp wavy contacts
Mangatawai Tephra		260	1.230	160 mm Dark brown sandy clay loam textured ash, greasy; paleosol 100 mm Black sandy ash beds
Papakai Formation		250	1.480	Dark brown fine sandy clay loam textured ash; with strongly cracked exterior, and brown coated root channels; indistinct lower contact; paleosol
Hinemaiaia Tephra		80	1.560	White coarse pumiceous ash interspersed in brown sandy clay loam textured ash; indistinct tephra; indistinct lower contact
Papakai Formation		440	2.000	Dark brown sandy clay loam textured ash; with strongly cracked exterior and dark brown coated root channels; with abundant fine and very fine bluish grey and brown lapilli interspersed through base of unit (reworked Poutu Lapilli); irregular distinct basal contact; paleosol
Mangamate Tephra	Poutu Lapilli	90	2.090	Strong brown and bluish grey dominantly fine lapilli; angular, sharp lapilli, weakly cemented at top; erosive upper contact; distinct wavy basal contact; ungraded tephra
	unnamed	150+	2.240	Very fine brown and dark grey lapilli and coarse ash, weakly cemented; prominent tephra; base of deposit not exposed

Section Name and Map Code: Poutu [PT]

Grid Reference: T19/481325 [N112/239901]

Locality: A large cutting on the National Park – Taupo Road, 5.7 km west of Rangipo. Description taken from Topping (1973), with modifications (this study) given in italics

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice		400	0.400	Pale yellow rhyolitic ash, lapilli and blocks
Mangatawai Tephra		420	0.820	Dark yellowish brown and dark grey ash
Papakai Formation & Waimihia Tephra & Hinemaiaia Tephra		300	1.120	Yellowish brown andesitic ash, with interbedded pale brown fine ash (Waimihia Tephra) and white coarse pumiceous ash (Hinemaiaia Tephra)
Papakai Formation		200	1.320	Strong brown ash with grey lithic lapilli dispersed throughout; paleosol
Papakai Formation & Motutere Tephra		200	1.520	Strong brown ash with interbedded pale brown fine and coarse ash 'cream cakes' (Motutere Tephra)
Mangamate Tephra	Poutu Lapilli	900	2.420	Brownish yellow weakly bedded lapilli
	Wharepu Tephra	60	2.480	Very dark greyish brown to dark olive grey ash
Poronui Tephra		30	2.510	Pale yellow fine rhyolitic ash
Mangamate Tephra	Ohinepango Tephra	60	2.570	30 mm Strong brown medium ash 30 mm Very dark grey medium ash
	Waihohonu lapilli	30	2.600	Yellowish red medium and coarse ash and fine lapilli
	unnamed tephra	30	2.630	Brown ash
	Oturere Lapilli	10	2.640	Yellowish brown medium lapilli
	Te Rato Lapilli	160	2.800	Very dark grey coarse ash and lapilli and pale yellow lapilli
***	***	*90*	2.890	*Dark brown sandy clay loam textured ash, greasy*
Pahoka Tephra		*20*	2.910	*Dark grey fine pumiceous lapilli and fine angular, platy pumiceous fragments; indistinct tephra*
?Bullot Formation (upper)	*unnamed*	530	3.440	*Greyish brown sandy clay loam textured ash, and interbedded yellowish brown fine lapilli; discrete lapilli beds*
?Waiohau Tephra		20	3.460	Yellow fine rhyolitic ash; discontinuous tephra
?Bullot Formation (upper)	*unnamed*	710	4.170	*Greyish brown andesitic ash; prominent; sharp lower contact*
Rotoaira Lapilli		380	4.550	160 mm Yellowish red coarse ash and lapilli 20 mm Black ash 20 mm Shower bedded brownish lapilli and coarse ash; erosion break
?Bullot Formation (upper)	*unnamed*	120	4.670	Yellowish brown ash with scattered strong brown lapilli
Rerewhakaaitu Tephra		80	4.750	Light olive brown ash with sparse strong brown lapilli; a few angular cobbles throughout these two units which may be water-laid; in places up to 50 mm white rhyolitic ash present (may not be primary)
?Bullot Formation	*unnamed*	380	5.130	Shower bedded strong brown and brownish yellow ash and lapilli
Hinuera Formation		820	5.950	Current bedded gravelly sands; erosion break
Oruanui Formation *(Kawakawa Tephra Formation)*	Oruanui Breccia *(Oruanui Ignimbrite)*	390	6.340	Pale brownish grey massive ash with scattered pumice lapilli
	Oruanui Ash *(Aokautere Ash)*	570	6.910	310 mm Very pale brown ash, shower bedded and studded with chalazoidites up to 30 mm across 100 mm Very pale brown shower bedded ash 40 mm Pale yellow shower bedded ash 120 mm Pale yellow shower bedded fine and coarse ash; sharp contact with
		2000+	8.910	Tuff, lapilli tuff and alluvium

Section Name and Map Code: Rangipo Section 1 [R1]

Grid Reference: T20/410035

Locality: A large cutting approx. 200 m south of Death Valley, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed		0.000	Grey sands and gravels unconformably overlying Mangaio Formation
Mangaio Formation		2000	2.000	Yellowish brown (10YR5/6) and grey (2.5Y5/0) sandy clay-sandy clay loam textured matrix; with matrix-supported andesitic pebbles to boulders, and hydrothermally altered clasts; Three units present; upper unit contains finer, dominantly coarse pebbles; lower unit contains dominantly cobbles; sharp basal contact marked by thin iron pan above Manutahi Formation deposits
Manutahi Formation	unnamed	310	2.310	Weakly bedded unit comprising pebble-rich, sand-rich, and sandy loam textured beds, discontinuous; pebble-rich beds are poorly sorted and comprise distinctly rounded, dominantly medium pumice pebbles and subrounded and angular andesitic pebbles, with some sand and granules; within these beds are pockets of clast-supported pebbles; sand-rich beds are well sorted and comprise olive grey sand and granules, with some showing low-angle cross-bedding
		420	2.730	Olive and black sand-rich beds comprising moderately well sorted and bedded coarse and fine sand; beds generally <10 mm; some beds grade laterally to pebble-rich beds
		60	2.790	Dark yellowish brown (10YR4/4) medium loamy sand textured unit, with common fine andesitic pebbles; prominent unit
		110	2.900	Alternating pebble-rich and coarse sand-rich beds, generally <20 mm depth; pebbles are fine and distinctly rounded
		80	2.980	Olive coarse sand, with granules and pebbles; ungraded
		30	3.010	Brown medium sandy clay loam textured unit
		30	3.040	Pebble-rich bed, comprising rounded andesitic and pumice pebbles, with some sand and granules
		40	3.080	Brown very fine loamy textured sand
		180	3.260	Weakly bedded sands and pebbles, with sand laminae at top of unit
?Papakai Formation and Hinemaiaia Tephra		160	3.420	Dark yellowish brown (10YR4/4) coarse sandy loam textured ash, with brown coated root channels. Interbedded within this unit are black ash-1 member and white coarse pumiceous rhyolitic ash (Hinemaiaia Tephra); prominent unit
Manutahi Formation	unnamed	200	3.620	Weakly bedded unit comprising interbedded black medium and coarse sand-rich beds, granule-rich beds, and pebble-rich beds; pebble-rich beds comprise red, black and grey dominantly fine, rounded andesitic pebbles and brown rounded pumice pebbles
		460	4.080	Weakly bedded unit comprising interbedded sand-rich beds, pebble-rich beds and prominent brown sandy loam textured beds
		110	4.190	Brown fine sandy loam textured unit with common andesitic granules, and brown coated root channels; prominent unit
		1800	5.990	Weakly bedded unit comprising discontinuous, thin pebble-rich beds, and fewer sand-rich and sandy loam textured beds; pebble-rich beds comprise dominantly coarse, rounded pumice and andesitic pebbles, with some sand and granules, with pockets of clast-supported pebbles; some beds are dominated by pumice pebbles and others by andesitic pebbles; most are ungraded but some show normal grading; other beds comprise bedded grey and brown fine sand
		130	6.120	Brown silt with interbedded laminae of grey very fine sand

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Manutahi Formation	unnamed	1200+	7.320	Weakly bedded unit comprising brown fine sandy loam textured beds and fewer pebble-rich, and sand-rich beds; beds generally 30 – 100 mm depth and discontinuous; pebble-rich beds are ungraded and comprise mostly rounded clast-supported pumice pebbles; sand dominant beds comprise bedded coarse to fine sands, some show low-angle cross-bedding

Section Name and Map Code: Rangipo Section 2 [R2]

Grid Reference: T20/417981

Locality: An exposure in the face of escarpment along the eastern margin of Karioi Forest, and approx. 300 m south of Wahianoa Aqueduct

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		230	0.230	Brownish grey sandy loam textured unit
Tufa Trig Formation	member Tf5	40	0.270	Black coarse ash
Makahikatoa Sands		140	0.410	Dark yellowish brown (10YR4/4) medium sand loam textured unit; indistinct basal contact
Bullot Formation (upper)	Ngamatea lapilli-1	70	0.480	Strong brown (7.5YR5/6 – 5/8) fine pumice lapilli and grey fine lithic lapilli; soft pumice; ungraded unit
	unnamed	110	0.590	Greyish brown ash with central bed of orange and black coarse ash; prominent unit; sharp contacts
		120	0.710	Yellowish brown (10YR5/6 – 5/8) sandy loam textured ash with scattered very fine orange pumice, and grey lithic lapilli; interbedded 20 mm from top of unit - grey coarse ash, pocketing, firm; distinct contacts
		90	0.800	70 mm Brownish yellow (10YR6/6), and pale yellow (2.5Y7/4, dry) dominantly medium pumice lapilli, with olive grey interiors, and grey and black lithic lapilli; angular lapilli; ungraded unit; with 20 mm dark grey coarse ash base
		140	0.940	Yellowish brown (10YR5/6) coarse sandy loam, becoming sandier toward base; prominent unit, with many brownish yellow very fine pumice lapilli; with common brown coated root channels;
		80	1.020	Yellowish brown (10YR5/6 – 5/8), and pale yellow (2.5Y8/4, dry), with light grey (2.5Y7/2) interior, dominantly medium pumice lapilli and few lithic lapilli; with matrix of very fine platy, angular, pumice fragments, and a 5 mm thick distinctive pale grey ash top
		30	1.050	Grey (5Y6/1 – 5Y5/1) medium ash
		40	1.090	Pale yellow dominantly fine, with very fine pumice lapilli and black and grey lithic lapilli; loose, subrounded lapilli; reversely graded unit; sharp basal contact
		70	1.160	Brownish grey coarse sandy loam textured ash with abundant very fine lithic and pumice lapilli; indistinct basal contact
		70	1.230	Pale yellow (2.5Y7/4) dominantly medium pumice lapilli, with olive interiors, and grey lithic lapilli, with coarse ash matrix; subangular lapilli; ungraded unit
		90	1.320	Light olive brown (2.5Y5/4) medium-fine sandy loam textured ash, with cracked exterior and many pale brown coated root channels; firm, prominent ash; with scattered fine pumice and lithic lapilli; iron-stained wavy contacts; paleosol
Tangatu Formation	unnamed	130	1.450	Yellowish grey medium loamy sand to sandy loam textured granule-rich matrix; with abundant fine andesitic pebbles and some pumice pebbles; distinct sharp contacts; ?hyperconcentrated flood flow deposit
		20	1.470	Pale yellow and grey fine sand and granules; sharp wavy contacts
		140	1.610	Coarse sand and granule matrix; with abundant fine grey, red and black andesitic pebbles, common fine pumice pebbles, and few cobbles; maximum clast 230 mm; subangular clasts; with lenses of cross bedded sands and fine pebbles; sharp wavy contacts; ?debris flow deposit
***	***	110	1.720	Light brownish grey gleyed (2.5Y6/2) fine sandy loam, with light yellowish brown (2.5Y6/3) mottling and common brownish yellow (10YR6/6) and dark brown coated root channels; brownish yellow (10YR6/6) iron-stained contacts; paleosol

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	190	1.910	Grey poorly sorted granule and sand matrix; with matrix-supported, dominantly medium red, grey and black andesitic pebbles, cobbles, some pumice pebbles, and lenses of pebbles maximum clast 190 mm; subangular and subrounded clasts
		30	1.940	Pale brown fine sand with scattered andesitic pebbles; wavy basal contact
		80	2.020	Pale grey coarse sand and granule matrix; with abundant fine and medium, dominantly grey andesitic pebbles, and black scoria; with pale grey medium-fine pumice pebbles; subrounded pebbles; ungraded unit; debris flow deposit
***	***	90	2.110	Dark yellowish brown (10YR4/4) medium sandy loam, friable; with few root channels and common very fine lapilli; paleosol
Bullot Formation (upper)	unnamed	70	2.180	Dominantly fine and very fine pumice and lithic lapilli, with basal 20 mm dominantly coarse ash, and a pale grey firm ash at top; reversely graded unit
		50	2.230	Pale yellow fine pumice lapilli and grey lithic lapilli, distinctive, with coarse sandy loam textured ash matrix; distinct contacts
***	***	70	2.300	Dark yellowish brown (10YR4/4) fine sandy clay textured ash, sticky, with many dark brown coated root channels; with common scattered yellow fine lapilli at base; paleosol
Tangatu Formation	unnamed	60	2.360	Olive medium sand
		120	2.480	Grey fine sand and granule matrix; with scattered fine andesitic pebbles; hyperconcentrated flood flow deposit
		170	2.650	Grey medium sand and granule matrix; with andesitic pebbles and some pumice pebbles; subangular and angular lithics and subrounded pumice; with pockets of clast-supported pebbles; slightly finer sand dominant basal 60 mm; sharp wavy basal contact; debris flow deposit
Bullot Formation (upper)	Shawcroft Tephra	100	2.750	Pale grey fine and very fine lithic lapilli and strong brown (7.5YR5/6 – 5/8) pumice lapilli, loose, gravelly texture; with a strong brown (7.5YR5/6 – 5/8) pumice dominant base; discontinuous unit, with scoured upper contact
		40	2.790	Pale brown fine to very fine sandy loam textured ash
Waiohau Tephra		40	2.830	White very fine ash, pocketing
Bullot Formation (upper)		50	2.880	Black-purplish black very fine sandy ash, discontinuous
***	***	60	2.940	Yellowish brown (10YR5/4) medium sandy loam textured medial unit, showing paleosol development; with many very fine and fine pale yellow pumice lapilli and common grey lithic lapilli, and a pocketing black coarse ash near base; with common pale brown coated root channels
Tangatu Formation	unnamed	120	3.060	Grey coarse sand and granule matrix, poorly bedded; with fine andesitic pebbles and common rounded pumice pebbles; with pumice-rich beds at top and base of unit, and a central bed of dominantly black andesitic pebbles; ?hyperconcentrated flood flow deposit
		320	3.380	Grey granule-rich and sand matrix; with many matrix-supported medium pale yellow pumice pebbles and fewer red and black andesitic pebbles, rounded; with scattered andesitic cobbles; top of unit comprises weakly bedded granule dominant and pebble dominant beds; fine basal 50 mm comprising only granules and sand; rest of unit is ungraded; debris flow deposit grading to hyperconcentrated flood flow deposit
		340	3.720	110 mm Bedded sands and pebbles; 50 mm thick beds comprising fine pebble-rich beds and sand-rich beds; pebble-rich beds contain abundant pumice pebbles, and andesitic pebbles 230 mm Bedded sands and pebbles, comprising fine and medium pebble-rich beds, dominated by either pumice or andesitic pebbles, and granule-rich beds with sand; sharp bed contacts; hyperconcentrated flood flow deposit

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
Tangatu Formation	unnamed	130	3.850	Grey coarse sand and granule matrix, moderately well sorted sands; with matrix-supported distinctive red and grey medium to coarse andesitic pebbles, subangular and angular, and some pale yellow fine pumice pebbles, rounded; ungraded unit with coarser clasts than overlying unit; sharp basal contact; debris flow deposit
		140	3.990	Grey granule-rich and coarse sand matrix; with clast-supported fine and medium black and red andesitic pebbles, and occasional hydrothermally altered pebbles; subangular pebbles; some rounded pumice pebbles; unit shows reverse grading from a sand and granule-rich base to fine pebble-rich top; sharp basal contact; debris flow deposit grading laterally to hyperconcentrated flood flow deposit; unit wedges out
		420	4.410	Sand and granule matrix, moderately well sorted; with matrix-supported dark red, pale grey and black andesitic dominantly medium and coarse pebbles, with some pumice pebbles; angular and protruding clasts; reversely graded unit; top 250 mm distinctly more clast-rich; sharp basal contact
		170	4.580	Poorly sorted sand and granule matrix; with fine and scattered medium to very coarse andesitic pebbles; unit shows normal to reverse grading from base to top; with weakly bedded base; sharp wavy basal contact; hyperconcentrated flood flow deposit
Tangatu Formation	unnamed	230	4.810	Granule-rich and sand matrix; with matrix-supported dominantly medium and fine brown pumice pebbles, with some scattered black scoria pebbles and cobbles; lithologically distinctive unit; pumice-rich beds occur at top and base of unit; debris flow deposit
		40	4.850	Grey fine sandy loam textured medial unit, with scattered pumice lapilli
Bullot Formation (upper)	unnamed	80	4.930	Pale brown and strong brown dominantly fine pumice lapilli with fine and very fine lithic lapilli; slight reverse grading
		110	5.040	Pale brown and pale yellow dominantly fine, and very fine pumice lapilli, soft; normally graded to very fine lapilli dominant top
		20	5.060	Coarse sandy ash and very fine lithic lapilli
		360	5.420	Bedded fine pumice lapilli and coarse ash; beds 60 mm thick, comprising dominantly fine pumice and lithic lapilli; lowermost bed has very dark grey fine lithic lapilll concentrated at base; distinct contacts
Tangatu Formation	unnamed	160	5.580	Loamy sand and granule matrix, poorly sorted; with matrix-supported dominantly fine andesitic pebbles, and scattered cobbles; rounded clasts; indistinct contacts
***	***	130	5.710	Loamy sand to sandy loam textured medial unit, with scattered pumice lapilli and andesitic pebbles
	unnamed	360+	6.070	Yellowish brown (10YR5/4) medium to coarse loamy sand textured matrix; with some scattered dominantly medium andesitic pebbles; maximum clast 40 mm; ?hyperconcentrated flood flow deposit

Section Name and Map Code: Rock Road [RR]

Grid Reference: T20/322941

Locality: A cutting within a drainage channel adjacent to Rock Road, Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Disturbed surface tephra cover; Dark brown fine sandy loam textured ash and reworked white Taupo Pumice lapilli
Papakai Formation		770	0.770	Dark yellowish brown (10YR4/4) fine sandy loam textured ash; moderately well developed fine nut and crumb structure; basal 100 mm contains interspersed fine pumice and lithic lapilli; indistinct basal contact
Bullot Formation (upper)	?Ngamatea lapilli-1	120	0.890	Strong brown fine and medium pumice lapilli, and grey lithic lapilli; loose lapilli
***	***	70	0.960	Dark yellowish brown (10YR4/4) fine sandy loam textured medial unit; slightly greasy; with scattered fine pumice and lithic lapilli
	unnamed lapilli ($?UI_1$)	150	1.110	30 mm Strong brown coarse ash 50 mm Coarse ash and fine lapilli, with sandy loam textured ash matrix 80 mm Strong brown fine and medium dominantly pumice lapilli, and lithic lapilli; few coarse lapilli
***	***	140	1.250	Yellowish brown (10YR5/6) coarse sandy loam textured medial unit; with many very fine pumice and lithic lapilli
	unnamed	250	1.500	Dark yellowish brown (10YR4/4) medium sandy loam textured unit, very greasy; with distinct root channels; paleosol
		40	1.540	Fine pumice and lithic lapilli and coarse ash; loose lapilli; gravelly texture; ungraded
		30	1.570	Fine sandy loam textured ash
		170	1.740	Strong brown fine and very fine pumice lapilli and black lithic lapilli; loose with gravelly texture; reversely graded unit, grading from dominantly fine lapilli upwards to coarse ash; sharp basal contact
***	***	150	1.890	Dark brown (10YR4/3) medium sandy loam textured medial unit, greasy; with root channels, and few scattered very coarse andesitic pebbles;
***	***	210	2.100	Dark yellowish brown (10YR4/4) fine sandy loam to sandy clay loam textured medial unit; with root channels, and coarse andesitic pebbles
Te Heuheu Formation	unnamed	370	2.470	Yellowish brown (10YR5/4) medium sandy loam textured matrix; with many matrix-supported red, purplish red, grey and iron-stained andesitic pebbles to cobbles; subrounded clasts; debris flow deposit

Section Name and Map Code: Scorpion Gully [SG]

Grid Reference: T20/435057

Locality: An exposure on the southern side of Scorpion Gully, adjacent to a stand of native trees and shrubs

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*	
Taupo Pumice	Taupo Ignimbrite	1320	1.320	White poorly sorted coarse and fine ash and lapilli, with charcoalised branches; sharp smooth contacts; overlain by Onetapu Formation debris flow deposits	
Mangatawai Tephra		290	1.610	10 mm	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, greasy, with brown coated root channels; paleosol
				190 mm	Black coarse ash beds, pocketing, with dark yellowish brown sandy loam textured interbeds; distinct contacts
Papakai Formation		220	1.830	Strong brown (7.5YR5/6), yellowish brown (10YR5/8) and olive grey (5Y5/2) medium sandy clay loam textured ash, greasy, with strong brown mottles and coated root channels; sharp distinct boundaries; paleosol	
Waimihia Tephra		30	1.860	Pale brown to white fine ash 'cream cakes', interbedded in sandy clay loam textured Papakai Formation	
Papakai Formation		100	1.960	Strong brown (7.5YR5/6) and olive grey (5Y5/2) medium sandy clay loam textured ash, greasy, with yellowish brown (10YR5/8) mottles and coated root channels; sharp lower boundary; paleosol	
Mangaio Formation		3100+	5.060	630 mm	Unit 1: yellowish brown (10YR5/8) and light grey (2.5Y7/0 and 7/2) medium sandy clay textured matrix with lithic granules; with matrix-supported, dominantly pale yellow (2.5Y8/4) and white (5Y8/2), soft, hydrothermally altered lithic clasts and common grey, red, and black dominantly coarse andesitic pebbles and cobbles (maximum clast 100 mm); hydrothermally altered clasts are concentrated in upper 150 mm; ungraded; distinct lower contact
				620 mm	Unit 2: strong brown (7.5YR5/8), grey (5Y6/1) and light grey (2.5Y7/0) fine sandy clay textured matrix, sticky; with matrix-supported, black, grey, red andesitic cobbles and pebbles (maximum clast 150 mm) with iron-stained faces; coarser clasts overall than in unit 1, and fewer pale yellow and white hydrothermally altered clasts
				1850 mm	Grey (2.5Y6/0 and 5/0), purplish grey gleyed, and strong brown (7.5YR5/8) mottled coarse sandy clay textured matrix; with matrix-supported dominantly pale yellow and white hydrothermally altered lithic clasts, grey, red and black andesitic pebbles, cobbles (dominant) and boulders (maximum clast 3 m)

Section Name and Map Code: Scorpion Gully Section 1 [SG 1]

Grid Reference: T20/442054

Locality: A shallow exposure on the southern side of Scorpion Gully, and at the junction with a vehicle track located approx. 50 m west of Whangaehu River

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	1800	1.800	Grey andesitic diamictons with matrix-supported andesitic pebbles, cobbles and boulders; debris flow deposits
Taupo Pumice	Taupo Ignimbrite	270	2.070	White poorly sorted fine and coarse ash; discontinuous, with sharp erosional contacts
Mangatawai Tephra		110	2.180	Yellowish brown (10YR5/6) fine sandy clay textured ash, with dark coated root channels; paleosol
***	***	190	2.370	Strong brown (7.5YR5/6) greasy sandy clay textured matrix; with many matrix-supported white hydrothermally altered fine and medium hydrothermally altered lithic pebbles, and grey andesitic pebbles; ungraded; sharp wavy and iron-stained contacts; debris flow deposit
Mangatawai Tephra		320	2.690	100 mm Dark yellowish brown (10YR4/4) fine sandy loam textured ash, greasy; with dark brown coated root channels; paleosol 80 mm Dark greyish brown (2.5Y4/2) fine sandy loam textured ash, greasy; with iron-stained, and imogolite-coated root channels; indistinct lower contact; paleosol 140 mm Dark grey and black coarse ash beds, with greasy, fine sandy loam textured ash interbeds
Papakai Formation		110	2.800	Dark greyish brown (2.5Y4/2) medium sandy loam textured ash, very greasy; with yellowish brown mottles and iron-stained root channels; paleosol
Waimihia Tephra		10	2.810	Pale brown fine ash 'cream cakes' interbedded in greasy fine sandy loam textured ash
Papakai Formation		160	2.970	Yellowish brown (10YR5/6) fine sandy loam, greasy; with iron-stained root channels and scattered pebbles at base; distinct lower contact
Mangaio Formation		110+	3.080	Strong brown (7.5YR5/6) and grey (2.5Y6/0) greasy sandy clay textured matrix, with many matrix-supported white hydrothermally altered lithic clasts; debris flow deposit

Section Name and Map Code: Scorpion Gully Section 2 [SG2]

Grid Reference: T20/432062

Locality: At a fork in a tributary channel of Whangaehu River, located on the north side of Scorpion Gully (see Plate 5.10)

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	1000	1.000	Grey fine to very coarse sand and granule matrix; with dominantly grey, with red and few black andesitic pebbles, cobbles and boulders, and few hydrothermally altered lithic pebbles; upper 750 mm more clast-rich; maximum clast 1 m; debris flow deposit
		380	1.380	Grey fine-medium sand and granule matrix; with many subrounded black scoria and common white and orange hydrothermally altered fine to very coarse lithic pebbles, and few scattered boulders; reversely graded unit, with basal 100 mm comprising poorly sorted fine to coarse pebbles; debris flow deposit
		180	1.560	Dark grey fine-medium sand matrix; with many fine to medium black scoria pebbles, and few cobbles to boulders, with few white and orange hydrothermally altered lithic pebbles; maximum clast 200 mm; reversely graded unit, with finer base; indistinct upper contact; debris flow deposit
		120	1.680	Dark grey medium to coarse sand and granule matrix; with many fine to coarse andesitic pebbles, and fewer cobbles and boulders; reversely graded unit; distinct contacts; debris flow deposit
		220	1.900	Dark grey medium to coarse sand matrix; with many heterolithologic, red and grey subangular andesitic cobbles, and pebbles, and few orange hydrothermally altered pebbles; with sand and granule-rich upper 100 mm; distinct sharp wavy contacts; debris flow deposit; erosional unconformity
Mangaio Formation		2000+	3.900	Yellowish brown (10YR5/8) and light grey (2.5Y7/0) greasy sandy clay textured matrix; with matrix-supported andesitic pebbles and cobbles

Section Name and Map Code: Shawcroft Road [SR]

Grid Reference: T20/385937

Locality: A cutting on Shawcroft Road, overlooking Whangaehu River

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
		170	0.170	Yellowish brown (10YR5/6) medium to fine sandy loam textured medial unit, showing paleosol development; with coated root channels, and many yellow fine pumice lapilli; indistinct basal contact
Bullot Formation (upper)	Ngamatea lapilli-2	120	0.290	Brownish yellow (10YR6/6) dominantly fine, with few medium and coarse pumice lapilli, with grey interiors, and fewer lithic lapilli; and some sandy loam textured ash; sharp basal contact
***	***	40	0.330	Pale brown fine sandy loam textured medial unit, showing paleosol development; with common brown coated root channels and scattered very fine pumice and lithic lapilli
	Ngamatea lapilli-1	80	0.410	Brownish yellow (10YR6/6) dominantly fine pumice lapilli, with light olive brown (2.5Y5/4) interiors; firm pumice; ungraded unit
***	***	120	0.530	Light yellowish brown (10YR6/4) medium sandy loam textured medial unit; with root channels and scattered pale yellow very fine pumice, and grey lithic lapilli;
	?Pourahu Member [tephra unit]	150	0.680	Pale yellow (5Y7/3) dominantly fine pumice lapilli, with same coloured interiors and grey and black lithic lapilli; common medium, some coarse, and few very coarse pumice and lithic lapilli; loose, gravelly texture; with finer lithic dominant basal 50 mm
***	***	80	0.740	Yellowish brown (10YR5/6) sandy loam textured medial unit, showing paleosol development; common dark brown coated root channels, and many very fine pale yellow pumice lapilli scattered throughout
	unnamed	30	0.770	10 mm Black coarse ash, firm 20 mm Pale grey coarse ash
***	***	70	0.840	Yellowish brown (10YR5/6) coarse sandy loam textured medial unit, with some root channels and many very fine pumice and lithic lapilli; indistinct lower contact
	unnamed	80	0.920	Pale yellow (5Y7/3) and some iron-stained yellow (10YR7/6) dominantly fine pumice lapilli, and distinctive black lithic lapilli; olive grey pumice interiors; with coarse loamy textured ash matrix
		40	0.960	Coarse loamy textured ash
	Shawcroft Tephra	110	1.070	Brownish yellow (10YR6/8) and light olive brown (2.5Y5/4) fine and very fine pumice lapilli, soft, with pale yellow interiors, and very dark grey (5Y3/1) and black fine and very fine lithic lapilli; with pumice dominant base; ungraded unit
	unnamed	30	1.100	Light brownish grey (2.5Y6/2) and iron-stained yellowish brown (10YR5/6) fine sandy loam textured ash, with common dark brown coated root channels
Waiohau Tephra		10	1.110	White fine rhyolitic ash, pocketing
***	***	120	1.230	Medium sandy loam textured medial unit, slightly greasy, with scattered fine pumice and lithic lapilli; common root channels
***	***	310	1.540	Light olive brown sandy loam textured medial unit; with dark brown coated root channels, and scattered fine pumice and lithic lapilli
Bullot Formation (upper)	unnamed	30	1.570	Pale yellow fine pumice lapilli, some iron-stained, and grey lithic lapilli; ungraded; indistinct boundaries
***	***	120	1.690	Light brownish grey (2.5Y6/2) coarse sandy clay loam textured medial unit; with some fine scattered pumice and lithic lapilli; and common brown coated root channels; indistinct contacts
	unnamed	30	1.720	Very fine pumice lapilli in yellowish brown coarse sandy loam textured ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
***	***	80	1.800	Pale purplish grey coarse sandy clay loam; with iron-stained contacts; paleosol
***	***	160	1.960	Light brownish grey (2.5Y6/2) sandy clay textured ash, greasy, with dark brown (7.5YR4/4) mottles and many dark brown coated root channels; paleosol
***	***	70	2.030	Strong brown (7.5YR5/8) iron-stained sandy clay loam textured medial unit; with abundant very fine pale yellow and strong brown iron-stained pumice lapilli scattered throughout; sharp contacts
Bullot Formation and Rerewhakaaitu Tephra		40	2.070	Brown very fine sandy loam textured ash, with interbedded very fine white rhyolitic ash
Te Heuheu Formation	unnamed	30	2.100	Strong brown iron-stained sandy clay loam textured matrix, with scattered line of cobbles at base
		50	2.150	Andesitic cobbles in fine sandy loam texture matrix; maximum clast 70 mm
		150	2.300	Pale brown coarse loamy sand textured matrix; with scattered very coarse, and many fine andesitic pebbles; ungraded; sharp contacts; debris flow deposit
		1500+	3.800	Sand and granule matrix, semi-lithified; with matrix-supported andesitic boulders, cobbles and pebbles; maximum clast 700 mm; subangular clasts; pebbles concentrated in top 200 mm; debris flow deposit

Section Name and Map Code: Tangiwai Swamp

Grid Reference: T20/319905

Locality: An exposure located within a NW–SE trending drainage ditch, and approx. 7 m west along channel from the junction with Whangaehu Road, at the southern end of Karioi Forest

^{14}C site for Onetapu Formation member Ond

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Disturbed soil surface
		30	0.030	Yellowish grey very fine sand; lensing unit
Onetapu Formation	unnamed	210	0.240	Greyish brown loamy sand with elongated strong brown mottles about root channels, and scattered fine and medium andesitic pebbles; distinct contacts
	Onf	520	0.760	Grey coarse sand and granules; with strong brown elongate mottles about root channels and protruding string roots; ungraded; hyperconcentrated flood flow deposit
***	***	60	0.820	Very dark greyish brown (10YR3/2) fine sandy loam textured unit, with crumb structure, grading laterally eastwards to peaty sandy loam; many protruding stringy roots; sharp contacts; paleosol
Onetapu Formation	Ond	550	1.370	Grey coarse sand and granule matrix; with abundant medium to very coarse andesitic pebbles; with white salts precipitated on faces of most clasts; ungraded unit; wood from within this unit is radiocarbon dated (NZ7465) at 450 ± 55 years B.P.; base of the unit is not exposed

Section Name and Map Code: Tangiwai Swamp Section 3 [TS3]

Grid Reference: T20/319903

Locality: Cutting on the western bank of Whangaehu River, approx. 200 m upstream of the Tangiwai rail bridge, Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	380	0.380	Grey (5Y5/1 – 6/1) sand and granule matrix, with matrix-supported fine andesitic pebbles and cobbles; unit is reversely graded, from a dominantly fine pebble base (150 mm) to a very coarse pebble dominant top, with cobbles; wavy basal contact; debris flow deposit
		130	0.510	Grey (5Y6/1) medium to coarse sand and fine reworked pumice lapilli; ungraded; wavy contacts; hyperconcentrated flood flow deposit
***	***	90	0.600	Reworked Taupo Pumice; white coarse to fine pumice lapilli; distinct wavy contacts
	unnamed	510	1.110	420 mm Greyish brown (2.5Y5/2) very coarse and coarse sand, weakly bedded; with laminae of greyish brown (2.5Y5/2) medium pumice lapilli; sharp basal contact over 90 mm Light olive grey (5Y6/2) to pale olive (5Y6/3) fine pumice pebbles, and grey andesitic pebbles; ungraded; distinct contacts; hyperconcentrated flood flow deposit
		170	1.280	80 mm Greyish brown (2.5Y5/2) medium to coarse sand and many fine andesitic and pumice pebbles, over 50 mm Bedded medium to coarse sand and fine pebbles; sharp contacts, over 40 mm Bedded light olive grey (5Y6/2) to pale olive (5Y6/3) medium and coarse sand; sharp contacts; hyperconcentrated flood flow deposit
		350	1.630	Light olive grey (5Y6/2) lithic granules and sand with fine and medium andesitic pebbles; reversely graded unit; weakly bedded; scoured sharp wavy basal contact; gravel-dominated hyperconcentrated flood flow deposit
		80	1.710	Grey (5Y5/1) to olive grey (5Y5/2) bedded coarse and medium sand and granules, with occasional scattered pebbles; wavy basal contact; hyperconcentrated flood flow deposit
		430	2.140	Olive grey (5Y4/2) to olive (5Y4/3) sand and granule matrix, with matrix-supported medium and coarse andesitic pebbles; reversely graded unit, grading upwards from fine grained sand and granule basal 130 mm, to sand and granule matrix with coarse pebbles, and pockets of clast-supported pebbles; debris flow deposit
***	***	120	2.260	Dark grey (2.5Y5/4) coarse to medium sandy loam textured medial unit, showing paleosol development; with scattered fine pebbles and some root channels; weak crumb structure; sharp boundaries
	unnamed	430	2.690	Yellowish brown (10YR5.6, dry) to olive (5Y4/3, moist) medium loamy sand textured matrix, with many matrix-supported fine to very coarse andesitic pebbles; no cobbles; unit shows slight reverse grading
Taupo Pumice	Taupo Ignimbrite	170	2.860	70 mm Pale yellow (2.5Y7/4) poorly sorted ash 100 mm Light brownish grey to brownish grey (2.5Y6/2 – 5/2) poorly sorted ash and fine lapilli, and charcoal; sharp contacts
***	***	100	2.960	Olive brown (2.5Y5/4) coarse sandy loam textured medial unit, showing paleosol development, with many scattered andesitic pebbles and some hydrothermally altered lithic granules; common brown coated root channels

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
Mangaio Formation (distal deposits)		470	3.430	Dark greyish brown (2.5Y4/2) grading downwards to olive (5Y4/3) coarse sand and granule matrix, poorly sorted; with matrix-supported fine to very coarse andesitic pebbles and common hydrothermally altered clasts; reversely graded unit; basal 10 mm comprises black (5Y5/2) fine sand; sharp basal contacts; debris flow deposit
		120	3.550	Grey (10YR5/1) coarse sandy clay loam textured matrix; with white-yellow hydrothermally altered clasts and some fine andesitic pebbles with reddish brown (5YR3/4) iron-stained faces; mottles about root channels; indistinct basal contact; ungraded unit; debris flow deposit
		970	4.520	Sandy loam textured matrix, with matrix-supported coarse and very coarse, rounded, andesitic pebbles and some cobbles, with dark raddish brown (5Y3/4) iron-stained pebble faces; common hydrothermally altered clasts; ungraded unit; sharp basal contact; debris flow deposit
		110	4.630	100 mm Light olive brown (2.5Y5/4) very coarse to medium sand 10 mm Grey (2.5Y5/0) to purplish grey gleyed medium sand with abundant hydrothermally altered lithic granules; sharp wavy iron-stained basal contact
		380	5.010	Olive (5Y5/4) very coarse sand and lithic granules; wavy contacts
		190	5.200	Yellowish red (5YR5/8) iron-stained very coarse sand and lithic granules
		150	5.350	Olive very coarse sand with yellowish red mottling; prominent white hydrothermally altered lithic granules; distinct contacts
		150+	5.500	Purplish grey sandy clay matrix, sticky, with yellowish red mottling and coated root channels; common fine hydrothermally altered pebbles and granules; base of unit not exposed

Section Name and Map Code: Tangiwai Swamp Type Section [TS]

Grid Reference: T20/319906

Locality: An exposure located within a NW – SE trending drainage ditch, and approx. 60 m west along channel from the junction with Whangaehu Road, at the southern end of Karioi Forest

Description is for a vertical section through deposits seen at the west side of the type section

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
		150	0.150	Very dark greyish brown (10YR3/2) fine sandy loam textured ash; disturbed present day soil surface
		70	0.220	Yellowish brown coarse pumiceous ash and very fine pumice lapilli; occurring in discontinuous lenses
Onetapu Formation	Onf	180	0.400	Pale grey dominantly medium sand, and scattered reworked white fine Taupo Pumice lapilli; with elongate mottles around root channels; hyperconcentrated flood flow deposit
***	***	150	0.550	Dark grey (10YR4/1) fine loamy sand textured medial unit, showing paleosol development; with some very coarse and medium pebbles occurring at 70 mm depth, and scattered reworked pale yellow and white fine Taupo Pumice lapilli
	Ond	830	1.380	Pale grey sand and granule matrix, with abundant, fine, dominantly black scoria pebbles, some white fine hydrothermally altered pebbles, few very coarse pebbles to boulders, and common reworked fine Taupo Pumice lapilli; many long protruding root fibres; hyperconcentrated flood flow deposit which grades laterally eastward to debris flow deposit; Member is radiocarbon dated [NZ7465] from a site east of the type section at *c.* 450 years B.P.
***	***	180	1.560	Dark greyish brown (10Yr4/2) to very dark greyish brown (10YR3/2) fine sandy loam textured medial unit, showing paleosol development; with common yellowish red (5YR4/6) elongate mottles about root channels; weakly developed crumb structure
		40	1.600	Greyish brown (2.5Y5/2) fine loamy sand
	Onc	280	1.880	Dark greyish brown (2.5Y4/2) coarse sand; with scattered reworked fine Taupo Pumice lapilli; common yellowish red (5YR4/6) elongate mottles; hyperconcentrated flood flow deposit
***	***	120	2.000	Dark greyish brown (2.5Y4/2) fine sandy loam textured medial unit; with concentration of reworked fine and medium Taupo Pumice lapilli
	Onb	750	2.750	Grey (2.5Y5/0) to purplish grey coarse sandy loam textured and granule matrix; with yellowish brown (10YR5/6) mottles; many matrix-supported reworked fine taupo Pumice lapilli scattered throughout unit, and many fine and medium andesitic pebbles (with medium pebbles concentrated in the top 160 mm) and orange-white hydrothermally altered pebbles; few cobbles and boulders; clast size grades laterally eastwards to fine pebble; debris flow deposit
***	***	90	2.840	Brown (7.5YR5/2) coarse sandy clay loam textured medial unit, greasy, showing paleosol development; with abundant lithic and many hydrothermally altered granules; with strong brown (7.5YR5/6) mottles; sharp contacts
	Ona	240	3.080	Purplish grey sandy loam textured and granule matrix; with common grey fine and medium andesitic pebbles, and orange-white hydrothermally altered clasts; with strong brown (7.5YR5/6 mottles; sharp contacts; debris flow deposit
Taupo Pumice	Taupo Ignimbrite	80	3.160	White to pale brown fine ash and lapilli, with charcoal; strong brown mottles; sharp smooth contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
***	***	120	3.280	Dark grey (10YR4/1) coarse sandy clay textured medial unit, showing paleosol development; sticky; with common black coated root channels
Mangaio Formation (distal deposits)		280	3.560	Yellowish brown (10YR5/6) and grey (2.5Y5/0) gleyed coarse sandy clay textured matrix; with many orange-white fine and medium hydrothermally altered lithic pebbles
		40	3.600	Grey (2.5Y5/0) medium sandy clay textured matrix, sticky, with yellowish brown (10YR5/8) mottles
		360	3.960	Grey (2.5Y5/0) gleyed coarse sandy clay textured matrix; with common orange-white fine hydrothermally altered lithic pebbles concentrated in base of unit; many yellowish brown (10YR5/8) elongated mottles about root channels
		150+	4.110	Dark grey (10YR4/1) medium sandy clay textured matrix, sticky; with hydrothermally altered lithic granules; base of deposit not exposed

Section Name and Map Code: Tangiwai Swamp Type Section [TS]

Grid Reference: T20/319906

Locality: An exposure located within a NW–SE trending drainage ditch, and approx. 60 m west along channel from the junction with Whangaehu Road, at the southern end of Karioi Forest

Description is for a vertical section through channel fill deposits seen at the east side of the type section

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Disturbed surface
Onetapu Formation	Ong	450	0.450	Dark grey (5Y4/1) fine to medium sand; with abundant yellowish brown (10YR5/8) elongated mottles about root channels; protruding fibrous roots; hyperconcentrated flood flow deposit
***	***	70	0.520	Bedded dark grey and light grey sand; with scattered fine pumice lapilli
***	***	120	0.640	Dark brown fibrous peat with sharp contacts; unit is radiocarbon dated [NZ7728] at 282 ± 35 years B.P.
	Onf	560	1.200	Dark greyish brown (2.5Y4/2) medium and coarse sand; with many yellowish brown (10YR5/8) mottles about root channels and abundant root fibres; hyperconcentrated flood flow deposit
	One_2	280	1.480	150 mm Peat; black to very dark brown fibrous peat with wood and interbedded lenses of sand. Peat is radiocarbon dated [NZ7388] at 390 ± 55 years B.P. Wedging in from eastern side of exposure where this peat bifurcates is: 130 mm Very dark grey (5Y3/1) medium to fine sand; with common yellowish brown (10YR5/6) mottles; hyperconcentrated flood flow deposit
***	***	40	1.520	Gleyed bluish grey to dark grey (2.5Y4/0) sandy loam textured paleosol, greasy
***	***	80	1.600	Bluish grey silty clay loam textured paleosol, greasy, plastic; with many root channels; discontinuous unit; sharp contacts
	Ond	1900	3.500	Very coarse sand and granule matrix, with dark red (10R3/6), grey, and black (2.5Y2/0) dominantly coarse, and many fine to very coarse andesitic pebbles, and few cobbles (<170 mm); white salts precipitated on exposed clast faces; basal 350 mm shows finer clast sizes and a coarse and medium sand matrix; unit overall tends reverse graded; abundant root channels and fibres, with some tree branches; wood from within this unit is radiocarbon dated [NZ7465] at 450 ± 55 years B.P.

Section Name and Map Code: Top Road [TR]

Grid Reference: T20/326994

Locality: A shallow cutting on the east side of a ford across and unnamed tributary channel at the junction of Top Road and Aqueduct Road, Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		180	0.180	Brownish grey fine sandy loam textured unit, and overlying black present day soil surface
Tufa Trig Formation	unnamed	10	0.190	Very dark grey medium and fine ash; discontinuous tephra
Makahikatoa Sands		30	0.220	Brownish grey coarse sandy loam textured unit
Makahikatoa Sands & Tufa Trig Formation	unnamed	70	0.290	Dark yellowish brown sandy loam textured unit, with two interbedded dark grey ash beds
Tufa Trig Formation	member Tf5	50	0.340	Very dark grey to black coarse ash, and brown very fine lapilli; with a 10 mm pale grey fine ash base; distinct contacts
Makahikatoa Sands		20	0.360	Brownish grey medium sandy loam textured unit
Tufa Trig Formation	member Tf4	20	0.380	Black medium sandy ash; discontinuous
Makahikatoa Sands		60	0.440	Brownish grey medium sandy loam textured unit
Tufa Trig Formation	member Tf3	20	0.460	Black medium sandy ash; pocketing; indistinct tephra
***	***	120	0.580	Yellowish brown fine sandy clay loam textured unit, greasy, with root channels; some fine lapilli and interspersed charcoal fragments; paleosol; distinct basal contact
Taupo Pumice	Taupo Ignimbrite	430	1.010	White poorly sorted ash and fine pumice lapilli, with charcoal; sharp distinct contacts
Mangatawai Tephra		50+	1.060	Dark brown sandy clay loam textured ash, very greasy; paleosol; base of tephra not exposed

Section Name and Map Code: Tufa Trig Section 1 [TT1]

Grid Reference: T20/378045

Locality: Cutting in the face of a dune at the top end and west side of main Road, Karioi Forest.

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		100	0.100	Very dark brown (10YR2/2) organic-rich medium and fine sand
Tufa Trig Formation	member Tf18	20	0.120	Very dark grey (2.5Y3/0) pocketing, loamy coarse ash; distinct contacts
Makahikatoa Sands		170	0.290	Very dark greyish brown (10YR3/2) fine sandy loam textured unit with few very fine orange pumice lapilli; many fine roots
Tufa Trig Formation	member Tf17	20	0.310	Very dark grey (2.5Y3/0) pocketing coarse ash with (2.5Y4/2) fine ash base and top; distinct contacts
Makahikatoa Sands		150	0.460	Very dark greyish brown (10YR3/2) fine sandy loam textured unit with many dispersed very fine orange pumice lapilli
Tufa Trig Formation	member Tf16	20	0.480	Very dark grey (2.5Y3/0) loamy coarse ash; distinct contacts
Makahikatoa Sands		20	0.500	Dark brown (10YR3/3) fine sandy loam textured unit; indistinct lower contact
Tufa Trig Formation	member Tf15	10	0.510	Very dark grey (2.5Y3/0) strongly pocketing coarse ash
Makahikatoa Sands		280	0.790	Dark brown (10YR3/3) to dark yellowish brown (10YR3/4) fine sandy loam textured unit; with few scattered very fine orange pumice lapilli; common roots
Tufa Trig Formation	member Tf14	45	0.835	20 mm Black (5Y2/1) loamy coarse ash 10 mm Black (10YR2/1) loamy coarse ash 15 mm Black (10YR2/1) coarse ash; laterally continuous member
Makahikatoa Sands		55	0.890	Very dark greyish brown (10YR3/2) medium sandy loam textured unit, with crumb structure; paleosol
Tufa Trig Formation	member Tf13	15	0.905	10 mm Black (10YR2/1) coarse ash 5 mm Dark greyish brown (2.5Y4/2) fine ash base; pocketing
Makahikatoa Sands		15	0.920	Very dark greyish brown (10YR3/2) fine sandy loam textured unit, with crumb structure; paleosol
Tufa Trig Formation	member Tf12	12	0.932	10 mm Black (10YR2/1) coarse ash; pocketing 2 mm Dark greyish brown (2.5Y4/2) fine ash base; pocketing
Makahikatoa Sands		20	0.952	Very dark greyish brown (10YR3/2) fine sandy loam textured unit, greasy, with crumb structure; paleosol
Tufa Trig Formation	member Tf11	20	0.972	5 mm Dark greyish brown (2.5Y4/2) fine ash 15 mm Black (5Y2/1) coarse ash with pumice; weak reverse grading
Makahikatoa Sands		30	1.002	Very dark greyish brown (10YR3/2) medium to fine sandy loam textured unit, with crumb structure; paleosol
Tufa Trig Formation	member Tf10	20	1.022	5 mm Dark greyish brown (2.5Y4/2) coarse ash 10 mm Black (5Y2/1) coarse ash 5 mm Dark greyish brown (2.5Y4/2) coarse ash
Makahikatoa Sands		40	1.062	Very dark greyish brown (10YR3/2) medium to fine sandy loam textured unit, with crumb structure; paleosol
Tufa Trig Formation	member Tf9	25	1.087	5 mm Grey fine ash 10 mm Black (5Y2/1) coarse ash 5 mm Grey fine ash
Makahikatoa Sands		10	1.097	Very dark greyish brown (10YR3/2) fine sandy loam textured unit
Tufa Trig Formation	member Tf8	60	1.157	30 mm Black coarse ash; normally graded 5 mm Grey coarse ash 20 mm Coarse pumiceous ash with many dark greyish brown (2.5Y4/2) very fine pumice lapilli; distinctive unit 5 mm Grey coarse ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands	unnamed	25	1.182	Dark brown (10YR3/3) fine sandy loam textured unit, with dark brown (7.5YR4/4) mottles and many root channels; paleosol
Tufa Trig Formation	member Tf7	30	1.212	Black (5Y2/1) bedded coarse-fine-coarse ash; gradational lower contact
	member Tf6	70	1.282	10 mm Fine ash 30 mm Dark greyish brown (2.5Y4/2) and black (10YR2/1) coarse ash with very fine pumice lapilli 30 mm Black (10YR2/1) coarse ash
Makahikatoa Sands		60	1.342	Very dark greyish brown (10YR3/2) to dark brown (7.5YR4/2) fine sandy loam textured unit, greasy, with strongly developed coarse crumb structure; paleosol
Tufa Trig Formation	member Tf5	75	1.417	10 mm Very dark greyish brown (10YR3/2) fine ash 60 mm Black coarse ash and very dark greyish brown (10YR3/2) and black (10YR2/1) very fine to fine vitric lapilli; few red lithic lapilli 5 mm Dark olive grey fine ash Sharp contacts; reverse to normal grading; laterally continuous member
Makahikatoa Sands		100	1.517	Very dark greyish brown (10YR3/2 – 2.5Y3/2) sandy loam textured unit, slightly greasy, with distinctive dark coated root channels; paleosol
Tufa Trig Formation	member Tf4	20	1.537	5 mm Grey fine ash 15 mm Very dark greyish brown (10YR3/2) fine sandy loam, pocketing
Makahikatoa Sands		190	1.727	120 mm Very dark greyish brown (10YR3/2) fine sandy loam textured unit 5 mm Interbedded white fine ash, pocketing 70 mm Dark brown (7.5YR4/2) greasy sandy clay loam textured unit, with weakly developed nut and crumb structure
Tufa Trig Formation	member Tf3	10	1.737	Very dark greyish brown (10YR3/2) to black (10YR2/1) coarse ash, pocketing; indistinct contacts
Makahikatoa Sands		90	1.827	Dark brown (7.5YR4/2 and 10YR3/3) fine sandy loam textured unit, with moderately developed medium blocky structure; common root channels with dark brown (7.5YR4/4) coatings; gradational lower boundary; paleosol
		30	1.857	Olive brown (2.5Y4/4) fine sandy loam textured unit, greasy; moderately developed medium blocky structure; common root channels with yellowish red (5YR4/6) coatings; paleosol
Tufa Trig Formation	member Tf2	50	1.907	Dark greyish brown (2.5Y4/2), olive brown (2.5Y4/4) and olive grey (5Y4/2) coarse scoriaceous lapilli, with same coloured glassy interiors; angular, hard lapilli; some grey lithic lapilli
***	***	220	2.127	Olive brown (2.5Y4/4) fine sandy loam textured ash, with iron-stained root channels and few scattered fine lithic lapilli; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	370	2.497	Poorly sorted coarse ash and lapilli with charcoal fragments

Section Name and Map Code: Tufa Trig Section 2 [TT2]

Grid Reference: T20/375046

Locality: A cutting in a face of a large beech-clad dune at the top end of Main Road, Karioi Forest, approx. 40 m north of Tufa Trig S.1 [TT1]

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		550	0.550	Light yellowish brown medium to coarse sand
Tufa Trig Formation	member Tf18	10	0.560	Black coarse ash, pocketing, indistinct
Makahikatoa Sands		400	0.960	Yellowish brown medium to coarse sand, with common reworked fine Taupo Pumice
Tufa Trig Formation	member Tf17	40	1.000	Dark grey medium to coarse sandy ash, discontinuous member
Makahikatoa Sands		280	1.280	Yellowish brown medium to coarse sand, with common reworked fine Taupo Pumice
Tufa Trig Formation	member Tf16	40	1.320	Dark grey medium sandy ash, pocketing, with fine grey ash base
Makahikatoa Sands		40	1.360	Yellowish brown sandy loam textured unit
Tufa Trig Formation	member Tf15	10	1.370	Dark grey fine sandy ash, discontinuous unit
Makahikatoa Sands		380	1.750	Yellowish brown medium sandy loam textured unit, with common reworked fine Taupo Pumice
Tufa Trig Formation	member Tf14	50	1.800	Dark grey medium to coarse sandy ash, continuous unit
Makahikatoa Sands		50	1.850	Light yellowish brown medium sandy loam textured unit, with common reworked fine Taupo Pumice
Tufa Trig Formation	member Tf13	20	1.870	Dark grey sandy ash
Makahikatoa Sands		50	1.920	Light yellowish brown medium sandy loam textured unit
Tufa Trig Formation	member Tf12	20	1.940	Dark grey fine sandy ash, discontinuous
Makahikatoa Sands		30	1.970	Light yellowish brown medium sand
Tufa Trig Formation	member Tf11	30	2.000	Dark grey to black medium sandy ash
Makahikatoa Sands		40	2.040	Greyish brown to yellowish brown sandy loam textured unit
Tufa Trig Formation	member Tf10	20	2.060	Dark grey sandy ash, discontinuous and indistinct unit
Makahikatoa Sands		50	2.110	Greyish brown sandy loam textured unit
Tufa Trig Formation	member Tf9	20	2.130	10 mm Dark grey medium sandy ash 10 mm Pale grey fine ash
Makahikatoa Sands		20	2.150	Yellowish brown sandy loam textured unit, with a 5 mm thick interbedded pocketing white ash
Tufa Trig Formation	member Tf8	60	2.210	Black medium to coarse sandy ash, normally graded, with yellowish grey very fine and fine pumice lapilli at base
Makahikatoa Sands		20	2.230	Greyish brown sandy loam textured unit, with scattered soft reworked Taupo Pumice; paleosol
Tufa Trig Formation	member Tf7	30	2.260	Dark grey-black medium and fine sandy ash; indistinct contacts
	member Tf6	40	2.300	Black medium to coarse sandy ash, with few fine vitric lapilli; slight reverse grading
Makahikatoa Sands		90	2.390	Yellowish brown sandy loam textured unit, with weakly developed blocky structure and dark coated root channels; paleosol
Tufa Trig Formation	member Tf5	100	2.490	Black coarse to medium sandy ash with very fine and fine vitric lapilli; ungraded unit
Makahikatoa Sands		60	2.550	Greyish brown fine sandy loam textured unit; with weakly developed blocky structure and few dark brown (7.5YR4/4) root coatings
Tufa Trig Formation	member Tf4	20	2.570	Dark grey medium sandy ash, discontinuous unit
Makahikatoa Sands		40	2.610	Greyish brown fine sandy loam textured unit; interbedded within this unit is 10 mm grey fine ash above 5 mm white ash, pocketing
Tufa Trig Formation	member Tf3	15	2.625	Dark grey fine sandy ash, discontinuous unit

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
***	***	320	2.945	Yellowish brown fine sandy loam textured unit; with weakly developed fine blocky and crumb structure; with distinct dark brown (7.5YR4/4) coated root channels, and few orange fine lapilli; paleosol
Tufa Trig Formation	member Tf2	70	3.015	Dark grey coarse scoriaceous lapilli with glassy interiors, and few dark grey lithic lapilli, interbedded in yellowish brown fine sandy loam textured ash
Makahikatoa Sands		170	3.185	Yellowish brown medium to fine sandy loam textured ash; with strongly developed crumb structure; few coatings in root channels; paleosol
		1600	4.785	Greyish brown medium loamy sand to sand; with common reworked fine Taupo Pumice
reworked Taupo Pumice		300	5.085	Iron-stained fine and medium pumice lapilli, with white interiors, and charcoal fragments; sharp smooth contacts
Makahikatoa Sands		1500	6.585	1300 mm Dark yellowish brown (10YR4/4) coarse loamy sand grading down to medium loamy sand; occasional root channels 200 mm Grey (10YR5/1) medium sandy loam with dark yellowish brown (10YR4/4) and dark brown (7.5YR4/4) coarse mottles, prominent; with common scattered reworked fine Taupo Pumice
Taupo Pumice	Taupo Ignimbrite	280	6.865	White poorly sorted coarse ash and lapilli, with charcoalised logs; sharp smooth contacts
Mangatawai Tephra		260	7.125	Very dark greyish brown (2.5Y3/2), grading down to dark yellowish brown (10YR3/4) fine sandy loam textured ash, greasy, with weakly developed blocky, and strongly developed coarse crumb structure; few scattered orange fine, soft pumice lapilli; paleosol; interbedded at 60 mm from base 10 mm black (10YR2/1) coarse ash, pocketing
Mapara Tephra		60	7.185	White very fine ash 'cream cakes'; with intermixed brown fine andesitic ash; prominent with sharp contacts
Mangatawai Tephra		210	7.395	130 mm Very dark greyish brown (2.5Y3/2) fine sandy loam textured ash, greasy, with dark brown (7.5YR3/2 and 7.5YR4/4) mottles, and coatings in root channels; paleosol 80 mm Very dark grey (7.5YR3/0) coarse ash beds, pocketing, distinct
Papakai Formation		180	7.575	Dark brown (7.5YR4/4) grading down to yellowish brown (10YR5/6) medium sandy loam textured ash , greasy; with few scattered orange very fine pumice lapilli. Interbedded 50 mm from base – 15 mm black (10YR2/1) coarse ash, pocketing, distinct; paleosol
Waimihia Tephra		50	7.625	Very pale brown (10YR7/3) fine ash 'cream cakes' with intermixed brown fine andesitic ash; prominent unit
Papakai Formation		20	7.645	Yellowish brown (10YR5/6) fine sandy loam textured ash, greasy; paleosol
	black ash-2	10	7.655	Black (10YR2/1) coarse ash, pocketing; sharp contacts
		180	7.835	Olive brown (2.5Y4/4) and dark brown (10YR4/3) fine sandy loam textured ash, greasy; with moderately developed fine blocky and coarse crumb structure; few scattered orange fine, soft pumice lapilli
	black ash-1	10	7.845	Black (10YR2/1) coarse ash, pocketing, firm; sharp discontinuous contacts
		20	7.865	Olive brown (2.5Y4/4) fine sandy loam textured ash
Hinemaiaia Tephra		80	7.945	Yellow coarse ash dispersed throughout dark brown (10YR4/3) fine sandy loam textured ash
Papakai Formation	orange lapilli-2	80	8.025	Strong brown (7.5YR5/8) and yellowish brown (10YR5/8) fine and medium, pumice lapilli, with greyish brown (2.5Y5/2) interiors; soft lapilli with fine sandy loam textured ash matrix
		100	8.125	Dark yellowish brown (10YR4/4) medium sandy loam textured ash, greasy; with common brown fine pumice lapilli, soft; indistinct contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Papakai Formation	orange lapilli-1	300	8.425	Strong brown (7.5YR5/8) fine and medium pumice lapIII with yellow (10YR7/6) interiors, and common dark grey lithic lapilli, with a coarse ash matrix; normal to reverse grading
		500	8.925	Dark yellowish brown (10YR4/4) medium sandy loam to sandy clay loam textured ash, greasy, becoming sandier toward base; common strong brown (7.5YR5/6) coated root channels
	unnamed	15	8.940	Grey fine lithic lapilli and brown pumice lapIII interspersed within Papakai Formation
Motutere Tephra		10	8.950	Pale brown fine to coarse ash 'cream cakes'; indistinct
Bullot Formation (upper)	unnamed	50	9.000	Strong brown (7.5YR5/6) fine and very fine pumice lapilli, with brownish yellow (10YR6/6) interiors, and common grey (2.5Y6/0) medium and fine lithic lapilli; ungraded unit; sharp basal contact
		440	9.440	400 mm Black and strong brown coarse lithic and pumiceous ash, with fine and very fine pumice lapilli at base 40 mm Olive medium sandy loam textured ash, slightly greasy, with many scattered strong brown very fine pumice lapIII
		100	9.540	Strong brown (7.5YR5/8) and yellowish brown (10YR5/8) very fine to fine pumice lapilli, soft, and very dark grey (5Y3/1) fine lithic lapilli; ungraded unit
		60	9.600	20 mm Medium sandy loam textured ash with scattered strong brown (7.5YR5/8) fine pumice lapIII 40 mm Light olive brown (2.5Y5/4) coarse ash
		30	9.630	Coarse ash and fine lithic and pumice lapilli
		130	9.760	Dark yellowish brown (10YR4/4) and greyish brown (2.5Y5/2) fine sandy loam to sandy clay loam textured medial unit, showing paleosol development; greasy, with yellowish red (5YR4/6) mottles and coated root channels; some scattered fine pumice lapilli
		40	9.800	Greyish brown coarse sandy ash
		60	9.860	Coarse to fine pumice lapilli, very vesicular, and fine lithic lapilli
		70	9.930	Medium to coarse sandy loam textured medial unit, with imogolite-coated root channels; paleosol
		100	10.030	Medium and few coarse pumice lapilli, very vesicular, and few medium lithic lapilli
	M_1	50	10.080	Bedded olive coarse ash over yellowish brown coarse ash
	unnamed	100	10.180	Brown coarse ash
		310	10.490	Undifferentiated medium to coarse pumice and lithic lapilli, and ash beds
		80	10.570	Medium to fine lithic and pumice lapilli with pumiceous ash matrix; ungraded unit
		80	10.650	Black coarse ash with fine lithic and pumice lapilli
	member L17	180	10.830	Dark brown (7.5YR4/4) and very pale brown (10YR7/4, dry) medium and fine phenocryst-rich pumice lapilli, with light olive brown (2.5Y5/4) interiors, and dark grey (5Y3/1) lithic lapilli
	unnamed	10	10.840	Very dark grey (5Y3/1) coarse ash, firm, prominent
	member L16	110	10.950	40 mm Black fine ash with many lithic lapilli and scattered pumice lapilli 30 mm Yellowish brown (10YR5/8) and brownish yellow (10YR6/8 and 10YR6/6, dry) medium and fine pumice lapilli, with same coloured interiors; with dark reddish brown (5YR3/4) and black (10YR2/1) medium and fine lithic lapilli 40 mm Olive brown (2.5Y4/4) coarse sandy ash on very dark greyish brown (2.5Y3/2) medium sandy ash
	unnamed	30	10.980	Olive brown medium sandy ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
		40	11.020	Black medium sandy ash with scattered black medium lithic lapilli on brown medium to coarse sand ash and lapilli
Waiohau Tephra		10	11.030	White fine ash; discontinuous, ungraded unit
Tangatu Formation	unnamed	150	11.180	Andesitic diamicton, wedging out laterally
Bullot Formation (upper)	unnamed	80	11.260	Yellowish brown (10YR5/6) and pale yellow (2.5Y7/4, dry) medium and few coarse pumice lapilli, very vesicular, and coarse ash matrix
		90	11.350	Dark greyish brown (10YR4/1) medium and fine lapilli with orange and black coarse ash top
		370	11.720	Undifferentiated pumice lapilli, lithic lapilli, and ash beds
		40	11.760	Greyish brown (2.5Y5/2) medium sandy ash, with common fine lithic and pumice lapilli; indistinct basal contact
		80	11.840	Pale yellow (5Y7/3) medium and fine pumice lapilli, moderately soft, and reddish brown (5YR4/3), yellowish red (5Y4/6) and very dark grey (2.5Y3/0) lithic lapilli; slight reverse grading
		40	11.880	Coarse lithic and pumiceous ash; ungraded unit
	member L10	180	12.060	Yellow (10YR8/8) and pale yellow (2.5Y8/4, dry) fine and medium pumice lapilli, very soft, with prominent phenocrysts, and grey (2.5Y5/0) lithic lapilli; with greyish brown (2.5Y5/2) fine sandy loam textured ash matrix; prominent unit; distinct contacts
	member L9	210	12.270	Pale yellow (2.5Y7/4) and white (2.5Y8/2, dry) pumice lapilli, and black (2.5Y2/0) lithic lapilli. Some dark grey (5Y4/1) scoriaceous lapilli; with black (2.5Y2/0) and pale yellow (2.5Y7/4) coarse ash matrix
		20	12.290	Very dark grey (2.5Y3/0) coarse lithic ash
	member LB	60	12.350	Pale yellow (2.5Y7/4) medium pumice lapilli, and black (2.5Y2/0) and pale yellow (2.5Y7/4) coarse ash matrix, reverse graded
	unnamed	160	12.510	Light brownish grey (10YR6/2) and pale pink medium and fine pumice lapilli, with pale olive (5Y6/3) interiors, soft-firm pumice; with few black medium and fine lithic lapilli; distinctive unit
		20	12.530	Light brown (7.5YR6/4) pumice lapilli, and black lithic lapilli
		80	12.610	Brownish yellow (10YR6/6) medium and fine with few coarse pumice lapilli, with pale yellow (2.5Y8/4 – 7/4) interiors; with brownish yellow (10YR6/6) coarse sandy loam textured ash matrix
***	***	100	12.710	Black medium to fine lithic and pumiceous ash, with some scattered lithic pebbles
		70	12.780	50 mm Pale yellow (2.5Y8/4 – 7/4) medium and coarse pumice lapilli with medium and coarse lithic lapilli and fine sandy loam textured ash matrix 20 mm Greasy sandy loam textured ash base
?Tangatu Formation	unnamed	580	13.360	Grey andesitic diamictons; weakly bedded pebbly sands
Rerewhakaaitu Tephra		30	13.390	White fine ash; discontinuous, preserved in lenses and interbedded within andesitic diamictons
***	***	300+	13.690	?Moraine and fluvial deposits

Section Name: unnamed section

Grid Reference: T20/406918

Locality: A dune-shaped exposure on the eastern side of the Desert Road, approx. 0.6 km north of Waiouru and 100 m north of Helwan S.2

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Papakai Formation			0.000	Disturbed tephra cover, over Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash; with interspersed fine lapilli and dark brown coated root channels; sharp erosional basal contact
Tangatu Formation	unnamed	380	0.380	Grey sand and granules, grading downwards to sand and granules and common medium (10 mm) andesitic pebbles; erosional upper contact; dune-shaped deposit; hyperconcentrated flood flow deposit
Bullot Formation (upper)	Ngamatea lapilli-1	40	0.420	Strong brown fine pumice and lithic lapilli; ungraded, wedging tephra layer
Tangatu Formation	unnamed	770	1.190	490 mm Yellowish grey coarse sand and granules, and common brownish yellow (10YR6/6) and reddish yellow (7.5YR6/6) fine pumice pebbles and grey andesitic pebbles; prominent unit; with iron-stained veins cutting across surface 280 mm Finer grained weakly bedded base, comprising yellowish grey medium sand and granules (pumiceous and lithic sand), with pebble dominant and sand dominant beds; fine pumice and andesitic pebbles; prominent unit; hyperconcentrated flood flow deposit
		310	1.500	Coarse sand and granules, and many pale yellow (2.5Y7/4) medium and coarse pumice pebbles, rounded, and occasional andesitic clasts; maximum clast 90 mm (cobble); reversely graded deposit, with coarser clasts concentrated toward top; deposit is offset by a small fault; debris flow deposit
		40	1.540	Pale grey poorly sorted dominantly coarse sand and granules
		390	1.930	Yellowish grey coarse lithic and pumiceous sand and granules, and fine to very coarse andesitic pebbles concentrated in centre of deposit; finer grained top and base comprising granules, sand and fine pebbles; debris flow deposit
		80	2.010	Pale grey sand, granules and fine to medium (15 mm) andesitic pebbles; ungraded; sharp contacts
		650	2.660	Dominantly medium sand and granule matrix, poorly sorted; with matrix-supported red and grey dominantly medium andesitic pebbles, and scoria, and some very coarse pebbles and cobbles (>90 mm); few pumice pebbles; reversely graded clasts, coarsening upwards; subangular clasts ; debris flow deposit, on Obscured lahar deposits

Section Name: unnamed section

Grid Reference: T20/441049

Locality: Cutting on the western river bank of Whangaehu River, approx. 400 m south of The Chute

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Thin veneer of Onetapu Formation sands and gravels
Taupo Pumice	Taupo Ignimbrite	920	0.920	Pink poorly sorted ash and fine lapilli, with a 10 mm thick coarse crystal-rich deposit immediately underlying the ignimbrite
Mangatawai Tephra		250	1.170	120 mm Dark yellowish brown (10YR4/4) medium sandy clay loam textured ash; with imogolite-coated root channels; paleosol 130 mm Bedded black and purplish black fine sandy ash; discontinuous beds, interbedded with dark greyish brown (10YR4/2) fine sandy loam textured ash
Papakai Formation		110	1.280	Yellowish brown (10YR5/6) fine sandy clay loam textured ash, very greasy; with many root channels; paleosol
Waimihia Tephra		10	1.290	Pale brown fine ash 'cream cakes', with intermixed brown fine andesitic ash
Papakai Formation		80	1.370	Yellowish brown (10YR5/6 – 5/8) medium sandy clay loam textured ash, greasy; with distinct strong brown coated root channels
***	***	120	1.490	Yellowish brown (10YR5/6 – 5/8) medium sandy clay loam textured medial unit, with common fine andesitic and hydrothermally altered pebbles; with distinct iron-stained root channels
Mangaio Formation		1400	2.890	500 mm Upper unit: strong brown and purplish grey sandy clay textured matrix, sticky; with matrix-supported dominantly very coarse andesitic and soft, hydrothermally altered pebbles, and fewer medium pebbles; scoured, erosional upper contact; finer clast sizes than underlying units 550 mm Middle unit: strong brown and grey gleyed medium sandy clay textured matrix, sticky; with matrix-supported dominantly grey andesitic cobbles, and many granules to coarse andesitic and hydrothermally altered pebbles, with yellowish red (5YR4/6) and dark brown (7.5YR4/4) iron-stained pebble faces; subangular and subrounded clasts 350 mm Lower unit: purplish grey coarse sandy clay loam textured matrix, distinctive colouring; with matrix-supported grey, purplish red, red and black andesitic granules to cobbles, and orange-white hydrothermally altered granules to cobbles; dominant clast is coarse pebble; maximum clast 100 mm (cobble); sharp basal contact
***	***	110	3.000	Strong brown very fine and fine pumice lapilll, with pale yellow interiors, soft, and grey very fine lithic lapilli; with a dark brown (7.5YR4/2) sandy clay loam textured ash matrix, greasy
***	***	90	3.090	Strong brown (7.5YR5/6) sandy clay loam textured medial unit, with many fine pumice and lithic pebbles and granules; soft pumice
Papakai Formation & Motutere Tephra		280	3.370	Purplish grey and greyish brown (2.5Y5/2) sandy clay loam textured ash, sticky, with distinct surface cracking and strong brown coated root channels; with interbedded pale pinkish brown fine and coarse pumiceous ash 'cream cakes' at half depth
***	***	70	3.440	Purplish grey and greyish brown sand clay-loam textured medial-unit, with common medium andesitic pebbles

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	480	3.920	Pale grey very coarse sand and granule matrix, poorly sorted; with matrix-supported andesitic pebbles to boulders; dominant clast size 15 mm (medium pebble), maximum clast 220 mm (cobble); reversely graded from dominantly medium pebble base to coarse pebble top with cobbles; semi-lithified, prominent unit; iron-stained upper contact; debris flow deposit
		20	3.940	Black medium sandy ash; sharp contacts
		20	3.960	Greyish brown medium loamy sand
		40	4.000	Yellowish red (5YR4/6) fine pumice lapilli, with pale yellow interiors, and lithic lapilli; ungraded; discontinuous unit
		30	4.030	Olive medium sand, well sorted
***	***	30	4.060	Greyish brown, gleyed, sandy clay loam textured medial unit, sticky; with many lithic and pumice granules and fine pebbles
***	***	40	4.100	Dark yellowish brown (10YR4/4) sandy clay loam textured medial unit; with fine yellow pumice and grey andesitic pebbles and granules
Bullot Formation (upper)	Ngamatea lapilli-1	60	4.160	Iron-stained, dominantly fine and very fine pumice lapilli, and lithic lapilli; soft pumice with pale yellow pumice interiors; loose lapilli
	unnamed	80	4.240	Yellowish grey coarse sandy ash and very fine lapilli
		40	4.280	Grey coarse ash and very fine lapilli
***	***	80	4.360	Yellowish brown (10YR5/6) coarse sandy loam textured medial unit, with many very fine pumice lapilli and grey lithic lapilli
***	***	50	4.410	Yellowish brown (10YR5/6 – 5/8) coarse sandy clay loam textured paleosol; with common root channels
	unnamed	80	4.490	Olive fine and medium pumice lapilli, with pale yellow and grey interiors, and fewer grey, purplish red, red and black lithic lapilli; distinct contacts
***	***	90	4.580	Yellowish brown (10YR5/4) fine sandy loam textured medial unit; cracked exterior, with distinct brown coated root channels; with common fine pumice and lithic lapilli
Tangatu Formation	unnamed	340+	4.920	Grey very coarse sand, and dominantly fine, dark grey, grey, red, purplish red and black andesitic pebbles, and occasional hydrothermally altered pebbles; subangular and angular clasts; maximum clast 40 mm (very coarse pebble); slight normal grading; ?hyperconcentrated flood flow deposit

Section Name: unnamed section

Grid Reference: T20/386898

Locality: A cutting on the southern side of State Highway 49

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Taupo Pumice	Taupo Ignimbrite	300	0.300	Greyish white ash and fine pumice lapilli; distinct smooth contacts
Papakai Formation		360	0.660	Yellowish brown sandy loam textured ash; cracked exterior; some brown coated root channels; paleosol
		100	0.760	Dark yellowish brown sandy loam textured ash, with scattered pale yellow pumice lapilli and some grey lithic lapilli
Bullot Formation (upper)	Ngamatea lapilli-2	120	0.880	Yellowish brown dominantly fine pumice lapilli, with few medium lapilli at top and base of unit; with some sandy loam textured ash matrix
		40	0.920	Fine sandy loam textured ash
	Ngamatea lapilli-1	100	1.020	Strong brown (7.5YR5/8) dominantly fine pumice lapilli, and some black fine lithic lapilli; more lithic lapilli and finer overall lapilli grade to member Ngamatea lapilli-2; loose lapilli with a gravelly texture; weakly bedded; distinct contacts
	unnamed	130	1.150	Pale yellow fine and medium pumice lapilli, and dark grey lithic lapilli; with a sandy clay loam textured ash matrix; distinctive tephra layer
***	***	100	1.250	Yellowish brown sandy clay-loam textured medial unit, slightly greasy; with many scattered fine pumice and lithic lapilli
	unnamed	90	1.340	Dominantly fine pumice, and lithic lapilli; indistinct lapilli, interbedded within yellowish brown sandy clay loam
***	***	420	1.760	Brown fine sandy loam textured medial unit; with common fine pumice and lithic lapilli, and root channels
Tertiary sediments		220+	1.980	Yellowish brown shell beds and sands; over bluish grey firm sand

Section Name: unnamed section

Grid Reference: T20/397957

Locality: A cutting in a low terrace at the base of the Whangaehu escarpment, proximal to Whangaehu River, and approx. 100 m south of a flood gauge on Whangaehu River

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		380	0.380	Brown fine to medium sandy loam textured unit, with indistinct pocketing coarse ash lenses; indistinct lower boundary.
		170	0.550	Yellowish brown fine sandy loam textured unit, with scattered very fine to fine reworked Taupo Pumice lapilli.
Taupo Pumice	Taupo Ignimbrite	270	0.820	White poorly sorted coarse ash and pumice lapilli. A 30 mm very coarse crystal-rich unit directly underlies the ignimbrite; sharp irregular contacts
?Mangatawai Tephra & Papakai Formation		600	1.420	130 mm Dark brown fine sandy clay loam textured ash, greasy; indistinct lower contact; paleosol 470 mm Brown fine sandy clay loam textured ash, greasy; with common scattered fine andesitic pumice lapilli and bluish grey very fine to fine soft lithic lapilli; many dark coated root channels; distinct basal contact; paleosol
Bullot Formation (upper)	?Ngamatea lapilli-2	70	1.490	Strong brown fine and medium pumice lapilli, slightly soft, and few lithic lapilli; with a greasy fine sandy loam textured matrix
***	***	110	1.600	Brown medium to fine sandy loam textured ash, greasy, with common scattered strong brown very fine and fine pumice lapilli, soft; with reddish brown coated root channels; paleosol
	?Ngamatea lapilli-1	70	1.670	Yellowish red and strong brown fine with few medium pumice lapilli, soft; loose gravelly texture
***	***	70	1.740	Brown medium to fine sandy loam textured ash, greasy, with scattered fine pumice lapilli
	unnamed	150	1.890	Yellowish red fine and few medium pumice lapilli, with grey interiors, and fine to very fine lithic lapilli; angular lapilli; ungraded unit; irregular basal contact
Tangatu Formation	unnamed	550	2.440	Greyish brown to grey coarse sand and granules, with common grey and some red very coarse to fine pebbles, and many scattered yellowish brown and pale yellow fine and medium pumice pebbles
		200	2.640	Pale brown coarse sand and granules, with common yellowish brown fine and medium pumice pebbles and andesitic pebbles; fewer clasts than overlying unit; hyperconcentrated flood flow deposit
		30	2.670	Black coarse sand and very fine-fine lithics; gravelly texture
***	***	20	2.690	Pale brown coarse sandy loam textured medial unit with scattered grey and pale yellow medium, and some coarse pumice lapilli; hard, blocky pumice
	unnamed	1000+	3.690	Bedded pale grey coarse to very coarse sand with many medium, and few coarse andesitic pebbles and cobbles and grey coarse pumice pebbles; some inversely graded beds; distinct contacts; hyperconcentrated flood flow deposits

Section Name and Map Code: Upper Seagull Gully [USG]

Grid Reference: T20/401048

Locality: An exposure at the northern end of Upper Seagull Gully, where the gully forks, and approx. 500 m south of a large beech stand

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation			0.000	Grey laharic sands and gravels overlying Taupo Pumice
Taupo Pumice	Taupo Ignimbrite	490	0.490	Grey (5Y6/1) ash and fine lapilli; with charcoalised logs; distinct, sharp contacts
***	***	60	0.550	Dark brown (10YR3/3) peaty clay loam, very greasy; sharp contacts
***	***	130	0.680	Weakly bedded sand and dominantly medium brown pumice, and black, grey and red andesitic pebbles; distinctly rounded pebbles; some sandy loam textured matrix; fluvial deposit
***	***	90	0.770	Yellowish brown (10YR5/6) fine sandy loam textured unit, with interbedded grey fine sand laminae
***	***	120	0.890	Weakly bedded grey sands, brown medium pumice, and andesitic pebbles, and brown fine sandy clay loam textured beds with interbedded grey fine sand laminae; lenses of cross bedded sands; distinctly rounded pumice pebbles, and rounded and angular andesitic pebbles; fluvial deposit
***	***	130	1.020	Weakly bedded black coarse and very coarse sand and beds of dominantly medium pumice and andesitic pebbles; rounded pebbles; fluvial deposit
***	***	240	1.260	Alternately bedded grey fine and medium sands, dark yellowish brown (10YR4/4) very fine greasy sandy clay loam textured beds, with yellowish red (5YR5/8) coated root channels, and pebble dominant beds comprising rounded pumice and andesitic pebbles
Mangatawai Tephra		240	1.500	110 mm Dark greyish brown (10YR4/2) medium sandy clay textured ash, greasy, with iron-stained root channels; paleosol 130 mm Bedded very dark grey ash, and greyish brown loamy sand textured ash beds; discontinuous beds; sharp contacts
Papakai Formation		130	1.630	Yellowish brown (10YR5/6) fine sandy loam textured ash; with many brown coated root channels; paleosol
Waimihia Tephra		20	1.650	Pale brown very fine ash 'cream cakes', with intermixed brown andesitic ash
Papakai Formation		210	1.860	Yellowish brown (10YR5/6) fine sandy loam textured ash, with brown coated root channels; paleosol
Hinemaiaia Tephra		40	1.900	White and yellow coarse pumiceous ash, interspersed in yellowish brown Papakai Formation
Papakai Formation		80	1.980	Yellowish brown fine sandy loam textured ash, with scattered brown fine pumice lapilli; indistinct basal contact
	orange lapilli-2	40	2.020	Strong brown (7.5YR5/8) fine and few medium pumice lapilli and coarse ash, and grey lithic lapilli; with some sandy clay loam textured ash matrix
		40	2.060	Medium sandy loam textured ash with brown coated root channels and scattered fine pumice and lithic lapilli; indistinct contacts
	orange lapilli-1	50	2.110	Strong brown (7.5YR5/8) dominantly fine pumice lapilli and grey lithic lapilli, with some coarse ash
***	***	60	2.170	Grey coarse to very coarse sand with pumice and lithic granules, firm; irregular contacts
		180	2.350	Yellowish brown fine sandy loam textured ash, with many black coated root channels, and occasional brown very fine pumice lapilli
Motutere Tephra		20	2.370	Pinkish brown fine and coarse ash 'cream cakes', with scattered white very fine pumice fragments

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Papakai Formation		90	2.460	Yellowish brown fine sandy loam textured ash, with black coated root channels
Tangatu Formation	unnamed	50	2.510	Weakly bedded brown, dominantly coarse pumice pebbles, rounded, and andesitic pebbles, with pockets of grey firm sands
		90	2.600	Grey (2.5Y6/0) lithified coarse sands
		250	2.850	Weakly bedded unit, comprising medium and coarse rounded pumice and andesitic pebbles and grey sands
	unnamed	290	3.140	Alternately bedded olive (5Y5/3) fine sand beds, and yellowish brown (10YR5/6) sandy loam to sandy clay loam textured beds with cracked exteriors and black and reddish brown coated root channels; sharp basal contact
		1150	4.290	Pale grey coarse sand and granule matrix, with matrix-supported andesitic pebbles and cobbles; ungraded; debris flow deposit
Bullot Formation (upper)	unnamed	2450	6.740	Undescribed lapilli and ash beds above member L17
	member L17	150	6.890	Strong brown (7.5YR5/6) dominantly fine pumice lapilli, and very dark grey (7.5YR3/0) lithic lapilli; dry pumice colours range between brownish yellow (10YR6/6) and yellow (10YR7/6); with loamy textured ash matrix, and a distinctive dark grey (5Y4/1) fine sandy ash at base; sharp basal contact
	unnamed	20	6.910	Coarse ash and very fine lithic and pumice lapilli
	member L16	110	7.020	Yellowish red (5YR4/6) dominantly fine pumice lapilli, and grey lithic lapilli; subangular lapilli; some loamy textured ash matrix; very similar appearance to member L17; distinct basal contact
Waiohau Tephra		30	7.050	White very fine ash, pocketing, with irregular contacts
Bullot Formation (upper)	unnamed	10	7.050	Purplish black fine sandy ash
Tangatu Formation	unnamed	460	7.510	Pale greyish brown coarse sand and granule matrix, poorly sorted, with matrix-supported, dominantly medium andesitic pebbles and fewer pumice pebbles, common cobbles and some boulders; maximum clast 700 mm (boulder); reversely graded deposit, with clast sizes fining towards base of unit; debris flow deposit
		520	8.030	Bedded unit comprising sand dominant beds and thin pebble dominant beds; base of unit is more massive, with lenses of clast-supported rounded pale yellow pumice pebbles, and occasional grey medium andesitic pebbles; sharp contacts; hyperconcentrated flood flow deposit
		10	8.040	Grey coarse sandy ash
		20	8.060	Greyish brown fine sand with scattered yellow fine and few medium pumice and lithic lapilli
		30	8.090	Grey lithic granules and fine pebbles, with loamy sand matrix
***	***	40	8.130	Yellowish brown (10YR5/6) sandy clay loam textured medial unit, greasy; with scattered brown very fine pumice, and lithic lapilli
	unnamed	80	8.210	Weakly bedded sand, medium pumice pebbles and coarse andesitic pebbles and cobbles; on yellowish brown coarse sandy loam

Section Name and Map Code: Wahianoa Aqueduct [WA]

Grid Reference: T20/435990

Locality: A large cutting on the east side of the Desert Road, approx. 100 m north of the Wahianoa Aqueduct Lookout

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation		240	0.240	Fine greyish brown sandy loam textured unit
Tufa Trig Formation	member Tf8	20	0.260	Grey pocketing coarse ash with very fine greyish brown pumice lapilli at base
Ngauruhoe Formation		30	0.290	Greyish brown fine sandy loam textured unit
Tufa Trig Formation	member Tf6	10	0.300	Dark grey pocketing coarse ash
Ngauruhoe Formation		20	0.320	Greyish brown fine sandy loam textured unit
Tufa Trig Formation	member Tf5	50	0.370	Black coarse ash and very fine lithic lapilli; distinctive tephra
Ngauruhoe Formation		110	0.480	Brownish grey fine sandy loam textured unit, with scattered very fine lapilli
Tufa Trig Formation	?member Tf2	40	0.520	Very dark greyish brown (2.5Y3/2) medium and fine pumice and scoriaceous lapilli, and black lithic lapilli
***	***	140	0.660	Very dark greyish brown (10YR3/2) fine sandy loam textured unit, with moderately developed fine nut structure and dark brown coated root channels; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	120	0.780	White poorly sorted coarse ash and lapilli
Mangatawai Tephra & Papakai Formation		420	1.200	Dark greyish brown (10YR4/2) fine sandy loam textured ash, with few indistinct pocketing beds of dark grey coarse ash; with scattered very fine lapilli
Waimihia Tephra		10	1.210	Pale brown to white fine ash 'cream cakes'
Papakai Formation		110	1.320	Dark yellowish brown (10YR4/4) fine sandy loam textured ash; with scattered fine lapilli; common root channels; paleosol
	unnamed	110	1.430	Very pale brown (10YR7/4) fine and few medium pumice lapilli, with yellowish brown (10YR5/6) interiors, and some grey (2.5Y5/0) coarse lithic lapilli; interbedded within Papakai Formation; discontinuous lobate tephra
		260	1.690	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, slightly greasy, with dark coated root channels, and abundant grey (2.5Y5/0) to bluish grey fine, soft lithic lapilli dispersed through ash
Mangamate Tephra	Poutu Lapilli	110	1.800	Yellow (10YR7/6) and dark brown (7.5YR4/4) iron-stained pumice lapilli fine and very fine pumice lapilli, with dark greyish brown (2.5Y4/2) interiors; angular, soft, loose lapilli
***	***	70	1.870	Olive brown (2.5Y4/4) medium sandy loam textured ash, with scattered fine lapilli
?Mangamate Tephra	?Wharepu Tephra	190	2.060	Variable thickness; grey (2.5Y5/0) very coarse ash, firm, weakly bedded; prominent; with dark grey ash interbeds
Bullot Formation (upper)	unnamed	40	2.100	Dark olive grey (5Y3/2) and strong brown coarse ash
		60	2.160	Medium sandy loam textured ash
		50	2.210	Dark olive grey (5Y3/2) and dark yellowish brown (10YR4/4) pocketing coarse ash, firm; prominent tephra
		30	2.240	Medium sandy loam textured ash; with root channels and scattered fine pumice and lithic lapilli
	?Ngamatea lapilli-2	40	2.280	Dark yellowish brown (10YR4/4) medium and fine pumice lapilli, with light grey (2.5Y7/2) interiors, and grey (2.5Y5/0) lithic lapilli; angular, soft pumice
	unnamed	70	2.350	Coarse granule-rich sandy loam textured ash, and scattered yellow fine pumice lapilli; distinct lower contact

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	Ngamatea lapilli-1	60	2.410	Strong brown (7.5YR5/6) fine and few medium pumice lapilli, with pale yellow (2.5Y8/4) interiors, soft; with a black coarse lithic ash and crystal matrix; loose, gravelly texture
***	***	80	2.490	Medium sandy loam textured medial unit; with fine pumice and lithic lapilli
	unnamed	100	2.590	Dark yellowish brown (10YR4/4) and light olive brown (2.5Y5/4) fine pumice lapilli, vesicular, soft, phenocryst-rich; with a 10 mm fine grey ash base
***	***	90	2.680	Fine sandy loam textured medial unit, greasy; with distinct coated root channels, and scattered fine lapilli; discontinuous unit
***	***	130	2.810	Grey coarse sandy loam textured medial unit; with root channels, and scattered fine pumice and lithic lapilli; sharp lower contact
	unnamed	20	2.830	Fine lithic and pumice lapilli
***	***	40	2.870	Dark greyish brown (2.5Y4/2) very coarse sand, semi-lithified, gravelly texture
***	***	70	2.940	Dark yellowish brown (10YR4/4) sandy loam textured ash and scattered fine pumice and lithic lapilli; discontinuous unit; paleosol
	unnamed	130	3.070	Yellowish brown (10YR5/6) fine and medium pumice lapilli, with pale yellow (2.5Y7/4) interiors, and grey (2.5Y5/0) lithic lapilli; with sandy loam textured ash matrix; ungraded tephra
***	***	160	3.230	Sandy clay loam textured medial unit, showing paleosol development; with yellowish brown (10YR5/6) fine pumice lapilli, with grey (2.5Y6/0) interiors, soft, and grey lithic lapilli; with many iron-stained root channels
	unnamed	40	3.270	Light olive brown (2.5Y5/4) fine and medium pumice lapilli, with pale yellow (2.5Y7/4) interiors, soft, and grey lithic lapilli, soft; ungraded tephra
		10	3.280	Grey fine ash and light olive brown scattered pumice lapilli
		30	3.310	Pale yellow fine and very fine pumice lapilli and black and red lithic lapilli; loose, ungraded tephra; discontinuous unit
***	***	100	3.410	Sandy clay loam to sandy loam textured medial unit, showing paleosol development, greasy; with scattered fine pumice and lithic lapilli, and dark brown coated root channels
	unnamed	180	3.590	Yellowish brown (10YR5/6) fine and few medium pumice lapilli, with pale yellow (2.5Y8/4) interiors, firm and soft lapilli, and fine lithic lapilli; ungraded tephra
***	***	120	3.710	Dark brown (7.5YR4/4) and grey (2.5Y5/0) mottled sandy clay loam textured medial unit, showing paleosol development, greasy; with many scattered very fine and some fine pumice and lithic lapilli, and dark brown coated root channels
	?Pourahu Member [tephra unit]	90	3.800	Pale pinkish brown and white (2.5Y8/2), and some light yellowish brown (10YR6/4) fine and few medium pumice lapilli, with very pale brown (10YR7/4) interiors; moderately soft pumice; with some greasy sandy clay loam textured ash matrix; ungraded tephra
***	***	130	3.930	Olive grey (5Y5/2) to grey (5Y5/1) sandy clay loam textured medial unit, showing paleosol development, greasy; with scattered very fine yellow pumice lapilli, and dark brown coated and iron-stained root channels
	unnamed	190	4.120	Brownish yellow (10YR6/6) and light olive brown (2.5Y7/4) fine and medium pumice lapilli, with fewer pale olive (5Y6/3) and dark grey (5Y4/1) lithic lapilli, and sandy loam textured ash matrix; ungraded tephra
***	***	40	4.160	Fine sandy clay loam textured medial unit, very greasy, with distinct dark coated root channels

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
Bullot Formation (upper)	Shawcroft Tephra	140	4.300	Very dark grey (5Y3/1) fine and very fine lithic lapilli, and fewer strong brown (7.5YR5/6) and brownish yellow (10YR6/6) fine and very fine pumice lapilli, with pale yellow (2.5Y7/4 – 8/4) interiors; with a 20 – 30 mm pumice dominant base; soft pumice
***	***	80	4.380	Light olive brown (2.5Y5/4) sandy loam textured medial unit, showing paleosol development, very greasy, with dark brown coated root channels; wavy lower boundary
Waiohau Tephra		30	4.410	White (5Y8/2) fine ash; pocketing; distinctive tephra
Bullot Formation (upper)	unnamed	20	4.430	Greyish brown coarse sandy ash
		80	4.510	Black (2.5Y2/0) to purplish black very coarse ash and very fine lithic lapilli; distinctive tephra
***	***	50	4.560	Medium sandy loam textured ash, greasy, with dark coated root channels
	unnamed	20	4.580	Purplish coarse ash; pocketing
		10	4.590	Brown sandy loam textured ash
		50	4.640	20 mm Sandy loam textured medial unit, showing paleosol development, very greasy, with distinct brown coated root channels 30 mm Greasy sandy loam textured medial unit with scattered yellow, soft medium pumice lapilli
		10	4.650	Black (2.5Y2/0) to purplish black coarse ash; pocketing
***	***	60	4.710	Strong brown (7.5YR5/8) iron-stained sandy loam textured medial unit, showing paleosol development, very greasy, with dark brown coated root channels
	unnamed	60	4.770	Light yellowish brown fine and fewer medium pumice lapilli, and dark grey (2.5Y4/0) lithic lapilli, soft, in greasy sandy loam textured ash
***	***	200	4.970	Dark greyish brown (2.5Y4/2) medium sandy loam textured medial unit, showing paleosol development, very greasy, with distinct dark coated root channels
	unnamed	90	5.060	Fine and very fine pumice and lithic lapilli; ungraded tephra
		90	5.150	Greyish brown coarse ash and scattered fine lapilli
		30	5.180	Black (2.5Y4/0) medium ash
		40	5.220	Pale yellow fine pumice lapilli and coarse ash; ungraded tephra
		190	5.410	Dark greyish brown (2.5Y4/2) loamy coarse ash
***	***	90	5.500	Grey (5Y5/1) coarse sandy loam textured medial unit, showing paleosol development, very greasy; with scattered fine pumice and lithic lapilli, and dark brown (7.5YR4/4) iron-stained root channels
	unnamed	30	5.530	Greyish brown (2.5Y5/2) fine pumice lapilli, and black and olive lithic lapilli; loose, gravelly texture
		60	5.590	Purplish black coarse loamy ash and scattered very fine lapilli
		60	5.650	Greyish brown (2.5Y5/2) fine and few medium pumice lapilli and fine black and red lithic lapilli; ungraded tephra
		20	5.670	Brownish grey coarse loamy ash
		20	5.690	Black (2.5Y2/0) to purplish black coarse ash
		40	5.730	Greyish brown coarse loamy ash
		70	5.800	Light brownish grey (10YR6/2) to pinkish brown fine pumice lapilli, with light grey (5Y7/2) interiors, and some coarse loamy ash matrix; ungraded tephra
		30	5.830	Purplish grey coarse loamy textured pumiceous ash
***	***	90	5.920	Fine sandy loam textured medial unit, showing paleosol development, very greasy, with distinct dark coated root channels
	unnamed	110	6.030	Very pale brown (10YR7/4) to pinkish brown medium and few coarse pumice lapilli, with light brownish grey (2.5Y6/2) interiors, and few lithic lapilli; very vesicular, soft, angular pumice lapilli; discontinuous tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Rerewhakaaitu Tephra		500	6.530	Pale brownish grey sandy loam textured medial unit, slightly greasy, with distinct dark coated root channels; with a white fine rhyolitic ash interbedded at base, pocketing (Rerewhakaaitu Tephra) on 20 mm black coarse ash. Boulders from lower debris flow deposit protrude into the base of this unit
Te Heuheu Formation	unnamed	1000	7.530	Yellowish brown fine sand dominant and granule matrix, with many matrix-supported coarse andesitic pebbles and cobbles, and few boulders; dominant clast size 150 mm (cobble), maximum clast 1 m (boulder); subrounded and rounded clasts with iron-stained faces; clasts concentrated toward top of unit, otherwise unit is ungraded; wavy, distinct basal contact; debris flow deposit
		550	8.080	Brown coarse sand dominant, and granule matrix, poorly sorted, indurated; with many matrix-supported strong brown fine and medium pumice pebbles, and distinctly fewer black, red, and grey coarse to fine andesitic pebbles and cobbles; no boulders; basal 40 mm dominantly granules and fewer pebbles; Basal contact marked by a distinctive 30 mm thick strong brown iron pan; debris flow deposit
***	***	10	8.090	Purplish grey greasy clay
		120	8.210	Sandy clay matrix, greasy, with brown coated root channels, and abundant yellow and brown fine to medium pumice pebbles, and black, purple, and grey andesitic pebbles; deposit pinches out; hyperconcentrated flood flow deposit
		540	8.750	Medium sand and granule matrix, indurated; with pockets of matrix to clast-supported pebbles and few scattered grey, purplish grey and red very coarse pebbles; with cross cutting iron oxide veins; debris flow deposit
		780+	9.530	Grey coarse sand (dominant) and granule matrix, loose; with many matrix-supported black and fewer red dominantly medium and coarse andesitic pebbles and scattered boulders (800+ mm); angular to subrounded clasts; upper 200 mm dominantly fine pebbles without boulders; debris flow deposit

Section Name and Map Code: Wahianoa River Section 1 [WRS1]

Grid Reference: T20/369027

Locality: River bank exposure on the eastern side of Wahianoa River, below a large hill at the northern end of Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		300	0.300	Brownish grey sand with interbedded uncorrelated Tufa Trig Formation tephras
Tufa Trig Formation	unnamed	30	0.330	Dark grey coarse ash with a fine grey ash base; pocketing
Makahikatoa Sands		70	0.400	Brownish grey medium to coarse sand, weakly bedded, with many scattered fine reworked Taupo Pumice lapilli
Tufa Trig Formation	member Tf5	95	0.495	90 mm Very dark grey coarse ash and fine lapilli; reversely graded unit from a coarse ash base to dominantly very fine lapilli top; with a 5 mm pale grey ash base
Makahikatoa Sands		80	0.575	Purplish grey medium sand with iron-stained laminae at top of unit
Tufa Trig Formation	member Tf4	20	0.595	Black and strong brown coarse ash
***	***	50	0.645	40 mm Purplish grey medium sandy loam textured unit, very greasy; sharp contacts 10 mm White clay, sticky; sharp contacts; fluvial sediments
Onetapu Formation	unnamed	250	0.895	Granule-rich grey (2.5Y5/0) to bluish grey, gleyed, coarse sandy loam to sandy clay loam textured matrix, with strong brown (7.5YR5/6) mottles and coated root channels; with matrix-supported fine and common medium andesitic and hydrothermally altered pebbles and few cobbles; angular clasts; ungraded unit with sharp contacts; debris flow deposit
***	***	130	1.025	Very dark brown (10YR2/2) to dark purplish grey peaty sandy loam, greasy, with twigs and wood fragments
	unnamed	930	1.955	10 mm Yellowish red (5YR4/6) iron-stained top; sharp boundaries 920 mm Coarse loamy sand and granule matrix, poorly sorted; with matrix-supported purplish red, red, black and grey dominantly coarse pebbles, with many fine, very coarse pebbles and cobbles, and few boulders; distinctive porphyritic andesitic pebbles, and scattered medium pumice lapilli; sub angular and subrounded clasts; ungraded unit; debris flow deposit
***	***	80	2.035	Dark greyish brown (10YR4/2) medium sandy loam textured unit, slightly greasy; with many scattered fine reworked Taupo Pumice lapilli; distinctive yellowish red iron-stained contacts; paleosol
Taupo Pumice	Taupo Ignimbrite	560	2.595	Pale grey poorly sorted ash and lapilli, with charcoalised branches; sharp smooth contacts
?Mangatawai Tephra		70	2.665	Dark purplish grey fine sandy clay loam textured ash, very greasy and sticky; with strong brown mottles and imogolite-lined root channels; paleosol
?Tangatu Formation	unnamed	470	3.135	Yellowish brown (10YR5/6) and grey (2.5Y5/0) coarse sandy loam and granule matrix; with matrix-supported dominantly coarse, and fine andesitic pebbles, and cobbles; some hydrothermally altered pebbles, soft; angular and subrounded clasts; ungraded unit; distinct contacts; debris flow deposit
		50	3.185	Dark brown (7.5YR4/4) fine sandy loam textured unit
		110	3.295	Yellowish grey very fine sandy loam textured unit, well sorted
		130	3.425	Yellowish brown fine sandy loam textured unit with scattered white fine hydrothermally altered pebbles at upper contact
		110	3.535	Black bedded fine to coarse sands, well sorted and semi-lithified; sharp smooth contacts; fluvial deposit

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
?Tangatu Formation	unnamed	80	3.615	Grey medium loamy sand textured unit, well sorted sands; levee deposit, on clast-supported boulders at stream level

Section Name and Map Code: Wahianoa River Section 2 [WRS2]

Grid Reference: T20/371016

Locality: River bank exposure on the western side of Wahianoa River

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		280	0.280	Dark yellowish brown (10YR4/4) medium loamy sand-sandy loam textured unit with indistinct pocketing Tufa Trig Formation tephras
***	white ash	15	0.295	White fine ash 'cream cakes'
Makahikatoa Sands		50	0.345	Brown fine sandy loam textured unit
Tufa Trig Formation	member TfB	30	0.375	20 mm Dark grey coarse ash 5 mm Pale yellow very fine pumice lapilli 5 mm Dark grey coarse ash
Makahikatoa Sands		30	0.405	Yellowish brown very fine sandy loam textured unit
Tufa Trig Formation	unnamed	10	0.415	Dark grey coarse ash; pocketing
Makahikatoa Sands		25	0.440	10 mm Pale brown very fine sand 15 mm Greyish brown fine loamy sand; distinct contacts
Tufa Trig Formation	member Tf6	20	0.460	15 mm Black coarse ash with 5 mm pale grey fine ash base
Makahikatoa Sands		40	0.500	Dark yellowish brown (10YR4/4) fine sandy loam textured unit; sharp distinct contacts
Tufa Trig Formation	member Tf5	90	0.590	80 mm Dark grey bedded coarse ash and fine lapilli, with a 10 mm grey fine ash base
Makahikatoa Sands		40	0.630	Dark yellowish brown (10YR4/4) fine to very fine sandy loam textured unit with root channels; paleosol
Tufa Trig Formation	member Tf4	10	0.640	Dark grey coarse ash, pocketing
Makahikatoa Sands		60	0.700	Dark yellowish brown (10YR4/4) fine to very fine sandy loam textured unit, with crumb structure, and root channels; sharp distinct basal contact; paleosol
Onetapu Formation	unnamed	700	1.400	Grey coarse loamy sand and granule matrix, poorly sorted; with matrix-supported heterolithologic dominantly medium and coarse black, and fewer grey and red andesitlc pebbles, many cobbles, and scattered boulders; subrounded and angular clasts; some scattered reworked Taupo Pumice lapilli; ungraded unit; sharp wavy basal contact; debris flow deposit
***	***	80	1.480	Greyish brown medium sandy loam textured ash with scattered fine reworked Taupo Pumice lapilli; strong brown (7.5YR5/8) iron-stained contacts
Taupo Pumice	Taupo Ignimbrite	600	2.080	Pale grey to white poorly sorted ash and lapilli; with charcoalised branches and twigs; erosional (scoured) upper, and sharp wavy basal contact
Mangatawai Tephra		450	2.530	90 mm Dark yellowish brown (10YR4/4) fine sandy clay loam textured ash with brown coated root channels 220 mm Yellowish brown (10YR5/6) fine sandy loam textured ash; with two discontinuous lapilli beds comprising yellowish brown fine and medium pumice lapilli and grey lithic lapilli 140 mm Black and very grey coarse ash beds; discontinuous beds with distinct contacts
Papakai Formation		70	2.600	Yellowish brown (10YR5/6) very fine sandy loam; friable; paleosol
Waimihia Tephra		30	2.630	Very pale brown fine ash 'cream cakes' with intermixed brown very fine andesitic ash; firm
Papakai Formation		470	3.100	Brownish yellow (10YR6/6) very fine sandy loam textured ash; friable; paleosol
	black ash-2	15	3.115	Black coarse ash, pocketing
		100	3.215	Yellowish brown (10YR5/6) fine sandy loam textured ash, with brown coated root channels; friable; paleosol

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
	unnamed	40	3.255	Strong brown (7.5YR5/6) fine and very fine pumice lapilli and grey lithic lapilli; soft pumice; with some fine sandy loam textured ash matrix
Papakai Formation		30	3.285	Yellowish brown (10YR5/6) fine sandy loam textured ash, with brown coated root channels; paleosol
	black ash-1	20	3.305	Dark grey coarse ash, firm, pocketing
Papakai Formation & Hinemaiaia Tephra		140	3.445	Brownish yellow (10YR6/6) fine sandy loam textured ash, greasy, with cracked surface, and brown coated root channels; with yellow coarse pumiceous rhyolitic ash dispersed throughout; wavy distinct lower contact
?Tangatu Formation	unnamed	1200	4.645	Brownish yellow (10YR6/6) fine sandy loam to sandy clay loam textured matrix, with root channels, and matrix-supported heterolithologic andesitic boulders (maximum clast 1.10 m), cobbles, pebbles, and scattered pumice pebbles; with pockets of lithified coarse sand and andesitic pebbles; subrounded clasts; ungraded unit; debris flow deposit
		280	4.925	Pale grey sand and granule matrix with thin fine pebble-rich beds; grading laterally to sand and granule matrix with matrix-supported cobbles and pebbles; ?hyperconcentrated flood flow – debris flow deposit
		1000	5.925	Very coarse sand and granule matrix; with matrix-supported heterolithologic andesitic cobbles and some very coarse to fine pebbles; subrounded and angular clasts; ungraded unit; indistinct contacts; ?debris flow deposit
		900	6.825	Coarse sand and granule matrix, poorly sorted and semi-lithified; with matrix-supported red, grey and black andesitic very coarse pebbles, and fewer fine pebbles and cobbles; tabular angular clasts; with pockets of clast-supported pebbles; ?debris flow deposit
		700+	7.525	Brown coarse loamy sand and granule matrix, moderately well sorted; with grey, red and black very coarse to coarse andesitic pebbles and cobbles; subrounded and subangular clasts; ungraded unit; ?debris flow deposit

Section Name and Map Code: Wahianoa Road Section 1 [W1]

Grid Reference: T20/391986

Locality: Road cutting at the junction of Wahianoa Road and Aqueduct Road, Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
		170	0.170	Disturbed present day soil surface
Ngauruhoe Formation		50	0.220	Very dark greyish brown (10YR3/2) medium sandy loam textured ash
Tufa Trig Formation	member Tf5	40	0.260	Black coarse ash and very fine lithic lapilli
Ngauruhoe Formation		140	0.400	Brown (10YR4/3) fine sandy loam textured ash, slightly greasy, with root channels; paleosol
Taupo Pumice	Taupo Ignimbrite	90	0.490	White ash and fine pumice lapilli, and charcoal; sharp contacts
Papakai Formation		190	0.680	Olive brown (2.5Y4/4) fine sandy loam textured ash, with cracked exterior and moderately developed fine blocky structure; paleosol
Waimihia Tephra		30	0.710	Pale brown to white fine ash 'cream cakes'; firm ash, with intermixed very fine pale brown andesitic ash
Papakai Formation		150	0.860	Brown fine sandy loam textured ash, with cracked exterior and weakly developed medium blocky structure; root channels; paleosol
	unnamed	40	0.900	Fine and medium pumice lapilli, with brownish yellow (10YR6/6) medium sandy loam textured ash matrix; indistinct unit
Hinemaiaia Tephra		100	1.000	Coarse pale brown and yellow pumiceous ash interspersed with brown sandy loam textured Papakai Formation
Papakai Formation	orange lapilli-2	220	1.220	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, slightly greasy; many brown coated root channels; interbedded within unit is orange lapilli-2 member, comprising a discrete line of strong brown pumice lapilli and pale grey lithic lapilli
	orange lapilli-1	60	1.280	Brownish yellow (10YR6/6) medium and fine pumice lapilli, interbedded with yellowish brown sandy loam textured Papakai Formation
		350	1.630	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, greasy; with distinctive surface cracking and common brown coated root channels; some scattered very fine pumice and lithic lapilli
?reworked Mangamate Tephra		30	1.660	Dark grey and orange coarse ash, firm, compacted, pocketing
Mangamate Tephra	Poutu Lapilli	30	1.690	Reddish brown very fine lapilli, loose, gravelly texture
	?Wharepu Tephra	30	1.720	Grey (2.5Y6/0) coarse ash, firm, compacted, pocketing
Bullot Formation (upper)	unnamed	50	1.770	Strong brown (7.5YR5/6) fine and medium pumice lapilli and grey lithic lapilli; interbedded within light yellowish brown (10YR6/4) sandy loam textured ash
		10	1.780	Grey (2.5Y6/0) coarse ash, pocketing
***	***	70	1.850	Yellowish brown (10YR5/6) fine sandy loam textured medial unit, with scattered pale brown (10YR7/4) fine pumice lapilli, and lithic lapilli
	Ngamatea lapilli-2	60	1.910	Brownish yellow (10YR6/6) dominantly fine pumice lapilli, with yellow (10YR7/6) interiors, and grey fine lithic lapilli; soft pumice lapilli; with minor sandy loam textured ash matrix; ungraded unit; distinct contacts
	unnamed	50	1.960	Yellowish brown (10YR5/6) medium sandy loam textured ash, with scattered fine pumice lapilli
		30	1.990	Light olive brown (2.5Y5/4) sandy loam textured ash; prominent
		25	2.015	Yellowish brown (10YR5/6) coarse sandy loam textured ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	Ngamatea lapilli-1	60	2.075	Strong brown (7.5YR5/8) and light yellowish brown (2.5Y6/4) fine pumice, and lithic lapilli; loose gravelly texture; subangular, soft pumice; slight reverse grading
***	***	70	2.145	Yellowish brown (10YR5/6) medium sandy loam textured medial unit, showing paleosol development, with cracked exterior; with many scattered very fine and fine lithic and pumice lapilli; distinct contacts
	Ul_2	130	2.275	Very pale brown (10YR7/4) fine and some medium-coarse pumice lapilli, with grey (2.5Y6/0) fine to coarse lithic lapilli; angular, prominent lithics; ungraded unit
***	***	60	2.335	Yellowish brown (10YR5/6) medium sandy loam textured medial unit, showing paleosol development; with scattered very fine and fine pumice and lithic lapilli and common brown coated root channels
***	***	40	2.375	Olive brown (2.5Y4/4) coarse sandy loam textured medial unit, with abundant very fine lithic and pumice lapilli; many brown coated root channels
***	***	30	2.405	Olive grey (5Y5/2) medium sandy loam textured medial unit; firm, with root channels and abundant very fine lithics
	Ul_1	90	2.495	30 mm Strong brown (7.5YR5/6) very fine angular, platy pumice fragments 60 mm Strong brown (7.5YR5/6) dominantly medium pumice lapilli, with light olive brown (2.5Y5/4) interiors, and light olive brown (2.5Y5/4) stained fine lithic lapilli; firm pumice; angular lithics; reversely graded unit
	unnamed	5	2.500	Grey ash
		10	2.510	Grey ash, compacted, with fine to very fine pumice and lithic lapilli
		60	2.570	Dark greyish brown (2.5Y5/2) fine and very fine pumice lapilli, and dark grey (5Y4/1) to very dark grey (5Y3/1) fine and very fine lithic lapilli; gravelly texture; ungraded
		20	2.590	Grey (5Y6/1) and purplish black coarse ash
***	***	70	2.660	Dark greyish brown (2.5Y4/2) coarse sandy loam textured medial unit, slightly greasy; with dispersed very fine lithic and pumice lapilli; strong reddish brown iron-stained contacts; distinctive unit
	unnamed	20	2.680	Dark greyish brown (2.5Y4/2) coarse sandy loam textured ash, firm
		40	2.720	Yellowish brown medium and fine pumice lapilli and fine grey and black lithic lapilli; with imogolite on lapilli faces; ungraded unit
		20	2.740	Brownish yellow very fine angular, platy pumice fragments
		40	2.780	Medium and fine pumice lapilli; ungraded
		30	2.810	Olive coarse ash and fine lapilli
		20	2.830	Grey coarse ash and fine lapilli
		20	2.850	Olive coarse ash and fine lapilli
	?member L17	160	3.010	Strong brown (7.5YR5/6) fine and medium pumice lapilli, with same coloured interiors, and black (2.5Y2/0) lithic lapilli; with a very dark grey (5Y3/1) coarse ash base, firm ash, prominent; sharp basal contact
reworked Shawcroft Tephra		640	3.650	Bedded coarse ash and fine strong brown pumice and dark grey lithic lapilli
Te Heuheu Formation		50+	3.700	Coarse loamy sand textured matrix with scattered andesitic pebbles

Section Name and Map Code: Wahianoa Road Section 2 [W2]

Grid Reference: T20/368931

Locality: Road cutting near the top of a steep incline on Wahianoa Road (eastern exposure), Karioi Forest

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		30	0.030	Dark brown fine sandy loam textured unit, with common reworked fine Taupo Pumice lapilli
Taupo Pumice	Taupo Ignimbrite	130	0.160	White poorly sorted ash and fine to medium pumice lapilli
Papakai Formation		590	0.750	Brownish yellow fine sandy loam textured ash with scattered interspersed fine lapilli
	?orange lapilli-1	100	0.850	Yellowish brown medium and fine pumice lapilli and grey lithic lapilli; ungraded tephra
		100	0.950	Brownish yellow fine sandy loam textured ash, slightly greasy, with weakly developed fine blocky structure and root channels; with many interspersed pale yellow fine soft pumice lapilli and grey lithic lapilli; paleosol
Bullot Formation (upper)	?Ngamatea lapilli-2	150	1.100	Strong brown fine and medium pumice lapilli, with yellow interiors, and grey lithic lapilli; loose lapilli
		120	1.220	Brownish yellow sandy loam textured ash, with weakly developed fine blocky structure; some root channels and interspersed lapilli
	?Ngamatea lapilli-1	130	1.350	Strong brown fine pumice lapilli and black lithic lapilli; loose, gravelly texture
***	***	410	1.760	Yellowish brown medium sandy loam textured medial unit, greasy, massive; with pockets of soft pumice lapilli; ?distal laharic sediments
	unnamed	70	1.830	Strong brown pumice lapilli and black lithic lapilli; with lithic dominant base; slight reverse grading; discontinuous tephra
***	***	340	2.170	Yellowish brown medium sandy loam textured unit, greasy, with interbedded fine pumice laminae; ?distal laharic sediments
***	***	470	2.640	Greyish brown (10YR5/2) brownish grey medium sandy loam textured medial unit, with few root channels and some fine pumice lapilli; discontinuous unit; ?distal laharic sediments
?Te Heuheu Formation	unnamed	100	2.740	Grey and brown bedded coarse sand and granules; lithified with platy structure
		800	3.540	Grey coarse sand, lithified, with many purple and red andesitic pebbles to cobbles, and yellow medium and fine pumice pebbles in base of deposit; soft pumice; sharp contacts; distal debris flow deposit
***	***	50	3.590	Purplish grey lignitic clay, hard; sharp contacts
	unnamed	30	3.620	Iron-stained fine sand
		400	4.020	Sandy loam textured matrix, with many yellow medium pumice pebbles and purplish black, grey and red soft andesitic pebbles, and cobbles; coarse andesitic clasts concentrated in base of deposit, and pumice pebbles in top; debris flow deposit
		700	4.720	480 mm Grey weakly bedded medium to coarse sand, poorly sorted, with discontinuous pebble dominant beds; purplish black, red and grey pebbles; semi-lithified 220 mm Grey medium sand with matrix-supported red, black, and grey andesitic pebbles, and yellow pumice pebbles; debris flow deposit
		10	4.730	Yellowish brown fine sandy loam textured unit
		20	4.750	Coarse sandy loam textured unit and interbedded yellow fine pumice
		50	4.800	Yellowish brown laminated silty clay loam textured unit
		20	4.820	Pale yellow pumiceous coarse sand; sharp contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
?Te Heuheu Formation	unnamed	900	5.720	Dark grey very coarse to medium sand matrix, poorly sorted, with matrix-supported predominantly black andesitic pebbles and yellow pumice pebbles; debris flow deposit
		10	5.720	Strong brown clay loam textured unit
		1500+	5.730	Coarse sand matrix, lithified, with matrix-supported purple, black and red andesitic pebbles, and yellow pumice pebbles; debris flow deposit; base not exposed

Section Name and Map Code: Waikato Stream Section 1 [WS1]

Grid Reference: T20/467102

Locality: A large cutting on the west side of the Desert Road, on the northern side of the bridge over Waikato Stream

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		50	0.050	Brownish grey coarse sandy loam textured unit
Tufa Trig Formation	member Tf5	80	0.130	Very dark grey coarse ash
Makahikatoa Sands		290	0.420	Brownish grey coarse sandy loam textured unit
Taupo Pumice	Taupo Ignimbrite	650	1.070	Poorly sorted coarse ash and lapilli, with charcoal fragments; sharp smooth contacts
Mangatawai Tephra		280	1.350	100 mm Dark yellowish brown (10YR4/4) very greasy sandy clay textured ash; with distinctive dark yellowish brown (10YR3/4) coated root channels; paleosol 180 mm Very dark grey to black coarse ash beds, pocketing, with distinct contacts
Papakai Formation and Waimihia Tephra		150	1.500	Reddish brown very greasy sandy clay textured ash, with interbedded 30 mm white to pale brown fine rhyolitic ash 'cream cakes'
Papakai Formation		230	1.730	Dark yellowish brown (10YR4/4) greasy fine sandy loam to sandy clay loam textured ash; with iron-stained root channels; distinct upper and indistinct lower contacts
Hinemaiaia Tephra		140	1.870	Yellow and white coarse ash, ungraded unit; interbedded within yellowish brown sandy loam textured Papakai Formation
Papakai Formation		220	2.090	Greyish brown (2.5Y5/2) gleyed sandy clay loam textured ash, with strong brown mottling; common dark brown coated root channels
Motutere Tephra		30	2.120	White very fine pumice fragments interbedded in gleyed greyish brown Papakai Formation
Papakai Formation		120	2.240	Greyish brown (2.5Y5/2) gleyed sandy clay loam textured ash; indistinct upper, and distinct lower contacts
Mangamate Tephra	Poutu Lapilli	180	2.420	Yellowish brown (10YR5/8) and olive brown (2.5Y4/4) iron-stained fine and medium lithic and few pumice lapilli, firm; top of unit is weakly cemented by iron oxide; indistinct upper, and sharp smooth basal contacts
	Wharepu Tephra	510	2.930	410 mm Olive brown (2.5Y4/4), very dark grey (5Y3/1) and yellowish brown (10YR5/8) fine and very fine lithic and few pumice lapilli, bedded unit 100 mm Brown coarse ash and fine lapilli base
Poronui Tephra		5	2.935	White very fine ash, pocketing
Mangamate Tephra	Ohinepango Tephra	30	2.965	Strong brown and black colour-banded coarse ash; orange beds are pumice rich and black beds are lithic rich; sharp smooth contacts
	Waihohonu Lapilli	230	3.195	Very dark grey (5Y3/1), olive brown (2.5Y4/4) and few strong brown (7.5YR5/6) dominantly fine lithic and few pumice lapilli; angular, loose and weakly bedded lapilli; with two 5 mm thick strong brown to yellowish brown very fine pumice-rich beds, distinctive, interbedded near base
	unnamed tephra	70	3.265	30 mm Grey coarse ash 20 mm Yellowish brown loamy ash 20 mm Grey coarse ash; distinct lower contact
	Oturere Lapilli	210	3.475	Very dark grey (5Y3/1), olive brown (2.5Y4/4) and strong brown (7.5YR5/6) medium and fine lithic, and few pumice lapilli; angular, loose lapilli; ungraded unit; distinct contacts
***	***	110	3.585	Brown very greasy sandy loam textured ash with common fine pumice lapilli
Pahoka Tephra		60	3.645	Pale grey and yellow colour-banded fine pumiceous lapilli, angular, with grey angular, platy, very fine pumice fragments
Bullot Formation (upper)	unnamed	120	3.765	Pale brown sandy loam textured ash, with scattered fine lapilli

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	Pourahu Member [tephra unit]	60	3.825	40 mm White and pinkish white medium and fine, with few coarse lapilli, with greasy sandy loam textured ash matrix 20 mm Coarse ash base
	unnamed	130	3.955	Greyish brown coarse ash with scattered fine lapilli, over yellowish brown greasy loamy textured ash, over grey coarse ash
		110	4.065	Dark brown (7.5YR4/4) very fine and fine angular, platy pumice fragments and coarse ash, over dark brown (7.5YR4/4) fine and few medium pumice lapilli, and black lithics; unit shows weak normal grading
		80	4.145	20 mm Coarse ash 60 mm Fine lithic and pumice lapilli with some coarse ash
	M_1	120	4.265	10 mm Greyish brown coarse ash 10 mm Yellow fine lapilli and coarse ash 30 mm Greyish brown coarse ash with scattered fine lithic and pumice lapilli 30 mm Strong brown very fine, angular, platy pumice fragments, with some fine lapilli 40 mm Grey coarse ash
	unnamed	20	4.285	Strong brown very fine, angular, platy pumice fragments
		40	4.325	Very dark grey to black fine lithic lapilli, and strong brown pumice lapilli, with matrix of very fine angular, platy pumice fragments and ash
		35	4.360	Yellowish grey coarse ash
		35	4.395	Very dark grey to black coarse ash
	member L17	190	4.585	Strong brown (7.5YR5/6) medium and fine pumice lapilli, and very fine angular, platy pumice fragments, with dark grey (5Y4/1) lithic lapilli; weak normal grading
	unnamed	20	4.605	Black to very dark grey coarse ash with fine lithic and pumice lapilli
		10	4.615	Brown loamy textured ash with fine lapilli
		20	4.635	Dark grey to black coarse ash
	member L16	160	4.795	Yellowish red (5YR4/8) medium and fine, with some coarse pumice lapilli, moderately soft, and very dark grey (5Y3/1) lithic lapilli; ungraded unit; sharp contacts
	unnamed	40	4.835	10 mm Dark grey to black coarse ash 30 mm Yellow loamy coarse ash over black coarse ash
		60	4.895	Fine and fewer medium and coarse pumice and lithic lapilli with central bed of black coarse ash
		90	4.985	Black (5Y2/1) coarse ash with scattered fine lithic lapilli and pebbles
	M_3	50	5.035	30 mm Yellow, dominantly very fine angular, platy pumice fragments 20 mm Dark purplish black coarse ash and very fine lithic lapilli
	unnamed	50	5.085	Brownish grey coarse ash with fine pumice and lithic lapilli; distinct contacts
	member L15	160	5.245	Yellowish red (5YR4/8) fine and medium pumice lapilli, with same coloured interiors, and black (5Y2/1) lithic lapilli; ungraded unit; sharp basal contact
	unnamed	30	5.275	20 mm Grey coarse ash 10 mm Loamy ash, firm
	member L14	50	5.325	Strong brown fine pumice lapilli and black lithic lapilli
	unnamed	70	5.395	50 mm Greyish brown loamy textured medial unit; with scattered fine pumice and lithic lapilli; 20 mm Fine, medium and few coarse pumice and lithic lapilli
		80	5.475	Dark purplish black to black (5Y2/1) bedded coarse ash with scattered pumice blocks (90 mm)
		30	5.505	Strong brown fine to medium pumice and lithic lapilli, with very fine angular, platy pumice fragments
		30	5.535	Dark purplish black very coarse ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	20	5.555	Yellowish grey coarse ash with fine and fewer medium pumice and lithic lapilli
		30	5.585	Dark purplish black coarse ash
		60	5.645	Dark brown (7.5YR4/4) medium with fewer coarse pumice lapilli, and lithic lapilli; ungraded unit
		30	5.675	Greyish brown coarse ash with few fine pumice and lithic lapilli; indistinct contacts
		10	5.685	Grey fine lithic lapilli and fewer pumice lapilli, with lithic-rich coarse ash
		30	5.715	Pale yellow (2.5Y7/4) very fine angular, platy pumice fragments, and fine pumice lapilli
		20	5.735	Grey coarse ash and fine lapilli
		30	5.765	Yellow very fine angular, platy pumice fragments, and fine lapilli
Rerewhakaaitu Tephra		30	5.795	Greyish brown (2.5Y5/2) loamy textured coarse ash with interbedded light olive grey (2.5Y5/2) glassy fine rhyolitic ash
Bullot Formation (middle)		40	5.835	Greyish brown coarse ash with very fine to fine pumice and lithic lapilli, and occasional coarse lithic lapilli; distinct contacts
		45	5.880	Fine and medium pumice lapilli, with very fine angular, platy pumice fragments and pumiceous ash; Manganese stained basal 5 mm
		30	5.910	Black (5Y2/1) coarse ash
		20	5.930	Grey loamy coarse ash
		60	5.990	Coarse ash with fine lithic and pumice lapilli; ungraded unit; indistinct contacts
		5	5.995	Grey coarse ash
		40	6.035	20 mm Coarse pumiceous ash 20 mm Yellowish brown (10YR5/8) fine pumice lapilli and very dark grey (5Y3/1) fine lithic lapilli; indistinct unit
		50	6.085	Black loamy textured ash with scattered fine lithic and pumice lapilli
	member L7b	70	6.155	Strong brown (7.5YR5/6) dominantly fine pumice lapilli and grey lithic lapilli; with matrix of very fine angular, platy pumice fragments
	unnamed	20	6.175	Black coarse ash
	member L7	110	6.285	Strong brown (7.5YR5/6) dominantly fine pumice lapilli and grey lithic lapilli and coarse ash; ungraded unit
	unnamed	10	6.295	Black coarse ash
		50	6.345	Brown fine sandy loam textured medial unit with paleosol development
Te Heuheu Formation	unnamed	210	6.555	Fine pumice and lithic lapilli and coarse ash; weakly bedded; with scattered heterolithologic andesitic pebbles; basal 120 mm dominantly coarse ash
***	***	5	6.560	Yellow coarse ash
		620	7.180	Horizontally stratified sands with fine pumice and andesitic pebbles; ?fluvial deposit
		210	7.390	Yellowish brown coarse loamy sand textured matrix, with scattered fine to medium pumice and andesitic pebbles; ungraded unit, sharp contacts; debris flow deposit
Bullot Formation (lower)	unnamed	30	7.420	Yellowish brown greasy loamy textured coarse ash
Kawakawa Tephra Formation		30	7.450	25 mm Very pale brown coarse ash 5 mm Pink coarse ash
***	***	20	7.470	Yellowish brown loamy textured ash
		80	7.550	Yellowish brown bedded loamy textured ash
Te Heuheu Formation	unnamed	390	7.940	Medium to coarse sandy matrix, with lenses of fine lithic and pumice pebbles; strongly laminated toward base; ?debris flow deposit

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Te Heuheu Formation	unnamed	370	8.310	Brownish yellow coarse lithic and pumiceous sandy ash matrix; with scattered fine to very coarse lithic and pumice pebbles and few boulders; some soft clay textured weathered lithics; ungraded unit; debris flow deposit
		1000+	9.310	Brownish yellow weakly bedded sands, semi-lithified; with lenses of bright orange and yellow fine to medium pumice pebbles; and interbeds of pinkish brown clay beds, firm; distinctive units

Section Name and Map Code: Waikato Stream Section 2 [WS2]

Grid Reference: T20/469102

Locality: Cliff face immediately east of the Desert Road and approx. 50 m north of the bridge over Waikato Stream. Description is for member L7b and older deposits only

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (middle)	member L7b	80	0.060	Strong brown (7.5YR5/6) fine pumice lapilli and very fine, platy, angular pumice fragments
	unnamed	20	0.080	Black coarse ash
	member L7	110	0.190	Strong brown (7.5YR5/8) fine and medium pumice lapilli, black lithic lapilli, and coarse ash; very vesicular and soft pumice lapilli.
	unnamed	40	0.230	Black coarse ash
		50	0.280	Reddish brown loamy coarse ash with abundant fine and medium lithic and pumice lapilli
		170	0.450	100 mm Strong brown fine and medium pumice lapilli with some black fine lithic lapilli and scoria; with a coarse ash matrix 70 mm Strong brown and some olive medium and fine pumice lapilli, and many black lithic lapilli; soft pumice, and angular lithics; sharp contacts
Bullot Formation (lower)	member L1	150	0.600	Greenish grey weakly bedded coarse crystal-rich ash; some beds dominantly yellow pumiceous ash
Te Heuheu Formation	unnamed	40	0.640	Black and brown coarse ash with scattered pebbles
Bullot Formation (lower)	unnamed	70	0.710	Black to olive coarse ash
Te Heuheu Formation	unnamed	80	0.790	Yellowish brown sandy loam textured matrix, with many matrix-supported fine to very coarse pumice and lithic pebbles; ungraded; ?debris flow deposit
		150	0.940	Greyish brown sand matrix, with abundant heterolithologic andesitic pebbles
		220	1.180	Bedded sands and pebbles
Bullot Formation (lower)	unnamed	40	1.200	Brown loamy textured ash; discontinuous
Kawakawa Tephra Formation		150	1.350	White to pale grey coarse ash with finer ash base; tephra cross-cuts andesitic diamictons (described below) over a vertical extent of *c.* 4 m
Te Heuheu Formation	unnamed	180	1.530	Yellowish brown loamy sand textured matrix, with matrix-supported heterolithologic andesitic pebbles; ?debris flow deposit
		1600	3.130	Reddish brown coarse sand matrix, with weakly developed horizontal stratification, lithified; with many andesitic pebbles and occasional boulders; sharp contacts
		270	3.400	Bright orange sandy loam textured matrix, semi-lithified; with many brightly coloured andesitic pebbles, cobbles, and fewer boulders; ungraded; sharp contacts; ?debris flow deposit
		930	4.330	Lithified sand and granule matrix; with many andesitic pebbles to boulders; ?debris flow deposit
		550	4.880	Grey bedded coarse sand and pinkish brown clay beds, firm; with lenses of lithic and pumice pebbles
			4.880	Over 10⁺ m of interbedded andesitic diamictons, sands and clay to stream level

Section Name and Map Code: Waiouru Tip [WT]

Grid Reference: T20/417935

Locality: Cutting at the southern end of Waiouru Tip; description is for deposits older than Ngamatea lapilli-1 member of Bullot Formation

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	Ngamatea lapilli-1	70	0.070	Strong brown dominantly fine pumice lapilli, and dark grey lithic lapilli; distinct lower contact
	unnamed	90	0.160	30 mm Grey coarse loamy ash and very fine lithic lapilli 30 mm Grey sandy ash, firm, with very fine lithic lapilli 30 mm Grey sand loam textured ash with very fine lithic and pumice lapilli
***	***	90	0.250	Pale brown coarse sandy loam textured medial unit, showing paleosol development; with iron-stained root channels
Tangatu Formation	unnamed	230	0.480	Fine and medium sand, and granules, with scattered fine and medium pumice pebbles; hyperconcentrated flood flow deposit
		120	0.600	Pale grey fine sand, with many iron-stained root channels
		1500	2.100	300 mm Fine and medium sand, with root channels and common fine lithic and pumice pebbles; indistinct contact with 1200 mm Bedded sands and pebbles; comprising alternating pebble dominant and sand dominant beds; bed thicknesses generally < 20 mm; fine andesitic and pumice pebbles; hyperconcentrated flood flow deposit
***	***	140	2.240	Greyish brown medium sandy loam textured medial unit, showing paleosol development, non-greasy, with distinct dark brown coated root channels, and some fine lapilli
Bullot Formation (upper)	unnamed	90	2.330	Strong brown and pale yellow fine pumice lapilli and black fine lithic lapilli; loose lapilli
***	***	110	2.440	Dark brown sandy clay loam textured medial unit, showing paleosol development, greasy; with distinct dark coated root channels and some fine, dominantly pale yellow pumice, and lithic lapilli
	unnamed	130	2.570	Pale yellow dominantly fine pumice lapilli, soft, and lithic lapilli; loose; lapilli; ungraded tephra
***	***	120	2.690	Greyish brown coarse sandy loam textured medial unit, with many interspersed very fine lapilli
	Shawcroft Tephra	110	2.800	Black fine and very fine lithic lapilli, angular, and strong brown fine and very fine pumice lapilli, and coarse ash; with a distinctive strong brown pumice dominant very fine lapilli base
***	***	220	3.020	Greyish brown and purplish grey medium sandy loam textured medial unit, showing paleosol development; with common iron-stained root channels, and interspersed white fine pumice lapilli
***	***	340	3.360	Brown loamy sand, grading downwards to sandy loam textured medial unit, with few iron-stained root channels; distinct contacts, on
Tangatu Formation	unnamed		3.360	Grey bedded sands and pebbles; hyperconcentrated flood flow deposit; base of deposit not exposed

Section Name and Map Code: Whangaehu Ford [WF]

Grid Reference: T20/425984

Locality: On the western bank of Whangaehu River, adjacent to a ford across Whangaehu River south of Wahianoa Aqueduct, Rangipo Desert

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	320	0.320	Pale brown very coarse sand (dominant) and granules, and many dominantly black fine subrounded and sub-angular andesitic pebbles, with some hydrothermally altered pebbles, and few pumice pebbles; sharp basal contact; hyperconcentrated flood flow deposit
	Ond	150	0.470	Coarse sand and granules, poorly sorted, and black scoria (dominant) medium pebbles, and red and grey porphyritic and aphanitic dominantly medium andesitic pebbles, and scoria, and some pumice and hydrothermally altered fine and medium pebbles; subangular clasts; basal 20 mm coarse sand and granules without pebbles; sharp contacts; hyperconcentrated flood flow deposit
	unnamed	190	0.660	Fine sand (dominant) and granules, poorly sorted, with matrix-supported, dominantly grey coarse andesitic pebbles, and some cobbles, with iron-stained faces, and some hydrothermally altered pebbles; maximum clast 150 mm (cobble); subrounded and subangular clasts; coarser clasts concentrated in basal half of unit; debris flow deposit
	?Onb	1130	1.790	Olive coarse loamy sand dominant and granule matrix, with many matrix-supported dominantly medium grey andesitic pebbles and scoria with iron-stained pebble faces, and some orange and white hydrothermally altered pebbles; subrounded, rounded and angular pebbles; basal 750 mm contains coarser clasts - dominantly very coarse pebbles and cobbles; maximum clast 170 mm (cobbles); debris flow deposit
Mangaio Formation		2290	4.080	290 mm Upper unit: light grey (2.5Y7/1) to grey (2.5Y6/1) and strong brown (7.5YR5/6) coarse sandy loam to sandy clay loam textured matrix; with many matrix-supported dominantly medium hydrothermally altered, and andesitic pebbles and common coarse and very coarse pebbles; maximum clast 80 mm (cobble); ungraded unit 900 mm Middle unit: greyish purple, pale grey (gleyed), and strong brown (7.5YR5/6 – 5/8) coarse sandy clay loam to sandy clay textured matrix; with abundant and dominantly fine hydrothermally altered andesitic pebbles, soft and clayey, and some cobbles; maximum clast 160 mm (cobble); ungraded unit 1100 mm Lower unit: dominantly purple and light grey (2.5Y7/1) to grey (2.5Y6/1), and strong brown (7.5YR5/6) coarse sandy clay loam textured matrix; with matrix-supported grey, dark grey, black and hydrothermally altered dominantly very coarse pebbles, with iron-stained faces, and many fine pebbles, cobbles and some boulders; maximum clast 350 mm (boulder); ungraded
Hinemaiaia Tephra		140	4.220	Dark brown (7.5YR4/2) to purplish brown medium sandy loam textured medial unit, showing paleosol development; friable, with common iron-stained root channels, and interspersed white coarse pumiceous ash (Hinemaiaia Tephra)
***	***	5	4.225	Strong brown iron pan; wavy contacts

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Manutahi Formation	unnamed	180	4.405	Coarse sandy loam textured matrix with granules; weakly bedded; with red, grey and black dominantly coarse andesitic pebbles; hyperconcentrated flood flow deposit
		210	4.615	Coarse sand and granule matrix; with abundant matrix-supported dominantly black, and purplish red andesitic pebbles; subangular to angular, distinctive pebbles; debris flow deposit
		300	4.915	Pale grey granules (dominant) and sand, weakly bedded, and few red and grey fine andesitic pebbles; hyperconcentrated flood flow deposit
		280	5.195	Reddish brown very coarse sand and granules, poorly sorted, and many fine and few medium andesitic pebbles, and some hydrothermally altered pebbles; sand dominant basal 30 mm; discontinuous unit; sharp basal contact; hyperconcentrated flood flow deposit
		190	5.385	Granules and coarse sand, weakly bedded, and black, grey and red dominantly fine (5 mm), and common medium andesitic pebbles, with iron-stained pebble faces; subrounded and subangular clasts; coarser clasts concentrated toward base of unit; very base of unit comprises coarse sand without pebbles; discontinuous, wedging deposit; ?hyperconcentrated flood flow deposit
		120	5.505	Coarse and very coarse sand dominant, and granule matrix, poorly sorted; with matrix-supported iron-stained dominantly medium andesitic pebbles, and some coarse and very coarse pebbles; maximum clast 40 mm (very coarse pebble); reversely graded clasts with coarser clasts occurring in top of unit; discontinuous lens-shaped unit; debris flow deposit
		260	5.765	Grey and strong brown coarse sandy clay loam textured matrix, with matrix-supported dominantly medium andesitic pebbles, and few cobbles; prominent unit; slight reverse grading; sharp wavy basal contact; debris flow deposit
		20	5.785	Purplish grey fine clay; distinct
***	***	200	5.985	Dark greyish brown (10YR4/2) coarse sandy loam textured medial unit, showing paleosol development; with interbedded fine sand laminae and few fine andesitic pebbles near top; with strong brown (7.5YR5/8) coated root channels; sharp wavy basal contact
	unnamed	390	6.375	Granule dominant and sand matrix, semi-lithified, with weakly bedded basal 30 mm; with some fine andesitic pebbles concentrated toward top of unit; maximum clast 30 mm (coarse pebble); hyperconcentrated flood flow deposit
***	***	90	6.465	Greyish brown (2.5Y5/2) to purplish brown medium sandy clay loam textured medial unit, friable, showing paleosol development; with abundant pale yellow pumice granules, soft, concentrated in lower 10 mm; with iron-stained root channels
***	***	90	6.555	Sandy clay loam textured medial unit, showing paleosol development; with many fine and medium lithic lapilli and pale yellow pumice lapilli; with iron-stained root channels
***	***	120	6.675	Pale greyish brown (2.5Y5/2) fine sandy clay loam textured medial unit, showing paleosol development, with interspersed lithic and pale yellow pumice granules and common pale brown coated root channels
Motutere Tephra		20	6.695	Pale pinkish brown coarse and fine ash 'cream cakes', and fine pumice fragments
***	***	250	6.945	Pale greyish brown (2.5Y5/2) fine sandy clay loam textured medial unit, showing paleosol development, with common pale brown coated root channels
***	***	70	7.015	Light olive brown (2.5Y5/4) sandy clay-loam textured medial unit, with scattered fine lithic lapilli, and strong brown iron-stained root channels
Bullot Formation (upper)	Ngamatea lapilli-1	60	7.075	Strong brown (7.5YR5/8) fine pumice lapilli, with pale yellow (2.5Y7/4) interiors, and fine grey lithic lapilll, soft pumice; ungraded tephra

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
***	***	20	7.095	Pale grey fine sandy loam textured medial unit, firm, prominent; sharp wavy basal contact
Bullot Formation (upper)	unnamed	110	7.205	Pale yellowish brown coarse loamy ash and pumice and lithic lapilli; loose, gravelly texture
Tangatu Formation	unnamed	140	7.345	Bedded unit comprising grey granule and sand dominant and pebble dominant beds; fine andesitic pebbles; wavy contacts; hyperconcentrated flood flow deposit
		310	7.655	Very coarse sand dominant, and granule matrix; with many matrix-supported black, grey and red fine and many medium andesitic pebbles and occasional cobbles; maximum clast 220 mm (cobble); subrounded and subangular clasts; with a finer sand dominant base; debris flow deposit
***	***	100	7.755	Strong brown (7.5YR5/6) coarse loamy sand textured medial unit, with common pale brown very fine and fine soft pumice lapilli
	unnamed	60	7.815	Grey fine sand, firm, weakly bedded
		20	7.835	Pale brown (10YR6/3) to light yellowish brown (10YR6/4) clay, sticky, with iron-stained sharp contacts
***	***	90	7.925	Purplish grey medium sandy clay loam to sandy clay textured medial unit, showing paleosol development, with strong brown coated root channels
	unnamed	110	8.035	Medium sand (dominant) and granules, and black and grey dominantly fine and medium andesitic pebbles, and brownish grey pumice pebbles; few scattered coarse andesitic pebbles and cobbles; basal 40 mm fine sand; ?hyperconcentrated flood flow deposit
		150	8.185	Purplish grey coarse sand (dominant) and granules, and dominantly medium andesitic pebbles, and few cobbles (70 mm) at base; subangular clasts; finer grained dominantly medium sand top; hyperconcentrated flood flow deposit
		130	8.315	Sand and granules (dominant), lithified, prominent; and many fine andesitic pebbles with iron-stained pebble faces; iron-stained contacts; hyperconcentrated flood flow deposit
		200	8.515	Sand, and granule dominant matrix; with many matrix-supported dominantly medium andesitic pebbles, and pockets of clast-supported cobbles (80 – 120 mm); with iron-stained clast faces and matrix around clasts; protruding clasts; ungraded deposit; debris flow deposit
		480	8.995	Weakly bedded pebble-rich beds with lithified sandy matrices and subrounded andesitic pebbles, and sand dominant beds; mottled sands; laminated sand base; hyperconcentrated flood flow deposit
		260	9.255	Weakly bedded unit comprising lithified reddish brown mottled coarse sand dominant and granule beds, and fine pebble dominant beds; occasional cobbles scattered throughout deposit; prominent unit with iron-stained contacts; prominent relief; hyperconcentrated flood flow deposit
		330	9.585	Sand and granule matrix, lithified; with matrix-supported dominantly coarse, and many very coarse andesitic pebbles, and fine pebble dominant interbeds; sharp wavy iron-stained contact; debris flow deposit
		160	9.745	Granule and sand matrix, lithified; with common pale yellow, orange and grey fine pumice pebbles and many very coarse red lithic pebbles, with many boulders, angular to subrounded clasts; ungraded; debris flow deposit

Section Name and Map Code: Whangaehu Junction [WJ]

Grid Reference: T20/445069

Locality: An exposure at the northern end of the Whangaehu escarpment, adjacent to Whangaehu River

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		270	0.270	Present day soil; sandy loam textured unit
Makahikatoa Sands & Tufa Trig Formation		20	0.290	Greyish brown loamy sand with interbedded pocketing grey ash
Tufa Trig Formation	unnamed	20	0.310	Dark grey medium ash
Makahikatoa Sands		60	0.370	Brownish grey sandy loam textured unit
Tufa Trig Formation	member Tf8	35	0.405	Dark grey medium ash
Makahikatoa Sands		5	0.410	Very dark greyish brown sandy loam textured unit
Tufa Trig Formation	member Tf6	25	0.435	Dark grey coarse and medium ash
Makahikatoa Sands		70	0.505	Greyish brown sandy loam textured unit
Tufa Trig	member Tf5	70	0.575	Dark grey coarse and medium ash; distinctive tephra
Makahikatoa Sands		30	0.605	Dark greyish brown sandy loam textured unit; paleosol
Tufa Trig Formation	member Tf4	20	0.625	Dark grey medium to fine ash
Makahikatoa Sands		60	0.685	Dark greyish brown sandy loam textured unit
Tufa Trig Formation	member Tf2	15	0.700	Fine pumice and scoriaceous lapilli
Makahikatoa Sands		90	0.790	Sandy loam textured unit; weak paleosol development
Tufa Trig Formation	member Tf1	25	0.815	Fine pumice lapilli
***	***	360	1.175	Greyish brown sandy loam textured unit; paleosol developed in Taupo Ignimbrite
Taupo Pumice	Taupo Ignimbrite	160	1.335	White poorly sorted ash and lapilli, with charcoal fragments
Mangatawai Tephra		450	1.785	230 mm Dark brown fine sandy loam textured ash; paleosol 220 mm Alternately bedded dark grey to black coarse ash beds, and brown sandy loam textured ash beds; distinct bed contacts
Papakai Formation		90	1.875	Dark brown fine sandy loam textured ash; paleosol
Papakai Formation & Waimihia Tephra		210	2.085	Dark yellowish brown slightly greasy sandy loam textured ash, and interbedded 20 mm pale brown to white fine rhyolitic ash 'cream cakes' (Waimihia Tephra)
Mangaio Formation		2000	4.085	Strong brown (7.5YR5/6) and grey (2.5Y5/0) sandy clay loam textured matrix, greasy, with matrix-supported hydrothermally altered, and many grey andesitic pebbles to boulders; discontinuous, dune-shaped deposit
Papakai Formation		180	4.265	Purplish grey medium sandy clay loam textured ash, greasy; paleosol
Hinemaiaia Tephra		80	4.345	White and grey coarse pumiceous ash dispersed throughout yellowish grey Papakai Formation; indistinct lower contact
Papakai Formation		200	4.545	Yellowish grey coarse sandy loam textured ash, greasy; with scattered fine pumice and lithic lapilli; paleosol
Bullot Formation (upper)	unnamed	90	4.635	Pale yellow medium and coarse pumice lapilli, and bluish grey lithic lapilli; with grey coarse sandy loam textured ash matrix
		20	4.655	Grey and yellow coarse ash
		20	4.675	Yellow very fine angular, platy pumice fragments
		60	4.735	Pale yellow fine and medium pumice lapilli, black lithic lapilli, and coarse ash; soft pumice
***	***	30	4.765	Purplish brown sandy loam textured medial unit; with scattered pumice and lithic lapilli
	unnamed	160	4.925	Yellowish brown (10YR5/4) and pale brown (10YR6/3) fine and medium pumice lapilli, with very pale brown (10YR7/3), light brownish grey (2.5Y6/2) and grey (2.5Y6/0) interiors; soft pumice; and grey and black lithic lapilli, angular, sharp, exfoliating; with coarse ash matrix; ungraded tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	160	5.085	Dark grey medium sandy loam textured ash grading upward to fine sandy loam textured ash (normal graded); with a 50 mm thick loamy sand textured interbed and scattered grey lapilli
		230	5.315	Pale brown (10YR6/3) and brownish yellow (10YR6/6) fine and fewer medium pumice lapilli, with greyish brown (2.5Y5/2) interiors, and scattered black and strong brown lithic lapilli; angular lapilli; sharp wavy basal contact
		90	5.405	Grey sandy ash
		60	5.465	Medium and fine pumice lapilli; discontinuous tephra
		20	5.485	Yellowish brown sandy ash
		40	5.525	Dark purplish black sandy ash
		40	5.565	Coarse lithic ash with interbedded strong brown fine pumice lapilli and black lithic lapilli
		5	5.570	Grey coarse ash over black coarse ash
		100	5.670	Brown medium sandy loam, slightly greasy; with scattered yellowish brown fine and fewer medium pumice lapilli and lithic lapilli
		50	5.720	Yellow to yellowish brown fine and fewer medium pumice lapilli, and grey lithic lapilli; with sandy loam textured ash matrix
		30	5.750	Brown sandy loam
		60	5.810	Fine pumice and lithic lapilli; loose, gravelly texture; ungraded tephra
		50	5.860	Sandy loam textured ash
	?Pourahu Member	160	6.020	Pale grey to white fine pumice lapilli and black lithic lapilli; with lithic-rich top
	unnamed	70	6.090	Black coarse ash, firm; sharp basal contact
		300	6.390	Dark brown (10YR4/3) grading down to olive brown (2.5Y4/3) fine sandy loam textured ash, with interbedded 30 mm grey coarse ash and purplish black coarse ash near centre of unit
		120	6.510	Dark yellowish brown (10YR4/4) fine and medium pumice lapilli, with dark greyish brown (2.5Y4/2) interiors, and fewer strong brown iron-stained lithic lapilli (concentrated in lower 70 mm); some sandy ash matrix; very vesicular, hard pumice; discontinuous tephra
***	***	500	7.010	Very dark greyish brown (10YR3/2) to yellowish brown (10YR5/4) fine sandy loam textured medial unit (poasibly loess), mottled; with scattered strong brown fine pumice lapilli, soft, and lithic lapilli; dune-shaped deposit
Waiohau Tephra		30	7.040	White very fine; discontinuous; with black coarse andesitic ash intermixed at base
Bullot Formation (upper)	unnamed	70	7.110	Dark grey (2.5Y3/1) to black coarse ash and black fine lithic lapilli and few orange fine, soft pumice lapilli
		40	7.150	Very dark brown (10YR2/2) to purplish brown coarse ash; wavy lower contact
		50	7.200	Olive grey fine sandy loam textured ash and scattered fine lapilli
		40	7.240	Very dark greyish brown (2.5Y3/2) coarse ash; discontinuous tephra
		100	7.340	Olive brown (2.5Y4/3) greasy fine sandy loam, grading to loamy sand textured medial unit at base; with scattered pale yellow to brown fine pumice lapilli at base; few coated root channels
		310	7.650	Coarse lithic and pumiceous ash
		30	7.680	Very dark grey (2.5Y3/1) fine lithic lapilli, angular, in sandy ash matrix
		20	7.700	Olive brown (2.5Y4/4) fine sandy loam textured ash and fine lithic lapilli; few dark coated root channels
		30	7.730	Dark grey (2.5Y4/1) coarse ash and scattered lapilli

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
Bullot Formation (upper)	unnamed	70	7.800	30 mm Black coarse sandy ash 30 mm Olive brown (2.5Y4/4) fine and medium pumice lapilli, with very dark greyish brown (2.5Y3/2) interiors, and black fine lithic lapilli, angular; ungraded tephra unit 10 mm Coarse lithic ash
		100	7.900	20 mm Fine sandy loam textured ash and very fine pumice and lithic lapilli; weak paleosol development, over Dark brown (10YR4/3) medium and fine pumice lapilli, with light olive brown (2.5Y5/4) and light grey (2.5Y7/2) interiors, and fewer black fine lithic lapilli and coarse ash; very vesicular, hard pumice lapilli 10 mm lithic dominant coarse ash
		60	7.960	Dark grey (2.5Y4/1) to purplish grey loamy coarse ash; with many fine pumice lapilli with olive interiors, and few black lithic lapilli
		30	7.990	Black coarse ash
		40	8.030	Light olive brown (2.5Y5/6) and yellowish brown (10YR5/6) fine and medium pumice lapilli, vesicular, hard, and grey lithic lapilli; ungraded tephra; with loamy coarse ash matrix
		40	8.070	Yellowish brown (10YR5/4) sandy loam textured ash and scattered fine lapilli
		140	8.210	Pale yellow to brown dominantly fine pumice lapilli, with pale grey interiors, and grey fine sandy loam textured ash matrix; soft pumice; normally graded tephra
***	***	75	8.285	Dark greyish brown (10YR4/2 to 2.5Y4/2) coarse sandy loam, grading down to greasy fine sandy loam textured medial unit; with scattered brown pumice lapilli and grey lithic lapilli
Rerewhakaaitu Tephra		15	8.300	White to pale grey fine glassy rhyolitic ash, discontinuous
***	***	45	8.345	Dark greyish brown greasy fine sandy loam textured medial unit; with scattered lapilli
Bullot Formation (middle)	member L7	200	8.545	160 mm Yellow (10YR7/6 and 2.5Y8/6) and pinkish yellow fine and medium pumice lapilli, with light yellowish brown (2.5Y6/4) interiors, and few lithic lapilli; soft pumice; interbedded within a greasy fine sandy loam textured ash matrix 40 mm Coarse lithic and pumiceous ash base
Te Heuheu Formation	unnamed	250	8.795	Dark grey (10YR4/1 to 2.5Y4/1) coarse sand, grading downwards in turn to coarse loamy sand, and dark grey (10YR4/1) medium sand, with some fine andesitic pebbles and cobbles; fine pebbles concentrated in basal 30 mm; ?hyperconcentrated flood flow deposit
		620	9.415	Sand and granule matrix; with scattered purple, grey, red and brown andesitic pebbles, weathered and soft, and bright yellow and orange pumice lapilli; few cobbles; upper 200 mm weakly bedded sand and granules with common pumice pebbles; ?debris flow deposit
***	***	480	9.895	Bedded pink clay, firm, and pebble beds comprising brown and yellow fine and medium pumice pebbles, and dark brown and black subangular to subrounded andesitic pebbles; bed depths averaging 50 – 100 mm; sharp wavy bed contacts; fluvial deposit
		350	10.245	Bedded dark grey (10YR4/1 to 2.5Y4/1) sand and granules, semi-lithified, with some red, purple and black andesitic pebbles and yellow pumice pebbles; hyperconcentrated flood flow deposit
***	***	50	10.295	Light reddish brown (5YR6/4) silty clay, with fine weathered andesitic and pumice pebbles; sharp basal contact; fluvial deposit
		1000	11.295	Sand and granule matrix, with matrix-supported scattered fine to coarse andesitic and pumice pebbles, and some cobbles and boulders interbedded at base; maximum clast 800 mm (boulder); sharp basal contact; debris flow deposit

Formation	Member	Unit Depth (mm)	Cum. Depth (m)	Description
Te Heuheu Formation	unnamed	1000	12.295	sandy matrix; with lenses of soft yellow and brown pumice, and coarse pebbles to boulders; ungraded; pumice concentrated in lower 300 mm; sharp wavy contact
		1300	13.595	Alternating 50 – 100 mm thick sand and granule, and 10 – 40 mm thick reddish brown (5YR6/4) greasy silty clay beds; sand and granule beds are weakly lithified, with many medium and fine yellow pumice pebbles, and many red, purple, grey and black andesitic pebbles; subrounded pebbles; soft pumice; to river level

Section Name and Map Code: Composite section of Whangaehu River Section 1 [WR1] and Whangaehu River Section 2 [WR2]

Grid Reference: T20/399954

Locality: An exposure on the Whangaehu escarpment, immediately east of Whangaehu River, and approx. 500 m south of a road leading to a flood gauge on Whangaehu River

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Ngauruhoe Formation & Tufa Trig Formation		380	0.380	Pale brown fine sandy loam textured unit with interbedded grey Tufa Trig Formation tephras, thin, pocketing
Taupo Pumice	Taupo Ignimbrite	120	0.500	White poorly sorted coarse ash and pumice lapilli, with charcoal; at base of the ignimbrite is a thin very coarse crystal-rich deposit
?Mangatawai Tephra		390	0.890	Brown fine sandy loam textured ash; distinct lower contact
Papakai Formation		420	1.310	Yellowish brown (10YR5/6) fine sandy loam, with cracked exterior and common coated root channels; with many bluish grey soft lapilli; paleosol
Bullot Formation (upper)	unnamed	30	1.340	Strong brown dominantly fine pumice lapilli and dark grey fine and very fine lithic lapilli; moderately soft pumice; ungraded unit
		140	1.480	Yellowish brown (10YR5/6) fine sandy loam textured ash with common root channels; sharp contacts; paleosol
	?Ngamatea lapilli-2	50	1.530	Strong brown (7.5YR5/6) very fine and fine, with few medium pumice lapilli, with pale yellow interiors, and grey very fine and fine lithic lapilli; ungraded unlt
	unnamed	80	1.590	Yellowish brown coarse sandy loam textured ash
	Ngamatea lapilli-1	80	1.670	Dark yellowish brown (10YR4/4) fine and medium pumice lapilli and grey lithic lapilli; loose lapilli, subrounded pumice lapilli; ungraded unit
***	***	400	2.070	Fine sandy loam textured medial unit, showing paleosol development; with scattered strong brown fine pumice lapilli; with many dark brown coated root channels
	unnamed	70	2.140	Fine pumice lapilli interbedded in medium loamy sand textured ash
		70	2.210	Fine sandy loam textured ash; with prominent iron-stained root channels; paleosol
		10	2.220	Grey coarse sandy ash, firm
***	***	80	2.300	Fine sandy loam textured medial unit, greasy, with scattered fine and few medium pumice and lithic lapilli
	unnamed	110	2.410	Brown fine and medium pumice lapilli, with grey interiors, and fewer lithic lapilli; angular lapilli; ungraded unit
		50	2.460	Granule-rich fine sandy loam textured ash, greasy
		50	2.510	Dark grey very fine and fine lithic lapilli, and fewer pumice lapilli
		180	2.690	Fine sandy loam textured ash with many very fine pumice and lithic lapilli; common root channels; distinct contacts
	?Pourahu Member	130	2.820	Light brownish grey (2.5Y6/2) fine and some medium pumice lapilli, with light grey (10YR7/1) interiors, and very dark grey (2.5Y3/0) fine lithic lapilli; hard pumice; ungraded unit
***	***	210	3.030	Olive (5Y5/3) sandy loam textured medial unit with scattered pale yellow fine pumice lapilli
	unnamed	30	3.080	Black and brown bedded sandy loam textured ash
***	***	180	3.240	Olive (5Y5/3) sandy loam textured medial unit, with common fine pumice lapilli
	unnamed	40	3.280	Dominantly fine, pumice and lithic lapilli, with a sandy loam textured ash matrix
		50	3.330	Coarse ash and fine pumice and lithic lapilli
		120	3.450	Olive (5Y5/3) fine and medium pumice lapilli and fewer dark grey (2.5Y3/0) fine lithic lapilli; loose lapilli; very vesicular, subrounded pumice and angular lithics; with lithic dominant fine lapilli base

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
***	***	70	3.520	Pale brown coarse sandy loam textured medial unit, with scattered fine lithic and pumice lapilli; common root channels
Bullot Formation (upper)	Shawcroft Tephra	120	3.640	Very dark grey (2.5Y3/0) and olive (5Y5/3) fine and very fine lithic lapilli and fewer strong brown iron-stained fine and very fine pumice lapilli; with distinct pumice dominant basal 10 mm; loose, angular lapilli; ungraded unit
	unnamed	30	3.670	Greyish brown medium sandy loam textured ash
Waiohau Tephra		30	3.700	White very fine ash , pocketing, with distinct, irregular contacts
***	***	80	3.780	Dark greyish brown (2.5Y4/2) sandy loam textured medial unit, slightly greasy, with scattered very fine pumice lapilli
Bullot Formation (upper)	unnamed	40	3.820	Very fine and fine pumice and lithic lapilli, with dark greyish brown (2.5Y4/2) coarse sandy loam textured ash matrix
***	***	90	3.910	Pale brown to grey sandy clay loam textured medial unit, slightly greasy; with many fine lithic and pumice lapilli and root channels
	unnamed	80	3.990	Brownish yellow (10YR6/8) fine and few medium pumice lapilli, with white (2.5Y8/2) interiors, and black lithic lapilli; with a coarse ash matrix; imogolite on faces of some pumice
***	***	90	4.080	Coarse sandy clay loam textured medial unit, sticky, showing paleosol development; with distinctive dark brown coated root channels
	unnamed	70	4.150	Strong brown very fine and fine pumice lapilli, and grey lithic lapilli; with a lithic lapilli dominant base; imogolite on some lapilli faces; loose lapilli; ungraded unit
***	***	150	4.300	Coarse sandy loam textured medial unit, slightly greasy, with distinctive dark brown coated root channels
	unnamed	70	4.370	Pale yellow (2.5Y7/4) fine pumice lapilli, with white interiors, and grey lithic lapilli, with some coarse ash matrix; discontinuous unit
***	***	70	4.440	Brownish grey coarse sandy loam textured medial unit
	unnamed	100	4.540	Black and yellow coarse pumiceous and lithic ash with scattered fine lithic and pumice lapilli
***	***	60	4.600	Grey (10YR5/1) fine sandy loam textured medial unit, slightly greasy, showing paleosol development; with scattered very fine white pumice lapilli
Rerewhakaaitu Tephra		10	4.610	White very fine ash, pocketing
***	***	110	4.720	Olive medium sandy loam textured medial unit with some root channels
Te Heuheu Formation	unnamed	90	4.810	Black coarse sand matrix, poorly sorted, with scattered andesitic cobbles at top of unit; debris flow deposit
		70	4.880	Brownish grey fine sandy loam textured unit
		90	4.970	Coarse loamy sand textured matrix, poorly sorted; sharp contacts; hyperconcentrated flood flow deposit
		60	5.030	Fine sand laminae, with root channels
		30 000+	35.030	Andesitic diamictons; thick deposits with sandy matrices and andesitic pebbles, cobbles and boulders; with fluvial interbeds

Section Name and Map Code: Whangaehu River Section 5 [WR5]

Grid Reference: T20/443045

Locality: A large exposure on the Whangaehu escarpment, approx. 300 m south of an unnamed vehicle track which joins the Desert Road

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Makahikatoa Sands		600	0.600	Grey loamy sand textured unit and overlying present-day soil surface
		40	0.640	Very dark brown (10YR2/2) loamy sand textured unit, with charcoal fragments; weakly developed paleosol
Tufa Trig Formation	?member Tf14	10	0.650	Dark grey coarse sandy ash, pocketing
Makahikatoa Sands		40	0.690	Dark brown (10YR3/3) fine sandy loam textured unit
Tufa Trig Formation	?member Tf13	10	0.700	Dark grey coarse sandy ash, pocketing
Makahikatoa Sands		30	0.730	Dark brown (10YR3/3) fine sandy loam textured unit
Tufa Trig Formation	?member Tf10	10	0.740	Black pocketing coarse ash
Makahikatoa Sands		20	0.760	Dark brown medium sandy loam textured unit, slightly greasy; weakly developed paleosol
Tufa Trig Formation	?member Tf8	45	0.805	10 mm Pale grey fine ash 10 mm Black coarse ash 15 mm Black coarse ash and very fine lithic and pumice lapilli 10 mm Black fine ash base
Makahikatoa Sands		30	0.835	Medium sandy loam textured unit, slightly greasy
Tufa Trig Formation	unnamed	10	0.845	7 mm Dark grey to black coarse ash 3 mm Pale grey fine ash base
Makahikatoa Sands		45	0.890	Medium sandy loam textured unit, slightly greasy
Tufa Trig Formation	unnamed	20	0.910	10 mm Black coarse ash 10 mm Pale grey fine ash base
Makahikatoa Sands		10	0.920	Medium sandy loam textured unit, slightly greasy
Tufa Trig Formation	member Tf6	40	0.960	30 mm Black coarse ash 10 mm Pale grey fine ash base
Makahikatoa Sands		40	1.000	Medium sandy loam textured unit, slightly greasy
Tufa Trig Formation	member Tf5	50	1.050	45 mm Black coarse ash 5 mm Paler grey ash base
Makahikatoa Sands		50	1.100	Sandy loam textured unit, greasy
Tufa Trig Formation	member Tf4	30	1.130	Black coarse ash
Makahikatoa Sands		190	1.320	Fine sandy loam textured unit, greasy; with scattered Taupo Pumice and charcoal fragments; paleosol
Tufa Trig Formation	member Tf2	40	1.360	Dark grey medium scoriaceous lapilli interbedded in sandy loam textured ash
***	***	300	1.660	Yellowish brown slightly greasy sandy loam textured unit; paleosol
Taupo Pumice	Taupo Ignimbrite	240	1.900	White poorly sorted coarse ash and lapilli, with charcoal
Mangatawai Tephra		410	2.310	170 mm Dark brown (10YR3/3) fine sandy clay loam textured ash, greasy; with distinct dark coated root channels 20 mm Black coarse ash, pocketing 70 mm Olive brown (2.5Y4/4) fine sandy loam textured ash 150 mm Alternately bedded black coarse ash and brown fine sandy loam textured ash beds; discontinuous beds
Papakai Formation		140	2.450	Yellowish brown (10YR5/4) fine sandy loam textured ash; paleosol
Waimihia Tephra		30	2.480	Very pale brown (10YR8/3) fine ash 'cream cakes'
Papakai Formation		250	2.730	Light olive brown (2.5Y5/4) fine sandy loam textured ash, with scattered lapilli
	black ash-2	20	2.750	Black coarse ash, pocketing; distinct tephra

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Papakai Formation & Hinemaiaia Tephra		180	2.930	Light olive brown (2.5Y5/4) fine sandy loam, slightly greasy, with interspersed white and yellowish brown (10YR5/5) coarse pumiceous ash
Papakai Formation	unnamed	?50	2.980	Fine and medium pale pumice lapilli, firm pumice; with light olive brown sandy loam textured ash matrix
		100	3.080	Yellowish brown (10YR5/6) medium sandy loam textured ash, slightly greasy
	unnamed	90	3.170	Medium and fine pumice lapilli; olive interiors, firm pumice
		320	3.490	Yellowish brown (10YR5/6) medium sandy loam textured ash, slightly greasy; with many scattered bluish grey lithic lapilli especially at base
reworked Mangamate Tephra		330	3.820	Weakly bedded olive, grey, and strong brown fine and very fine dominantly lithic lapilli, and very fine angular platy fragments; sharp contacts
Mangamate Tephra	?Poutu Lapilli	50	3.870	Grey, and strong brown iron-stained medium and fine lithic lapilli and few poorly vesicular pumice lapilli
	?Wharepu Tephra	420	4.290	Weakly bedded olive grey fine and very fine dominantly lithic lapilli, and few pumice lapilli; loose sharp angular lapilli; normally graded
		170	4.460	Dark greyish brown (10YR4/2) to dark brown (10YR4/3) coarse lithic ash and fine lapilli, with few strong brown iron-stained very fine pumice lapilli
		30	4.490	Dark grey (10YR4/1) to purplish grey coarse loamy ash
		150	4.640	Very dark grey (10YR3/1) and dark brown (7.5YR4/4) fine and very fine lapilli; angular, non- and poorly vesicular lapilli
		70	4.710	Very dark grey (10YR3/1) fine lithic lapilli, and fewer strong brown pumiceous lapilli; normally graded tephra, grading upwards to coarse ash
Poronui Tephra		30	4.740	White very fine ash, pocketing, interbedded with yellowish brown (10YR5/5) coarse andesitic ash
Mangamate Tephra	Ohinepango Tephra	90	4.830	Colour-banded tephra comprising alternating black lithic dominant, and strong brown pumice dominant coarse ash beds
Bullot Formation (upper)	unnamed	30	4.860	Very pale brown (10YR7/3) medium and fine pumice lapilli, and black lithic lapilli; very vesicular pumice; angular lithics
		5	4.865	Black coarse sandy ash
		30	4.895	Strong brown fine and medium pumice lapilli with sandy loam textured ash matrix
		20	4.915	Yellowish brown coarse sandy loam textured ash, greasy
		20	4.935	Pumice and lithic lapilli, and greasy coarse sandy loam textured ash matrix
***	***	50	4.985	Yellowish brown (10YR5/6) and greyish brown (2.5Y5/2) coarse sandy loam to sandy clay loam textured medial unit, showing paleosol development; with yellowish red iron-stained contacts and mottles
	unnamed	50	5.035	Yellowish brown (10YR5/6) coarse sandy loam textured ash and fine and very fine strong brown pumice lapilli and grey lithic lapilli
		50	5.085	Brownish yellow (10YR6/6) fine and medium pumice lapilli, with light grey (10YR7/2) interiors, and a coarse ash matrix
		90	5.175	Grey (2.5Y5/2) loamy sand
***	***	130	5.305	Yellowish brown (10YR5/4) sandy loam textured medial unit, greasy; with scattered lapilli
	unnamed	80	5.385	Yellowish brown fine and fewer medium pumice lapilli and very fine angular, platy pumice fragments, and a variety of lithic lapilli; loose lapilli, gravelly texture
***	***	280	5.665	Coarse sandy loam textured medial unit, slightly greasy; with many interspersed fine lithic and pumice lapilli, increasing in concentration toward base of unit
***	***	70	5.735	Greyish brown (2.5Y5/2) gleyed sandy loam textured medial unit, showing paleosol development, greasy, with interspersed medium pumice and lithic lapilli, and distinct dark coated root channels; with yellowish brown (10YR5/6) iron-stained contacts;

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	40	5.775	Dark yellowish brown (10YR4/4) medium and fine pumice lapilli; with pale yellow ?imogolite coatings on lapilli faces; some coarse sandy loam textured ash matrix
		50	5.825	Coarse sandy loam textured medial unit, with dark coated root channels, and some pumice and lithic lapilli
		30	5.855	Purplish grey coarse ash and scattered lapilli
		80	5.935	Strong brown (7.5YR5/6) medium and fine pumice lapilli, with yellowish brown interiors, and black lithic lapilli; ?imogolite coatings on pumice faces
		50	5.985	Yellowish brown (10YR5/4) coarse sandy ash and lapilli
		50	6.035	Light olive brown (2.5Y5/4) coarse sandy ash; with lapilli at base
		50	6.085	Dark grey (2.5Y4/0) to purplish grey coarse sandy ash
		20	6.105	Grey ash and fine lapilli
		20	6.125	Yellow medium pumice lapilli; some ash matrix
		30	6.155	Black coarse sandy ash
	member L17	50	6.205	Dark greyish brown (2.5Y4/2) medium and coarse pumice lapilli, and few lithic lapilli; very vesicular, brittle pumice; loose lapilli
	unnamed	40	6.245	Yellowish brown loamy ash
		60	6.305	Pumice lapilli and coarse ash
		20	6.325	Yellowish brown greasy sandy loam
	M_2	90	6.415	10 mm Black coarse ash 30 mm Brownish grey loamy ash 20 mm Fine lapilli and coarse ash 30 mm Brownish grey greasy sandy loam textured ash
	member L16	80	6.495	Olive brown (2.5Y4/4) and yellow (10YR7/6) fine, medium, and few coarse pumice lapilli, with yellow and very pale brown (10YR7/3 – 8/3) interiors, and with black lithic lapilli
	unnamed	50	6.545	Dark yellowish brown (10YR4/4) fine sandy loam textured ash, greasy
		60	6.605	Yellowish brown medium pumice lapilll and sandy loam textured ash
		40	6.645	Yellowish brown medium sandy loam textured ash, slightly greasy
		30	6.675	Medium pumice lapilli in brown sandy loam textured ash
		60	6.735	Brown sandy loam textured ash
		50	6.785	Strong brown pumice and black lithic lapilli; discontinuous tephra
		60	6.845	Grey fine sandy loam textured ash, slightly greasy
Waiohau Tephra		40	6.885	White (10YR8/2) very fine ash; discontinuous tephra; with intermixed black fine andesitic lapilli in base
Bullot Formation (upper)	unnamed	20	6.905	Brownish grey sandy loam textured ash
		20	6.925	Dark purplish black coarse ash
		20	6.945	Purplish grey sandy ash
		60	7.005	Dark purple sandy ash
***	***	110	7.115	Grey gleyed sandy loam textured medial unit, showing paleosol development; very greasy, with scattered lapilli and coated root channels; with dark brown (7.5YR4/4) and dark grey (10YR4/1) contacts
	unnamed	70	7.185	Grey coarse sandy loam textured ash and scattered fine pumice and lithic lapilli; gravelly texture
		60	7.245	Yellowish brown medium and few coarse pumice lapilli, and grey lithic lapilli
		10	7.255	Dark purplish black coarse ash
***	***	60	7.315	Yellowish brown fine sandy loam textured medial unit
	unnamed	20	7.335	Yellow soft pumice lapilli interbedded in a grey sandy ash matrix
		40	7.375	Dark purplish black ash and basal very fine lithic lapilli
		50	7.425	Yellowish brown fine sandy loam textured ash

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Bullot Formation (upper)	unnamed	90	7.515	Olive brown (2.5Y4/4) fine and medium pumice lapilli, with very dark greyish brown (2.5Y3/2) interiors, and very fine angular, platy pumice fragments and few lithic lapilli; very vesicular pumice
***	***	110	7.625	Olive brown (2.5Y4/4) fine sandy loam textured medial unit, showing paleosol development, slightly greasy; with dark coated root channels and interbedded medium lapilll
Bullot Formation (upper)	?member L8	120	7.745	Light yellowish brown (10YR6/4) to light olive brown (2.5Y5/4) medium to very fine pumice lapilli, and pumiceous coarse ash; very soft pumice; reversely graded tephra, grading upwards from dominantly coarse ash, to dominantly medium lapilli
	unnamed	80	7.805	Dark greyish brown (10YR4/2) fine and medium pumice lapilli
		50	7.855	Lithic lapilli with fewer dark greyish brown (10YR4/2) fine pumice lapilli
***	***	80	7.915	Dark greyish brown medium sandy loam textured medial unit, with interspersed scattered fine lapilll
Rerewhakaaitu Tephra		40	7.955	Light grey (10YR7/1) fine ash interbedded within dark grey coarse andesitic ash and very fine lithic lapilli; discontinuous tephra
Bullot Formation (middle)	unnamed	40	7.995	Greyish brown loamy ash and fine lithic and fewer pumice lapilli
		40	8.035	Greyish brown coarse ash
	member L7	100	8.135	Brownish yellow (10YR6/6) and yellowish brown (10YR5/4) fine, medium and few coarse pumice lapilli, with olive grey (5Y5/2) interiors, and few black and brownish red lithic lapilli concentrated in basal 20 mm; some grey sandy ash matrix
	unnamed	120	8.255	Dark brown (10YR4/3) grey and brown coarse loamy ash
	member L5	220	8.475	Olive (5YR5/6) fine and medium pumice lapilli, with same coloured interiors, and black and olive grey lithic lapilli; with a coarse ash matrix
Te Heuheu Formation	unnamed	8000	16.475	Iron-stained coarse sand and granule matrix, lithlfied; with matrix-supported dominantly medium purple, red, black and grey andesitic pebbles, and brownish yellow and multicoloured fine and medium pumice pebbles; some cobbles and boulders; angular and subrounded clasts; poorly bedded deposit; debris flow deposit
		5000	21.475	Brown sand and granule matrix; with matrix and pockets of clast-supported andesitic pebbles, cobbles and boulders; maximum clast 2 m (boulder); lower 1 m finer grade with overall smaller clasts; debris flow deposit
		1400	22.875	Bedded coarse and fine sand with pebbles; beds thicknesses generally 50 – 100 mm; some cross-beds; fluvial deposit
		700	23.575	Dark brown (10YR3/3) centimetre- and millimetre-bedded sand and granule matrix, lithified, with andesitic and pumice pebbles; deposit shows characteristics transitional between fluvial and hyperconcentrated flood flow deposits
Bullot Formation (middle)	unnamed	100	23.675	Strong brown fine airfall pumice lapilli, angular; with a sandy loam textured ash matrix
Te Heuheu Formation	unnamed	1200	24.875	Light brown coarse sand and granule matrix, lithified, and bedded at base; with abundant multicolored fine andesitic pebbles and pale yellow pumice pebbles concentrated in base of deposit; hyperconcentrated flood flow deposit
		2000	26.875	Coarse sand and granule matrix, lithified; upper 400 mm poorly bedded; with many fine and coarse andesitic pebbles; prominent, bluff-forming unit; hyperconcentrated flood flow deposit
		3400	30.275	Pink laminated clay with pocketing olive grey sand interbeds
		100	30.375	Olive grey greasy sandy loam textured medial unit
Bullot Formation (middle)	unnamed	80	30.455	Grey and strong brown pumice lapilli, strongly weathered pumice; with a sandy loam textured ash matrix

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Te Heuheu Formation	unnamed	800	31.255	Grey (5Y6/1) pebbly sand; massive; hyperconcentrated flood flow deposit
		400	31.655	Pink sandy clay matrix; with yellow and multicoloured, very vesicular, phenocryst-rich fine and medium pumice pebbles; massive; distinctive; hyperconcentrated flood flow deposit
Te Heuheu Formation	unnamed	100	31.755	Brownish grey loamy sand, with some iron-stained root channels, and scattered yellow medium pumice pebbles;
		240	31.995	Grey pebble-rich coarse sand; hyperconcentrated flood flow deposit
		1600	33.595	Loamy sand and granule matrix; with matrix-supported andesitic pebbles, cobbles and boulders; ungraded deposit; sharp basal contact; debris flow deposit
		250	33.845	Grey pebbly sand; hyperconcentrated flood flow deposit
		4000	37.845	Sand and granule matrix, lithified; with matrix-supported andesitic coarse pebbles, cobbles and boulders; normally graded clasts, with upper 70 mm containing finer clasts than at base; debris flow deposit
		4000	41.845	Sand and granule matrix; with matrix-supported cobbles and boulders; normally graded clasts; debris flow deposit
		3000	44.845	Poorly exposed deposit comprising bedded sands and granules and andesitic pebbles; hyperconcentrated flood flow deposit
		5000	49.845	Coarse sand and granule matrix, with matrix-supported andesitic pebbles to boulders; clasts are normally graded throughout unit; debris flow deposit
		4000	53.845	Debris flow deposits
***	***	220	54.065	Loamy sand textured medial unit, showing paleosol development
		500+	54.565	Pebble-rich debris flow deposits, over multiple older inaccessible andesitic diamictons

Section Name and Map Code: Whangaehu River Section 6 [WR6]

Grid Reference: T20/438033

Locality: A large cutting on the western river bank of Whangaehu River, Rangipo Desert, south of The Chute

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	140	0.140	Pale brownish grey coarse sand and granule matrix, poorly sorted; with matrix-supported fine and some medium to coarse red, black and grey andesitic pebbles and scoria; angular and subangular pebbles; sharp contacts; debris flow deposit
		300	0.440	Pale grey weakly bedded sands and andesitic pebbles; comprising granule dominant, and sand dominant beds, <100 mm depth, and interbedded sand laminae; with few fine andesitic pebbles (maximum clast 10 mm) scattered within beds; discontinuous unit; hyperconcentrated flood flow deposit
		130	0.570	Grey medium loamy sand textured matrix, moderately well sorted, with matrix-supported fine dominantly black scoria pebbles, and occasional cobbles; with common reworked white Taupo Pumice lapilli; Finer basal 10 mm comprising brown fine sand and black sand laminae; discontinuous unit; debris flow deposit
Makahikatoa Sands		90	0.660	Dark grey, moderately well sorted medium sand with reworked very fine Taupo Pumice lapilli and coarse ash, scattered throughout and also occurring in lenses
***	***	60	0.720	Dark yellowish brown (10YR4/4) coarse sandy loam textured medial unit
Onetapu Formation	unnamed	920	1.640	Grey and purplish grey sandy loam textured matrix, with strong brown mottles; many matrix-supported black and red andesitic cobbles, boulders and fine pebbles, and common strong brown and white hydrothermally altered lithic granules, and few pumice pebbles; maximum clast 600 mm; subrounded and angular protruding clasts with iron-stained faces; ungraded unit; distinct wavy basal contact; debris flow deposit
		120	1.760	Bedded brown and black medium sand, well sorted, with laminae of fine sand at base of unit; scattered very fine reworked Taupo Pumice; sharp contacts; ?fluvial deposit
	Ond	650	2.410	Medium sand and granule matrix, poorly sorted; with matrix-supported pebbles and boulders; dominant clast size is very coarse pebble; dominant lithology is black scoria; many grey andesitic pebbles and white iron-stained hydrothermally altered clasts; subrounded and subangular clasts; slightly finer pebble-rich basal 150 mm; debris flow deposit
***	***	10	2.420	Dark greyish brown (10YR4/2) fine, very greasy sandy clay textured medial unit, sticky
Tufa Trig Formation	member Tf6	45	2.465	Black coarse ash, well sorted, bifurcating along exposure
Makahikatoa Sands		20	2.485	Dark brown (7.5YR4/2) coarse sandy loam textured unit, with reddish brown mottles about root channels; distinct contacts
Tufa Trig Formation	member Tf5	45	2.530	Black (5Y2/1) coarse ash, with a grey thin fine ash base; member shows distinct reverse grading
Makahikatoa Sands		30	2.560	Dark greyish brown (10YR4/2) fine sandy loam textured unit; with iron-stained root channels; wavy distinct contacts
Tufa Trig Formation	member Tf4	20	2.580	Very dark grey coarse ash, pocketing
***	***	130	2.710	Dark yellowish brown (10YR4/4) medium sandy clay loam textured medial unit, showing paleosol development; with scattered fine lapilli and dark brown coated root channels; sharp basal contact

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Onetapu Formation	unnamed	470	3.180	Very coarse sand, and granules, and many fine to coarse red, black and grey andesitic pebbles, and grey pumice pebbles; maximum clast 30 mm; discontinuous unit; ungraded; possibly hyperconcentrated flood flow deposit
***	***	70	3.250	Dark yellowish brown (10YR4/4) medium sandy loam textured medial unit, with few scattered very fine and fine lithic lapilli
	unnamed	120	3.370	Loamy coarse sand and granule matrix; with matrix-supported, dominantly medium and coarse andesitic pebbles and scattered cobbles; maximum clast 100 mm; red grey and fewer black scoria pebbles with iron-stained faces; rounded clasts; discontinuous, ungraded unit; debris flow deposit
Taupo Pumice	Taupo Ignimbrite	1250	4.620	Greyish brown (2.5Y5/2) poorly sorted coarse ash and fine pumice lapilli, with charcoal; very coarse crystal-rich deposit at base of ignimbrite; sharp smooth contacts, with eroded upper surface
?Papakai Formation		60	4.680	Dark brown (7.5YR4/2) coarse sandy loam textured unit, greasy
		60	4.740	Dark greyish brown (10YR4/2) coarse sandy loam textured unit, greasy; sharp basal contact
Mangaio Formation (distal deposits)		140	4.880	Coarse sandy clay loam textured unit, with many hydrothermally altered lithic granules, and grey and black medium to very coarse andesitic pebbles, with iron-stained faces; maximum clast 50 mm; subrounded and subangular pebbles; basal 20 mm comprises sand laminae; ?hyperconcentrated flood flow deposit
		110	4.990	Grey gleyed sandy clay loam textured unit; with common hydrothermally altered lithic granules and scattered fine andesitic pebbles; with brown coated root channels
		200	5.190	Yellowish brown (10YR6/8 – 5/8) coarse sandy clay loam matrix, with yellowish red (5YR5/6) mottles; with matrix-supported dominantly coarse grey andesitic pebbles, with iron-stained faces, and common very coarse pebbles to cobbles; maximum clast 120 mm; ungraded; debris flow deposit
		120	5.310	Purplish grey to greyish brown gleyed, greasy sandy clay loam textured unit, over grey gleyed and mottled greasy coarse sandy clay loam
		180	5.490	Grey coarse sandy clay loam textured unit, granule-rich, with yellowish brown mottling; many medium and fine grey, red and hydrothermally altered andesitic pebbles; sharp contacts; hyperconcentrated flood flow deposit
		10	5.500	Yellowish brown (iron-stained) coarse sandy clay, greasy
		50	5.550	Moderately well sorted, dominantly coarse sand, and hydrothermally altered lithic granules; sharp contacts
		210	5.760	Yellowish brown coarse sandy clay textured unit, with lithic granules (dominantly hydrothermally altered, and soft) and fine pebbles
***	***	170	5.930	Weakly bedded yellowish brown well sorted sand-rich beds, granule-rich beds, and orange clay beds
		260	6.190	Sandy clay loam textured matrix; with abundant matrix-supported hydrothermally altered, and grey, red, and black andesitic pebbles; maximum clast 10 mm; clasts fine towards top of unit; gleyed basal 50 mm
		130	6.320	Brown coarse sandy loam textured unit, very greasy
***	***	120	6.440	Black coarse sand
		110	6.550	At river level: yellowish brown very coarse sand and hydrothermally altered lithic granules; base of unit not exposed

Section Name and Map Code: Whangaehu River Section 8 [WR8]

Grid Reference: T20/397951

Locality: An exposure on the Whangaehu escarpment, immediately east of Whangaehu River, and approx. 300 m south of Whangaehu River S.1 (WR1)

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Papakai Formation		540	0.540	Yellowish brown medium sandy loam textured ash, with thin, indistinct interbedded lapilli units; paleosol
		70	0.610	Yellowish brown fine sandy loam textured-ash, with root channels, and scattered fine lapilli; paleosol
Bullot Formation (upper)	?Ngamatea lapilli-1	80	0.690	Dark brown (7.5YR4/4) fine and medium pumice lapilli, and fewer dark grey fine lithic lapilli; loose lapilli, gravelly texture
	unnamed	20	0.710	Grey coarse ash, firm
***	***	120	0.830	Yellowish brown medium sandy loam textured medial unit
Tangatu Formation	unnamed	280	1.110	Pale greyish brown coarse sand and granules, poorly sorted, and dominantly grey fine andesitic pebbles, some scoria, and occasional cobbles; maximum clast 70 mm; poorly sorted base, becoming weakly stratified at top; ?hyperconcentrated flood flow deposit
		50	1.160	Fine sandy loam textured unit with abundant lithic granules and common fine pumice lapilli
		310	1.470	Dark grey stratified sands and lithic granules, with many grey fine andesitic pebbles; slight normal grading, with finer grained stratified top; distinct contacts; finer grained deposit than overlying unit; hyperconcentrated flood flow deposit
		30	1.500	Light brown granule-rich fine sandy loam textured unit
		330	1.830	Grey coarse sand and granules, with many medium grey andesitic pebbles and occasional cobbles; slight normal grading to finer weakly stratified top; semi-lithified, prominent unit; sharp contacts; hyperconcentrated flood flow deposit
		70	1.900	Weakly bedded grey coarse sand
***	***	80	1.980	Yellowish brown (10YR5/8) fine sandy loam- sandy clay loam textured paleosol
Bullot Formation (upper)	unnamed	120	2.100	Brown fine pumice and grey lithic lapilli; ungraded
		20	2.120	Pale grey lithic coarse ash and fine lapilli
***	***	30	2.150	Greyish brown fine sandy clay loam textured medial unit; with many very fine pumice and lithic lapilli; common root channels; distinct contacts
	Shawcroft Tephra	170	2.320	Very dark grey fine lithic lapilli and yellowish brown fine pumice lapilli; basal 30 mm comprises yellowish brown pumice lapilli; soft pumice; angular lithic lapilli
	unnamed	20	2.340	Pale brown fine sandy loam textured ash
Waiohau Tephra		20	2.360	White very fine ash, pocketing
Bullot Formation (upper)	unnamed	20	2.380	Black coarse ash
		70	2.450	Purplish black medium sandy ash
***	***	150	2.600	50 mm Greyish brown fine sandy clay loam textured medial unit, greasy, with common fine yellow pumice lapilli 30 mm Greyish brown fine sandy clay loam textured medial unit with very fine lithic and pumice lapilli 70 mm Greyish brown fine sandy clay, greasy
	unnamed	50	2.650	Yellowish brown fine pumice lapilli, with pale yellow interiors, and dark grey very fine lithic lapilli
***	***	70	2.720	Greyish brown medium sandy clay textured ash, with root channels; paleosol

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Tangatu Formation	unnamed	320	3.040	Grey sands and granules with dominantly very coarse andesitic pebbles; slight normal grading; lenticular ?hyperconcentrated flood flow deposit
***	***	30	3.070	Greyish brown medium sandy loam textured unit, greasy
Bullot Formation	unnamed	50	3.120	Pale yellow fine pumice lapilli, grey lithic lapilli, and coarse pumiceous ash; soft pumice
?Tangatu Formation	unnamed	130	3.250	Bedded greyish brown medium loamy textured sand and grey fine loamy textured sand
Bullot Formation	unnamed	70	3.320	Fine and very fine lithic and pumice lapilli in sandy loam textured ash matrix
Te Heuheu Formation	unnamed	530	3.850	Medium sandy loam textured matrix, with interbedded lenses of grey loamy sand; many fine and medium andesitic pebbles, rounded; unit fines upwards; debris flow deposit
		270	4.120	Grey fine sand and granule matrix, poorly sorted, with many medium and some very coarse andesitic pebbles; lenticular unit; ungraded; debris flow deposit
			4.120	on undescribed cliff-forming sequence of debris flow deposits

Section Name and Map Code: Whangaehu River Section 9 [WR9]

Grid Reference: T20/411966

Locality: An exposure on the Whangaehu escarpment, at the northern end of small pine plantation, on the highest terrace

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
			0.000	Stratigraphy above Shawcroft Tephra is obscured
Bullot Formation (upper)	Shawcroft Tephra	80	0.080	60 mm Black fine and very fine lithic lapilli and fewer strong brown (7.5YR5/8) fine and very fine pumice lapilli 20 mm Strong brown (7.5YR5/8) fine and very fine pumice lapilli, with pale yellow to white interiors, soft pumice; sharp basal contact
***	***	40	0.120	Yellowish brown (10YR5/4) fine sandy loam textured paleosol; with common root channels; friable
Waiohau Tephra		30	0.150	White very fine ash; discontinuous; sharp contacts
Bullot Formation		40	0.190	Very dark grey (2.5Y3/2 to 10YR3/1) loamy textured coarse ash and very fine lithic lapilli
***	***	60	0.250	Light olive brown (2.5Y5/4) sandy loam textured medial unit, with common very fine lithic lapilli; greasy, with common root channels; paleosol
	unnamed	60	0.310	Greyish brown (2.5Y5/2) to brown (10YR5/3) coarse ash and fine lithic lapilli, and olive pumice lapilli with light brownish grey (2.5Y6/2) interiors; ungraded; sharp contacts
		70	0.380	Light yellowish brown (2.5Y6/4) sandy loam textured ash, with root channels
		60	0.440	Light olive brown (2.5Y5/4) coarse ash
		80	0.520	Greyish brown (2.5Y5/2) and dark brown (10YR4/3) coarse ash and very fine lithic lapilli; gravelly texture
		80	0.600	Pale brown (10YR6/3) and light brownish grey (2.5Y6/2) dominantly fine pumice lapilli, with pale yellow interiors; very vesicular pumice; few black fine lithic lapilli; some coarse ash matrix
***	***	150	0.750	Dark yellowish brown (10YR4/4) to olive brown (2.5Y4/4) coarse sandy loam textured paleosol, greasy; with some root channels; friable; sharp contacts
	unnamed	140	0.890	50 mm Yellowish brown fine pumice lapilli, with pale grey interiors, and dark grey (2.5Y4/0) lithic lapilli, and coarse ash 40 mm Dark grey coarse lithic ash 50 mm Yellowish grey fine pumice lapilli, dark grey lithic lapilli, and coarse ash
		90	0.980	30 mm Very dark grey (2.5Y3/0) coarse loamy textured ash 40 mm Very dark grey coarse ash 20 mm Dark brown (10YR4/3) loamy textured coarse ash; distinct contacts
	?member L6	60	1.040	Pale brown (10YR6/3) dominantly fine pumice lapilli, and few coarse lapilli, with greyish brown (2.5Y5/2) interiors; and fewer black lithic lapilli; ungraded tephra
Te Heuheu Formation	unnamed	2000	3.040	Yellowish brown (10YR5/6) sandy loam textured matrix, semi-lithified; with dominantly very coarse andesitic pebbles, and cobbles, and scattered yellow pumice pebbles; few clasts in upper 800 mm; debris flow deposit
		1000	4.040	Sequence of thin (200 mm) grey sand and granule beds, with occasional andesitic pebbles; hyperconcentrated flood flow deposits
		40	4.080	Sand dominant unit, with common andesitic pebbles
Bullot Formation	unnamed	80	4.160	Brown fine sandy loam textured ash with three interbedded yellow fine pumice lapilli units, on

Formation	*Member*	*Unit Depth (mm)*	*Cum. Depth (m)*	*Description*
Te Heuheu Formation	unnamed		4.160	On cliff-forming sequence of lithified hyperconcentrated flood flow and debris flow deposits; containing andesitic pebbles and pumice pebbles; interbedded with occasional light reddish brown (5Y6/4) clay beds, grey sandy loam textured beds, and some Bullot Formation lapilli units

APPENDIX III

ELECTRON MICROPROBE AND X-RAY FLUORESCENCE ANALYSES

IIIa	Rhyolitic Glass	EMP	*p. A176*
IIIb	Clinopyroxene	EMP	*p. A194*
IIIc	Orthopyroxene	EMP	*p. A225*
IIId	Olivine	EMP	*p. A256*
IIIe	Hornblende	EMP	*p. A264*
IIIf	Titanomagnetite/Ilmenite	EMP	*p. A275*
IIIg	Glass	EMP	*p. A282*
IIIh	Bulk Rock Pumice Lapilli	XRF	*p. A293*

Column title

Core	:	Phenocryst core
Rim	:	Phenocryst rim
Gms	:	Groundmass
Gs	:	Glass shard
Inclpx	:	Glass is inclusion in pyroxene
Inclpl	:	Glass is inclusion in plagioclase
Inclol	:	Glass is inclusion in olivine
Band x	:	Indicates band in which glass was analysed

Analyses are numbered consequetively, with analyses from the same mineral grain given the same number with 'a' and 'b' suffix.

Values below accurate detection limit

Values below detection limit are given, but prefixed with an asterisk. They are, however, excluded from all mean and standard deviation calculations.

Mean and standard deviation statistics

Mean and standard deviations presented are calculated for values above detection limit only. Where both core and rim analyses are presented (orthopyroxene, clinopyroxene, olivine, hornblende) only core anlayses are used. For glass results, only groundmass analyses (excluding inclusions) are used, and in the titanomagnetite/ilmenite results only the titanomagnetite values are included.

Water content and normalisation

In glass analyses the water content is assumed to be the difference between analysis total and 100%. Only results above the detection limit are normalised.

Abbreviations

The following abbreviations are used in the tabled presentation of analyses:

na	not analysed
L.O.I.	loss on ignition
Mg Nº	magnesium number
Fo%	forsterite content
En%	enstatite content
Fs%	ferrosilite content
Wo%	wollastonite content

Calculations

Calculations use Mg, Fe and Ca cation values only (Mn is excluded).

Mg Nº	= 100* Mg/(Mg + Fe)
Fo%	= 100* Mg/(Mg + Fe)
En%	= 100* Mg/(Mg + Fe + Ca)
Fs%	= 100* Fe/(Mg + Fe + Ca)
Wo%	= 100* Ca/(Mg + Fe + Ca)

RHYOLITIC GLASS			
Sample Code	**Tephra**	**Section**	**Page**
R4	Waimihia Tephra	Tufa Trig S.2	*A176*
R6	Hinemaiaia Tephra	Desert Road S.11	*A177*
R7	Hinemaiaia Tephra	Death Valley T.L.	*A179*
R8	Whakatane Tephra	Death Valley S.6	*A180*
R9	Motutere Tephra	Death Valley S.4	*A181*
R11	Waiohau Tephra	Wahianoa Aqueduct	*A182*
R12	Waiohau Tephra	Missile Ridge	*A184*
R14	Rerewhakaaitu Tephra	Bullot Track S.1	*A185*
R15	Rerewhakaaitu Tephra	Whangaehu River S.5	*A186*
R16	Rerewhakaaitu Tephra	Desert Road S.10	*A187*
R18	Okareka Tephra	Bullot Track S.1	*A188*
-	Okareka Tephra	Okareka Quarry T.L.	*A190*
R19	Kawakawa Tephra Formation	Desert Road S.10	*A192*

CLINOPYROXENE	
Tephra	**Page**
Member Tf14, Tufa Trig Formation	*A194*
Member Tf8, Tufa Trig Formation	*A195*
Member Tf5, Tufa Trig Formation	*A196*
Member Tf1, Tufa Trig Formation	*A197*
Poutu Lapilli, Mangamate Tephra	*A198*
Waihohonu Lapilli, Mangamate Tephra	*A200*
Oturere Lapilli, Mangamate Tephra	*A202*
Te Rato Lapilli, Mangamate Tephra	*A203*
Okupata Tephra	*A205*
Pahoka Tephra	*A204*
Pourahu Member [tephra unit] [BT1], Bullot Formation	*A206*
Pourahu Member [tephra unit] [WS1], Bullot Formation	*A207*
Pourahu Member [tephra unit] [DR16], Bullot Formation	*A208*
Pourahu Member [tephra unit] [OT], Bullot Formation	*A209*
Pourahu Member [ignimbrite unit] [CT], Bullot Formation	*A210*
Pouahu Member [ignimbrite unit] [MQ], Bullot Formation	*A211*
Ngamatea lapilli-1, Bullot Formation	*A212*
Helwan lapilli, Bullot Formation	*A213*
Member L17, Bullot Formation	*A214*
Member L16, Bullot Formation	*A215*
Shawcroft Tephra, Bullot Formation	*A216*
Rotoaira Lapilli	*A218*
Member L8, Bullot Formation	*A219*
Member L7b, Bullot Formation	*A220*
Member L6 (pink lapilli), Bullot Formation	*A221*
Member L4, Bullot Formation	*A222*
Member L3 (hokey pokey lapilli), Bullot Formation	*A223*
Member L1 (green ash), Bullot Formation	*A224*

ORTHOPYROXENE	
Tephra	**Page**
Member Tf14, Tufa Trig Formation	*A225*
Member Tf8, Tufa Trig Formation	*A226*
Member Tf5, Tufa Trig Formation	*A227*
Member Tf1, Tufa Trig Formation	*A228*
Poutu Lapilli, Mangamate Tephra	*A229*
Waihohonu Lapilli, Mangamate Tephra	*A230*
Oturere Lapilli, Mangamate Tephra	*A231*
Te Rato Lapilli, Mangamate Tephra	*A232*
Pahoka Tephra	*A233*
Okupata Tephra	*A234*
Pourahu Member [tephra unit] [BT1], Bullot Formation	*A236*
Pourahu Member [tephra unit] [WS1], Bullot Formation	*A238*
Pourahu Member [tephra unit] [DR16], Bullot Formation	*A239*
Pourahu Member [tephra unit] [OT], Bullot Formation	*A240*
Pourahu Member [ignimbrite unit] [CT], Bullot Formation	*A241*
Pourahu Member [ignimbrite unit] [MQ], Bullot Formation	*A242*
Ngamatea lapilli-1, Bullot Formation	*A243*
Helwan lapilli, Bullot Formation	*A244*
Member L17, Bullot Formation	*A245*
Member L16, Bullot Formation	*A246*
Shawcroft Tephra, Bullot Formation	*A247*
Rotoaira Lapilli	*A249*
Member L8, Bullot Formation	*A250*
Member L7b, Bullot Formation	*A251*
Member L6 (pink lapilli), Bullot Formation	*A252*
Member L4, Bullot Formation	*A253*
Member L3 (hokey pokey lapilli), Bullot Formation	*A254*
Member L1 (green ash), Bullot Formation	*A255*

OLIVINE	
Tephra	**Page**
Poutu Lapilli, Mangamate Tephra	*A256*
Waihohonu Lapilli, Mangamate Tephra	*A257*
Oturere Lapilli, Mangamate Tephra	*A259*
Pourahu Member [tephra unit] [OT], Bullot Formation	*A260*
Shawcroft Tephra, Bullot Formation	*A261*
Rotoaira Lapilli	*A262*
Member L3 (hokey pokey lapilli), Bullot Formation	*A263*

HORNBLENDE	
Tephra	**Page**
Oturere Lapilli, Mangamate Tephra	*A264*
Te Rato Lapilli, Mangamate Tephra	*A265*
Pahoka Tephra	*A267*
Ngamatea lapilli-1, Bullot Formation	*A269*
Pourahu Member [tephra unit] [OT], Bullot Formation	*A270*
Pourahu Member [tephra unit] [DR16], Bullot Formation	*A271*
Member L17, Bullot Formation	*A272*
Member L6 (pink lapilli), Bullot Formation	*A273*
Member L1 (green ash), Bullot Formation	*A274*

TITANOMAGNETITE and ILMENITE	
Tephra	**Page**
Ngamatea lapilli-1, Bullot Formation	*A275*
Pourahu Member [tephra unit] [BT1], Bullot Formation	*A276*
Pourahu Member [ignimbrite unit] [CT], Bullot Formation	*A277*
Member L17, Bullot Formation	*A278*
Member L16, Bullot Formation	*A279*
Member L8, Bullot Formation	*A280*
Member L6 (pink lapilli), Bullot Formation	*A281*

GLASS	
Tephra	**Page**
Member Tf14, Tufa Trig Formation	*A282*
Member Tf8, Tufa Trig Formation	*A283*
Member Tf5, Tufa Trig Formation	*A284*
Poutu Lapilli, Mangamate Tephra	*A285*
Pourahu Member [tephra unit] [BT1], Bullot Formation	*A286*
Pourahu Member [tephra unit] [DR16], Bullot Formation	*A287*
Pourahu Member [ignimbrite unit] [CT]: unbanded, Bullot Formation	*A288*
Pourahu Member [ignimbrite unit] [CT]: banded, Bullot Formation	*A289*
Member L6 (pink lapilli), Bullot Formation	*A291*
Member L3 (hokey pokey lapilli), Bullot Formation	*A292*

R4 [Waimihia Tephra], Tufa Trig S.2
EMP analyses: glass

R4	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	Mean[1]	Std. Dev.[1]
SiO_2	76.08	76.32	75.79	75.90	76.31	76.67	76.36	74.92	76.44	76.14	76.67	76.15	(0.47)
Al_2O_3	12.58	12.84	12.69	12.71	12.74	12.61	12.79	12.50	12.66	12.67	12.70	12.68	(0.09)
TiO_2	0.16	0.17	0.17	0.17	0.24	0.13	0.21	0.14	0.15	0.23	0.24	0.18	(0.04)
FeO	1.75	2.03	1.67	1.65	1.55	1.61	1.66	1.64	1.66	1.76	1.77	1.70	(0.12)
MgO	0.16	0.21	*0.00	0.10	0.18	0.21	0.19	0.18	0.15	0.11	0.19	0.17	(0.04)
CaO	1.34	1.30	1.12	1.10	1.29	1.37	1.35	1.27	1.30	1.21	1.18	1.26	(0.09)
Na_2O	4.05	3.86	4.12	4.09	4.23	4.10	4.06	3.92	3.75	3.59	3.40	3.92	(0.24)
K_2O	3.25	2.87	2.94	2.96	3.05	3.07	2.81	2.83	2.93	2.94	3.03	2.97	(0.12)
Cl	0.08	0.13	0.12	0.07	0.12	0.13	0.12	0.10	0.12	0.07	0.13	0.11	(0.02)
Total	99.44	99.72	98.61	98.75	99.72	99.90	99.55	97.50	99.16	98.70	99.32	99.12	(0.66)
Analyses above detection limit normalised to 100% loss free													
SiO_2	76.51	76.53	76.86	76.86	76.52	76.75	76.70	76.84	77.09	77.14	77.20	76.82	(0.24)
Al_2O_3	12.65	12.87	12.87	12.87	12.77	12.63	12.85	12.82	12.77	12.83	12.79	12.79	(0.08)
TiO_2	0.16	0.17	0.17	0.18	0.24	0.13	0.21	0.14	0.15	0.23	0.24	0.18	(0.04)
FeO	1.76	2.03	1.69	1.67	1.56	1.61	1.67	1.68	1.68	1.78	1.78	1.72	(0.12)
MgO	0.16	0.21	-	0.10	0.18	0.21	0.19	0.19	0.15	0.11	0.19	0.17	(0.04)
CaO	1.35	1.31	1.14	1.11	1.30	1.37	1.36	1.30	1.31	1.23	1.19	1.27	(0.09)
Na_2O	4.07	3.87	4.18	4.14	4.24	4.10	4.08	4.02	3.78	3.63	3.42	3.96	(0.24)
K_2O	3.26	2.87	2.98	2.99	3.06	3.07	2.82	2.90	2.95	2.98	3.05	2.99	(0.11)
Cl	0.08	0.13	0.12	0.07	0.12	0.13	0.12	0.11	0.12	0.07	0.13	0.11	(0.02)
Water[3]	0.56	0.28	1.39	1.25	0.28	0.10	0.45	2.50	0.84	1.30	0.68	0.88	(0.66)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for values above detection limit only.
[3] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R6 [Hinemaiaia Tephra], Desert Road S.11
EMP analyses: glass *(continued ...)*

R6	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	15 Gs	16 Gs	17 Gs	18 Gs	19 Gs
SiO_2	73.66	73.18	76.38	74.50	73.83	76.27	76.11	74.52	76.35	73.71	73.94	74.24	74.69	76.87	76.81	76.17	78.11	78.38	76.80
Al_2O_3	12.32	12.36	12.75	12.60	12.36	12.82	12.93	12.44	12.54	12.51	12.35	12.62	12.83	12.72	12.39	12.85	12.72	12.81	12.91
TiO_2	0.14	0.18	0.48	0.27	0.17	0.24	0.18	0.13	0.09	0.28	0.24	0.20	0.17	0.13	0.09	0.13	0.32	0.11	0.18
FeO	1.61	1.72	1.55	1.70	1.52	1.51	1.38	1.66	1.41	1.54	1.55	1.42	1.54	1.55	1.54	1.53	1.49	1.87	1.77
MgO	0.16	0.17	0.19	0.15	0.20	0.19	0.11	0.23	0.19	0.18	0.20	0.21	0.20	0.20	0.18	0.19	0.17	0.18	0.19
CaO	1.27	1.29	1.20	1.14	1.22	1.42	1.25	1.33	1.22	1.25	1.14	1.25	1.25	1.35	1.24	1.33	1.28	1.28	1.38
Na_2O	4.32	4.20	4.20	4.30	4.06	4.04	4.23	3.99	3.97	3.75	3.41	3.59	4.09	4.08	4.07	4.08	4.23	3.88	4.10
K_2O	2.80	2.91	2.93	2.91	2.97	2.98	2.99	2.90	2.98	3.02	2.77	2.82	3.04	2.91	2.89	2.92	2.82	2.98	2.88
Cl	0.17	0.09	0.15	*0.00	0.13	0.21	0.17	0.14	0.16	0.18	0.14	0.17	0.11	0.09	0.20	0.12	*0.03	0.15	0.13
Total	96.44	96.09	98.83	97.57	98.46	99.67	99.35	97.35	97.90	98.41	95.73	96.52	97.72	98.88	98.18	98.29	99.11	99.37	99.29
Analyses above detection limit normalised to 100% loss free																			
SiO_2	76.37	76.15	76.27	76.38	76.54	76.52	76.61	76.54	76.96	76.46	77.24	76.92	78.43	78.88	77.01	76.48	78.80	78.84	78.34
Al_2O_3	12.78	12.86	12.90	12.92	12.81	12.86	13.01	12.78	12.81	12.98	12.90	13.07	12.93	12.89	12.62	13.07	12.84	12.89	13.00
TiO_2	0.14	0.19	0.48	0.27	0.17	0.24	0.18	0.14	0.10	0.27	0.25	0.21	0.17	0.13	0.09	0.13	0.32	0.11	0.18
FeO	1.67	1.79	1.57	1.74	1.58	1.52	1.39	1.71	1.44	1.60	1.62	1.47	1.57	1.57	1.57	1.55	1.50	1.88	1.78
MgO	0.17	0.18	0.19	0.15	0.21	0.19	0.11	0.24	0.19	0.18	0.20	0.21	0.20	0.21	0.17	0.19	0.17	0.18	0.19
CaO	1.31	1.35	1.22	1.17	1.27	1.42	1.26	1.37	1.25	1.30	1.19	1.30	1.28	1.37	1.28	1.35	1.27	1.27	1.37
Na_2O	4.48	4.37	4.24	4.41	4.21	4.05	4.26	4.10	4.05	3.89	3.56	3.72	4.19	4.11	4.14	4.13	4.27	3.88	4.13
K_2O	2.90	3.03	2.97	2.98	3.07	2.99	3.01	2.98	3.04	3.13	2.90	2.92	3.11	2.95	2.94	2.97	2.84	3.00	2.88
Cl	0.17	0.09	0.16	-	0.14	0.21	0.17	0.14	0.16	0.19	0.15	0.17	0.11	0.09	0.20	0.12	-	0.15	0.13
Water[t]	3.56	3.91	1.17	2.43	3.54	0.33	0.65	2.65	2.10	3.59	4.28	3.48	2.28	1.32	1.82	1.71	0.89	0.83	0.71

* Indicates value w as below the detection limit.
[!] Means and standard deviations are for values above detection limit only.
[t] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R6 [Hinemaiaia Tephra], Desert Road S.11
EMP analyses: glass *(... continued)*

R6	Mean[†]	Std. Dev.[†]
SiO_2	74.95	(0.98)
Al_2O_3	12.61	(0.20)
TiO_2	0.19	(0.09)
FeO	1.56	(0.10)
MgO	0.18	(0.02)
CaO	1.27	(0.07)
Na_2O	4.03	(0.23)
K_2O	2.91	(0.07)
Cl	0.15	(0.03)
Total	97.84	(1.24)
normalised		
SiO_2	76.61	(0.28)
Al_2O_3	12.89	(0.11)
TiO_2	0.20	(0.09)
FeO	1.60	(0.11)
MgO	0.19	(0.03)
CaO	1.29	(0.07)
Na_2O	4.12	(0.22)
K_2O	2.98	(0.07)
Cl	0.15	(0.03)
Water[‡]	2.16	(1.24)

* Indicates value was below the detection limit.
† Means and standard deviations are for values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R7 [Hinemaiaia Tephra], Death Valley Type Locality
EMP analyses: glass

R7	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	Mean[1]	Std. Dev.[1]
SiO_2	74.83	76.15	75.79	76.60	75.68	74.88	72.75	75.45	76.14	76.10	75.72	76.24	75.74	76.38	75.60	(0.93)
Al_2O_3	12.62	12.75	12.53	12.79	12.64	12.59	12.10	12.77	12.80	12.73	12.79	12.72	12.80	12.75	12.67	(0.18)
TiO_2	0.22	0.18	0.15	0.23	0.20	0.25	0.20	0.25	0.25	0.17	0.17	0.24	0.22	0.19	0.21	(0.03)
FeO	1.69	1.82	1.60	1.61	1.76	1.69	1.45	1.52	1.80	1.71	1.59	1.65	1.73	1.63	1.65	(0.09)
MgO	0.17	0.17	0.07	0.17	0.20	0.17	0.19	0.24	0.18	0.19	0.18	0.24	0.18	0.13	0.18	(0.04)
CaO	1.00	1.09	1.00	1.12	1.35	1.26	1.08	1.29	1.35	1.32	1.24	1.37	1.27	1.22	1.21	(0.12)
Na_2O	4.17	4.18	4.29	4.18	3.78	4.24	4.01	4.05	4.08	3.94	4.14	4.13	3.89	4.11	4.08	(0.14)
K_2O	3.06	3.07	3.08	2.97	3.01	2.72	2.69	2.93	3.15	2.84	2.80	2.92	3.20	3.06	2.96	(0.15)
Cl	0.12	0.11	0.12	0.15	0.11	0.17	*0.06	*0.05	0.15	0.16	0.11	0.11	0.14	0.18	0.13	(0.02)
Total	97.88	99.31	98.63	99.82	98.72	97.96	94.47	98.50	99.88	99.16	98.74	99.60	99.16	99.64	98.67	(1.32)
Analyses above detection limit normalised to 100% loss free																
SiO_2	76.45	76.68	76.85	76.75	76.66	76.44	77.01	76.60	76.23	76.75	76.69	76.54	76.38	76.66	76.62	(0.19)
Al_2O_3	12.90	12.84	12.70	12.81	12.80	12.85	12.81	12.96	12.81	12.84	12.95	12.77	12.91	12.80	12.84	(0.07)
TiO_2	0.22	0.19	0.15	0.23	0.20	0.25	0.21	0.25	0.25	0.17	0.18	0.24	0.22	0.19	0.21	(0.03)
FeO	1.73	1.63	1.63	1.61	1.78	1.73	1.53	1.55	1.80	1.73	1.61	1.66	1.75	1.63	1.67	(0.08)
MgO	0.17	0.17	0.07	0.17	0.20	0.17	0.20	0.24	0.18	0.19	0.18	0.24	0.18	0.13	0.18	(0.04)
CaO	1.02	1.10	1.01	1.12	1.37	1.28	1.14	1.31	1.35	1.33	1.25	1.37	1.28	1.22	1.23	(0.12)
Na_2O	4.26	4.21	4.35	4.19	3.83	4.33	4.25	4.11	4.08	3.97	4.20	4.14	3.92	4.12	4.14	(0.14)
K_2O	3.13	3.09	3.12	2.97	3.04	2.78	2.85	2.97	3.15	2.87	2.83	2.93	3.23	3.07	3.00	(0.13)
Cl	0.12	0.11	0.12	0.15	0.11	0.17	-	-	0.15	0.18	0.11	0.11	0.14	0.18	0.14	(0.02)
Water[2]	2.12	0.69	1.37	0.18	1.28	2.04	5.53	1.50	0.12	0.85	1.27	0.40	0.84	0.36	1.33	(1.32)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R8 [Whakatane Tephra], unnamed section
EMP analyses: glass

R8	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	Mean†	Std. Dev.†
SiO_2	78.72	78.10	77.64	77.79	78.32	77.97	77.79	78.01	78.04	(0.32)
Al_2O_3	11.96	12.31	12.21	12.08	12.12	12.23	12.24	12.25	12.18	(0.11)
TiO_2	0.17	0.14	*0.05	0.15	0.10	*0.07	*0.07	0.14	0.14	(0.02)
FeO	0.96	0.85	0.94	0.78	0.84	0.60	0.37	0.85	0.77	(0.18)
MgO	0.09	0.09	0.10	0.11	0.10	0.14	*0.05	*0.05	0.10	(0.02)
CaO	0.63	0.71	0.72	0.71	0.79	0.73	0.74	0.82	0.73	(0.05)
Na_2O	3.62	3.71	3.93	3.89	3.89	3.54	3.52	4.11	3.78	(0.20)
K_2O	3.67	3.62	4.07	3.66	3.65	3.33	3.23	3.62	3.61	(0.24)
Cl	*0.04	0.16	0.16	0.12	0.13	0.20	*0.00	*0.00	0.15	(0.03)
Total	99.81	99.69	99.77	99.29	99.94	98.74	97.88	99.81	99.37	(0.67)
Analyses above detection limit normalised to 100% loss free										
SiO_2	78.87	78.35	77.81	78.35	78.37	78.97	79.47	78.16	78.54	(0.49)
Al_2O_3	11.98	12.35	12.24	12.17	12.13	12.38	12.51	12.28	12.26	(0.15)
TiO_2	0.17	0.14	-	0.15	0.10	-	-	0.14	0.14	(0.02)
FeO	0.96	0.86	0.94	0.78	0.84	0.61	0.38	0.85	0.78	(0.18)
MgO	0.09	0.09	0.10	0.11	0.10	0.14	-	-	0.10	(0.02)
CaO	0.63	0.71	0.72	0.72	0.79	0.74	0.75	0.82	0.73	(0.05)
Na_2O	3.63	3.72	3.94	3.92	3.89	3.59	3.60	4.11	3.80	(0.18)
K_2O	3.67	3.63	4.08	3.69	3.65	3.38	3.30	3.63	3.63	(0.22)
Cl	-	0.16	0.16	0.12	0.13	0.20	-	-	0.15	(0.03)
Water‡	0.19	0.31	0.23	0.71	0.06	1.27	2.12	0.19	0.63	(0.67)

* Indicates value was below the detection limit.
† Means and standard deviations are for values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R9 [Motutere Tephra], Death Valley S.4
EMP analyses: glass

R9	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	Mean[1]	Std. Dev.[1]
SiO_2	75.14	76.38	76.27	76.47	75.85	75.41	76.05	75.35	75.36	75.34	73.83	75.26	75.56	(0.69)
Al_2O_3	12.91	12.80	12.69	12.79	12.59	12.76	13.00	12.52	12.70	12.73	12.05	12.75	12.69	(0.23)
TiO_2	0.18	0.21	0.10	*0.00	0.16	0.27	0.26	0.22	0.17	0.23	0.17	0.25	0.20	(0.05)
FeO	1.75	1.86	1.37	1.78	1.55	1.69	1.65	1.84	1.87	1.69	1.48	1.58	1.67	(0.15)
MgO	0.20	0.16	0.17	0.16	0.12	0.13	0.17	0.20	0.21	0.12	0.13	0.18	0.16	(0.03)
CaO	1.53	1.48	1.55	1.48	1.43	1.46	1.48	1.35	1.43	1.39	1.64	1.46	1.47	(0.07)
Na_2O	4.15	4.08	3.73	3.73	3.92	3.96	3.82	3.65	3.71	3.69	3.57	3.93	3.83	(0.17)
K_2O	3.09	2.94	3.03	3.15	3.09	3.08	2.92	3.05	3.11	3.62	2.71	2.94	3.06	(0.21)
Cl	0.15	0.09	0.13	0.12	0.14	0.15	0.16	0.16	0.11	0.10	0.12	0.12	0.13	(0.02)
Total	99.09	100.00	99.03	99.66	98.85	98.92	99.50	98.33	98.67	98.91	95.69	98.45	98.76	(1.03)
Analyses above detection limit normalised to 100% loss free														
SiO_2	75.84	76.38	77.01	76.73	76.73	76.24	76.43	76.63	76.37	76.17	77.16	76.44	76.51	(0.35)
Al_2O_3	13.03	12.80	12.82	12.83	12.74	12.90	13.06	12.74	12.87	12.87	12.59	12.95	12.85	(0.13)
TiO_2	0.18	0.21	0.10	-	0.16	0.28	0.26	0.22	0.18	0.23	0.17	0.25	0.20	(0.05)
FeO	1.77	1.86	1.38	1.79	1.57	1.71	1.65	1.87	1.90	1.71	1.54	1.60	1.70	(0.15)
MgO	0.20	0.16	0.17	0.16	0.12	0.13	0.17	0.20	0.21	0.12	0.14	0.18	0.16	(0.03)
CaO	1.54	1.48	1.56	1.48	1.45	1.47	1.49	1.38	1.45	1.41	1.72	1.48	1.49	(0.08)
Na_2O	4.19	4.08	3.76	3.74	3.97	4.00	3.84	3.71	3.76	3.73	3.73	3.99	3.87	(0.16)
K_2O	3.12	2.94	3.06	3.16	3.13	3.11	2.93	3.10	3.15	3.66	2.83	2.98	3.10	(0.20)
Cl	0.15	0.09	0.13	0.12	0.14	0.16	0.16	0.16	0.11	0.10	0.13	0.12	0.13	(0.02)
Water[2]	0.91	0.00	0.97	0.34	1.16	1.08	0.50	1.67	1.33	1.09	4.31	1.55	1.24	(1.03)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for values above detection limit only.
[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R11 [Waiohau Tephra], Wahianoa Aqueduct Section

EMP analyses: glass *(continued ...)*

R11	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	15 Gs	16 Gs	17 Gs	18 Gs	19 Gs	20 Gs
SiO_2	75.95	78.05	75.31	77.97	78.12	78.43	78.52	76.93	76.39	75.82	75.53	78.25	76.99	75.83	77.15	77.43	77.18	75.89	78.40	77.14
Al_2O_3	11.74	12.05	11.38	12.18	12.12	11.76	11.62	12.01	11.39	11.95	11.75	12.10	11.86	11.86	11.98	11.81	11.93	11.67	12.01	11.90
TiO_2	0.15	0.14	0.24	0.14	*0.00	0.10	0.16	0.16	0.10	0.16	0.16	0.14	0.10	0.08	0.15	0.16	0.25	0.12	*0.05	0.16
FeO	0.58	0.80	0.72	0.75	0.67	0.88	0.88	0.76	0.71	0.84	0.62	0.84	0.96	0.77	0.93	0.96	1.05	0.86	0.91	1.01
MgO	0.11	*0.06	0.11	0.11	0.13	0.14	0.08	0.07	0.13	0.17	0.10	0.13	0.16	0.13	0.13	0.14	0.10	0.12	0.12	0.11
CaO	0.91	0.87	0.74	0.97	0.95	0.79	0.80	0.82	0.65	0.82	0.93	0.86	0.94	0.86	0.80	0.93	0.92	0.88	0.91	0.86
Na_2O	3.61	3.95	3.35	3.89	4.13	4.10	2.55	3.74	3.13	3.26	3.60	3.86	3.85	3.63	3.83	3.61	3.89	3.64	3.83	3.91
K_2O	3.11	3.31	3.12	3.23	3.47	3.44	3.47	3.21	3.39	3.19	3.53	3.23	3.36	3.34	3.32	3.22	3.30	2.91	3.14	3.62
Cl	0.15	0.12	0.10	0.17	0.16	0.15	0.13	0.10	0.17	0.16	0.14	0.11	0.14	0.14	0.15	0.19	0.16	0.12	0.15	0.11
Total	96.31	99.29	95.07	99.43	99.76	99.79	98.20	97.79	96.05	96.37	96.35	99.52	98.36	96.63	98.44	98.44	98.78	96.22	99.48	98.80
Analyses above detection limit normalised to 100% loss free																				
SiO_2	78.87	78.60	79.22	78.42	78.31	78.60	79.96	78.67	79.52	78.68	78.39	78.63	78.28	78.47	78.38	78.66	78.13	78.87	78.82	78.08
Al_2O_3	12.19	12.14	11.97	12.25	12.15	11.78	11.83	12.28	11.86	12.40	12.19	12.16	12.05	12.27	12.17	12.00	12.08	12.13	12.08	12.04
TiO_2	0.15	0.14	0.25	0.14	-	0.10	0.16	0.17	0.11	0.16	0.17	0.14	0.11	0.08	0.15	0.16	0.26	0.12	-	0.16
FeO	0.60	0.81	0.75	0.76	0.67	0.88	0.89	0.77	0.74	0.87	0.64	0.85	0.97	0.80	0.94	0.97	1.06	0.90	0.92	1.02
MgO	0.12	-	0.12	0.11	0.13	0.14	0.08	0.07	0.13	0.18	0.11	0.13	0.17	0.13	0.13	0.14	0.10	0.13	0.12	0.11
CaO	0.95	0.88	0.78	0.98	0.95	0.80	0.81	0.84	0.68	0.85	0.96	0.86	0.96	0.89	0.82	0.94	0.93	0.92	0.92	0.87
Na_2O	3.75	3.98	3.52	3.92	4.14	4.11	2.59	3.82	3.26	3.38	3.73	3.88	3.91	3.76	3.89	3.67	3.94	3.78	3.85	3.95
K_2O	3.23	3.33	3.28	3.25	3.48	3.45	3.54	3.28	3.53	3.31	3.66	3.25	3.41	3.46	3.37	3.27	3.34	3.03	3.16	3.66
Cl	0.15	0.12	0.11	0.17	0.16	0.15	0.13	0.10	0.18	0.17	0.15	0.11	0.14	0.14	0.15	0.19	0.16	0.12	0.15	0.11
Water[3]	3.69	0.71	4.93	0.57	0.24	0.21	1.80	2.21	3.95	3.63	3.65	0.48	1.64	3.37	1.56	1.56	1.22	3.78	0.52	1.20

* Indicates value was below the detection limit.

[1] Means and standard deviations are for values above detection limit only.

[3] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R11 [Waiohau Tephra], Wahianoa Aqueduct Section
EMP analyses: glass *(... continued)*

R11	21 Gs	Mean[1]	Std. Dev.[1]
SiO_2	76.20	77.02	(1.04)
Al_2O_3	11.71	11.85	(0.21)
TiO_2	*0.03	0.15	(0.04)
FeO	1.01	0.83	(0.13)
MgO	0.14	0.12	(0.02)
CaO	0.92	0.86	(0.08)
Na_2O	3.58	3.66	(0.35)
K_2O	3.15	3.29	(0.16)
Cl	0.12	0.14	(0.02)
Total	96.83	97.90	(1.43)
Analyses above the detection limit normalised to 100% loss free			
SiO_2	78.70	78.68	(0.44)
Al_2O_3	12.09	12.10	(0.15)
TiO_2	-	0.15	(0.04)
FeO	1.05	0.85	(0.13)
MgO	0.14	0.12	(0.02)
CaO	0.95	0.88	(0.07)
Na_2O	3.70	3.74	(0.33)
K_2O	3.25	3.36	(0.15)
Cl	0.12	0.14	(0.02)
Water[2]	3.17	2.10	(1.43)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for values above detection limit only.
[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R12 [Waiohau Tephra], Missile Ridge
EMP analyses: glass

R12	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	Mean[1]	Std. Dev.[1]
SiO_2	77.13	76.02	75.13	77.74	78.33	78.65	76.87	77.78	75.75	77.30	77.89	77.14	(1.06)
Al_2O_3	11.84	11.67	11.72	12.02	12.05	12.19	11.68	12.25	11.70	12.18	11.87	11.93	(0.21)
TiO_2	0.10	*0.07	0.14	*0.05	*0.07	0.13	*0.00	0.11	*0.06	0.14	0.22	0.14	(0.04)
FeO	0.93	0.90	0.84	1.02	0.84	0.96	0.99	0.99	0.99	0.97	0.79	0.93	(0.07)
MgO	0.15	0.11	0.12	0.15	0.11	0.09	0.11	0.11	0.13	0.11	0.07	0.11	(0.02)
CaO	0.84	0.88	0.81	0.81	0.85	0.91	0.86	0.91	1.32	0.96	0.83	0.91	(0.14)
Na_2O	3.58	3.79	3.52	4.02	3.80	4.02	3.93	3.97	3.79	3.54	3.82	3.80	(0.18)
K_2O	3.22	3.23	2.92	3.29	3.48	2.86	3.25	3.29	3.01	3.24	2.74	3.14	(0.21)
Cl	0.13	0.10	0.10	0.15	0.13	0.10	0.09	0.12	0.18	*0.01	0.15	0.12	(0.03)
Total	97.92	96.71	95.29	99.19	99.59	99.89	97.78	99.53	96.86	98.43	98.38	98.14	(1.36)
Analyses above detection limit normalised to 100 % loss free													
SiO_2	78.77	78.61	78.85	78.38	78.65	78.73	78.61	78.15	78.20	78.53	79.17	78.60	(0.28)
Al_2O_3	12.10	12.07	12.30	12.12	12.10	12.21	11.95	12.31	12.08	12.37	12.07	12.15	(0.12)
TiO_2	0.10	-	0.15	-	-	0.13	-	0.11	-	0.15	0.22	0.14	(0.04)
FeO	0.95	0.93	0.88	1.03	0.84	0.96	1.01	0.99	1.02	0.99	0.80	0.94	(0.07)
MgO	0.15	0.12	0.12	0.16	0.11	0.09	0.11	0.11	0.13	0.11	0.07	0.12	(0.02)
CaO	0.85	0.91	0.84	0.81	0.85	0.91	0.88	0.91	1.36	0.97	0.85	0.92	(0.14)
Na_2O	3.66	3.92	3.69	4.05	3.81	4.02	4.02	3.99	3.92	3.59	3.89	3.87	(0.15)
K_2O	3.29	3.34	3.06	3.32	3.50	2.87	3.32	3.31	3.10	3.29	2.78	3.20	(0.21)
Cl	0.13	0.11	0.10	0.15	0.13	0.10	0.09	0.12	0.19	-	0.15	0.13	(0.03)
Water[2]	2.08	3.29	4.72	0.82	0.41	0.11	2.22	0.48	3.14	1.57	1.62	1.86	(1.36)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R14 [Rerewhakaaitu Tephra], Bullot Track S.1
EMP analyses: glass

R14	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	15 Gs	16 Gs	17 Gs	Mean[1]	Std. Dev.[1]
SiO_2	76.75	76.76	74.69	77.10	75.62	78.13	75.41	76.23	75.16	76.61	76.69	75.87	75.50	75.20	75.54	77.34	76.95	76.14	(0.90)
Al_2O_3	12.31	12.71	12.24	12.57	12.24	11.85	12.57	12.33	12.30	12.10	12.16	12.42	12.15	12.07	12.58	11.38	12.69	12.27	(0.32)
TiO_2	0.09	0.11	0.07	0.12	0.09	0.11	0.23	0.10	0.09	0.12	*0.03	*0.05	0.10	0.14	0.18	0.28	0.17	0.13	(0.05)
FeO	0.84	0.84	0.86	0.83	0.74	0.68	1.28	0.84	0.85	0.97	0.83	0.73	0.75	0.84	1.42	1.34	1.36	0.94	(0.24)
MgO	*0.06	0.09	*0.04	*0.04	0.06	0.07	0.27	0.10	0.06	*0.05	0.06	0.07	0.08	0.07	0.23	0.21	0.24	0.12	(0.08)
CaO	0.57	0.70	0.76	0.65	0.64	0.62	1.39	0.65	0.72	0.73	0.54	0.53	0.58	0.59	1.31	1.43	1.38	0.81	(0.32)
Na_2O	3.77	3.49	3.64	3.35	3.54	3.52	3.64	3.65	3.34	3.44	3.62	3.48	3.85	3.37	3.70	3.95	3.78	3.58	(0.16)
K_2O	3.98	3.87	3.86	4.13	4.14	4.09	2.84	4.15	4.02	3.92	4.14	4.17	4.15	3.78	2.86	2.75	2.82	3.74	(0.53)
Cl	0.11	0.15	0.14	0.15	0.16	0.18	0.09	0.16	0.14	0.16	0.18	0.18	0.12	0.12	0.12	0.10	0.11	0.14	(0.03)
Total	97.42	98.72	96.26	98.90	97.23	99.23	97.72	98.19	96.87	98.05	98.22	97.22	97.08	98.17	97.94	98.75	99.49	97.84	(0.97)
Analyses above detection limit normalised to 100% loss free																			
SiO_2	77.76	77.76	77.59	77.96	77.77	78.73	77.17	77.63	77.75	78.13	78.08	77.83	77.79	78.20	77.13	78.31	77.35	77.82	(0.39)
Al_2O_3	12.64	12.87	12.72	12.71	12.59	11.94	12.87	12.56	12.72	12.34	12.38	12.78	12.52	12.55	12.84	11.52	12.76	12.55	(0.34)
TiO_2	0.09	0.11	0.08	0.12	0.10	0.11	0.23	0.10	0.09	0.12	-	-	0.10	0.15	0.18	0.27	0.17	0.13	(0.05)
FeO	0.86	0.85	0.90	0.84	0.76	0.68	1.31	0.85	0.88	0.99	0.84	0.75	0.78	0.87	1.45	1.35	1.37	0.96	(0.24)
MgO	-	0.10	-	-	0.06	0.07	0.28	0.10	0.07	-	0.07	0.07	0.08	0.07	0.24	0.21	0.24	0.13	(0.08)
CaO	0.58	0.71	0.79	0.66	0.65	0.63	1.42	0.66	0.74	0.74	0.55	0.55	0.58	0.61	1.34	1.45	1.38	0.83	(0.32)
Na_2O	3.87	3.53	3.78	3.39	3.64	3.55	3.73	3.72	3.48	3.51	3.89	3.57	3.78	3.51	3.78	4.00	3.80	3.66	(0.16)
K_2O	4.08	3.92	4.01	4.17	4.25	4.12	2.80	4.22	4.18	3.99	4.22	4.29	4.28	3.91	2.92	2.79	2.83	3.83	(0.55)
Cl	0.11	0.15	0.15	0.16	0.17	0.18	0.10	0.16	0.14	0.16	0.18	0.18	0.12	0.13	0.12	0.11	0.11	0.14	(0.03)
Water[2]	2.59	1.28	3.74	1.10	2.77	0.77	2.28	1.81	3.33	1.95	1.78	2.78	2.94	3.84	2.06	1.25	0.51	2.16	(0.97)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R15 [Rerewhakaaitu Tephra], Whangaehu River S.5
EMP analyses: glass

R15	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	Mean[1]	Std. Dev.[1]
SiO_2	78.68	76.71	74.48	77.06	76.23	76.03	76.28	76.47	76.31	77.24	78.33	74.98	78.12	76.27	76.72	(0.79)
Al_2O_3	12.41	12.73	12.46	12.80	12.56	12.14	11.92	12.28	12.08	12.10	12.83	12.28	12.28	11.92	12.32	(0.28)
TiO_2	*0.06	0.25	0.20	0.22	0.21	0.07	*0.03	*0.07	0.08	*0.08	0.25	0.13	0.11	0.08	0.16	(0.07)
FeO	0.79	1.25	1.52	1.18	1.30	0.87	0.88	0.75	0.81	0.54	1.29	0.98	0.77	0.82	0.95	(0.29)
MgO	0.07	0.22	0.20	0.22	0.13	*0.04	0.07	*0.05	0.11	*0.02	0.27	0.12	0.08	0.09	0.14	(0.07)
CaO	0.81	1.30	1.57	1.19	1.24	0.57	0.54	0.58	0.73	0.52	1.42	1.04	0.85	0.56	0.89	(0.37)
Na_2O	3.50	3.98	3.97	3.72	3.98	3.72	3.40	3.54	3.81	3.82	3.47	3.88	3.73	3.46	3.68	(0.19)
K_2O	4.13	2.61	2.75	3.03	2.78	4.04	4.02	4.12	3.79	4.07	2.97	3.11	4.10	4.26	3.55	(0.61)
Cl	0.14	0.09	0.15	0.07	0.12	0.15	0.12	0.17	0.18	0.18	0.12	0.17	0.13	0.16	0.14	(0.03)
Total	98.20	98.14	97.29	99.27	97.52	98.38	98.04	98.88	98.85	98.27	98.95	98.83	97.94	96.60	97.48	(0.97)
Analyses above detection limit normalised to 100% loss free																
SiO_2	77.96	77.15	78.55	77.82	77.14	77.85	78.39	77.90	77.93	78.81	77.14	77.59	77.73	77.92	77.68	(0.52)
Al_2O_3	12.84	12.97	12.81	12.89	12.87	12.80	12.41	12.88	12.47	12.31	12.97	12.89	12.52	12.34	12.64	(0.21)
TiO_2	-	0.28	0.21	0.22	0.22	0.07	-	-	0.08	-	0.25	0.13	0.11	0.08	0.16	(0.07)
FeO	0.80	1.27	1.58	1.19	1.33	0.89	0.71	0.77	0.84	0.55	1.30	1.00	0.78	0.84	0.97	(0.29)
MgO	0.07	0.22	0.21	0.22	0.13	-	0.07	-	0.11	-	0.27	0.12	0.08	0.09	0.14	(0.07)
CaO	0.82	1.33	1.81	1.19	1.27	0.59	0.58	0.59	0.75	0.53	1.44	1.08	0.88	0.58	0.92	(0.37)
Na_2O	3.57	4.06	4.08	3.75	4.08	3.85	3.54	3.85	3.74	3.88	3.51	4.00	3.80	3.58	3.78	(0.20)
K_2O	4.20	2.88	2.83	3.05	2.83	4.19	4.18	4.25	3.92	4.14	3.00	3.22	4.19	4.40	3.65	(0.64)
Cl	0.14	0.09	0.15	0.07	0.13	0.15	0.13	0.17	0.18	0.18	0.13	0.18	0.13	0.16	0.14	(0.03)
Water[2]	1.80	1.88	2.71	0.73	2.48	3.82	3.97	3.12	3.35	1.73	1.05	3.37	2.08	3.40	2.52	(0.97)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for values above detection limit only.
[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R16 [Rerewhakaaitu Tephra], Desert Road S.10
EMP analyses: glass

R16	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	Mean[†]	Std. Dev.[†]
SiO_2	76.65	76.52	77.02	75.74	76.94	76.62	77.01	76.98	77.75	76.69	(0.62)
Al_2O_3	12.00	11.88	12.01	11.84	12.91	12.69	12.06	12.46	12.25	12.23	(0.36)
TiO_2	0.09	*0.07	*0.01	0.12	0.19	0.19	0.10	0.22	0.13	0.15	(0.05)
FeO	0.96	0.78	0.76	0.99	1.29	1.23	0.99	1.29	0.88	1.02	(0.20)
MgO	0.11	0.13	*0.06	0.08	0.26	0.30	*0.03	0.25	0.06	0.17	(0.09)
CaO	0.68	0.62	0.76	0.78	1.42	1.38	0.68	1.54	0.61	0.93	(0.37)
Na_2O	3.35	3.54	3.51	3.38	3.64	3.77	3.79	3.54	3.71	3.58	(0.15)
K_2O	4.46	4.51	4.31	4.27	2.99	2.97	4.47	2.96	4.43	3.93	(0.68)
Cl	0.20	0.16	0.13	0.13	0.11	0.10	0.18	0.12	0.08	0.13	(0.04)
Total	97.49	98.14	98.50	97.31	99.75	99.24	99.18	99.36	99.90	98.78	(0.90)
Analyses above detection limit normalised to 100% loss free											
SiO_2	77.59	77.98	78.19	77.83	77.13	77.20	77.65	77.47	77.83	77.65	(0.33)
Al_2O_3	12.30	12.11	12.20	12.16	12.94	12.78	12.16	12.54	12.26	12.39	(0.28)
TiO_2	0.09	-	-	0.12	0.19	0.19	0.10	0.22	0.13	0.15	(0.05)
FeO	0.99	0.79	0.77	1.02	1.29	1.24	1.00	1.30	0.88	1.03	(0.19)
MgO	0.12	0.13	-	0.08	0.26	0.30	-	0.25	0.06	0.17	(0.09)
CaO	0.69	0.63	0.77	0.80	1.43	1.39	0.69	1.55	0.61	0.94	(0.37)
Na_2O	3.44	3.61	3.57	3.47	3.65	3.80	3.82	3.56	3.71	3.63	(0.13)
K_2O	4.57	4.59	4.37	4.38	3.00	3.00	4.51	2.97	4.44	3.98	(0.70)
Cl	0.21	0.17	0.13	0.13	0.11	0.10	0.18	0.12	0.08	0.13	(0.04)
Water[‡]	2.51	1.87	1.50	2.69	0.25	0.76	0.82	0.64	0.10	1.24	(0.90)

* Indicates value was below the detection limit.
† Means and standard deviations are for values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R18 [Okareka Tephra], Bullot Track S.1
EMP analyses: glass *(continued ...)*

R18	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	15 Gs	16 Gs	17 Gs	18 Gs	19 Gs	20 Gs
SiO_2	75.33	76.54	75.61	77.91	75.82	75.24	75.38	75.83	77.76	78.08	76.22	77.38	75.49	78.31	78.11	76.73	75.76	75.57	76.24	77.44
Al_2O_3	11.65	11.73	11.82	12.09	11.68	11.72	11.77	11.69	12.07	11.85	11.85	11.85	11.78	12.27	12.17	11.79	11.98	11.63	12.09	12.13
TiO_2	0.12	0.19	*0.03	0.22	0.14	*0.07	*0.05	*0.00	0.14	0.07	0.09	0.12	0.15	0.14	0.13	0.11	*0.07	*0.05	0.15	0.10
FeO	0.67	1.01	0.86	0.99	0.98	0.73	0.89	0.88	1.12	0.89	0.94	0.97	1.03	1.04	0.99	0.78	0.96	0.82	0.93	0.83
MgO	0.09	0.10	*0.01	0.17	0.09	0.08	*0.04	0.06	0.11	0.08	*0.06	0.14	0.16	0.16	0.14	0.13	0.09	0.13	0.14	0.10
CaO	0.78	0.94	0.60	0.89	0.90	0.77	0.79	0.76	0.87	0.71	0.73	0.86	0.88	0.98	0.89	0.90	0.65	0.75	0.86	0.75
Na_2O	3.33	3.52	3.45	4.02	3.70	3.33	3.44	3.40	3.84	3.48	3.67	3.91	3.82	3.62	3.60	3.68	3.58	3.32	3.85	3.85
K_2O	3.90	3.26	4.04	3.30	3.28	4.00	4.18	4.15	3.48	4.18	4.07	3.73	3.02	3.21	3.46	3.24	4.16	3.97	4.07	4.13
Cl	0.12	0.15	0.17	0.18	0.11	0.15	0.10	0.14	0.09	0.12	0.16	0.17	0.16	0.18	0.14	0.15	0.16	0.13	0.17	*0.06
Total	96.18	97.44	96.73	99.76	98.87	98.02	98.54	96.90	99.49	97.43	97.74	99.12	96.50	99.91	99.82	97.52	97.33	96.33	98.29	99.12
Analyses above detection limit normalised to 100% loss free																				
SiO_2	78.32	78.54	78.16	78.10	78.42	78.36	78.07	78.25	78.18	78.08	77.99	78.06	78.23	78.38	78.41	78.69	77.83	78.46	77.58	78.13
Al_2O_3	12.12	12.03	12.21	12.12	12.08	12.20	12.19	12.08	12.13	12.18	12.13	11.95	12.21	12.28	12.22	12.09	12.30	12.08	12.30	12.24
TiO_2	0.12	0.19	-	0.22	0.14	-	-	-	0.14	0.08	0.09	0.13	0.15	0.14	0.13	0.11	-	-	0.15	0.10
FeO	0.91	1.04	0.89	0.99	1.00	0.76	0.93	0.90	1.13	0.91	0.97	0.98	1.07	1.04	0.99	0.79	0.98	0.85	0.95	0.84
MgO	0.09	0.10	-	0.17	0.10	0.08	-	0.06	0.11	0.08	-	0.14	0.17	0.16	0.14	0.14	0.09	0.14	0.14	0.10
CaO	0.81	0.96	0.83	0.90	0.93	0.81	0.81	0.78	0.88	0.72	0.75	0.86	0.91	0.98	0.90	0.93	0.67	0.77	0.87	0.75
Na_2O	3.48	3.61	3.58	4.03	3.83	3.46	3.56	3.51	3.85	3.57	3.76	3.94	3.96	3.63	3.61	3.78	3.68	3.45	3.71	3.68
K_2O	4.05	3.35	4.17	3.30	3.39	4.17	4.33	4.28	3.50	4.29	4.17	3.76	3.13	3.21	3.47	3.33	4.27	4.12	4.14	4.17
Cl	0.12	0.16	0.17	0.18	0.11	0.16	0.11	0.15	0.09	0.12	0.16	0.17	0.16	0.18	0.14	0.15	0.16	0.14	0.18	-
Water[‡]	3.82	2.56	3.27	0.24	3.33	3.98	3.46	3.10	0.51	2.57	2.26	0.88	3.50	0.09	0.38	2.49	2.87	3.68	1.71	0.89

* Indicates value was below the detection limit.
† Means and standard deviations are for values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R18 [Okareka Tephra], Bullot Track S.1
EMP analyses: glass *(... continued)*

R18	21 Gs	22 Gs	23 Gs	Mean[1]	Std. Dev.[1]
SiO_2	77.81	76.73	77.22	76.50	(0.99)
Al_2O_3	11.90	11.81	11.86	11.88	(0.18)
TiO_2	0.20	0.15	0.11	0.14	(0.04)
FeO	0.94	0.98	1.00	0.93	(0.09)
MgO	0.11	0.18	0.16	0.12	(0.03)
CaO	0.93	0.92	0.88	0.83	(0.08)
Na_2O	3.55	3.88	3.90	3.61	(0.19)
K_2O	3.33	3.00	3.35	3.67	(0.41)
Cl	0.12	0.13	0.15	0.14	(0.02)
Total	98.90	98.52	98.64	97.77	(1.26)
Analyses above detection limit normalised to 100% loss free					
SiO_2	78.68	78.48	78.29	78.25	(0.26)
Al_2O_3	12.03	12.24	12.02	12.15	(0.09)
TiO_2	0.20	0.18	0.11	0.14	(0.04)
FeO	0.95	1.00	1.02	0.95	(0.09)
MgO	0.11	0.16	0.16	0.12	(0.03)
CaO	0.94	0.95	0.90	0.85	(0.08)
Na_2O	3.59	3.79	3.95	3.70	(0.17)
K_2O	3.37	3.11	3.40	3.76	(0.44)
Cl	0.12	0.13	0.15	0.15	(0.02)
Water[3]	1.10	3.48	1.36	2.23	(1.26)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for values above detection limit only.
[3] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Okareka Tephra, Okareka Quarry Type Locality

EMP analyses: glass *(continued ...)*

Okareka Tephra	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	15 Gs	16 Gs	17 Gs	18 Gs	19 Gs	20 Gs
SiO_2	77.25	77.24	77.04	76.64	76.24	74.41	76.81	76.13	77.04	76.37	77.32	77.32	76.61	77.09	77.49	76.45	76.59	77.50	76.84	77.78
Al_2O_3	11.58	12.09	12.01	11.84	12.00	11.73	11.88	12.09	12.02	11.92	11.67	11.92	11.68	11.86	11.89	11.78	12.00	11.68	11.91	11.96
TiO_2	0.16	0.12	*0.06	0.09	0.09	*0.00	0.13	0.09	0.19	0.13	*0.06	0.34	*0.06	*0.07	0.15	0.12	0.15	0.10	0.11	0.18
FeO	0.79	0.78	0.90	0.85	0.82	0.94	0.81	0.78	0.98	0.92	0.78	0.91	0.80	0.77	0.85	0.43	0.92	0.81	0.82	0.81
MgO	0.08	0.07	0.07	0.12	0.10	0.12	0.09	0.09	0.14	0.07	0.15	*0.03	0.07	0.11	0.09	0.08	0.12	0.09	0.09	*0.05
CaO	0.71	0.87	0.77	0.92	0.84	0.83	0.78	0.72	0.81	0.81	0.72	0.83	0.72	0.72	0.76	0.78	0.82	0.79	0.81	0.76
Na_2O	3.15	3.56	3.48	3.45	3.34	3.25	3.50	3.43	3.71	3.29	3.52	3.57	3.27	3.52	3.47	3.31	3.33	3.46	3.55	3.61
K_2O	4.13	3.98	4.12	3.96	3.80	3.94	3.98	3.98	3.99	3.91	3.93	4.17	3.91	4.18	4.06	3.95	4.07	4.03	4.09	4.01
Cl	0.10	0.12	0.13	0.14	0.13	0.12	0.09	0.13	0.13	0.12	0.14	0.09	0.15	*0.02	0.14	0.14	0.17	0.14	0.16	0.12
Total	97.94	98.80	98.52	98.00	97.36	95.34	98.05	97.43	98.99	97.53	98.22	99.16	97.21	98.24	98.90	97.05	98.16	98.57	97.38	99.20
Analyses above detection limit normalised to 100% loss free																				
SiO_2	78.88	78.18	78.20	78.21	78.31	78.05	78.34	78.13	77.82	78.30	78.72	77.97	78.80	78.47	78.35	78.78	78.03	78.62	77.88	78.38
Al_2O_3	11.82	12.24	12.19	12.08	12.32	12.30	12.11	12.41	12.14	12.22	11.88	12.02	12.02	12.07	12.02	12.14	12.22	11.83	12.23	12.06
TiO_2	0.17	0.12	-	0.09	0.09	-	0.13	0.09	0.19	0.13	-	0.34	-	-	0.15	0.13	0.15	0.10	0.11	0.18
FeO	0.81	0.79	0.91	0.86	0.84	0.99	0.82	0.80	0.99	0.94	0.79	0.92	0.83	0.78	0.86	0.45	0.94	0.82	0.84	0.82
MgO	0.08	0.07	0.07	0.12	0.10	0.13	0.09	0.09	0.14	0.08	0.15	-	0.07	0.11	0.09	0.08	0.12	0.09	0.09	-
CaO	0.72	0.88	0.78	0.94	0.86	0.87	0.79	0.74	0.82	0.83	0.74	0.84	0.74	0.73	0.77	0.90	0.83	0.80	0.83	0.78
Na_2O	3.21	3.80	3.54	3.52	3.43	3.41	3.57	3.52	3.75	3.38	3.59	3.60	3.36	3.58	3.51	3.41	3.40	3.51	3.65	3.64
K_2O	4.22	4.01	4.18	4.04	3.91	4.13	4.05	4.08	4.03	4.01	4.00	4.21	4.02	4.26	4.11	4.07	4.15	4.09	4.20	4.05
Cl	0.10	0.12	0.13	0.14	0.13	0.13	0.09	0.13	0.13	0.12	0.14	0.09	0.16	-	0.14	0.14	0.17	0.14	0.18	0.12
Water[‡]	2.06	1.20	1.48	2.01	2.64	4.68	1.95	2.57	1.01	2.47	1.78	0.84	2.79	1.76	1.10	2.95	1.84	1.43	2.62	0.80

* Indicates value was below the detection limit.

† Means and standard deviations are for values above detection limit only.

‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Okareka Tephra, Okareka Quarry Type Locality
EMP analyses: glass *(... continued)*

Okareka Quarry	21 Gms	Mean[1]	Std. Dev.[1]
SiO_2	75.78	76.71	(0.75)
Al_2O_3	11.83	11.87	(0.14)
TiO_2	0.14	0.14	(0.06)
FeO	0.83	0.82	(0.11)
MgO	0.12	0.10	(0.02)
CaO	0.84	0.79	(0.05)
Na_2O	3.48	3.44	(0.13)
K_2O	3.40	3.98	(0.16)
Cl	0.13	0.13	(0.02)
Total	96.55	97.93	(0.92)
Analyses above the detection limit normalised to 100% loss free			
SiO_2	78.49	78.33	(0.30)
Al_2O_3	12.25	12.12	(0.15)
TiO_2	0.15	0.14	(0.06)
FeO	0.86	0.84	(0.11)
MgO	0.12	0.10	(0.02)
CaO	0.87	0.81	(0.06)
Na_2O	3.60	3.51	(0.12)
K_2O	3.52	4.06	(0.15)
Cl	0.13	0.13	(0.02)
Water[1]	3.45	2.07	(0.92)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for values above detection limit only.
[1] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R19 [Kawakawa Tephra Formation], Desert Road S.10
EMP analyses: glass *(continued ...)*

R19	1 Gs	2 Gs	3 Gs	4 Gs	5 Gs	6 Gs	7 Gs	8 Gs	9 Gs	10 Gs	11 Gs	12 Gs	13 Gs	14 Gs	15 Gs	16 Gs	17 Gs	18 Gs	19 Gs	20 Gs
SiO_2	76.33	75.87	75.88	75.69	75.98	75.92	76.24	76.22	76.41	75.96	75.80	75.59	75.98	75.70	75.61	75.92	75.95	76.23	76.38	76.15
Al_2O_3	11.83	11.74	11.70	11.57	11.70	11.72	11.76	11.98	11.89	11.70	11.76	11.76	11.74	11.96	11.70	11.44	11.74	11.62	11.76	11.71
TiO_2	0.08	0.18	0.15	0.13	0.21	0.11	0.19	0.13	*0.07	0.10	0.21	0.01	0.23	0.11	0.12	0.17	0.12	0.10	0.09	0.09
FeO	1.01	1.23	0.95	0.94	0.96	1.15	1.15	1.21	1.03	1.16	0.99	0.80	1.10	1.27	0.98	0.80	1.02	0.94	1.24	1.07
MgO	0.14	0.09	0.08	0.09	0.16	0.14	0.10	0.15	0.12	0.16	0.10	0.10	*0.06	0.10	0.13	0.09	0.14	0.13	0.10	0.15
CaO	1.01	1.11	1.07	0.96	0.92	0.90	1.07	0.91	1.03	1.01	0.92	1.02	1.12	1.01	0.97	1.03	0.97	1.08	1.05	1.10
Na_2O	3.58	3.61	3.10	3.13	3.27	3.32	3.42	3.53	2.97	3.19	3.11	2.91	2.98	3.54	2.99	3.10	3.21	3.14	3.49	3.37
K_2O	2.76	2.86	2.70	2.97	3.08	3.26	3.33	3.13	3.08	3.36	2.94	3.01	2.83	2.96	2.84	2.98	3.08	2.94	2.76	3.03
Cl	0.18	0.15	*0.06	0.15	0.25	0.24	0.31	0.22	0.33	0.22	*0.00	0.08	0.19	*0.02	0.25	0.14	0.10	0.25	*0.07	0.20
Total	96.92	96.83	95.64	95.62	96.53	96.74	97.57	97.50	96.86	96.85	95.83	95.27	96.16	96.65	95.58	95.67	96.31	96.43	96.87	96.87
Analyses above detection limit normalised to 100% loss free																				
SiO_2	78.76	78.35	78.34	78.16	78.71	78.47	78.14	78.18	78.89	78.43	78.10	78.34	78.02	78.32	78.11	78.36	78.86	79.05	78.85	78.61
Al_2O_3	12.20	12.12	12.23	12.10	12.12	12.11	12.05	12.29	12.28	12.08	12.27	12.35	12.21	12.37	12.24	11.96	12.19	12.05	12.14	12.09
TiO_2	0.09	0.19	0.16	0.13	0.22	0.11	0.19	0.14	-	0.10	0.22	0.01	0.24	0.12	0.12	0.18	0.13	0.10	0.09	0.09
FeO	1.04	1.27	1.00	0.99	0.99	1.18	1.18	1.24	1.06	1.20	1.03	0.83	1.14	1.32	1.02	0.83	1.05	0.98	1.28	1.10
MgO	0.15	0.09	0.08	0.09	0.16	0.14	0.10	0.15	0.12	0.16	0.10	0.10	-	0.11	0.13	0.10	0.14	0.13	0.11	0.16
CaO	1.04	1.14	1.12	1.00	0.95	0.93	1.10	0.94	1.07	1.04	0.96	1.07	1.16	1.05	1.02	1.07	1.01	1.12	1.08	1.13
Na_2O	3.69	3.73	3.24	3.27	3.38	3.43	3.50	3.62	3.07	3.29	3.25	3.05	3.10	3.66	3.13	3.24	3.33	3.25	3.61	3.48
K_2O	2.85	2.96	2.83	3.11	3.19	3.37	3.42	3.21	3.17	3.47	3.06	3.15	2.94	3.06	2.97	3.12	3.20	3.05	2.85	3.13
Cl	0.18	0.15	-	0.16	0.26	0.25	0.32	0.23	0.34	0.22	-	0.09	0.20	-	0.26	0.15	0.10	0.26	-	0.20
Water[‡]	3.08	3.17	4.36	4.38	3.47	3.26	2.43	2.51	3.14	3.15	4.17	4.73	3.84	3.35	4.42	4.33	3.69	3.57	3.13	3.13

* Indicates value was below the detection limit.
† Means and standard deviations are for values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

R19 [Kawakawa Tephra Formation], Desert Road S.10
EMP analyses: glass *(... continued)*

R19	21 Gs	Mean[†]	Std. Dev.[†]
SiO_2	76.35	76.01	(0.25)
Al_2O_3	11.73	11.74	(0.12)
TiO_2	0.22	0.14	(0.05)
FeO	1.05	1.05	(0.13)
MgO	0.18	0.12	(0.03)
CaO	1.08	1.02	(0.07)
Na_2O	3.23	3.25	(0.21)
K_2O	3.17	3.00	(0.18)
Cl	0.22	0.20	(0.07)
Total	97.23	96.47	(0.64)
Analyses above detection limit normalised to 100% loss free			
SiO_2	78.53	78.79	(0.38)
Al_2O_3	12.06	12.17	(0.11)
TiO_2	0.23	0.14	(0.06)
FeO	1.08	1.09	(0.13)
MgO	0.19	0.13	(0.03)
CaO	1.11	1.05	(0.07)
Na_2O	3.32	3.36	(0.20)
K_2O	3.26	3.11	(0.18)
Cl	0.22	0.21	(0.07)
Water[‡]	2.77	3.53	(0.64)

* Indicates value was below the detection limit.
† Means and standard deviations are for values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Member Tf14, Tufa Trig Formation
EMP analyses: clinopyroxene

Member Tf14	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	Mean†	Std. Dev.†
SiO_2	52.45	50.72	50.70	50.62	50.30	50.90	50.86	50.98	50.85	51.21	51.34	50.99	(0.53)
Al_2O_3	1.97	2.26	1.74	2.15	3.28	3.08	2.66	2.33	2.63	2.62	2.67	2.49	(0.43)
TiO_2	0.14	0.41	0.50	0.54	0.49	0.40	0.38	0.49	0.31	0.37	0.41	0.40	(0.11)
FeO	4.71	10.10	10.81	11.45	7.79	7.44	7.19	9.32	7.03	7.11	7.28	8.20	(1.90)
MnO	0.15	0.19	0.29	0.35	0.24	0.24	0.26	*0.14	*0.00	0.31	0.15	0.24	(0.06)
MgO	17.74	14.26	14.26	13.67	15.43	15.42	15.90	15.10	15.98	15.81	16.07	15.42	(1.06)
CaO	21.39	21.07	19.92	20.40	20.42	21.05	21.53	20.53	21.01	21.44	21.07	20.89	(0.49)
Na_2O	0.29	0.36	0.34	0.30	0.32	0.35	0.26	0.37	0.32	0.32	0.28	0.32	(0.03)
K_2O	*0.01	*0.00	*0.01	*0.01	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	-	-
NiO	*0.05	*0.00	*0.00	*0.02	*0.09	*0.00	*0.08	*0.05	*0.06	*0.02	*0.06	-	-
Cr_2O_3	0.42	*0.09	*0.00	*0.02	0.43	*0.12	0.19	0.30	0.21	*0.10	0.17	0.29	(0.10)
Total	99.27	99.38	98.55	99.48	98.69	98.88	99.23	99.43	98.34	99.18	99.44	99.08	(0.38)
Cations on the basis of 6 oxygens													
Si	1.932	1.914	1.932	1.919	1.891	1.905	1.901	1.912	1.911	1.911	1.910	1.913	(0.012)
Al	0.086	0.101	0.078	0.096	0.145	0.136	0.117	0.103	0.116	0.115	0.117	0.110	(0.019)
Ti	0.004	0.012	0.014	0.015	0.014	0.011	0.011	0.014	0.009	0.010	0.011	0.011	(0.003)
Fe	0.145	0.319	0.344	0.363	0.245	0.233	0.225	0.292	0.221	0.222	0.226	0.258	(0.062)
Mn	0.005	0.006	0.009	0.011	0.008	0.008	0.008	*0.005	*0.000	0.010	0.005	0.008	(0.002)
Mg	0.974	0.802	0.810	0.772	0.865	0.860	0.886	0.844	0.895	0.879	0.891	0.862	(0.052)
Ca	0.844	0.852	0.813	0.829	0.822	0.844	0.862	0.825	0.846	0.857	0.840	0.839	(0.015)
Na	0.020	0.027	0.025	0.022	0.024	0.025	0.019	0.027	0.023	0.023	0.020	0.023	(0.003)
K	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.00	-	-
Ni	*0.002	*0.000	*0.000	*0.001	*0.003	*0.000	*0.002	*0.002	*0.002	*0.001	*0.002	-	-
Cr	0.012	*0.003	*0.000	*0.001	0.013	*0.004	0.006	0.009	0.006	*0.003	0.005	0.009	(0.003)
Total	4.022	4.033	4.025	4.027	4.027	4.022	4.035	4.026	4.027	4.027	4.025	4.027	(0.004)
Mg N°	87.04	71.54	70.19	68.02	77.93	78.68	79.75	74.30	80.20	79.84	79.77	77.02	(5.24)
En%	49.62	40.65	41.18	39.31	44.77	44.40	44.91	43.04	45.62	44.89	45.53	43.99	(2.71)
Fs%	7.39	16.17	17.49	18.48	12.68	12.03	11.40	14.89	11.26	11.34	11.55	13.15	(3.11)
Wo%	43.00	43.18	41.33	42.21	42.55	43.57	43.69	42.07	43.12	43.77	42.92	42.86	(0.72)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member Tf8, Tufa Trig Formation
EMP analyses: clinopyroxene

Member Tf8	1 Core	2a Core	2b Rim	3 Core	4 Core	5 Rim	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	Mean[1]	Std. Dev.[1]
SiO_2	50.23	51.17	51.01	50.99	50.73	50.88	50.44	50.98	52.71	52.24	52.15	50.57	51.22	(0.81)
Al_2O_3	2.91	2.88	1.71	1.51	1.95	1.82	2.88	2.75	1.71	1.75	2.22	3.57	2.41	(0.64)
TiO_2	0.59	0.44	0.54	0.50	0.68	0.60	0.41	0.38	0.19	0.19	0.23	0.38	0.40	(0.16)
FeO	9.80	7.53	10.55	10.35	11.18	10.54	8.59	6.87	5.05	6.54	5.25	6.49	7.76	(2.02)
MnO	*0.11	*0.11	0.30	0.34	0.25	0.29	0.20	0.21	0.15	0.15	0.24	0.17	0.21	(0.06)
MgO	14.34	15.29	14.79	14.54	14.19	14.70	14.71	15.33	17.70	17.83	16.64	15.44	15.60	(1.27)
CaO	20.23	21.61	19.46	20.18	19.92	19.99	21.25	21.90	21.36	19.72	22.03	21.90	21.01	(0.86)
Na_2O	0.34	0.32	0.24	0.25	0.35	0.28	0.34	0.29	0.23	0.21	0.23	0.29	0.29	(0.05)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.01	*0.00	*0.00	*0.01	*0.01	*0.00	-	-
NiO	*0.05	*0.07	*0.04	*0.07	*0.00	*0.00	*0.03	*0.00	*0.00	*0.10	*0.02	*0.05	-	-
Cr_2O_3	*0.06	*0.08	*0.00	0.16	*0.14	*0.10	*0.08	0.37	0.37	*0.07	0.25	*0.08	0.29	(0.09)
Total	98.42	99.23	98.60	98.82	99.25	99.07	98.81	99.09	99.47	98.61	99.25	98.82	98.98	(0.32)
Cations on the basis of 6 oxygens														
Si	1.904	1.908	1.936	1.935	1.920	1.924	1.902	1.907	1.940	1.941	1.930	1.891	1.918	(0.017)
Al	0.130	0.127	0.076	0.068	0.087	0.081	0.128	0.121	0.074	0.076	0.097	0.157	0.107	(0.029)
Ti	0.017	0.012	0.015	0.014	0.019	0.017	0.012	0.011	0.005	0.005	0.007	0.011	0.011	(0.004)
Fe	0.311	0.235	0.335	0.328	0.354	0.334	0.271	0.215	0.156	0.203	0.162	0.203	0.244	(0.066)
Mn	*0.004	*0.003	0.010	0.011	0.008	0.009	0.007	0.007	0.005	0.005	0.007	0.006	0.007	(0.002)
Mg	0.810	0.850	0.836	0.823	0.801	0.829	0.827	0.855	0.971	0.987	0.918	0.860	0.870	(0.063)
Ca	0.822	0.864	0.791	0.820	0.808	0.810	0.859	0.878	0.842	0.785	0.874	0.877	0.843	(0.031)
Na	0.025	0.023	0.018	0.019	0.025	0.020	0.025	0.021	0.017	0.015	0.017	0.021	0.021	(0.004)
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.002	*0.002	*0.001	*0.002	*0.000	*0.000	*0.001	*0.000	*0.000	*0.003	*0.001	*0.002	-	-
Cr	*0.002	*0.002	*0.000	0.005	*0.004	*0.003	*0.002	0.011	0.011	*0.002	0.007	*0.002	0.009	(0.003)
Total	4.019	4.019	4.017	4.023	4.022	4.024	4.031	4.026	4.021	4.017	4.019	4.026	4.022	(0.004)
Mg N[2]	72.26	78.34	71.39	71.50	69.35	71.28	75.32	79.91	86.16	82.94	85.00	80.90	78.17	(5.56)
En%	41.69	43.61	42.61	41.76	40.80	42.02	42.26	43.89	49.31	49.97	46.98	44.33	44.46	(3.08)
Fs%	16.01	12.06	17.07	16.64	18.03	16.93	13.85	11.04	7.92	10.28	8.29	10.46	12.48	(3.35)
Wo%	42.31	44.33	40.32	41.60	41.16	41.05	43.89	45.07	42.76	39.75	44.73	45.21	43.08	(1.76)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member Tf5, Tufa Trig Formation
EMP analyses: clinopyroxene

Member Tf5	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	Mean†	Std. Dev.†
SiO_2	50.58	50.59	50.59	50.42	51.79	50.41	51.19	50.19	50.61	51.14	50.85	50.27	51.07	50.30	50.02	50.67	(0.45)
Al_2O_3	2.41	1.63	1.69	2.06	2.51	3.73	2.64	2.51	2.31	2.75	1.68	1.78	1.65	2.16	2.68	2.28	(0.55)
TiO_2	0.50	0.67	0.58	0.54	0.31	0.45	0.35	0.60	0.44	0.34	0.45	0.64	0.55	0.55	0.64	0.51	(0.11)
FeO	8.68	11.59	11.41	10.53	6.63	6.82	6.67	11.85	8.80	6.06	10.37	10.77	11.62	11.59	11.80	9.68	(2.11)
MnO	0.26	0.29	0.26	0.30	0.20	0.15	0.17	0.25	0.22	*0.10	0.29	0.26	0.28	0.32	0.30	0.25	(0.05)
MgO	14.59	13.90	13.71	13.84	16.66	15.44	16.16	13.66	14.89	16.39	14.53	14.26	14.09	14.15	13.41	14.64	(1.01)
CaO	21.04	19.56	19.51	20.81	21.01	21.50	21.89	19.32	20.83	21.99	20.30	19.98	20.40	19.33	19.83	20.49	(0.87)
Na_2O	0.21	0.30	0.31	0.35	0.30	0.33	0.29	0.44	0.31	0.28	0.32	0.24	0.28	0.41	0.46	0.32	(0.07)
K_2O	*0.00	*0.00	*0.02	*0.00	*0.00	*0.01	*0.00	*0.01	*0.00	*0.02	*0.00	*0.01	*0.01	*0.01	*0.01	-	-
NiO	*0.00	*0.00	*0.08	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	*0.02	*0.00	*0.04	*0.05	*0.00	-	-
Cr_2O_3	*0.06	0.19	0.21	*0.07	0.17	*0.14	*0.15	*0.04	0.17	0.22	*0.07	*0.10	*0.05	*0.05	*0.04	0.19	(0.02)
Total	98.27	98.72	98.26	98.84	99.58	98.81	99.35	98.81	98.57	99.17	98.80	98.19	99.90	98.82	99.13	98.88	(0.47)
Cations on the basis of 6 oxygens																	
Si	1.918	1.931	1.936	1.918	1.918	1.885	1.904	1.913	1.915	1.902	1.930	1.922	1.927	1.916	1.904	1.916	(0.013)
Al	0.108	0.074	0.076	0.092	0.109	0.164	0.116	0.113	0.103	0.120	0.075	0.080	0.073	0.097	0.120	0.101	(0.024)
Ti	0.014	0.019	0.017	0.016	0.009	0.013	0.010	0.017	0.013	0.010	0.013	0.018	0.016	0.016	0.018	0.015	(0.003)
Fe	0.276	0.370	0.365	0.335	0.205	0.213	0.207	0.378	0.279	0.189	0.329	0.344	0.367	0.369	0.376	0.307	(0.069)
Mn	0.008	0.009	0.008	0.010	0.006	0.005	0.005	0.008	0.007	*0.003	0.009	0.008	0.008	0.010	0.010	0.008	(0.002)
Mg	0.825	0.791	0.782	0.785	0.920	0.861	0.896	0.776	0.840	0.908	0.822	0.813	0.793	0.803	0.761	0.825	(0.048)
Ca	0.855	0.800	0.800	0.848	0.834	0.861	0.872	0.789	0.845	0.876	0.825	0.819	0.825	0.789	0.809	0.830	(0.028)
Na	0.015	0.022	0.023	0.026	0.021	0.024	0.021	0.033	0.022	0.020	0.024	0.018	0.019	0.030	0.034	0.023	(0.005)
K	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.002	*0.000	-	-
Cr	*0.002	0.006	0.006	*0.002	0.005	*0.004	*0.004	*0.001	0.005	0.007	*0.002	*0.003	*0.001	*0.002	*0.001	0.006	(0.001)
Total	4.019	4.022	4.013	4.030	4.027	4.026	4.031	4.027	4.029	4.032	4.027	4.022	4.028	4.030	4.032	4.026	(0.005)
Mg N°	74.93	68.13	68.18	70.09	81.78	80.17	81.23	67.24	75.07	82.77	71.42	70.27	68.36	68.52	66.93	73.01	(5.64)
En%	42.18	40.34	40.18	39.88	46.96	44.50	45.37	39.94	42.77	46.02	41.60	41.14	39.95	40.95	39.11	42.06	(2.43)
Fs%	14.11	18.87	18.75	17.02	10.46	11.01	10.48	19.45	14.21	9.58	16.65	17.41	18.49	18.82	19.32	15.64	(3.54)
Wo%	43.71	40.80	41.09	43.09	42.57	44.50	44.15	40.61	43.02	44.40	41.75	41.45	41.56	40.23	41.57	42.30	(1.39)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member Tf1, Tufa Trig Formation
EMP analyses: clinopyroxene

Member Tf1	1 Core	2 Rim	3 Core	4 Rim	5 Rim	6 Core	7 Rim	8a Core	8b Rim	9 Core	10a Core	10b Rim	11 Core	12 Core	13 Core	14a Core	14b Rim	Mean[1]	Std. Dev.[1]
SiO_2	50.66	50.89	52.76	52.88	52.16	51.76	50.99	53.15	51.16	50.71	51.89	51.40	52.43	50.66	51.16	52.77	53.22	51.79	(0.91)
Al_2O_3	2.02	2.50	2.23	2.56	3.07	1.56	2.12	1.98	1.78	2.42	1.70	2.03	2.11	4.67	4.47	3.09	1.69	2.63	(1.05)
TiO_2	0.62	0.64	0.20	0.21	0.23	0.61	0.87	0.18	0.59	0.61	0.60	0.48	0.43	0.49	0.46	0.23	0.29	0.44	(0.17)
FeO	12.45	11.48	5.47	5.61	4.90	10.48	10.11	5.15	10.34	11.83	10.21	11.41	7.91	6.62	6.13	5.60	6.80	8.18	(2.66)
MnO	0.29	0.27	0.18	0.17	0.16	0.29	0.26	0.16	0.28	0.30	0.30	0.40	0.29	0.17	0.23	0.16	0.22	0.24	(0.06)
MgO	14.15	13.96	18.39	18.43	17.82	15.59	14.79	18.04	14.74	13.94	15.27	14.02	16.99	15.77	16.33	18.81	18.64	16.34	(1.63)
CaO	18.29	19.65	19.21	19.28	20.56	19.59	19.92	20.61	19.28	19.55	20.19	19.92	19.57	21.13	21.00	18.67	18.88	19.78	(0.90)
Na_2O	0.42	0.39	0.30	0.30	0.23	0.22	0.24	0.25	0.26	0.41	0.18	0.41	0.15	0.30	0.29	0.28	0.16	0.28	(0.08)
K_2O	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	-	-
NiO	*0.01	*0.02	*0.08	*0.05	*0.08	*0.00	*0.01	*0.00	*0.02	*0.00	*0.00	*0.04	*0.05	*0.05	*0.04	*0.07	*0.08	-	-
Cr_2O_3	0.12	*0.08	0.25	0.11	0.70	*0.00	*0.02	0.35	*0.07	*0.02	*0.03	*0.00	*0.00	*0.03	0.19	0.88	0.11	0.36	(0.27)
Total	99.03	99.78	98.99	99.54	99.82	100.10	99.09	99.86	98.43	99.77	100.33	100.08	99.87	89.81	100.24	100.57	100.02	99.86	(0.49)
Cations on the basis of 6 oxygens																			
Si	1.927	1.916	1.941	1.934	1.908	1.933	1.923	1.943	1.940	1.915	1.933	1.932	1.935	1.870	1.876	1.811	1.946	1.918	(0.025)
Al	0.091	0.111	0.097	0.110	0.132	0.068	0.094	0.085	0.080	0.108	0.075	0.090	0.092	0.203	0.193	0.132	0.073	0.115	(0.045)
Ti	0.018	0.018	0.006	0.006	0.006	0.017	0.018	0.005	0.017	0.017	0.017	0.014	0.012	0.014	0.013	0.006	0.008	0.013	(0.005)
Fe	0.396	0.362	0.168	0.171	0.150	0.327	0.319	0.157	0.328	0.374	0.318	0.359	0.244	0.204	0.188	0.169	0.208	0.255	(0.087)
Mn	0.009	0.009	0.005	0.005	0.005	0.009	0.008	0.005	0.009	0.010	0.009	0.013	0.009	0.005	0.007	0.005	0.007	0.007	(0.002)
Mg	0.803	0.783	1.008	1.005	0.972	0.868	0.832	0.883	0.833	0.765	0.848	0.786	0.934	0.868	0.893	1.021	1.016	0.901	(0.079)
Ca	0.745	0.793	0.757	0.756	0.806	0.784	0.805	0.807	0.783	0.791	0.806	0.802	0.774	0.836	0.825	0.724	0.740	0.785	(0.034)
Na	0.031	0.028	0.021	0.021	0.017	0.016	0.017	0.018	0.019	0.030	0.013	0.030	0.011	0.021	0.021	0.020	0.011	0.020	(0.006)
K	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.001	*0.002	*0.001	*0.002	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.002	*0.002	*0.001	*0.002	*0.002	-	-
Cr	0.004	*0.002	0.007	0.003	0.020	*0.000	*0.001	0.010	*0.002	*0.000	*0.001	*0.000	*0.000	*0.001	0.005	0.025	0.003	0.010	(0.008)
Total	4.024	4.020	4.010	4.011	4.016	4.023	4.017	4.013	4.009	4.030	4.019	4.026	4.011	4.021	4.021	4.013	4.012	4.019	(0.006)
Mg N°	66.97	68.38	85.71	85.46	86.63	72.64	72.28	86.23	71.75	67.73	72.73	68.65	78.28	80.87	82.61	85.80	83.01	78.07	(7.09)
En%	41.31	40.40	52.15	52.02	50.41	43.86	42.54	50.48	42.85	40.26	43.00	40.37	47.85	45.48	46.85	53.34	51.73	46.46	(4.27)
Fs%	20.37	18.68	8.68	8.85	7.78	16.52	16.31	8.06	16.87	18.18	16.13	18.44	12.50	10.68	8.86	8.83	10.59	13.08	(4.36)
Wo%	38.32	40.82	39.16	38.13	41.80	39.62	41.16	41.45	40.28	40.56	40.87	41.18	38.65	43.82	43.28	37.83	37.68	40.46	(1.87)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Poutu Lapilli, Mangamate Tephra
EMP analyses: clinopyroxene *(continued ...)*

Poutu Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	18 Core	19 Core	20 Core
SiO_2	52.39	51.90	52.67	52.34	51.59	51.68	52.63	51.54	52.77	51.57	52.00	51.50	53.01	52.01	52.12	53.04	53.45	52.66	52.96	52.09
Al_2O_3	1.84	2.26	1.69	1.87	2.91	2.83	1.80	2.74	1.47	3.29	1.91	2.63	1.39	2.41	2.80	1.99	1.46	1.59	1.66	2.85
TiO_2	0.21	0.26	0.14	0.23	0.30	0.31	0.18	0.31	0.19	0.31	0.19	0.32	0.21	0.29	0.29	0.22	0.17	*0.14	0.21	0.22
FeO	6.11	4.79	4.78	8.02	6.68	6.40	4.73	6.41	6.00	6.87	6.36	6.07	5.87	6.58	6.50	5.19	3.93	4.83	4.88	5.96
MnO	0.20	*0.03	0.19	0.23	*0.13	0.20	0.20	0.21	0.22	*0.13	0.19	*0.00	0.25	0.17	0.20	0.16	*0.10	*0.07	*0.12	*0.15
MgO	17.18	16.65	17.24	16.81	16.37	16.42	17.19	16.54	17.66	17.84	17.34	16.51	18.58	16.80	16.40	17.40	17.95	16.74	16.96	16.15
CaO	21.28	22.56	22.32	21.17	21.61	21.16	22.54	21.47	20.30	19.28	20.93	21.81	20.33	21.27	21.53	21.92	22.60	22.17	22.39	21.48
Na_2O	0.21	0.17	0.18	*0.08	0.20	0.23	0.19	0.24	*0.14	*0.02	*0.18	*0.21	*0.00	*0.10	*0.03	*0.06	*0.05	0.24	*0.16	0.27
K_2O	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	*0.01	*0.00	*0.01	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	*0.01
NiO	*0.00	*0.06	*0.00	*0.00	*0.05	*0.00	*0.03	*0.00	*0.00	*0.00	*0.02	*0.00	*0.02	*0.04	*0.02	*0.05	*0.00	*0.05	*0.10	*0.03
Cr_2O_3	0.25	0.65	0.30	*0.00	0.43	0.29	0.60	0.33	*0.11	*0.00	0.23	0.30	0.44	0.32	0.33	0.49	0.85	0.50	0.43	0.27
Total	99.68	99.24	99.50	98.66	100.10	99.51	100.06	99.80	98.61	99.16	99.15	99.14	100.07	99.84	100.16	100.42	100.41	98.72	99.49	99.29
Cations on the basis of 6 oxygens																				
Si	1.934	1.920	1.941	1.946	1.902	1.913	1.931	1.906	1.955	1.904	1.927	1.911	1.940	1.918	1.916	1.934	1.942	1.950	1.945	1.925
Al	0.080	0.098	0.073	0.082	0.126	0.123	0.078	0.119	0.064	0.143	0.083	0.115	0.060	0.105	0.121	0.086	0.062	0.069	0.072	0.124
Ti	0.006	0.007	0.004	0.006	0.008	0.009	0.005	0.009	0.005	0.009	0.005	0.009	0.006	0.008	0.008	0.006	0.005	*0.004	0.006	0.006
Fe	0.189	0.148	0.147	0.187	0.206	0.198	0.145	0.198	0.186	0.212	0.197	0.188	0.180	0.203	0.200	0.158	0.119	0.150	0.150	0.184
Mn	0.006	*0.001	0.006	0.007	*0.004	0.006	0.006	0.007	0.007	*0.004	0.006	*0.000	0.008	0.005	0.006	0.005	*0.003	*0.002	*0.004	*0.005
Mg	0.945	0.918	0.947	0.932	0.900	0.906	0.940	0.912	0.975	0.982	0.958	0.913	1.014	0.923	0.899	0.946	0.972	0.924	0.929	0.890
Ca	0.842	0.894	0.881	0.843	0.853	0.839	0.886	0.851	0.806	0.762	0.831	0.867	0.797	0.841	0.848	0.857	0.880	0.880	0.881	0.850
Na	0.015	0.012	0.013	*0.006	0.014	0.016	0.014	0.017	*0.010	*0.001	*0.013	*0.015	*0.000	*0.007	*0.002	*0.004	*0.003	0.017	*0.012	0.019
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000
Ni	*0.000	*0.002	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.002	*0.000	*0.001	*0.003	*0.001
Cr	0.007	0.019	0.009	*0.000	0.013	0.008	0.017	0.010	*0.003	*0.000	0.007	0.009	0.013	0.009	0.010	0.014	0.025	0.015	0.012	0.008
Total	4.024	4.016	4.021	4.003	4.022	4.018	4.022	4.029	3.998	4.012	4.014	4.012	4.018	4.012	4.008	4.006	4.005	4.005	3.995	4.006
Mg N^a	83.33	86.12	86.56	83.29	81.37	82.07	86.64	82.16	83.98	82.24	82.94	82.92	84.92	81.97	81.80	85.69	89.09	86.03	86.10	82.87
En%	47.82	46.84	47.95	47.50	45.94	46.63	47.69	46.51	49.57	50.20	48.24	46.39	50.93	46.92	46.17	48.24	49.32	47.29	47.40	46.26
Fs%	9.56	7.55	7.44	9.53	10.52	10.19	7.36	10.10	9.46	10.84	9.92	9.55	9.04	10.32	10.27	8.06	6.04	7.68	7.65	9.56
Wo%	42.61	45.61	44.61	42.97	43.54	43.18	44.95	43.40	40.98	38.96	41.84	44.05	40.03	42.76	43.55	43.70	44.65	45.04	44.95	44.18

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Poutu Lapilli, Mangamate Tephra
EMP analyses: clinopyroxene *(... continued)*

Poutu Lapilli	21 Core	22 Core	23 Core	24 Core	25 Core	26 Core	27 Core	28 Core	Mean†	Std. Dev.†
SiO_2	53.69	51.90	52.87	53.42	53.28	51.79	51.83	51.94	52.38	(0.64)
Al_2O_3	1.32	2.98	1.96	1.74	1.77	2.69	2.84	3.79	2.23	(0.64)
TiO_2	*0.13	0.26	*0.00	*0.12	*0.13	0.26	0.32	0.22	0.24	(0.05)
FeO	5.14	6.16	6.15	6.21	6.26	6.60	6.84	7.24	5.91	(0.80)
MnO	*0.13	0.21	*0.18	0.21	*0.00	*0.12	0.21	0.21	0.20	(0.02)
MgO	17.70	15.90	16.81	17.11	16.79	16.60	16.31	16.76	16.95	(0.59)
CaO	21.33	21.78	21.26	20.44	21.24	20.29	21.38	19.54	21.33	(0.84)
Na_2O	0.17	0.23	*0.16	0.20	*0.17	0.25	0.23	0.23	0.22	(0.03)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.04	*0.00	-	-
NiO	*0.00	*0.00	*0.00	*0.03	*0.00	*0.00	*0.03	*0.00	-	-
Cr_2O_3	0.46	0.34	0.24	*0.15	*0.16	0.28	0.34	*0.17	0.39	(0.15)
Total	99.81	99.75	99.28	99.32	99.35	98.76	100.29	99.92	99.55	(0.52)
Cations on the basis of 6 oxygens										
Si	1.961	1.917	1.949	1.963	1.958	1.925	1.909	1.906	1.930	(0.018)
Al	0.057	0.130	0.085	0.076	0.077	0.118	0.123	0.164	0.097	(0.028)
Ti	*0.004	0.007	*0.000	*0.003	*0.004	0.007	0.009	0.006	0.007	(0.002)
Fe	0.157	0.190	0.190	0.191	0.192	0.205	0.210	0.222	0.182	(0.025)
Mn	*0.004	0.006	*0.006	0.006	*0.000	*0.004	0.007	0.006	0.006	(0.001)
Mg	0.964	0.875	0.924	0.937	0.920	0.920	0.895	0.917	0.931	(0.030)
Ca	0.835	0.862	0.840	0.805	0.836	0.808	0.843	0.768	0.842	(0.033)
Na	0.012	0.017	*0.012	0.014	*0.012	0.018	0.016	0.016	0.015	(0.002)
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	-	-
Ni	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	-	-
Cr	0.013	0.010	0.007	*0.004	*0.005	0.008	0.010	*0.005	0.012	(0.004)
Total	3.999	4.014	3.995	3.992	3.983	4.009	4.022	4.005	4.009	(0.011)
Mg N°	86.99	82.16	82.94	83.07	82.73	81.78	81.00	80.51	83.65	(2.07)
En%	49.28	45.41	47.29	48.47	47.23	47.59	45.94	48.09	47.61	(1.32)
Fs%	8.03	9.86	9.72	9.88	9.86	10.61	10.78	11.64	9.32	(1.31)
Wo%	42.69	44.73	42.99	41.65	42.92	41.80	43.28	40.27	43.07	(1.61)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Waihohonu Lapilli, Mangamate Tephra
EMP analyses: clinopyroxene *(continued ...)*

Waihohonu Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8a Core	8b Rim	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	18 Core	19 Core
SiO_2	52.43	52.78	50.28	52.42	51.93	52.87	53.21	51.07	51.52	53.05	52.70	50.83	51.98	52.73	53.22	52.62	51.45	52.80	52.05	52.12
Al_2O_3	1.36	0.95	3.52	1.21	2.24	0.96	1.02	1.98	3.01	1.24	1.60	2.68	1.69	1.25	1.19	1.58	2.34	1.13	1.88	1.85
TiO_2	0.14	0.13	0.53	*0.00	0.22	0.11	0.09	0.63	0.38	0.12	0.15	0.50	0.19	0.13	0.12	0.19	0.25	0.12	0.20	0.22
FeO	4.20	3.94	8.44	4.07	5.90	3.90	3.43	11.13	6.70	3.46	5.33	8.39	4.06	3.60	3.65	5.42	5.76	3.56	4.24	5.69
MnO	0.15	*0.13	*0.00	*0.09	0.17	*0.09	*0.06	0.27	0.21	*0.11	0.21	0.26	0.19	0.14	*0.14	0.17	0.16	*0.09	0.17	0.17
MgO	17.26	17.86	15.93	17.73	16.81	17.89	18.35	13.85	15.99	17.74	18.16	15.42	17.55	17.78	17.89	17.30	16.93	17.66	17.29	17.27
CaO	22.77	22.29	19.09	22.31	21.56	22.40	21.79	20.36	21.45	22.80	20.26	21.11	22.24	22.81	22.85	21.45	21.22	23.04	21.72	21.29
Na_2O	0.25	*0.14	0.27	0.26	0.17	0.18	*0.13	0.35	0.24	0.20	0.19	0.33	*0.17	*0.15	0.17	0.17	0.27	0.18	0.21	0.20
K_2O	*0.01	*0.00	*0.00	*0.00	*0.02	*0.00	*0.00	*0.02	*0.02	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.01	*0.01	*0.02	*0.01	*0.00
NiO	*0.00	*0.00	*0.00	*0.00	*0.02	*0.01	*0.00	*0.05	*0.06	*0.03	*0.00	*0.03	*0.00	*0.00	*0.00	*0.03	*0.00	*0.02	*0.07	*0.01
Cr_2O_3	0.77	0.35	*0.10	0.79	0.21	0.61	0.60	*0.06	*0.12	0.79	0.36	*0.03	1.08	0.76	0.73	0.25	0.38	0.84	1.09	0.24
Total	99.32	96.30	98.07	98.79	99.21	98.92	98.48	99.64	99.50	99.40	98.97	99.52	98.97	99.18	99.81	99.14	98.76	99.33	98.84	99.07
Cations on the basis of 6 oxygens																				
Si	1.937	1.956	1.895	1.942	1.925	1.952	1.961	1.927	1.909	1.947	1.946	1.902	1.923	1.941	1.946	1.946	1.917	1.943	1.928	1.933
Al	0.059	0.041	0.156	0.053	0.098	0.042	0.044	0.088	0.131	0.053	0.069	0.118	0.073	0.054	0.051	0.069	0.103	0.049	0.082	0.081
Ti	0.004	0.004	0.015	*0.000	0.008	0.003	0.003	0.018	0.011	0.003	0.004	0.014	0.005	0.003	0.003	0.005	0.007	0.003	0.005	0.006
Fe	0.130	0.122	0.266	0.128	0.183	0.120	0.106	0.351	0.207	0.106	0.165	0.262	0.125	0.111	0.112	0.168	0.179	0.109	0.131	0.177
Mn	0.005	*0.004	*0.000	*0.003	0.005	*0.003	*0.002	0.009	0.007	*0.004	0.006	0.008	0.006	0.004	*0.004	0.005	0.005	*0.003	0.005	0.005
Mg	0.951	0.987	0.895	0.979	0.929	0.985	1.008	0.779	0.883	0.971	0.999	0.860	0.968	0.976	0.975	0.954	0.940	0.969	0.955	0.955
Ca	0.901	0.885	0.771	0.885	0.856	0.886	0.860	0.823	0.851	0.897	0.801	0.846	0.882	0.900	0.895	0.850	0.847	0.909	0.862	0.846
Na	0.018	*0.010	0.020	0.019	0.013	0.013	*0.010	0.025	0.017	0.014	0.014	0.024	*0.012	*0.011	0.012	0.012	0.020	0.013	0.015	0.014
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000
Ni	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.002	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.002	*0.000
Cr	0.023	0.010	*0.003	0.023	0.006	0.018	0.017	*0.002	*0.003	0.023	0.011	*0.001	0.031	0.022	0.021	0.007	0.011	0.025	0.032	0.007
Total	4.026	4.005	4.018	4.027	4.021	4.018	3.999	4.020	4.016	4.014	4.015	4.034	4.013	4.011	4.015	4.016	4.029	4.020	4.015	4.024
Mg N^{a}	87.97	89.00	77.09	88.60	83.54	89.14	90.48	68.94	81.01	90.16	85.82	76.65	88.56	89.79	89.70	85.03	84.00	89.89	87.94	84.36
En%	47.98	49.50	46.33	49.20	47.21	49.47	51.06	39.88	45.49	49.19	50.84	43.70	49.01	49.12	49.19	48.38	47.81	48.77	49.02	48.28
Fs%	6.56	6.12	13.77	6.33	9.30	6.03	5.37	17.97	10.66	5.37	8.40	13.31	6.33	5.59	5.65	6.52	9.10	5.49	6.72	8.95
Wo%	45.46	44.38	39.91	44.47	43.50	44.50	43.57	42.14	43.84	45.44	40.76	42.99	44.66	45.29	45.16	43.10	43.08	45.75	44.25	42.77

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Waihohonu Lapilli, Mangamate Tephra
EMP analyses: clinopyroxene *(... continued)*

Waihohonu Lapilli	Mean[1]	Std. Dev.[1]
SiO_2	52.24	(0.80)
Al_2O_3	1.67	(0.65)
TiO_2	0.22	(0.16)
FeO	5.17	(2.03)
MnO	0.19	(0.04)
MgO	17.19	(1.05)
CaO	21.76	(1.02)
Na_2O	0.23	(0.06)
K_2O	-	-
NiO	-	-
Cr_2O_3	0.62	(0.28)
Total	99.04	(0.43)
Cations		
Si	1.935	(0.017)
Al	0.073	(0.029)
Ti	0.006	(0.004)
Fe	0.160	(0.065)
Mn	0.006	(0.001)
Mg	0.949	(0.053)
Ca	0.863	(0.035)
Na	0.016	(0.004)
K	-	-
Ni	-	-
Cr	0.018	(0.008)
Total	4.018	(0.008)
Mg N[a]	85.61	(5.57)
En%	48.10	(2.49)
Fs%	8.15	(3.35)
Wo%	43.75	(1.55)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Oturere Lapilli, Mangamate Tephra
EMP analyses: clinopyroxene

Oturere Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	Mean†	Std. Dev.†
SiO_2	47.71	51.84	50.31	51.17	52.95	49.38	52.27	51.59	51.44	50.14	50.38	50.71	51.91	50.60	50.87	(1.26)
Al_2O_3	8.72	2.79	4.35	2.89	0.81	5.35	2.30	2.32	3.19	4.60	4.44	4.30	2.94	4.32	3.66	(1.45)
TiO_2	0.93	0.38	0.44	0.58	0.22	0.85	0.24	0.30	0.28	0.48	0.49	0.48	0.28	0.45	0.44	(0.18)
FeO	8.57	8.83	8.88	9.15	8.04	9.02	8.43	7.91	7.23	7.39	7.43	7.12	8.72	6.99	7.55	(0.83)
MnO	*0.14	0.21	0.20	*0.00	0.27	0.17	0.18	0.28	0.20	0.22	0.22	*0.13	0.18	0.20	0.21	(0.04)
MgO	13.98	18.43	16.40	13.92	16.12	14.25	17.09	17.47	18.58	16.33	16.78	16.75	18.51	16.64	16.66	(1.06)
CaO	20.50	20.95	21.52	22.05	22.78	20.99	21.02	19.27	20.50	21.38	21.43	21.52	21.47	21.53	21.20	(0.78)
Na_2O	0.34	0.28	0.29	0.38	0.22	0.32	0.21	*0.15	*0.00	0.28	0.28	0.32	0.18	0.26	0.28	(0.05)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.02	*0.02	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	-	-
NiO	*0.00	*0.00	*0.03	*0.04	*0.00	*0.03	*0.05	*0.08	*0.00	*0.13	*0.05	*0.07	*0.00	*0.05	-	-
Cr_2O_3	*0.13	*0.11	0.19	*0.04	*0.08	*0.09	0.20	*0.05	*0.00	*0.11	*0.12	0.18	*0.15	*0.12	0.19	(0.02)
Total	98.75	99.48	99.57	99.92	100.38	100.13	99.92	99.14	99.42	99.78	100.44	100.35	100.19	99.99	99.82	(0.48)
Cations on the basis of 6 oxygens																
Si	1.797	1.913	1.870	1.914	1.983	1.839	1.924	1.918	1.907	1.880	1.858	1.888	1.909	1.870	1.886	(0.041)
Al	0.298	0.122	0.190	0.119	0.035	0.235	0.100	0.101	0.139	0.201	0.193	0.187	0.127	0.188	0.160	(0.064)
Ti	0.028	0.011	0.012	0.018	0.008	0.018	0.007	0.008	0.008	0.013	0.014	0.013	0.008	0.013	0.012	(0.005)
Fe	0.270	0.211	0.214	0.288	0.249	0.281	0.198	0.248	0.224	0.229	0.229	0.219	0.207	0.216	0.234	(0.027)
Mn	*0.004	0.007	0.008	*0.000	0.008	0.005	0.005	0.009	0.006	0.007	0.007	*0.004	0.008	0.006	0.007	(0.001)
Mg	0.785	0.907	0.863	0.778	0.838	0.791	0.938	0.987	0.918	0.848	0.888	0.885	0.905	0.862	0.866	(0.055)
Ca	0.827	0.831	0.857	0.883	0.904	0.838	0.828	0.787	0.814	0.849	0.847	0.849	0.848	0.852	0.842	(0.030)
Na	0.025	0.019	0.021	0.028	0.018	0.023	0.015	*0.011	*0.000	0.020	0.020	0.023	0.013	0.019	0.020	(0.004)
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.001	*0.001	*0.000	*0.001	*0.001	*0.002	*0.000	*0.004	*0.001	*0.002	*0.000	*0.001	-	-
Cr	*0.004	*0.003	0.008	*0.001	*0.002	*0.003	0.008	*0.001	*0.000	*0.003	*0.003	0.005	*0.004	*0.004	0.006	(0.000)
Total	4.028	4.021	4.029	4.020	4.017	4.030	4.022	4.014	4.014	4.027	4.038	4.029	4.021	4.026	4.024	(0.006)
Mg N°	74.41	81.13	79.94	73.07	77.05	73.79	82.57	79.72	80.35	78.74	79.12	79.80	81.38	79.96	78.65	(2.84)
En%	41.71	48.54	44.33	39.90	42.03	41.41	47.74	48.84	48.88	44.03	44.85	44.75	48.22	44.66	44.55	(2.49)
Fs%	14.35	10.83	11.12	14.70	12.52	14.71	10.08	12.42	11.48	11.89	11.78	11.33	10.57	11.19	12.07	(1.46)
Wo%	43.84	42.84	44.54	45.40	45.45	43.87	42.18	38.74	41.88	44.08	43.57	43.82	43.21	44.15	43.38	(1.65)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Te Rato Lapilli, Mangamate Tephra
EMP analyses: clinopyroxene

Te Rato Lapilli	1 Core	2 Core	3a Core	3b Rim	4a Core	4b Rim	5 Core	6 Core	7 Core	8 Core	9 Core	Mean[1]	Std. Dev.[1]
SiO_2	51.06	51.50	52.66	52.31	51.41	51.21	51.53	51.33	51.88	51.00	51.64	51.53	(0.46)
Al_2O_3	1.96	2.01	2.33	2.19	2.09	2.66	2.12	2.07	2.28	3.65	1.68	2.24	(0.53)
TiO_2	0.52	0.51	0.24	0.21	0.54	0.24	0.54	0.57	0.52	0.32	0.56	0.48	(0.11)
FeO	10.35	9.41	5.83	5.44	9.61	6.95	9.80	10.34	7.90	6.26	10.04	8.84	(1.65)
MnO	0.35	0.23	0.19	0.18	*0.00	0.26	0.29	0.27	*0.00	*0.00	0.24	0.26	(0.05)
MgO	14.46	15.43	16.91	16.88	15.08	15.68	14.86	14.48	14.70	15.76	14.50	15.13	(0.76)
CaO	20.68	20.49	21.02	22.07	21.04	20.70	21.16	21.00	20.91	20.84	20.34	20.83	(0.26)
Na_2O	*0.23	*0.21	*0.06	*0.16	*0.15	*0.18	*0.31	*0.32	*0.34	*0.21	0.25	0.25	(0.00)
K_2O	*0.00	*0.03	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	-	-
NiO	*0.00	*0.03	*0.03	*0.09	*0.00	*0.01	*0.01	*0.02	*0.02	*0.11	*0.00	-	-
Cr_2O_3	*0.08	*0.05	0.43	0.51	*0.00	*0.00	*0.00	*0.00	*0.10	1.35	*0.00	0.89	(0.46)
Total	99.37	99.59	99.61	99.79	99.76	97.69	100.29	100.06	97.98	99.17	99.25	99.45	(0.62)
Cations on the basis of 6 oxygens													
Si	1.923	1.924	1.937	1.924	1.922	1.929	1.918	1.919	1.943	1.890	1.944	1.924	(0.015)
Al	0.087	0.088	0.101	0.095	0.092	0.118	0.093	0.091	0.101	0.159	0.075	0.099	(0.023)
Ti	0.015	0.014	0.007	0.006	0.015	0.007	0.015	0.016	0.015	0.009	0.016	0.014	(0.003)
Fe	0.326	0.294	0.179	0.167	0.300	0.219	0.305	0.323	0.248	0.194	0.316	0.276	(0.053)
Mn	0.011	0.007	0.006	0.005	*0.000	0.008	0.009	0.008	*0.000	*0.000	0.008	0.008	(0.002)
Mg	0.812	0.859	0.927	0.926	0.840	0.880	0.825	0.807	0.824	0.871	0.814	0.842	(0.036)
Ca	0.834	0.820	0.828	0.870	0.843	0.836	0.844	0.841	0.842	0.828	0.821	0.833	(0.009)
Na	*0.016	*0.015	*0.004	*0.011	*0.011	*0.013	*0.022	*0.024	*0.025	*0.015	0.018	0.018	(0.000)
K	*0.000	*0.002	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.000	*0.001	*0.001	*0.003	*0.000	*0.000	*0.000	*0.001	*0.000	*0.003	*0.000	-	-
Cr	*0.002	*0.001	0.013	0.015	*0.000	*0.000	*0.000	*0.000	*0.003	0.040	*0.000	0.027	(0.014)
Total	4.008	4.006	3.998	4.008	4.012	3.997	4.009	4.005	3.973	3.991	4.012	4.002	(0.012)
Mg N^a	71.35	74.50	83.82	84.72	73.68	80.07	73.01	71.42	76.87	81.78	72.04	75.38	(4.30)
En%	41.18	43.54	47.93	47.17	42.36	45.48	41.79	40.94	43.05	46.01	41.72	43.17	(2.22)
Fs%	16.53	14.90	9.26	8.51	15.13	11.32	15.45	16.39	12.96	10.25	16.20	14.12	(2.55)
Wo%	42.29	41.56	42.81	44.32	42.51	43.20	42.76	42.67	43.99	43.74	42.08	42.71	(0.72)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Pahoka Tephra
EMP analyses: clinopyroxene

Pahoka Tephra	1 Core	2 Core	3 Core	4 Core	5 Core	Mean†	Std. Dev.†
SiO_2	49.47	51.35	50.33	48.35	52.00	50.30	(1.30)
Al_2O_3	4.65	2.37	4.44	6.07	2.44	3.99	(1.41)
TiO_2	0.49	0.25	0.55	0.65	*0.17	0.48	(0.15)
FeO	8.18	4.93	8.07	10.00	9.68	8.17	(1.80)
MnO	0.21	*0.11	*0.18	*0.18	0.23	0.22	(0.01)
MgO	15.20	16.56	14.31	13.31	15.97	15.07	(1.16)
CaO	20.70	22.03	21.38	20.17	18.94	20.64	(1.06)
Na_2O	*0.25	*0.23	0.31	0.36	0.25	0.31	(0.04)
K_2O	*0.01	*0.01	*0.01	*0.00	*0.02	-	-
NiO	*0.07	*0.09	*0.06	*0.03	*0.00	-	-
Cr_2O_3	0.17	0.66	0.29	*0.10	*0.12	0.37	(0.21)
Total	99.07	98.15	99.65	98.91	99.51	99.06	(0.53)
Cations on the basis of 8 oxygens							
Si	1.852	1.916	1.874	1.826	1.934	1.880	(0.040)
Al	0.205	0.104	0.195	0.270	0.107	0.176	(0.063)
Ti	0.014	0.007	0.015	0.018	*0.005	0.014	(0.004)
Fe	0.256	0.154	0.251	0.316	0.301	0.256	(0.057)
Mn	0.007	*0.003	*0.006	*0.006	0.007	0.007	(0.000)
Mg	0.848	0.921	0.794	0.749	0.885	0.839	(0.062)
Ca	0.830	0.880	0.853	0.816	0.754	0.827	(0.042)
Na	*0.018	*0.016	0.022	0.026	0.018	0.022	(0.003)
K	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.002	*0.002	*0.002	*0.001	*0.000	-	-
Cr	0.005	0.019	0.008	*0.003	*0.004	0.011	(0.006)
Total	4.017	4.001	4.012	4.021	4.006	4.011	(0.007)
Mg N°	76.81	85.67	75.98	70.33	74.62	76.68	(5.02)
En%	43.85	47.11	41.83	39.82	45.62	43.65	(2.60)
Fs%	13.24	7.88	13.22	16.80	15.52	13.33	(3.05)
Wo%	42.92	45.01	44.94	43.38	38.87	43.02	(2.24)

* Indicates value was below the detection limit.

† Means and standard deviations are for core values above detection limit only.

Okupata Tephra
EMP analyses: clinopyroxene

Okupata Tephra	1 Core	2 Core	3 Core	4 Core	5 Rim	6 Core	7 Core	8 Rim	9 Core	10 Core	11 Core	12 Core	Mean[1]	Std. Dev.[1]
SiO_2	51.49	50.83	49.88	49.92	50.82	50.95	50.69	49.73	50.81	50.54	50.05	50.65	50.52	(0.50)
Al_2O_3	2.17	1.69	2.31	2.39	1.20	1.55	1.57	2.65	2.47	1.95	2.65	2.01	2.08	(0.37)
TiO_2	0.27	0.48	0.57	0.58	0.24	0.50	0.45	0.82	*0.00	0.53	0.83	0.37	0.49	(0.11)
FeO	8.81	10.35	11.53	10.48	11.85	10.03	11.00	10.38	7.99	10.34	11.12	10.41	9.98	(1.44)
MnO	0.18	0.28	0.29	0.31	0.32	0.37	0.31	0.29	0.25	0.32	0.24	0.38	0.29	(0.06)
MgO	18.24	14.38	13.68	14.04	13.89	14.52	14.21	14.01	16.55	14.25	13.75	13.89	14.55	(0.96)
CaO	21.47	20.64	20.19	20.48	21.09	20.84	20.12	19.99	20.28	20.19	19.90	20.73	20.48	(0.43)
Na_2O	0.25	0.33	0.44	0.34	0.33	0.27	0.37	0.37	0.40	0.38	0.42	0.38	0.36	(0.06)
K_2O	*0.00	*0.00	*0.01	*0.01	*0.01	*0.01	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	-	-
NiO	*0.05	*0.03	*0.00	*0.02	*0.07	*0.10	*0.13	*0.06	*0.00	*0.01	*0.00	*0.00	-	-
Cr_2O_3	0.17	*0.03	*0.08	*0.07	*0.01	*0.01	0.26	*0.08	*0.04	*0.04	*0.08	0.28	0.24	(0.05)
Total	98.84	98.75	98.67	98.51	99.34	99.02	98.98	98.03	98.58	98.51	98.78	99.09	98.77	(0.20)
Cations on the basis of 6 oxygens														
Si	1.924	1.925	1.902	1.905	1.938	1.930	1.927	1.903	1.908	1.925	1.908	1.923	1.917	(0.010)
Al	0.096	0.076	0.104	0.108	0.054	0.069	0.071	0.119	0.110	0.088	0.119	0.090	0.093	(0.016)
Ti	0.008	0.014	0.017	0.017	0.007	0.014	0.013	0.018	*0.000	0.015	0.018	0.011	0.014	(0.003)
Fe	0.206	0.329	0.369	0.334	0.371	0.318	0.350	0.332	0.252	0.329	0.354	0.331	0.317	(0.047)
Mn	0.005	0.008	0.009	0.010	0.010	0.012	0.010	0.009	0.008	0.010	0.008	0.012	0.009	(0.002)
Mg	0.905	0.815	0.779	0.799	0.777	0.820	0.805	0.789	0.929	0.809	0.780	0.786	0.823	(0.049)
Ca	0.859	0.841	0.828	0.837	0.861	0.846	0.820	0.820	0.818	0.824	0.812	0.843	0.833	(0.014)
Na	0.018	0.024	0.033	0.025	0.024	0.020	0.027	0.027	0.029	0.028	0.031	0.028	0.026	(0.004)
K	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.001	*0.001	*0.000	*0.001	*0.002	*0.003	*0.004	*0.002	*0.000	*0.000	*0.000	*0.000	-	-
Cr	0.005	*0.001	*0.002	*0.002	*0.000	*0.000	0.008	*0.002	*0.001	*0.001	*0.002	0.008	0.007	(0.001)
Total	4.028	4.032	4.041	4.034	4.040	4.029	4.031	4.027	4.052	4.028	4.028	4.032	4.033	(0.007)
Mg N°	81.48	71.24	67.88	70.49	67.88	72.08	69.70	70.85	78.88	71.09	68.78	70.37	72.17	(4.16)
En%	45.94	41.08	39.42	40.53	38.88	41.33	40.78	40.95	48.47	41.23	40.08	40.10	41.69	(2.33)
Fs%	10.48	16.57	18.67	16.96	16.47	16.03	17.72	17.02	12.81	16.77	16.19	16.89	16.09	(2.44)
Wo%	43.60	42.37	41.90	42.51	42.66	42.64	41.52	42.03	40.92	42.00	41.73	43.01	42.22	(0.73)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [BT1], Bullot Formation
EMP analyses: clinopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	Mean[†]	Std. Dev.[†]
SiO_2	50.04	51.04	50.85	49.84	51.09	52.02	50.81	(0.72)
Al_2O_3	2.94	1.65	2.04	4.15	2.03	1.34	2.36	(0.94)
TiO_2	0.73	0.47	0.63	0.77	0.52	0.38	0.58	(0.14)
FeO	11.24	9.92	11.19	9.44	10.75	10.51	10.51	(0.65)
MnO	0.23	0.35	0.30	0.21	0.33	0.41	0.31	(0.07)
MgO	13.84	14.56	14.61	14.23	14.46	14.63	14.39	(0.28)
CaO	19.92	20.57	19.06	20.42	20.09	20.40	20.08	(0.51)
Na_2O	0.20	0.17	0.30	0.22	0.16	0.12	0.20	(0.06)
K_2O	*0.00	*0.01	*0.01	*0.00	*0.00	*0.00	-	-
NiO	*0.04	*0.00	*0.03	*0.06	*0.03	*0.00	-	-
Cr_2O_3	*0.09	*0.06	0.14	*0.07	0.15	0.18	0.15	(0.02)
Total	99.13	98.73	99.11	99.26	99.58	99.97	99.30	(0.39)
Cations on the basis of 6 oxygens								
Si	1.897	1.935	1.924	1.873	1.925	1.950	1.917	(0.025)
Al	0.131	0.074	0.091	0.184	0.090	0.059	0.105	(0.042)
Ti	0.021	0.013	0.018	0.022	0.015	0.011	0.017	(0.004)
Fe	0.356	0.315	0.354	0.297	0.339	0.329	0.332	(0.021)
Mn	0.007	0.011	0.010	0.007	0.011	0.013	0.010	(0.002)
Mg	0.782	0.823	0.824	0.797	0.812	0.817	0.809	(0.016)
Ca	0.809	0.835	0.773	0.822	0.811	0.819	0.812	(0.019)
Na	0.014	0.013	0.022	0.016	0.012	0.009	0.014	(0.004)
K	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.000	*0.001	*0.002	*0.001	*0.000	-	-
Cr	*0.003	*0.002	0.004	*0.002	0.004	0.005	0.004	(0.000)
Total	4.017	4.019	4.020	4.018	4.019	4.012	4.018	(0.003)
Mg N[a]	68.72	72.32	69.95	72.85	70.55	71.29	70.95	(1.40)
En%	40.16	41.71	42.23	41.60	41.39	41.58	41.45	(0.63)
Fs%	18.28	15.97	18.14	15.50	17.28	16.74	16.99	(1.03)
Wo%	41.55	42.32	39.62	42.90	41.34	41.68	41.57	(1.02)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [WS1], Bullot Formation
EMP analyses: clinopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	Mean†	Std. Dev.†
SiO_2	51.70	50.79	51.33	51.66	51.40	51.37	(0.32)
Al_2O_3	1.49	2.29	1.85	1.29	1.31	1.65	(0.38)
TiO_2	0.48	0.63	0.47	0.34	0.29	0.44	(0.12)
FeO	9.59	10.75	10.48	10.12	10.92	10.37	(0.47)
MnO	0.30	0.32	0.34	0.31	0.28	0.31	(0.02)
MgO	14.55	13.90	14.44	14.27	13.40	14.11	(0.42)
CaO	20.79	20.23	20.18	20.61	21.23	20.61	(0.39)
Na_2O	0.15	0.34	0.30	0.23	0.23	0.25	(0.07)
K_2O	*0.02	*0.01	*0.00	*0.00	*0.00	-	-
NiO	*0.00	*0.02	0.11	*0.00	*0.05	0.11	(0.00)
Cr_2O_3	*0.00	*0.03	*0.03	*0.00	*0.03	-	-
Total	99.03	99.25	99.49	98.83	99.05	99.13	(0.22)
Cations on the basis of 6 oxygens							
Si	1.949	1.921	1.934	1.956	1.953	1.943	(0.013)
Al	0.066	0.102	0.082	0.058	0.059	0.073	(0.017)
Ti	0.014	0.018	0.013	0.010	0.008	0.013	(0.003)
Fe	0.302	0.340	0.330	0.320	0.347	0.328	(0.016)
Mn	0.009	0.010	0.011	0.010	0.009	0.010	(0.001)
Mg	0.818	0.784	0.811	0.806	0.759	0.796	(0.022)
Ca	0.840	0.820	0.815	0.836	0.864	0.835	(0.017)
Na	0.011	0.025	0.022	0.017	0.017	0.018	(0.005)
K	*0.001	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.001	0.003	*0.000	*0.001	0.003	(0.000)
Cr	*0.000	*0.001	*0.001	*0.000	*0.001	-	-
Total	4.009	4.020	4.021	4.013	4.016	4.016	(0.004)
Mg N°	73.04	69.75	71.08	71.58	68.63	70.81	(1.52)
En%	41.73	40.33	41.46	41.08	38.53	40.63	(1.15)
Fs%	15.41	17.49	16.87	16.31	17.61	16.74	(0.81)
Wo%	42.86	42.18	41.67	42.61	43.86	42.63	(0.73)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [DR16], Bullot Formation
EMP analyses: clinopyroxene

Pourahu Member	1 Core	2 Core	3a Core	3b Rim	4 Core	5 Core	6 Core	7 Core	8a Core	8b Rim	9a Core	9b Rim	10 Core	11 Core	12 Core	Mean[1]	Std. Dev.[1]
SiO_2	51.43	51.48	52.00	51.58	51.15	51.87	52.38	50.35	51.30	52.55	50.39	50.84	51.70	52.23	52.44	51.54	(0.66)
Al_2O_3	1.89	1.79	1.40	1.59	2.19	1.94	0.90	4.73	3.48	1.48	4.05	3.82	2.85	0.59	1.15	2.23	(1.24)
TiO_2	0.50	0.53	0.38	0.48	0.84	0.51	0.35	0.52	0.32	0.23	0.52	0.38	0.32	0.33	0.28	0.43	(0.11)
FeO	10.54	10.40	10.32	10.58	10.23	10.88	10.09	7.85	7.54	9.17	7.19	7.94	7.07	10.04	10.18	9.34	(1.42)
MnO	0.35	0.37	0.31	0.29	0.30	0.25	0.34	0.28	0.17	0.35	0.13	0.22	0.20	0.18	0.24	0.26	(0.07)
MgO	13.99	14.31	14.32	14.31	14.34	14.59	14.59	15.17	15.04	17.25	15.42	18.30	15.71	14.48	14.66	14.72	(0.49)
CaO	20.38	20.45	20.79	20.17	20.88	19.78	20.78	20.79	21.45	18.43	20.81	18.82	21.54	21.24	20.93	20.80	(0.46)
Na_2O	0.34	0.32	0.30	0.27	0.32	0.35	0.28	0.28	0.32	0.15	0.27	0.24	0.25	0.21	0.34	0.30	(0.04)
K_2O	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.02	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
NiO	*0.05	*0.08	*0.00	*0.00	*0.00	*0.04	*0.00	*0.00	*0.03	*0.00	0.12	*0.01	*0.01	*0.00	*0.00	0.12	(0.00)
Cr_2O_3	*0.00	*0.00	*0.00	*0.00	*0.01	*0.07	*0.03	0.11	0.18	*0.03	0.39	0.24	0.18	*0.00	*0.00	0.21	(0.11)
Total	99.19	99.88	99.82	99.28	99.85	99.98	99.72	99.85	99.78	99.81	99.28	88.40	99.82	99.30	100.23	99.70	(0.29)
Cations on the basis of 6 oxygens																	
Si	1.944	1.938	1.952	1.948	1.921	1.935	1.985	1.888	1.905	1.950	1.878	1.881	1.915	1.970	1.958	1.929	(0.031)
Al	0.075	0.079	0.082	0.071	0.087	0.088	0.040	0.207	0.152	0.085	0.178	0.159	0.124	0.026	0.051	0.098	(0.054)
Ti	0.014	0.015	0.011	0.014	0.018	0.014	0.010	0.014	0.009	0.006	0.014	0.011	0.009	0.009	0.008	0.012	(0.003)
Fe	0.333	0.327	0.324	0.334	0.321	0.340	0.317	0.237	0.234	0.285	0.224	0.247	0.219	0.317	0.318	0.293	(0.046)
Mn	0.011	0.012	0.010	0.009	0.009	0.008	0.011	0.008	0.005	0.011	0.004	0.007	0.006	0.006	0.008	0.008	(0.002)
Mg	0.788	0.802	0.801	0.805	0.803	0.814	0.816	0.838	0.832	0.954	0.857	0.904	0.888	0.815	0.816	0.821	(0.023)
Ca	0.824	0.824	0.836	0.816	0.832	0.793	0.835	0.826	0.853	0.733	0.831	0.782	0.855	0.858	0.838	0.834	(0.017)
Na	0.025	0.024	0.022	0.020	0.023	0.025	0.020	0.020	0.023	0.011	0.020	0.018	0.018	0.015	0.025	0.022	(0.003)
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.002	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	0.004	*0.000	*0.000	*0.000	*0.000	0.004	(0.000)
Cr	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.001	0.003	0.005	*0.001	0.011	0.007	0.005	*0.000	*0.000	0.006	(0.003)
Total	4.014	4.019	4.018	4.015	4.024	4.015	4.014	4.022	4.018	4.015	4.022	4.028	4.019	4.016	4.022	4.019	(0.003)
Mg N[a]	70.29	71.04	71.20	70.68	71.44	70.54	72.02	77.97	78.05	77.00	79.28	78.54	79.85	72.00	71.96	73.80	(3.59)
En%	40.51	41.07	40.85	41.18	41.05	41.81	41.48	44.11	43.36	48.38	44.82	46.77	44.70	40.95	41.38	42.17	(1.54)
Fs%	17.12	16.74	16.52	17.08	18.41	17.48	18.11	12.48	12.19	14.45	11.72	12.78	11.28	15.83	16.13	15.01	(2.24)
Wo%	42.37	42.19	42.83	41.74	42.54	40.73	42.43	43.43	44.45	37.17	43.46	40.48	44.03	43.12	42.49	42.82	(0.93)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [OT], Bullot Formation
EMP analyses: clinopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.04	50.92	51.21	51.33	50.78	50.75	51.35	50.69	51.13	(0.42)
Al_2O_3	1.69	1.85	3.44	3.59	4.05	3.92	1.80	3.85	3.02	(0.98)
TiO_2	0.48	0.55	0.33	0.41	0.45	0.43	0.58	0.40	0.45	(0.07)
FeO	10.78	10.20	8.35	7.34	7.03	7.68	11.51	7.31	8.77	(1.66)
MnO	0.37	0.35	0.28	0.22	0.09	0.26	0.26	0.22	0.25	(0.08)
MgO	14.25	13.76	15.75	15.40	15.45	15.23	14.12	15.08	14.88	(0.69)
CaO	20.58	20.39	19.96	21.28	21.38	20.35	19.83	21.82	20.70	(0.67)
Na_2O	0.34	0.27	0.27	0.30	0.30	0.34	0.38	0.26	0.31	(0.04)
K_2O	*0.01	*0.01	*0.00	*0.01	*0.01	*0.00	*0.00	*0.01	-	-
NiO	*0.00	*0.04	*0.00	*0.05	*0.00	*0.00	*0.00	*0.01	-	-
Cr_2O_3	*0.00	*0.00	*0.02	0.16	0.38	*0.05	*0.03	0.19	0.24	(0.10)
Total	100.53	98.28	99.59	100.01	99.89	98.94	99.80	99.81	99.61	(0.65)
Cations on the basis of 6 oxygens										
Si	1.943	1.941	1.904	1.899	1.881	1.896	1.935	1.884	1.910	(0.024)
Al	0.074	0.083	0.151	0.156	0.177	0.173	0.080	0.169	0.133	(0.043)
Ti	0.013	0.016	0.009	0.011	0.012	0.012	0.016	0.011	0.013	(0.002)
Fe	0.337	0.325	0.260	0.227	0.218	0.239	0.363	0.227	0.275	(0.054)
Mn	0.012	0.011	0.009	0.007	0.003	0.006	0.008	0.007	0.008	(0.003)
Mg	0.793	0.782	0.873	0.850	0.853	0.848	0.793	0.836	0.829	(0.032)
Ca	0.823	0.832	0.795	0.843	0.848	0.814	0.800	0.869	0.828	(0.023)
Na	0.025	0.020	0.019	0.022	0.021	0.024	0.028	0.018	0.022	(0.003)
K	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.002	-	-
Ni	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.002	-	-
Cr	*0.000	*0.000	*0.001	0.005	0.011	*0.002	*0.001	0.005	0.007	(0.003)
Total	4.020	4.010	4.020	4.020	4.024	4.014	4.023	4.026	4.020	(0.005)
Mg N[a]	70.16	70.84	77.05	78.92	79.65	78.01	68.60	78.65	75.21	(4.28)
En%	40.80	40.33	45.28	44.27	44.45	44.61	40.54	43.27	42.92	(1.95)
Fs%	17.26	18.78	13.49	11.82	11.38	12.57	18.56	11.75	14.20	(2.69)
Wo%	42.14	42.91	41.23	43.91	44.19	42.82	40.90	44.98	42.88	(1.34)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Pourahu Member [ignimbrite unit] [CT], Bullot Formation
EMP analyses: clinopyroxene

Pourahu Member	1 Core	2 Rim	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	Mean†	Std. Dev.†
SiO_2	51.94	51.90	51.61	52.13	51.85	51.99	50.47	51.89	51.70	(0.52)
Al_2O_3	1.76	1.25	1.76	0.70	1.85	1.30	2.35	1.84	1.65	(0.48)
TiO_2	0.49	0.40	0.54	0.22	0.41	0.38	0.56	0.27	0.41	(0.12)
FeO	11.19	10.22	10.30	9.99	9.77	10.17	10.95	10.98	10.48	(0.51)
MnO	0.30	0.39	0.24	0.27	0.31	0.31	0.24	0.31	0.28	(0.03)
MgO	14.59	14.64	14.86	15.05	15.17	14.84	14.52	14.18	14.74	(0.31)
CaO	19.22	20.63	20.62	21.02	20.58	20.63	19.92	20.53	20.36	(0.55)
Na_2O	0.37	0.23	0.32	0.23	0.19	0.18	0.25	0.32	0.26	(0.07)
K_2O	*0.02	*0.03	*0.02	*0.00	*0.01	*0.01	*0.02	*0.01	-	-
NiO	*0.05	*0.00	*0.05	*0.00	*0.03	*0.02	*0.00	*0.01	-	-
Cr_2O_3	*0.09	*0.04	*0.13	*0.00	*0.13	*0.00	*0.06	*0.03	-	-
Total	99.86	99.65	100.24	99.62	100.12	99.79	99.25	100.31	99.88	(0.35)
Cations on the basis of 6 oxygens										
Si	1.945	1.950	1.927	1.960	1.932	1.949	1.909	1.941	1.938	(0.015)
Al	0.078	0.055	0.078	0.031	0.081	0.058	0.105	0.081	0.073	(0.021)
Ti	0.014	0.011	0.015	0.006	0.012	0.011	0.016	0.007	0.012	(0.004)
Fe	0.350	0.321	0.321	0.314	0.304	0.319	0.346	0.344	0.328	(0.017)
Mn	0.010	0.012	0.008	0.009	0.010	0.010	0.008	0.010	0.009	(0.001)
Mg	0.815	0.820	0.827	0.843	0.843	0.829	0.819	0.791	0.824	(0.017)
Ca	0.771	0.831	0.825	0.847	0.821	0.829	0.807	0.823	0.818	(0.022)
Na	0.027	0.017	0.023	0.017	0.014	0.013	0.018	0.023	0.019	(0.005)
K	*0.001	*0.002	*0.001	*0.000	*0.000	*0.001	*0.001	*0.001	0.000	0.000
Ni	*0.001	*0.000	*0.002	*0.000	*0.001	*0.001	*0.000	*0.001	0.000	0.000
Cr	*0.003	*0.001	*0.004	*0.000	*0.004	*0.000	*0.002	*0.001	0.000	0.000
Total	4.010	4.017	4.024	4.027	4.017	4.018	4.028	4.020	4.021	(0.006)
Mg N°	69.96	71.87	72.04	72.86	73.50	72.21	70.30	69.69	71.51	(1.40)
En%	42.10	41.58	41.92	42.07	42.84	41.93	41.53	40.40	41.83	(0.69)
Fs%	18.08	16.28	16.27	15.67	15.45	16.14	17.55	17.57	16.67	(0.96)
Wo%	39.82	42.14	41.81	42.27	41.72	41.93	40.92	42.03	41.50	(0.79)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [ignimbrite unit] [MQ], Bullot Formation
EMP analyses: clinopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	Mean†	Std. Dev.†
SiO_2	51.90	50.86	51.40	51.22	51.85	51.45	(0.39)
Al_2O_3	1.60	2.11	1.50	2.05	1.30	1.71	(0.32)
TiO_2	0.45	0.48	0.43	0.52	0.37	0.45	(0.05)
FeO	9.72	11.91	10.16	10.31	9.98	10.42	(0.77)
MnO	0.34	0.43	0.33	0.28	0.31	0.34	(0.05)
MgO	14.41	13.74	14.23	14.66	14.64	14.33	(0.34)
CaO	20.85	19.60	20.73	20.10	20.40	20.34	(0.45)
Na_2O	0.28	0.39	0.26	0.27	0.27	0.29	(0.05)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.02	-	-
NiO	*0.02	*0.03	*0.00	*0.03	*0.04	-	-
Cr_2O_3	0.19	*0.03	0.10	*0.01	*0.02	0.14	(0.05)
Total	99.74	99.53	99.12	99.40	99.12	99.38	(0.24)
Cations on the basis of 6 oxygens							
Si	1.946	1.926	1.944	1.928	1.955	1.940	(0.011)
Al	0.071	0.094	0.067	0.091	0.058	0.076	(0.014)
Ti	0.013	0.014	0.012	0.015	0.011	0.013	(0.001)
Fe	0.305	0.377	0.321	0.325	0.315	0.329	(0.025)
Mn	0.011	0.014	0.011	0.009	0.010	0.011	(0.002)
Mg	0.805	0.776	0.802	0.823	0.823	0.806	(0.017)
Ca	0.837	0.795	0.840	0.811	0.824	0.821	(0.017)
Na	0.020	0.029	0.019	0.020	0.020	0.022	(0.004)
K	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.000	*0.001	*0.000	*0.001	*0.001	-	-
Cr	0.006	*0.001	0.003	*0.000	*0.000	0.005	(0.002)
Total	4.014	4.025	4.019	4.022	4.016	4.019	(0.004)
Mg N°	72.52	67.30	71.42	71.69	72.32	71.05	(1.92)
En%	41.35	39.84	40.86	42.01	41.95	41.20	(0.80)
Fs%	15.67	19.35	16.35	16.59	16.06	16.80	(1.31)
Wo%	42.99	40.81	42.79	41.40	42.00	42.00	(0.82)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Ngamatea lapilli-1, Bullot Formation
EMP analyses: clinopyroxene

Ngamatea lapilli-1	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	Mean†	Std. Dev.†
SiO_2	51.90	50.52	51.63	51.73	51.79	52.18	50.94	50.33	51.54	51.39	(0.61)
Al_2O_3	2.06	1.84	1.79	1.80	1.33	1.52	2.99	3.33	1.96	2.07	(0.62)
TiO_2	0.38	0.51	0.45	0.49	0.41	0.55	0.65	0.54	0.52	0.50	(0.08)
FeO	10.00	10.38	9.62	10.27	10.34	9.88	9.08	9.47	10.27	9.92	(0.43)
MnO	0.30	0.28	0.27	0.29	0.38	0.38	0.25	0.23	0.34	0.30	(0.05)
MgO	14.86	14.96	14.90	14.98	14.81	14.90	14.93	13.88	14.67	14.77	(0.32)
CaO	20.12	19.78	20.23	20.36	20.40	20.53	20.22	21.20	20.46	20.37	(0.36)
Na_2O	0.30	0.27	0.35	0.30	0.28	0.25	0.23	0.32	0.19	0.28	(0.05)
K_2O	*0.01	*0.02	*0.00	*0.00	*0.01	*0.01	*0.02	*0.00	*0.00	-	-
NiO	*0.01	*0.00	*0.02	*0.00	*0.00	*0.04	*0.06	*0.00	*0.00	-	-
Cr_2O_3	*0.00	*0.02	*0.13	*0.04	*0.05	*0.08	0.17	*0.03	*0.04	0.17	(0.00)
Total	99.92	98.55	99.23	100.21	99.75	100.18	99.45	99.29	99.94	99.61	(0.51)
Cations on the basis of 6 oxygens											
Si	1.938	1.921	1.939	1.932	1.945	1.944	1.906	1.897	1.930	1.928	(0.016)
Al	0.091	0.083	0.079	0.079	0.059	0.067	0.132	0.148	0.087	0.092	(0.028)
Ti	0.011	0.015	0.013	0.014	0.012	0.015	0.018	0.015	0.015	0.014	(0.002)
Fe	0.312	0.330	0.302	0.321	0.325	0.308	0.284	0.299	0.322	0.311	(0.014)
Mn	0.009	0.009	0.009	0.009	0.012	0.012	0.009	0.007	0.011	0.009	(0.002)
Mg	0.828	0.848	0.834	0.834	0.829	0.827	0.833	0.780	0.819	0.826	(0.018)
Ca	0.805	0.806	0.814	0.814	0.821	0.820	0.810	0.856	0.821	0.819	(0.014)
Na	0.022	0.020	0.025	0.022	0.021	0.018	0.016	0.024	0.013	0.020	(0.004)
K	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.002	*0.000	*0.000	-	-
Cr	*0.000	*0.001	*0.004	*0.001	*0.001	*0.002	0.005	*0.001	*0.001	0.005	(0.000)
Total	4.016	4.032	4.014	4.025	4.024	4.011	4.012	4.026	4.018	4.020	(0.007)
Mg N°	72.63	71.99	73.42	72.21	71.84	72.86	74.57	72.29	71.78	72.62	(0.85)
En%	42.57	42.74	42.77	42.36	41.97	42.30	43.23	40.31	41.74	42.22	(0.79)
Fs%	16.04	16.63	15.49	16.30	16.46	15.75	14.74	15.45	16.41	15.92	(0.58)
Wo%	41.39	40.63	41.74	41.34	41.57	41.94	42.03	44.24	41.85	41.86	(0.93)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Helwan lapilli, Bullot Formation
EMP analyses: clinopyroxene

Helwan lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	Mean†	Std. Dev.†
SiO_2	51.03	50.95	50.32	50.72	50.59	50.38	50.88	50.26	50.82	51.18	51.35	50.59	50.49	50.55	50.91	50.72	(0.31)
Al_2O_3	2.00	1.88	2.27	2.12	2.05	3.45	2.18	2.68	2.15	1.84	1.68	2.09	3.34	2.26	1.87	2.25	(0.50)
TiO_2	0.61	0.58	0.58	0.57	0.54	0.67	0.51	0.64	0.57	0.55	0.49	0.37	0.68	0.59	0.55	0.57	(0.07)
FeO	10.20	10.79	11.24	10.63	9.98	10.65	10.27	11.53	10.80	11.33	10.76	11.75	10.78	11.13	11.16	10.87	(0.48)
MnO	0.21	0.46	0.24	0.24	0.30	0.23	0.24	0.38	0.28	0.23	0.29	0.17	0.15	0.35	0.36	0.27	(0.08)
MgO	14.74	14.45	14.25	14.26	14.52	13.36	14.57	13.72	14.42	14.24	14.62	14.17	13.88	13.95	15.02	14.28	(0.41)
CaO	20.55	20.29	20.63	20.47	21.18	20.16	21.09	20.25	20.34	20.66	20.54	19.90	20.18	20.88	20.25	20.49	(0.34)
Na_2O	0.34	0.33	0.30	0.33	0.34	0.47	0.34	0.47	0.37	0.33	0.36	0.44	0.52	0.41	0.39	0.38	(0.06)
K_2O	*0.00	*0.01	*0.00	*0.00	*0.01	0.06	*0.00	*0.00	*0.02	*0.00	*0.01	*0.01	*0.03	*0.01	*0.00	0.06	(0.00)
NiO	*0.08	*0.02	*0.00	*0.00	*0.00	*0.03	*0.00	*0.08	*0.03	*0.02	*0.00	*0.00	*0.01	*0.00	*0.06	-	-
Cr_2O_3	*0.04	*0.02	*0.03	*0.08	*0.11	*0.09	*0.04	*0.05	*0.00	*0.00	*0.10	0.61	*0.13	*0.00	*0.01	0.61	(0.00)
Total	99.68	99.71	99.84	99.35	99.50	99.42	100.09	99.90	99.55	100.35	100.08	100.08	100.01	100.11	100.53	99.88	(0.33)
Cations on the basis of 6 oxygens																	
Si	1.918	1.921	1.901	1.917	1.909	1.900	1.909	1.898	1.912	1.922	1.927	1.909	1.893	1.908	1.908	1.910	(0.009)
Al	0.088	0.083	0.101	0.095	0.091	0.153	0.096	0.118	0.098	0.081	0.074	0.093	0.148	0.101	0.083	0.100	(0.022)
Ti	0.017	0.016	0.017	0.016	0.015	0.019	0.014	0.018	0.016	0.015	0.014	0.010	0.019	0.017	0.016	0.016	(0.002)
Fe	0.321	0.340	0.355	0.338	0.315	0.338	0.322	0.364	0.341	0.356	0.338	0.371	0.338	0.351	0.350	0.342	(0.015)
Mn	0.007	0.015	0.008	0.008	0.010	0.007	0.008	0.012	0.009	0.007	0.009	0.005	0.005	0.011	0.011	0.009	(0.003)
Mg	0.828	0.813	0.803	0.804	0.817	0.751	0.815	0.772	0.812	0.797	0.818	0.797	0.778	0.784	0.839	0.802	(0.022)
Ca	0.828	0.820	0.835	0.829	0.858	0.814	0.848	0.819	0.823	0.831	0.828	0.805	0.811	0.843	0.813	0.827	(0.014)
Na	0.025	0.024	0.022	0.024	0.025	0.034	0.025	0.035	0.027	0.024	0.028	0.032	0.038	0.030	0.029	0.028	(0.005)
K	*0.000	*0.000	*0.000	*0.000	*0.001	0.003	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	0.003	(0.000)
Ni	*0.002	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.002	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.002	-	-
Cr	*0.001	*0.001	*0.001	*0.002	*0.003	*0.003	*0.001	*0.002	*0.000	*0.000	*0.003	0.018	*0.004	*0.000	*0.000	0.018	(0.000)
Total	4.030	4.032	4.042	4.029	4.038	4.017	4.037	4.038	4.036	4.033	4.032	4.040	4.028	4.043	4.049	4.035	(0.007)
Mg N°	72.01	70.51	69.34	70.53	72.17	69.09	71.68	67.96	70.42	69.12	70.76	68.24	69.66	69.07	70.56	70.08	(1.25)
En%	41.82	41.21	40.29	40.83	41.10	39.51	41.08	39.49	41.09	40.17	41.27	40.40	40.31	39.64	41.91	40.67	(0.75)
Fs%	18.25	17.23	17.81	17.06	15.85	17.67	18.22	18.62	17.28	17.94	17.05	18.80	17.56	17.75	17.48	17.37	(0.80)
Wo%	41.92	41.56	41.90	42.10	43.06	42.82	42.72	41.89	41.65	41.89	41.68	40.80	42.13	42.62	40.61	41.96	(0.66)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L17, Bullot Formation
EMP analyses: clinopyroxene

Member L17	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	Mean†	Std. Dev.†
SiO_2	49.13	50.10	49.81	49.85	50.18	48.95	51.12	50.83	50.82	50.09	(0.71)
Al_2O_3	4.61	2.03	2.18	2.53	2.03	4.17	1.45	3.50	1.61	2.68	(1.07)
TiO_2	0.51	0.52	0.53	0.63	0.59	0.50	0.47	0.37	0.53	0.52	(0.07)
FeO	7.66	11.17	11.86	10.68	9.73	7.37	10.24	6.58	9.98	9.48	(1.73)
MnO	0.21	0.28	0.29	0.28	0.29	*0.11	0.30	0.20	0.38	0.28	(0.05)
MgO	14.74	13.50	13.17	13.41	14.09	14.72	14.20	15.67	14.49	14.22	(0.76)
CaO	21.24	20.43	20.40	20.31	20.84	22.19	21.01	21.40	20.98	20.98	(0.56)
Na_2O	0.29	0.29	0.35	0.41	0.36	0.33	0.26	0.29	0.27	0.32	(0.05)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.02	*0.00	*0.00	-	-
NiO	*0.07	*0.01	*0.00	*0.03	*0.03	*0.01	*0.00	*0.06	*0.00	-	-
Cr_2O_3	*0.02	*0.01	*0.04	*0.06	*0.08	*0.01	*0.00	0.35	*0.02	0.35	(0.00)
Total	98.39	98.32	98.60	98.09	98.10	98.24	99.04	99.20	99.06	98.56	(0.41)
Cations on the basis of 6 oxygens											
Si	1.856	1.921	1.912	1.911	1.917	1.855	1.938	1.893	1.926	1.903	(0.028)
Al	0.205	0.092	0.099	0.114	0.091	0.186	0.065	0.154	0.072	0.120	(0.047)
Ti	0.015	0.015	0.015	0.018	0.017	0.014	0.013	0.010	0.015	0.015	(0.002)
Fe	0.242	0.358	0.381	0.342	0.311	0.234	0.324	0.205	0.316	0.301	(0.057)
Mn	0.007	0.009	0.010	0.009	0.009	*0.004	0.010	0.006	0.012	0.009	(0.002)
Mg	0.830	0.772	0.754	0.766	0.803	0.832	0.802	0.870	0.819	0.805	(0.035)
Ca	0.859	0.839	0.839	0.834	0.853	0.901	0.853	0.854	0.852	0.854	(0.019)
Na	0.021	0.022	0.026	0.030	0.027	0.025	0.019	0.021	0.020	0.023	(0.003)
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	-	-
Ni	*0.002	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.002	*0.000	-	-
Cr	*0.001	*0.000	*0.001	*0.002	*0.002	*0.000	*0.000	0.010	*0.001	0.010	(0.000)
Total	4.035	4.028	4.036	4.024	4.028	4.047	4.024	4.023	4.032	4.031	(0.007)
Mg N°	77.43	68.32	66.43	69.13	72.08	78.05	71.23	80.93	72.16	72.86	(4.62)
En%	42.98	39.21	38.20	39.44	40.82	42.30	40.53	45.10	41.22	41.09	(2.00)
Fs%	12.53	18.18	19.30	17.61	15.81	11.90	16.37	10.63	15.90	15.36	(2.84)
Wo%	44.48	42.61	42.50	42.95	43.37	45.81	43.10	44.27	42.88	43.55	(1.03)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L16, Bullot Formation
EMP analyses: clinopyroxene

Member L16	1 Core	2 Core	3 Core	4 Core	5 Core	Mean†	Std. Dev.†
SiO_2	51.36	51.11	50.89	51.88	50.57	51.12	(0.38)
Al_2O_3	1.96	1.66	2.35	2.00	3.26	2.25	(0.55)
TiO_2	0.57	0.52	0.48	0.55	0.44	0.51	(0.05)
FeO	10.02	10.84	10.38	9.59	8.63	9.89	(0.75)
MnO	*0.00	0.26	0.22	0.29	*0.14	0.26	(0.03)
MgO	14.66	13.74	14.26	15.35	14.72	14.55	(0.53)
CaO	20.95	20.30	20.98	20.24	20.90	20.67	(0.33)
Na_2O	0.25	0.33	0.33	0.35	0.21	0.29	(0.05)
K_2O	*0.00	*0.00	*0.00	*0.02	*0.00	-	-
NiO	*0.00	*0.00	*0.00	*0.07	*0.03	-	-
Cr_2O_3	*0.00	*0.05	0.20	*0.01	*0.00	0.20	(0.00)
Total	99.75	98.81	100.08	100.04	98.73	99.48	(0.59)
Cations on the basis of 6 oxygens							
Si	1.927	1.942	1.911	1.926	1.903	1.922	(0.014)
Al	0.087	0.075	0.104	0.088	0.144	0.100	(0.024)
Ti	0.016	0.015	0.014	0.015	0.012	0.014	(0.001)
Fe	0.314	0.345	0.325	0.299	0.272	0.311	(0.025)
Mn	*0.000	0.009	0.007	0.009	*0.004	0.008	(0.001)
Mg	0.820	0.778	0.799	0.853	0.825	0.815	(0.025)
Ca	0.842	0.827	0.843	0.809	0.843	0.833	(0.013)
Na	0.018	0.024	0.024	0.025	0.016	0.021	(0.004)
K	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.000	*0.000	*0.000	*0.002	*0.001	-	-
Cr	*0.000	*0.001	0.008	*0.000	*0.000	0.006	(0.000)
Total	4.024	4.015	4.033	4.024	4.015	4.022	(0.007)
Mg N°	72.31	69.26	71.09	74.05	75.21	72.38	(2.10)
En%	41.50	39.90	40.82	43.50	42.53	41.61	(1.29)
Fs%	15.89	17.89	16.52	15.25	14.02	15.87	(1.23)
Wo%	42.61	42.41	42.66	41.25	43.45	42.52	(0.72)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Shawcroft Tephra, Bullot Formation
EMP analyses: clinopyroxene *(continued ...)*

Shawcroft Tephra	1 Core	2 Core	3a Core	3b Rim	4a Core	4b Rim	5a Core	5b Rim	6 Core	7 Rim	8 Core	9 Rim	10 Rim	11 Core	12 Core	13 Core	14a Core	14b Rim	15a Core	15b Rim
SiO_2	50.14	51.29	50.77	49.98	51.11	50.93	50.58	49.37	50.89	50.03	50.81	50.52	51.35	50.74	50.47	50.35	52.14	50.91	50.55	51.01
Al_2O_3	3.88	1.58	3.88	3.79	1.88	1.55	2.50	3.85	3.55	3.98	2.33	2.43	1.53	2.38	3.10	3.14	1.91	1.99	2.27	2.30
TiO_2	0.42	0.39	0.28	0.44	0.39	0.39	0.50	0.58	0.42	0.48	0.25	0.29	0.33	0.53	0.41	0.24	0.18	0.58	0.83	0.49
FeO	8.87	10.79	8.98	9.90	11.03	10.31	10.95	10.80	8.41	9.07	11.72	11.07	10.32	10.72	10.09	9.84	5.04	9.08	10.43	10.01
MnO	0.20	0.28	*0.18	0.20	0.27	0.27	0.29	0.24	0.22	0.20	0.27	0.33	0.28	0.30	0.29	0.28	0.08	0.25	0.21	0.24
MgO	14.52	14.47	15.83	14.01	13.97	14.45	14.13	13.78	14.69	14.25	14.07	13.88	14.58	14.00	13.89	14.35	17.75	15.05	14.08	15.05
CaO	20.54	20.29	21.18	19.88	19.88	20.31	19.39	19.78	20.49	20.18	19.45	20.17	20.82	19.39	20.59	20.19	20.87	20.17	19.39	19.27
Na_2O	0.38	0.34	0.28	0.44	0.35	0.31	0.39	0.43	0.34	0.48	0.38	0.35	0.21	0.45	0.41	0.34	0.18	0.30	0.45	0.24
K_2O	*0.00	*0.00	*0.00	*0.01	*0.01	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.01	*0.01	*0.00	*0.00	*0.02	*0.00	*0.00
NiO	*0.00	*0.02	*0.01	*0.07	*0.04	*0.00	*0.01	*0.04	*0.04	*0.08	*0.00	*0.00	*0.00	*0.00	*0.05	*0.07	*0.00	*0.05	*0.00	*0.00
Cr_2O_3	*0.10	*0.00	0.30	*0.15	*0.00	*0.00	*0.13	*0.14	*0.06	0.17	*0.06	0.18	*0.00	*0.07	*0.08	0.28	0.50	*0.02	0.12	*0.02
Total	98.71	99.41	99.25	98.82	98.85	98.51	98.70	98.40	99.00	98.78	99.27	99.01	99.39	98.51	99.22	98.98	98.85	98.29	98.13	98.81
Cations on the basis of 6 oxygens																				
Si	1.891	1.937	1.888	1.890	1.943	1.938	1.919	1.881	1.900	1.887	1.925	1.920	1.938	1.928	1.904	1.903	1.934	1.929	1.928	1.928
Al	0.183	0.070	0.170	0.169	0.083	0.069	0.112	0.184	0.157	0.177	0.104	0.109	0.068	0.108	0.138	0.140	0.083	0.089	0.102	0.102
Ti	0.012	0.011	0.007	0.013	0.011	0.011	0.014	0.016	0.012	0.013	0.007	0.008	0.009	0.015	0.012	0.007	0.005	0.016	0.019	0.014
Fe	0.280	0.341	0.217	0.313	0.351	0.328	0.347	0.338	0.264	0.288	0.371	0.352	0.328	0.341	0.318	0.311	0.158	0.287	0.333	0.318
Mn	0.006	0.008	*0.006	0.007	0.009	0.009	0.009	0.008	0.007	0.006	0.009	0.011	0.008	0.010	0.009	0.008	0.002	0.008	0.007	0.008
Mg	0.818	0.815	0.888	0.790	0.792	0.820	0.800	0.783	0.832	0.801	0.795	0.775	0.819	0.793	0.781	0.808	0.981	0.850	0.801	0.848
Ca	0.830	0.821	0.844	0.808	0.801	0.828	0.789	0.808	0.823	0.815	0.789	0.821	0.842	0.790	0.932	0.817	0.829	0.819	0.793	0.781
Na	0.028	0.025	0.019	0.032	0.028	0.023	0.029	0.032	0.024	0.034	0.028	0.028	0.015	0.033	0.030	0.025	0.013	0.022	0.033	0.018
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.00	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000
Ni	*0.000	*0.001	*0.000	*0.002	*0.001	*0.000	*0.000	*0.001	*0.001	*0.002	*0.000	*0.000	*0.000	*0.000	*0.001	*0.002	*0.000	*0.001	*0.000	*0.000
Cr	*0.003	*0.000	0.009	*0.004	*0.000	*0.000	*0.004	*0.004	*0.002	0.005	*0.002	0.005	*0.000	*0.002	*0.003	0.008	0.015	*0.001	0.004	*0.000
Total	4.024	4.028	4.020	4.020	4.018	4.028	4.019	4.030	4.019	4.024	4.028	4.027	4.025	4.018	4.024	4.027	4.018	4.020	4.019	4.018
Mg N°	74.45	70.50	79.98	71.62	69.28	71.43	68.75	69.85	75.91	73.69	68.18	68.77	71.53	69.83	71.08	72.21	88.28	74.76	70.83	72.85
En%	42.37	41.22	44.94	41.38	40.74	41.50	41.32	40.59	43.38	42.11	40.68	39.78	41.22	41.22	40.45	41.74	49.90	43.46	41.57	43.60
Fs%	14.54	17.25	11.26	16.40	16.08	16.60	17.92	17.52	13.78	15.04	18.99	18.07	16.41	17.72	16.47	16.08	7.93	14.67	17.29	16.25
Wo%	43.08	41.53	43.80	42.22	41.20	41.90	40.75	41.69	42.89	42.85	40.38	42.15	42.38	41.06	43.09	42.20	42.17	41.87	41.15	40.15

* Indicates value was below the detection limit.
' Means and standard deviations are for core values above detection limit only.

Shawcroft Tephra, Bullot Formation
EMP analyses: clinopyroxene *(... continued)*

Shawcroft Tephra	Mean[1]	Std. Dev.[1]
SiO_2	50.80	(0.50)
Al_2O_3	2.68	(0.73)
TiO_2	0.39	(0.13)
FeO	9.57	(1.86)
MnO	0.24	(0.06)
MgO	14.65	(1.05)
CaO	20.12	(0.61)
Na_2O	0.35	(0.07)
K_2O	-	-
NiO	-	-
Cr_2O_3	0.29	(0.14)
Total	98.87	(0.36)
Cations		
Si	1.917	(0.018)
Al	0.119	(0.032)
Ti	0.011	(0.004)
Fe	0.303	(0.061)
Mn	0.008	(0.002)
Mg	0.823	(0.052)
Ca	0.813	(0.019)
Na	0.026	(0.005)
K	-	-
Ni	-	-
Cr	0.009	(0.004)
Total	4.021	(0.004)
Mg N[a]	73.18	(5.07)
En%	42.46	(2.55)
Fs%	15.60	(3.11)
Wo%	41.94	(1.05)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Rotoaira Lapilli
EMP analyses: clinopyroxene

Rotoaira Lapilli	1a Core	1b Rim	2 Core	3a Core	3b Rim	4 Core	5 Rim	6a Core	6b Rim	7a Core	7b Rim	8a Core	8b Rim	9a Core	9b Rim	Mean[1]	Std. Dev.[1]
SiO_2	50.61	52.15	51.29	51.63	51.37	50.68	51.13	50.68	51.22	50.98	51.04	53.22	52.04	51.03	50.93	51.31	(0.81)
Al_2O_3	1.74	2.71	1.54	2.68	1.68	1.55	2.23	1.68	1.95	1.95	1.94	1.48	1.58	2.04	1.70	1.85	(0.37)
TiO_2	0.43	0.21	0.34	0.38	0.32	0.35	0.50	0.43	0.38	0.33	0.33	*0.04	0.17	0.38	0.37	0.37	(0.04)
FeO	11.65	5.80	11.57	5.73	9.34	11.54	11.13	10.95	10.22	10.19	9.88	4.82	7.47	9.78	10.94	9.55	(2.57)
MnO	0.28	*0.14	0.40	0.21	0.28	0.38	0.25	0.38	0.31	0.33	0.28	0.21	0.24	0.28	0.36	0.31	(0.07)
MgO	13.67	16.62	14.07	17.38	15.19	13.98	14.05	14.22	14.61	14.78	14.92	16.59	16.45	15.07	14.39	15.24	(1.66)
CaO	19.61	21.04	20.14	19.94	20.10	19.91	20.02	19.70	20.20	19.98	20.12	20.74	19.98	20.33	20.10	20.07	(0.31)
Na_2O	0.29	0.16	0.34	0.24	0.17	0.30	0.28	0.32	0.24	0.28	0.32	0.22	0.23	0.28	0.23	0.28	(0.04)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	*0.01	*0.02	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.02	-	-
NiO	*0.04	*0.01	*0.06	*0.06	*0.00	*0.01	*0.00	*0.01	*0.03	*0.00	*0.02	*0.00	*0.00	*0.05	*0.00	-	-
Cr_2O_3	*0.11	0.36	*0.01	0.62	*0.06	*0.00	*0.09	*0.05	*0.04	*0.03	*0.04	0.76	0.16	*0.07	*0.00	0.70	(0.08)
Total	98.87	99.27	99.69	98.99	98.82	98.90	99.58	98.47	99.12	98.80	98.59	100.05	98.31	99.14	99.01	99.11	(0.48)
Cations on the basis of 6 oxygens																	
Si	1.929	1.924	1.939	1.917	1.939	1.939	1.927	1.931	1.933	1.930	1.933	1.942	1.953	1.923	1.933	1.931	(0.008)
Al	0.078	0.116	0.069	0.117	0.063	0.070	0.099	0.064	0.067	0.067	0.067	0.063	0.070	0.090	0.076	0.082	(0.016)
Ti	0.012	0.008	0.010	0.010	0.009	0.010	0.014	0.012	0.011	0.009	0.009	*0.001	0.005	0.011	0.010	0.011	(0.001)
Fe	0.376	0.179	0.366	0.177	0.295	0.366	0.351	0.349	0.323	0.323	0.306	0.147	0.234	0.306	0.347	0.302	(0.084)
Mn	0.009	*0.004	0.013	0.007	0.009	0.012	0.008	0.011	0.010	0.011	0.008	0.007	0.008	0.009	0.012	0.010	(0.002)
Mg	0.766	0.925	0.793	0.958	0.855	0.794	0.789	0.808	0.822	0.833	0.842	1.012	0.920	0.848	0.814	0.854	(0.079)
Ca	0.809	0.832	0.816	0.790	0.813	0.813	0.808	0.804	0.817	0.811	0.816	0.811	0.802	0.821	0.817	0.809	(0.009)
Na	0.022	0.013	0.025	0.017	0.012	0.022	0.019	0.023	0.017	0.021	0.023	0.016	0.016	0.019	0.017	0.021	(0.003)
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.001	*0.000	*0.026	*0.002	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Cr	*0.003	0.011	*0.003	0.018	*0.002	*0.000	*0.003	*0.002	*0.001	*0.001	*0.001	0.022	0.005	*0.002	*0.000	0.020	(0.002)
Total	4.025	4.008	4.031	4.011	4.015	4.028	4.015	4.022	4.020	4.025	4.024	4.020	4.013	4.027	4.026	4.024	(0.006)
Mg N°	67.56	83.79	66.42	84.41	74.35	66.33	69.21	69.84	71.79	72.08	73.34	87.32	79.72	73.31	70.11	73.91	(7.17)
En%	39.90	47.76	40.15	49.77	43.58	40.20	40.50	41.20	41.90	42.35	42.87	51.37	47.03	42.84	41.15	43.47	(4.23)
Fs%	19.14	9.25	16.53	9.19	15.03	16.63	16.02	17.80	16.46	16.42	15.58	7.48	11.96	15.59	17.54	15.35	(4.22)
Wo%	40.96	42.98	41.32	41.04	41.42	41.16	41.48	41.00	41.64	41.23	41.55	41.17	41.00	41.57	41.30	41.18	(0.18)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L8, Bullot Formation
EMP analyses: clinopyroxene

Member L8	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	Mean'	Std. Dev.'
SiO_2	50.79	50.94	51.70	51.71	51.80	51.78	50.83	51.36	(0.44)
Al_2O_3	1.95	2.02	2.22	1.80	1.32	1.90	2.26	1.92	(0.29)
TiO_2	0.58	0.50	0.58	0.48	0.54	0.48	0.51	0.52	(0.04)
FeO	10.21	11.17	9.55	9.71	10.38	9.70	11.08	10.26	(0.61)
MnO	0.29	0.25	0.23	0.30	0.25	0.25	0.34	0.27	(0.03)
MgO	14.08	13.57	14.78	14.88	15.38	14.91	13.49	14.44	(0.67)
CaO	21.30	21.08	21.04	21.17	19.98	19.90	20.76	20.75	(0.53)
Na_2O	0.29	0.23	0.32	0.27	0.25	0.30	0.33	0.28	(0.03)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	-	-
NiO	*0.08	*0.01	*0.00	*0.00	0.22	*0.01	*0.02	0.22	(0.00)
Cr_2O_3	*0.11	*0.00	*0.00	*0.03	*0.05	*0.08	*0.00	-	-
Total	99.48	99.75	100.39	100.29	100.09	99.21	99.60	99.83	(0.41)
Cations on the basis of 8 oxygens									
Si	1.917	1.925	1.924	1.929	1.938	1.943	1.922	1.928	(0.009)
Al	0.087	0.090	0.097	0.079	0.058	0.084	0.101	0.085	(0.013)
Ti	0.018	0.014	0.018	0.013	0.015	0.014	0.015	0.015	(0.001)
Fe	0.322	0.353	0.297	0.303	0.325	0.304	0.350	0.322	(0.021)
Mn	0.009	0.008	0.007	0.009	0.008	0.008	0.011	0.009	(0.001)
Mg	0.791	0.784	0.820	0.828	0.858	0.834	0.761	0.808	(0.034)
Ca	0.881	0.853	0.839	0.848	0.801	0.800	0.841	0.834	(0.023)
Na	0.021	0.017	0.023	0.020	0.018	0.022	0.024	0.021	(0.002)
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.002	*0.000	*0.000	*0.000	0.007	*0.000	*0.001	0.007	(0.000)
Cr	*0.003	*0.000	*0.000	*0.001	*0.001	*0.002	*0.000	-	-
Total	4.024	4.024	4.023	4.027	4.028	4.009	4.025	4.023	(0.006)
Mg N°	71.07	88.40	73.41	73.21	72.48	73.29	68.50	71.48	(2.05)
En%	40.07	38.78	41.92	41.88	43.19	43.03	38.99	41.12	(1.70)
Fs%	18.31	17.92	15.18	15.33	18.40	15.89	17.93	16.39	(1.06)
Wo%	43.82	43.30	42.89	42.79	40.41	41.28	43.08	42.48	(1.09)

* Indicates value was below the detection limit.
' Means and standard deviations are for core values above detection limit only.

Member L7b, Bullot Formation
EMP analyses: clinopyroxene

Member L7b	1 Core	2a Core	2b Rim	3 Core	4 Core	5 Core	6 Core	7 Core	8a Core	8b Rim	9 Core	10 Core	11a Core	11b Rim	Mean[1]	Std. Dev.[1]
SiO_2	51.49	51.94	49.83	51.77	50.48	51.65	51.49	51.35	51.39	51.41	51.40	51.76	51.36	50.77	51.46	(0.36)
Al_2O_3	2.28	2.83	2.22	1.51	3.10	1.66	2.09	2.14	3.10	1.70	2.11	1.77	1.90	2.09	2.23	(0.53)
TiO_2	0.33	0.25	0.48	0.43	0.45	0.51	0.47	0.52	0.26	0.50	0.61	0.46	0.52	0.56	0.44	(0.11)
FeO	9.57	5.19	8.70	9.14	9.41	10.37	8.62	9.70	6.25	8.97	9.45	9.79	9.02	9.48	8.77	(1.52)
MnO	0.22	0.10	0.20	0.31	0.31	0.26	0.24	0.26	0.16	0.24	0.27	0.25	0.23	0.30	0.24	(0.06)
MgO	15.02	16.71	14.31	14.91	14.85	14.38	15.24	14.82	16.42	15.15	14.66	15.13	15.15	14.75	15.19	(0.70)
CaO	20.27	21.78	20.58	21.07	20.32	19.99	20.87	20.41	20.93	20.86	20.60	20.46	20.83	20.46	20.68	(0.47)
Na_2O	0.24	0.29	0.32	0.32	0.33	0.34	0.28	0.29	0.27	0.26	0.33	0.28	0.25	0.30	0.29	(0.03)
K_2O	*0.00	*0.01	*0.01	*0.01	*0.02	*0.01	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	*0.01	*0.01	-	-
NiO	*0.02	*0.01	*0.00	*0.04	*0.00	*0.02	*0.09	*0.03	*0.00	*0.06	*0.02	*0.01	*0.00	*0.00	-	-
Cr_2O_3	*0.03	0.85	0.55	*0.00	0.17	*0.07	*0.07	0.12	0.59	*0.02	*0.04	*0.07	*0.06	*0.00	0.43	(0.31)
Total	99.42	99.95	97.19	99.45	99.22	99.16	99.28	99.60	99.38	99.10	99.42	99.90	99.24	98.71	99.46	(0.25)
Cations on the basis of 6 oxygens																
Si	1.930	1.909	1.915	1.943	1.900	1.947	1.927	1.926	1.904	1.933	1.929	1.934	1.928	1.922	1.925	(0.014)
Al	0.101	0.123	0.100	0.067	0.137	0.074	0.092	0.094	0.136	0.075	0.093	0.078	0.084	0.093	0.098	(0.023)
Ti	0.009	0.007	0.014	0.012	0.013	0.014	0.013	0.015	0.007	0.014	0.017	0.013	0.015	0.016	0.012	(0.003)
Fe	0.300	0.159	0.279	0.287	0.296	0.327	0.270	0.304	0.194	0.282	0.297	0.306	0.283	0.300	0.275	(0.049)
Mn	0.007	0.003	0.007	0.010	0.010	0.008	0.008	0.008	0.006	0.008	0.009	0.008	0.007	0.010	0.008	(0.002)
Mg	0.839	0.916	0.820	0.834	0.822	0.808	0.850	0.829	0.907	0.850	0.820	0.843	0.848	0.833	0.847	(0.033)
Ca	0.814	0.858	0.848	0.847	0.820	0.807	0.837	0.820	0.831	0.840	0.829	0.819	0.838	0.830	0.829	(0.014)
Na	0.018	0.021	0.024	0.023	0.024	0.024	0.020	0.021	0.019	0.019	0.024	0.020	0.018	0.022	0.021	(0.002)
K	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.000	*0.000	*0.001	*0.000	*0.001	*0.003	*0.001	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	-	-
Cr	*0.001	0.025	0.017	*0.000	0.005	*0.002	*0.002	0.004	0.017	*0.001	*0.001	*0.002	*0.002	*0.000	0.013	(0.009)
Total	4.018	4.021	4.024	4.023	4.027	4.009	4.017	4.021	4.021	4.021	4.018	4.021	4.021	4.026	4.020	(0.004)
Mg N°	73.66	85.21	74.61	74.40	73.52	71.19	75.89	73.17	82.38	75.09	73.41	73.37	74.98	73.52	75.56	(4.08)
En%	42.96	47.39	42.12	42.38	42.41	41.61	43.43	42.45	46.95	43.10	42.14	42.84	43.07	42.44	43.42	(1.83)
Fs%	15.36	8.23	14.33	14.58	15.27	18.84	13.80	15.57	10.04	14.30	15.26	15.55	14.37	15.28	14.08	(2.48)
Wo%	41.68	44.39	43.55	43.04	42.31	41.56	42.77	41.99	43.01	42.60	42.60	41.62	42.56	42.28	42.50	(0.79)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L6 (pink lapilli), Bullot Formation
EMP analyses: clinopyroxene

Member L6	1 Core	2 Core	3 Core	4 Core	5 Core	6a Core	6b Rim	7 Core	8 Core	9a Core	9b Rim	Mean[1]	Std. Dev.[1]
SiO_2	50.98	50.80	51.28	51.85	51.79	51.41	50.01	51.27	51.71	50.82	49.43	51.30	(0.35)
Al_2O_3	2.31	2.92	1.91	1.87	1.52	1.83	3.11	2.01	1.72	2.08	4.41	1.99	(0.40)
TiO_2	0.58	0.66	0.51	0.48	0.35	0.40	0.78	0.28	0.58	0.48	0.80	0.47	(0.11)
FeO	10.16	10.38	11.73	9.07	11.27	11.82	10.31	9.83	9.35	12.71	9.66	10.70	(1.17)
MnO	0.23	0.28	0.28	0.26	0.19	0.44	0.26	0.32	0.28	0.31	0.23	0.29	(0.07)
MgO	14.33	13.75	13.78	15.48	14.40	13.73	13.72	13.83	14.83	13.12	14.35	14.12	(0.64)
CaO	21.17	20.88	19.88	21.28	19.97	20.33	21.24	21.94	21.54	19.99	20.78	20.75	(0.72)
Na_2O	0.33	0.35	0.45	0.21	0.43	0.41	0.23	0.39	0.34	0.47	0.24	0.37	(0.07)
K_2O	*0.02	*0.03	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.03	*0.01	-	-
NiO	*0.00	*0.00	*0.02	*0.00	*0.05	*0.01	*0.08	*0.00	*0.00	*0.02	*0.00	-	-
Cr_2O_3	*0.06	*0.09	*0.01	*0.13	0.29	*0.01	*0.08	*0.09	*0.00	0.28	*0.00	0.29	(0.00)
Total	100.05	99.79	99.79	100.31	100.20	100.18	99.65	99.87	100.12	100.21	99.89	100.05	(0.18)
Cations on the basis of 6 oxygens													
Si	1.912	1.908	1.935	1.920	1.942	1.937	1.886	1.827	1.832	1.822	1.853	1.926	(0.011)
Al	0.102	0.128	0.085	0.082	0.067	0.072	0.138	0.088	0.078	0.082	0.195	0.088	(0.018)
Ti	0.016	0.018	0.014	0.014	0.010	0.011	0.022	0.008	0.016	0.013	0.022	0.013	(0.003)
Fe	0.319	0.325	0.370	0.282	0.353	0.373	0.325	0.308	0.282	0.402	0.303	0.336	(0.038)
Mn	0.007	0.009	0.009	0.008	0.006	0.014	0.008	0.010	0.008	0.010	0.007	0.008	(0.002)
Mg	0.801	0.770	0.775	0.858	0.805	0.771	0.771	0.775	0.815	0.738	0.802	0.790	(0.032)
Ca	0.850	0.832	0.803	0.848	0.802	0.821	0.858	0.883	0.862	0.810	0.835	0.835	(0.027)
Na	0.024	0.025	0.033	0.015	0.031	0.030	0.017	0.028	0.024	0.034	0.018	0.027	(0.006)
K	*0.001	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.001	-	-
Ni	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.002	*0.000	*0.000	*0.001	*0.000	-	-
Cr	*0.002	*0.003	*0.000	*0.004	0.008	*0.000	*0.002	*0.003	*0.000	0.008	*0.000	0.008	(0.000)
Total	4.031	4.017	4.024	4.027	4.025	4.029	4.025	4.028	4.026	4.031	4.035	4.027	(0.004)
Mg N°	71.52	70.32	67.89	75.26	68.52	67.40	70.35	71.48	73.82	64.77	72.58	70.18	(3.07)
En%	40.66	39.86	38.78	43.16	41.07	38.24	38.48	39.40	41.39	37.88	41.34	40.28	(1.43)
Fs%	16.18	16.87	18.99	14.19	18.01	18.88	18.83	15.71	14.83	20.60	15.62	17.15	(2.02)
Wo%	43.15	43.18	41.22	42.66	40.92	41.78	43.81	44.88	43.78	41.52	43.04	42.57	(1.24)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L4, Bullot Formation
EMP analyses: clinopyroxene

Member L4	1 Core	2 Core	3 Core	4 Core	5a Core	5b Rim	6 Core	7 Core	8 Core	9 Core	10a Core	10b Rim	11 Core	12 Core	Mean[1]	Std. Dev.[1]
SiO_2	51.52	51.73	50.94	51.01	52.39	51.37	50.52	51.19	51.17	51.22	50.79	50.97	49.91	51.53	51.15	(0.60)
Al_2O_3	1.44	1.26	2.36	2.09	1.74	1.74	2.67	2.00	2.00	1.80	4.18	2.13	2.61	1.38	2.13	(0.76)
TiO_2	0.44	0.34	0.60	0.55	0.17	0.47	0.60	0.51	0.55	0.49	0.29	0.58	0.60	0.41	0.46	(0.13)
FeO	11.22	10.20	9.64	9.48	7.79	9.18	9.51	9.52	9.40	9.59	6.43	9.43	10.27	9.97	9.42	(1.17)
MnO	0.36	0.30	0.29	0.33	0.31	0.21	0.36	0.27	0.36	0.25	0.18	0.25	0.34	0.23	0.30	(0.05)
MgO	14.26	14.86	14.59	14.60	17.45	15.11	14.33	14.69	14.83	14.86	16.94	14.68	14.09	14.28	14.98	(1.02)
CaO	20.86	20.67	21.32	21.47	18.49	21.06	21.40	21.25	21.07	21.01	19.84	21.34	21.00	21.60	20.83	(0.83)
Na_2O	0.33	0.26	0.28	0.28	0.24	0.28	0.29	0.26	0.29	0.24	0.22	0.28	0.33	0.29	0.28	(0.03)
K_2O	*0.00	*0.00	*0.00	*0.00	*0.01	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	-	-
NiO	*0.05	*0.02	*0.00	*0.00	*0.04	*0.00	*0.00	*0.00	*0.00	*0.03	*0.00	*0.03	*0.00	*0.04	-	-
Cr_2O_3	*0.00	*0.01	*0.09	*0.08	0.42	*0.12	*0.05	*0.06	0.14	*0.00	0.31	*0.07	*0.01	*0.10	0.29	(0.12)
Total	100.42	99.66	99.92	99.81	99.00	99.42	99.66	99.69	99.79	99.46	99.18	99.65	99.15	99.68	99.62	(0.37)
Cations on the basis of 6 oxygens																
Si	1.933	1.944	1.906	1.914	1.947	1.928	1.900	1.921	1.919	1.927	1.881	1.914	1.895	1.938	1.919	(0.020)
Al	0.064	0.057	0.104	0.092	0.076	0.077	0.118	0.086	0.088	0.080	0.182	0.094	0.117	0.061	0.094	(0.033)
Ti	0.012	0.010	0.017	0.015	0.005	0.013	0.017	0.014	0.016	0.014	0.008	0.016	0.017	0.012	0.013	(0.004)
Fe	0.352	0.320	0.302	0.297	0.242	0.288	0.299	0.299	0.295	0.302	0.199	0.296	0.326	0.314	0.296	(0.038)
Mn	0.011	0.010	0.009	0.011	0.010	0.007	0.011	0.009	0.011	0.008	0.006	0.008	0.011	0.007	0.010	(0.002)
Mg	0.798	0.933	0.815	0.817	0.967	0.845	0.803	0.822	0.829	0.833	0.935	0.822	0.797	0.801	0.838	(0.063)
Ca	0.839	0.833	0.856	0.883	0.738	0.847	0.883	0.855	0.847	0.847	0.787	0.858	0.854	0.871	0.838	(0.037)
Na	0.024	0.020	0.020	0.020	0.017	0.020	0.021	0.019	0.021	0.017	0.018	0.021	0.024	0.021	0.020	(0.002)
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.001	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.001	-	-
Cr	*0.000	*0.000	*0.003	*0.002	0.012	*0.003	*0.001	*0.002	0.004	*0.000	0.009	*0.002	*0.000	*0.003	0.008	(0.003)
Total	4.033	4.027	4.029	4.029	4.012	4.025	4.032	4.027	4.030	4.028	4.023	4.029	4.041	4.025	4.028	(0.007)
Mg №	69.39	72.25	72.98	73.34	79.98	74.58	72.87	73.33	73.75	73.39	82.45	73.52	70.97	71.84	73.88	(3.52)
En%	40.12	41.94	41.31	41.33	49.72	42.88	40.87	41.80	42.08	42.03	48.87	41.60	40.31	40.33	42.52	(3.06)
Fa%	17.70	18.11	15.31	15.02	12.44	14.55	15.22	15.13	14.97	15.24	10.38	14.98	18.49	15.81	14.98	(1.82)
Wo%	42.18	41.94	43.39	43.65	37.84	42.78	43.92	43.27	42.97	42.73	40.97	43.42	43.20	43.86	42.49	(1.63)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L3 (hokey pokey lapilli), Bullot Formation
EMP analyses: clinopyroxene

Member L3	1a Core	1b Rim	2 Core	3 Core	4a Core	4b Rim	5 Core	6 Core	7 Core	8a Core	8b Rim	9 Core	10 Core	11a Core	11b Rim	Mean†	Std. Dev.†
SiO_2	51.43	51.79	51.87	52.50	51.05	52.58	52.50	51.63	52.14	52.13	52.47	51.10	51.43	53.23	50.59	51.91	(0.64)
Al_2O_3	1.71	1.71	3.83	3.01	3.77	1.39	2.85	1.69	2.58	3.30	2.78	4.52	3.81	1.78	3.65	2.98	(0.92)
TiO_2	0.50	0.54	0.38	0.22	0.43	0.41	0.24	0.58	0.31	0.31	0.23	0.49	0.45	0.23	0.52	0.38	(0.12)
FeO	10.03	8.91	5.94	5.33	8.37	6.93	6.24	10.14	6.49	6.34	5.04	6.23	6.99	5.02	9.93	6.83	(1.62)
MnO	0.33	0.23	*0.12	0.20	*0.13	0.28	0.15	0.31	*0.13	*0.04	0.15	0.21	*0.10	0.18	0.23	0.23	(0.07)
MgO	14.19	15.84	17.31	18.16	16.27	17.52	16.97	14.42	16.32	18.68	17.44	16.08	16.33	17.85	14.39	16.60	(1.35)
CaO	21.10	20.71	20.13	19.42	21.02	20.35	20.59	20.73	21.45	17.85	21.43	21.11	20.72	21.26	20.38	20.49	(1.00)
Na_2O	0.31	0.24	0.30	0.36	0.27	0.15	0.29	0.32	0.32	0.28	0.28	0.43	0.34	0.22	0.44	0.31	(0.05)
K_2O	*0.01	*0.02	*0.01	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.02	*0.00	-	-
NiO	*0.00	*0.00	*0.00	*0.00	*0.10	*0.02	*0.05	*0.00	*0.06	*0.04	*0.11	*0.08	*0.09	*0.07	*0.00	-	-
Cr_2O_3	*0.00	*0.08	0.64	0.88	0.47	0.15	0.20	*0.13	*0.00	0.84	0.61	*0.10	0.43	0.38	0.19	0.55	(0.23)
Total	99.60	99.96	100.40	100.07	99.65	99.74	100.03	99.81	99.61	99.74	100.43	100.17	100.50	100.14	100.32	99.97	(0.30)
Cations on the basis of 6 oxygens																	
Si	1.936	1.928	1.891	1.914	1.885	1.941	1.925	1.936	1.925	1.905	1.913	1.875	1.886	1.942	1.887	1.911	(0.023)
Al	0.076	0.075	0.164	0.130	0.164	0.061	0.123	0.075	0.112	0.142	0.120	0.195	0.165	0.076	0.161	0.129	(0.039)
Ti	0.014	0.015	0.010	0.006	0.012	0.011	0.007	0.016	0.009	0.009	0.006	0.013	0.012	0.006	0.015	0.010	(0.003)
Fe	0.316	0.277	0.181	0.162	0.197	0.214	0.191	0.318	0.201	0.194	0.154	0.191	0.214	0.153	0.310	0.211	(0.053)
Mn	0.011	0.007	*0.004	0.006	*0.004	0.009	0.005	0.010	*0.004	*0.001	0.005	0.006	*0.003	0.006	0.007	0.007	(0.002)
Mg	0.796	0.879	0.941	0.987	0.895	0.965	0.927	0.806	0.898	1.018	0.948	0.880	0.892	0.971	0.800	0.910	(0.066)
Ca	0.851	0.826	0.786	0.759	0.832	0.805	0.809	0.833	0.849	0.699	0.837	0.830	0.814	0.831	0.814	0.808	(0.043)
Na	0.023	0.017	0.021	0.025	0.019	0.011	0.020	0.023	0.023	0.020	0.020	0.030	0.024	0.015	0.032	0.022	(0.004)
K	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.000	*0.000	*0.000	*0.000	*0.003	*0.001	*0.001	*0.000	*0.002	*0.001	*0.003	*0.002	*0.003	*0.002	*0.000	-	-
Cr	*0.000	*0.002	0.019	0.025	0.014	0.004	0.006	*0.004	*0.000	0.024	0.018	*0.003	0.012	0.011	0.005	0.016	(0.007)
Total	4.023	4.024	4.013	4.014	4.018	4.021	4.013	4.017	4.017	4.011	4.021	4.020	4.019	4.011	4.031	4.016	(0.004)
Mg N^a	71.58	76.04	83.87	86.90	81.98	81.85	82.92	71.71	81.71	83.99	86.03	82.17	80.65	86.39	72.07	81.17	(4.78)
En%	40.55	44.35	49.32	51.73	46.52	48.64	48.11	41.19	46.10	53.27	48.89	46.29	48.48	49.87	41.58	47.20	(3.72)
Fs%	16.10	13.98	9.49	8.49	10.24	10.79	9.91	18.25	10.32	10.15	7.94	10.05	11.15	7.83	16.11	10.91	(2.63)
Wo%	43.35	41.88	41.19	39.78	43.24	40.57	41.98	42.57	43.58	36.58	43.17	43.86	42.40	42.51	42.31	41.89	(2.01)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L1 (green ash), Bullot Formation
EMP analyses: clinopyroxene

Member L1	1 Core	2a Core	2b Rim	3a Core	3b Rim	4 Core	Mean†	Std.Dev.†
SiO_2	50.83	51.26	51.31	53.72	51.42	52.16	51.99	(1.11)
Al_2O_3	3.03	3.23	2.40	1.89	1.65	1.82	2.49	(0.64)
TiO_2	0.70	0.37	0.70	0.21	0.51	0.54	0.46	(0.18)
FeO	10.12	6.59	9.67	5.38	9.51	8.78	7.72	(1.85)
MnO	0.25	0.16	0.24	0.17	0.36	0.33	0.22	(0.07)
MgO	13.85	16.11	14.95	18.20	14.98	15.66	15.95	(1.55)
CaO	20.61	21.17	20.13	20.02	20.49	20.67	20.62	(0.41)
Na_2O	0.36	0.32	0.38	0.23	0.28	0.25	0.29	(0.05)
K_2O	*0.01	*0.00	*0.00	*0.00	*0.03	*0.00	-	-
NiO	*0.00	*0.06	*0.05	*0.05	*0.03	*0.04	-	-
Cr_2O_3	*0.09	0.39	*0.01	0.37	*0.00	0.14	0.30	(0.11)
Total	99.75	99.60	99.78	100.18	99.19	100.34	99.96	(0.30)
Cations on the basis of 6 oxygens								
Si	1.907	1.899	1.918	1.953	1.936	1.933	1.923	(0.021)
Al	0.134	0.141	0.106	0.081	0.073	0.079	0.109	(0.029)
Ti	0.020	0.010	0.020	0.006	0.014	0.015	0.013	(0.005)
Fe	0.318	0.204	0.302	0.164	0.300	0.272	0.240	(0.060)
Mn	0.008	0.005	0.008	0.005	0.011	0.010	0.007	(0.002)
Mg	0.774	0.890	0.833	0.987	0.841	0.865	0.879	(0.076)
Ca	0.829	0.840	0.806	0.780	0.827	0.821	0.818	(0.023)
Na	0.026	0.023	0.027	0.016	0.020	0.018	0.021	(0.004)
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.000	*0.002	*0.002	*0.002	*0.001	*0.001	-	-
Cr	*0.003	0.011	*0.000	0.011	*0.000	0.004	0.009	(0.003)
Total	4.016	4.023	4.020	4.003	4.022	4.017	4.015	(0.007)
Mg №	70.88	81.35	73.39	85.75	73.71	76.08	78.52	(6.58)
En%	40.29	46.02	42.92	51.11	42.73	44.18	45.40	(3.89)
Fs%	16.55	10.55	15.56	8.49	15.24	13.89	12.37	(3.09)
Wo%	43.15	43.43	41.52	40.39	42.02	41.93	42.23	(1.20)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member Tf14, Tufa Trig Formation
EMP analyses: orthopyroxene

Member Tf14	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	Mean[1]	Std. Dev.[1]
SiO_2	50.77	53.08	53.94	53.41	51.87	51.76	53.39	52.09	53.72	53.85	52.56	52.77	(0.98)
Al_2O_3	1.57	1.12	2.31	1.38	1.03	1.14	1.68	1.70	1.38	1.31	1.19	1.44	(0.35)
TiO_2	0.34	0.22	0.10	0.14	0.39	0.36	0.16	0.14	0.13	0.13	0.28	0.22	(0.10)
FeO	22.36	15.91	9.59	14.36	20.28	19.94	11.73	19.58	13.82	13.57	17.46	16.24	(3.83)
MnO	0.56	0.39	0.21	0.30	0.47	0.38	0.25	0.33	0.27	0.31	0.33	0.35	(0.10)
MgO	20.85	26.11	29.86	27.15	22.17	22.74	28.61	23.32	27.86	27.75	24.64	25.55	(2.83)
CaO	1.85	1.76	2.12	1.65	2.06	1.93	1.94	1.54	1.60	1.65	1.98	1.82	(0.19)
Na_2O	*0.04	*0.00	*0.06	*0.04	*0.01	*0.00	*0.00	*0.07	*0.05	*0.02	*0.01	-	-
K_2O	*0.00	*0.00	*0.00	*0.03	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	-	-
NiO	*0.09	*0.01	*0.00	*0.04	*0.00	*0.02	*0.09	*0.07	*0.00	*0.01	*0.00	-	-
Cr_2O_3	*0.10	*0.07	0.29	*0.08	*0.00	*0.08	0.27	0.30	*0.00	*0.07	*0.03	0.28	(0.01)
Total	98.29	98.58	98.42	98.37	98.27	98.25	98.02	99.00	98.78	98.56	98.44	98.45	(0.26)
Cations on the basis of 6 oxygens													
Si	1.937	1.954	1.932	1.952	1.960	1.951	1.940	1.942	1.952	1.958	1.953	1.948	(0.009)
Al	0.071	0.048	0.097	0.060	0.046	0.050	0.072	0.075	0.059	0.056	0.052	0.062	(0.015)
Ti	0.010	0.006	0.003	0.004	0.011	0.010	0.004	0.004	0.004	0.003	0.008	0.006	(0.003)
Fe	0.713	0.490	0.287	0.439	0.641	0.629	0.356	0.611	0.420	0.413	0.543	0.504	(0.128)
Mn	0.018	0.012	0.006	0.009	0.015	0.012	0.008	0.011	0.008	0.009	0.010	0.011	(0.003)
Mg	1.186	1.433	1.595	1.479	1.249	1.278	1.550	1.296	1.509	1.504	1.365	1.404	(0.130)
Ca	0.076	0.070	0.081	0.064	0.083	0.078	0.078	0.061	0.062	0.064	0.079	0.072	(0.008)
Na	*0.003	*0.000	*0.004	*0.003	*0.001	*0.000	*0.000	*0.005	*0.003	*0.001	*0.001	-	-
K	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.003	*0.000	*0.000	*0.001	*0.000	*0.001	*0.003	*0.002	*0.000	*0.000	*0.000	-	-
Cr	*0.003	*0.002	0.008	*0.002	*0.000	*0.002	0.008	0.009	*0.000	*0.002	*0.001	0.008	(0.000)
Total	4.011	4.013	4.009	4.007	4.005	4.008	4.014	4.009	4.014	4.007	4.010	4.010	(0.003)
Mg N°	62.45	74.52	84.75	77.11	66.08	67.02	81.32	67.96	78.23	78.46	71.54	73.59	(6.76)
En%	60.05	71.90	81.25	74.62	63.30	64.38	78.20	65.85	75.79	75.92	68.70	70.91	(6.56)
Fs%	38.10	24.59	14.62	22.15	32.49	31.69	17.98	31.05	21.09	20.85	27.33	25.45	(6.48)
Wo%	3.85	3.51	4.13	3.23	4.21	3.93	3.83	3.10	3.11	3.23	3.98	3.65	(0.40)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member Tf8, Tufa Trig Formation
EMP analyses: orthopyroxene

Member Tf8	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	Mean†	Std. Dev.†
SiO_2	51.78	52.27	52.01	52.56	51.43	52.92	52.94	51.77	52.51	52.22	52.74	53.88	51.77	51.62	51.78	52.28	(0.63)
Al_2O_3	1.12	0.90	1.13	1.26	1.54	1.69	2.48	1.18	1.26	1.19	1.22	1.85	1.05	1.14	1.05	1.34	(0.39)
TiO_2	0.29	0.09	0.38	0.26	0.29	0.27	0.21	0.33	0.32	0.28	0.22	0.12	0.28	0.35	0.32	0.27	(0.08)
FeO	20.70	20.15	19.69	18.44	21.18	15.43	12.56	21.13	19.21	19.11	16.70	12.99	20.28	20.82	20.81	18.61	(2.78)
MnO	0.51	0.41	0.41	0.39	0.49	0.30	0.23	0.42	0.42	0.33	0.34	0.25	0.36	0.50	0.52	0.39	(0.09)
MgO	22.06	22.89	22.85	24.20	21.89	26.37	28.21	22.08	23.10	23.35	25.20	27.76	22.65	21.87	21.98	23.76	(2.07)
CaO	1.60	1.51	1.93	1.71	1.68	1.52	1.44	1.80	1.82	1.73	1.77	1.51	1.82	1.87	1.90	1.71	(0.15)
Na_2O	*0.00	*0.00	*0.02	*0.01	*0.06	*0.07	*0.05	*0.04	*0.10	*0.06	*0.01	*0.03	*0.02	*0.04	*0.01	-	-
K_2O	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.01	*0.02	*0.01	*0.00	*0.01	*0.00	-	-
NiO	*0.07	*0.00	*0.02	*0.03	*0.00	*0.02	*0.00	*0.02	*0.00	*0.05	*0.09	*0.07	*0.03	*0.05	*0.06	-	-
Cr_2O_3	*0.05	*0.02	*0.00	*0.05	*0.08	*0.11	*0.00	*0.10	0.18	*0.06	*0.05	0.25	*0.08	*0.00	*0.07	0.21	(0.04)
Total	98.06	98.22	96.39	98.80	98.49	98.48	98.06	98.73	98.82	98.20	98.18	98.61	98.21	98.18	98.34	98.38	(0.25)
Cations on the basis of 6 oxygens																	
Si	1.961	1.970	1.956	1.953	1.944	1.942	1.926	1.951	1.959	1.958	1.956	1.951	1.954	1.956	1.958	1.953	(0.010)
Al	0.050	0.040	0.050	0.055	0.069	0.073	0.106	0.053	0.055	0.053	0.053	0.079	0.047	0.051	0.047	0.059	(0.016)
Ti	0.008	0.003	0.011	0.007	0.008	0.007	0.006	0.009	0.009	0.008	0.006	0.003	0.008	0.010	0.009	0.007	(0.002)
Fe	0.655	0.635	0.619	0.573	0.669	0.473	0.382	0.666	0.599	0.599	0.518	0.394	0.640	0.660	0.658	0.583	(0.094)
Mn	0.016	0.013	0.013	0.012	0.016	0.009	0.007	0.014	0.013	0.010	0.011	0.008	0.012	0.016	0.017	0.012	(0.003)
Mg	1.245	1.286	1.281	1.341	1.233	1.442	1.530	1.241	1.285	1.305	1.393	1.499	1.275	1.236	1.239	1.322	(0.095)
Ca	0.065	0.061	0.078	0.068	0.068	0.060	0.056	0.073	0.073	0.069	0.070	0.059	0.074	0.076	0.077	0.068	(0.007)
Na	*0.000	*0.000	*0.001	*0.000	*0.004	*0.005	*0.003	*0.003	*0.007	*0.004	*0.001	*0.002	*0.001	*0.003	*0.001	-	-
K	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.001	*0.000	*0.001	*0.000	-	-
Ni	*0.002	*0.000	*0.001	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.003	*0.002	*0.001	*0.002	*0.002	-	-
Cr	*0.002	*0.001	*0.000	*0.002	*0.002	*0.003	*0.000	*0.003	0.005	*0.002	*0.001	0.007	*0.003	*0.000	*0.002	0.006	(0.001)
Total	4.000	4.008	4.008	4.009	4.007	4.006	4.013	4.007	3.998	4.002	4.007	4.000	4.010	4.005	4.005	4.006	(0.004)
Mg N°	65.53	66.94	67.42	70.06	64.83	75.30	80.02	65.08	68.21	68.54	72.89	79.19	68.58	65.19	65.31	69.41	(4.93)
En%	83.36	84.88	84.76	87.68	82.59	73.01	77.74	82.88	85.66	88.14	70.32	76.79	84.10	82.88	82.77	87.01	(4.95)
Fs%	33.33	32.04	31.29	28.91	33.98	23.95	19.41	33.64	30.61	30.36	26.15	20.18	32.18	33.47	33.33	29.52	(4.70)
Wo%	3.31	3.08	3.94	3.43	3.45	3.04	2.85	3.89	3.73	3.50	3.53	3.02	3.72	3.85	3.90	3.47	(0.34)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member Tf5, Tufa Trig Formation
EMP analyses: orthopyroxene

Member Tf5	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	Mean†	Std. Dev.†
SiO_2	53.03	52.55	53.77	53.98	53.68	53.43	51.97	52.94	52.85	53.82	53.49	53.06	52.25	53.93	51.75	53.10	(0.70)
Al_2O_3	2.33	0.93	1.60	1.34	1.81	1.83	0.94	1.35	1.46	1.54	0.76	2.01	0.92	1.92	1.17	1.45	(0.44)
TiO_2	0.15	*0.06	0.16	0.14	0.16	0.13	0.21	0.23	0.20	0.11	0.09	0.18	0.25	0.18	0.23	0.17	(0.05)
FeO	13.49	19.06	12.77	12.34	12.94	12.85	20.74	14.28	16.45	12.22	15.69	13.73	18.73	11.58	20.52	15.16	(3.06)
MnO	0.27	0.37	0.31	0.27	0.28	0.28	0.51	0.37	0.34	0.29	0.36	0.29	0.41	0.29	0.34	0.33	(0.06)
MgO	27.50	23.60	28.09	28.58	28.12	28.31	22.56	27.45	26.13	28.75	26.16	27.55	23.63	29.00	22.48	26.53	(2.25)
CaO	1.87	1.53	1.43	1.68	1.54	1.51	1.71	1.62	1.48	1.51	1.66	1.54	1.84	1.37	1.76	1.60	(0.14)
Na_2O	*0.03	*0.02	*0.02	*0.04	*0.05	*0.03	*0.07	*0.00	*0.00	*0.00	*0.03	*0.08	*0.00	*0.00	*0.00	-	-
K_2O	*0.00	*0.00	*0.00	*0.01	*0.00	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.02	*0.01	*0.00	*0.00	-	-
NiO	*0.02	*0.00	*0.02	*0.02	*0.04	*0.09	*0.00	*0.10	*0.00	*0.00	*0.00	*0.09	*0.08	*0.00	*0.01	-	-
Cr_2O_3	0.49	*0.14	*0.12	*0.10	*0.10	0.28	*0.05	*0.09	*0.03	*0.11	*0.13	*0.12	*0.00	*0.12	*0.11	0.39	(0.10)
Total	99.13	98.03	98.12	96.33	88.32	98.62	98.63	98.25	98.91	98.24	98.20	98.35	98.01	98.25	98.25	98.38	(0.31)
Cations on the basis of 6 oxygens																	
Si	1.922	1.970	1.954	1.955	1.949	1.936	1.958	1.940	1.943	1.950	1.971	1.933	1.962	1.946	1.954	1.950	(0.013)
Al	0.100	0.041	0.068	0.057	0.069	0.078	0.042	0.058	0.063	0.066	0.033	0.086	0.041	0.082	0.052	0.062	(0.018)
Ti	0.004	*0.002	0.004	0.004	0.004	0.003	0.006	0.006	0.006	0.003	0.002	0.005	0.007	0.004	0.006	0.005	(0.001)
Fe	0.409	0.597	0.388	0.374	0.393	0.389	0.653	0.438	0.506	0.370	0.483	0.418	0.588	0.349	0.648	0.467	(0.102)
Mn	0.008	0.012	0.009	0.008	0.009	0.008	0.016	0.011	0.011	0.009	0.011	0.009	0.013	0.009	0.011	0.010	(0.002)
Mg	1.486	1.319	1.522	1.543	1.522	1.530	1.267	1.500	1.432	1.553	1.437	1.496	1.323	1.560	1.265	1.450	(0.102)
Ca	0.073	0.061	0.056	0.065	0.060	0.059	0.069	0.064	0.058	0.059	0.065	0.060	0.074	0.053	0.071	0.063	(0.006)
Na	*0.002	*0.001	*0.001	*0.003	*0.004	*0.002	*0.005	*0.000	*0.000	*0.000	*0.002	*0.006	*0.000	*0.000	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.000	*0.001	*0.001	*0.001	*0.003	*0.000	*0.003	*0.000	*0.000	*0.000	*0.003	*0.002	*0.000	*0.000	-	-
Cr	0.014	*0.004	*0.003	*0.003	*0.003	0.008	*0.001	*0.002	*0.001	*0.003	*0.004	*0.004	*0.000	*0.003	*0.103	0.011	(0.003)
Total	4.016	4.000	4.001	4.006	4.006	4.011	4.011	4.017	4.019	4.010	4.002	4.007	4.008	4.003	4.007	4.008	(0.006)
Mg N°	78.42	68.84	79.69	80.49	79.48	79.73	65.99	77.40	73.89	80.76	74.84	78.16	68.23	81.72	66.13	75.65	(5.33)
En%	75.51	86.72	77.42	77.85	77.08	77.35	83.70	74.93	71.74	78.36	72.39	75.79	86.85	79.51	63.76	73.25	(5.29)
Fs%	20.78	30.20	19.74	18.87	19.80	19.87	32.83	21.88	25.35	18.87	24.33	21.18	29.62	17.79	32.66	23.56	(5.11)
Wo%	3.71	3.09	2.85	3.28	3.04	2.98	3.47	3.20	2.91	2.98	3.27	3.04	3.73	2.70	3.58	3.19	(0.30)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member Tf1, Tufa Trig Formation
EMP analyses: orthopyroxene

Member Tf1	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10a Core	10b Rim	11 Core	12 Core	13 Core	Mean[†]	Std. Dev.[†]
SiO_2	52.03	52.64	52.74	53.74	52.47	52.88	53.15	51.69	53.09	52.64	53.12	52.69	52.13	52.22	52.62	(0.52)
Al_2O_3	1.25	0.73	0.57	0.51	1.15	1.64	0.90	1.43	0.71	1.17	0.55	1.42	1.69	1.24	1.11	(0.38)
TiO_2	0.33	0.27	0.29	0.21	0.33	0.25	0.27	0.29	0.22	0.34	0.24	0.23	0.39	0.32	0.29	(0.05)
FeO	21.69	21.14	21.11	19.66	21.99	18.58	18.41	22.71	20.95	20.52	19.21	19.47	20.70	20.66	20.59	(1.22)
MnO	0.46	0.52	0.50	0.53	0.42	0.34	0.51	0.49	0.49	0.49	0.36	0.40	0.44	0.43	0.46	(0.05)
MgO	22.12	22.46	22.36	23.95	22.17	24.32	24.61	21.92	22.95	23.35	24.46	23.60	22.97	23.10	23.07	(0.83)
CaO	1.78	1.78	1.75	1.39	1.70	1.87	1.64	1.59	1.43	1.57	1.65	1.80	1.70	1.68	1.67	(0.14)
Na_2O	*0.03	*0.00	*0.00	*0.02	*0.03	*0.04	*0.01	0.07	*0.02	*0.01	*0.02	0.21	*0.01	*0.01	0.14	(0.07)
K_2O	*0.02	*0.02	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
NiO	*0.02	*0.05	*0.00	*0.02	*0.05	*0.04	*0.06	*0.07	*0.09	*0.02	*0.05	*0.08	*0.09	*0.06	-	-
Cr_2O_3	*0.00	*0.01	*0.01	*0.00	*0.00	*0.05	*0.03	*0.02	*0.00	*0.00	*0.00	*0.04	*0.00	*0.00	-	-
Total	99.64	99.55	99.32	100.00	100.23	99.87	99.50	100.19	99.83	100.07	99.59	99.82	100.03	99.65	99.82	(0.27)
Cations on the basis of 6 oxygens																
Si	1.949	1.967	1.975	1.980	1.953	1.944	1.960	1.935	1.972	1.950	1.964	1.948	1.935	1.946	1.955	(0.014)
Al	0.055	0.032	0.025	0.022	0.051	0.071	0.039	0.063	0.031	0.051	0.024	0.062	0.074	0.055	0.049	(0.017)
Ti	0.009	0.008	0.008	0.006	0.009	0.007	0.007	0.008	0.006	0.009	0.007	0.006	0.011	0.009	0.008	(0.001)
Fe	0.679	0.661	0.661	0.606	0.684	0.571	0.568	0.711	0.651	0.636	0.594	0.602	0.643	0.644	0.640	(0.041)
Mn	0.015	0.017	0.016	0.017	0.013	0.011	0.016	0.016	0.015	0.015	0.011	0.013	0.014	0.013	0.015	(0.002)
Mg	1.235	1.251	1.248	1.316	1.230	1.332	1.353	1.223	1.271	1.290	1.349	1.301	1.271	1.283	1.277	(0.039)
Ca	0.071	0.071	0.070	0.055	0.068	0.074	0.065	0.064	0.057	0.062	0.065	0.071	0.068	0.067	0.066	(0.005)
Na	*0.002	*0.000	*0.000	*0.001	*0.002	*0.003	*0.001	0.005	*0.002	*0.000	*0.001	0.015	*0.000	*0.001	0.010	(0.005)
K	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.002	*0.000	*0.001	*0.001	*0.001	*0.002	*0.002	*0.003	*0.001	*0.002	*0.002	*0.003	*0.002	-	-
Cr	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	-	-
Total	4.013	4.007	4.003	4.002	4.008	4.010	4.008	4.025	4.003	4.013	4.014	4.018	4.016	4.017	4.011	(0.007)
Mg N[a]	64.52	65.43	65.37	68.47	64.26	69.99	70.43	63.24	66.13	66.98	69.43	68.37	66.41	66.58	66.63	(2.10)
En%	62.22	63.09	63.06	66.57	62.06	67.37	68.13	61.21	64.22	64.89	67.18	65.91	64.13	64.34	64.40	(2.04)
Fs%	34.21	33.33	33.40	30.65	34.51	28.88	28.60	35.59	32.90	31.99	29.58	30.50	32.44	32.30	32.25	(2.03)
Wo%	3.58	3.58	3.54	2.78	3.43	3.74	3.27	3.20	2.88	3.12	3.24	3.60	3.43	3.36	3.35	(0.28)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Poutu Lapilli, Mangamate Tephra
EMP analyses: orthopyroxene

Poutu Lapilli	1 Core	Mean†	Std. Dev.†
SiO_2	52.72	52.72	(0.00)
Al_2O_3	0.84	0.84	(0.00)
TiO_2	*0.09	-	-
FeO	20.79	20.79	(0.00)
MnO	0.71	0.71	(0.00)
MgO	22.98	22.98	(0.00)
CaO	1.13	1.13	(0.00)
Na_2O	*0.02	-	-
K_2O	*0.02	-	-
NiO	*0.00	-	-
Cr_2O_3	*0.06	-	-
Total	99.18	99.18	(0.00)
Cations on the basis		of 6 oxygens	
Si	1.969	1.969	(0.000)
Al	0.037	0.037	(0.000)
Ti	*0.002	-	-
Fe	0.650	0.650	(0.000)
Mn	0.022	0.022	(0.000)
Mg	1.279	1.279	(0.000)
Ca	0.045	0.045	(0.000)
Na	*0.001	-	-
K	*0.001	-	-
Ni	*0.000	-	-
Cr	*0.002	-	-
Total	4.002	4.002	(0.000)
Mg Nº	66.30	66.30	(0.00)
En%	64.79	64.79	(0.00)
Fs%	32.93	32.93	(0.00)
Wo%	2.28	2.28	(0.00)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Waihohonu Lapilli, Mangamate Tephra
EMP analyses: orthopyroxene

Waihohonu Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.90	54.22	52.95	53.01	52.39	53.10	(0.60)
Al_2O_3	1.81	1.60	2.20	2.20	2.27	2.01	(0.26)
TiO_2	0.24	0.13	0.18	0.18	0.19	0.18	(0.03)
FeO	15.16	11.37	14.39	13.33	18.14	14.48	(2.23)
MnO	0.39	0.22	0.36	0.25	0.38	0.32	(0.07)
MgO	26.29	29.20	27.11	27.81	24.50	26.98	(1.56)
CaO	1.80	1.56	1.48	1.58	1.30	1.54	(0.16)
Na_2O	*0.05	*0.08	*0.01	*0.01	*0.00	-	-
K_2O	*0.00	*0.00	*0.01	*0.00	*0.00	-	-
NiO	*0.00	*0.01	*0.00	*0.04	*0.10	-	-
Cr_2O_3	*0.00	*0.12	*0.10	*0.03	*0.01	-	-
Total	98.58	98.29	98.67	98.35	99.18	98.61	(0.32)
Cations on the basis of 6 oxygens							
Si	1.941	1.953	1.931	1.931	1.933	1.938	(0.008)
Al	0.078	0.068	0.095	0.094	0.099	0.087	(0.012)
Ti	0.007	0.004	0.005	0.005	0.005	0.005	(0.001)
Fe	0.465	0.342	0.439	0.406	0.560	0.442	(0.072)
Mn	0.012	0.007	0.011	0.008	0.012	0.010	(0.002)
Mg	1.438	1.568	1.474	1.510	1.348	1.468	(0.074)
Ca	0.071	0.060	0.058	0.062	0.051	0.060	(0.006)
Na	*0.004	*0.005	*0.001	*0.001	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.000	*0.001	*0.003	-	-
Cr	*0.000	*0.003	*0.003	*0.001	*0.000	-	-
Total	4.012	4.002	4.013	4.016	4.008	4.010	(0.005)
Mg N°	75.56	82.09	77.05	78.81	70.65	76.83	(3.78)
En%	72.85	79.59	74.78	76.34	68.81	74.48	(3.59)
Fs%	23.56	17.38	22.27	20.53	28.59	22.46	(3.70)
Wo%	3.60	3.05	2.94	3.13	2.60	3.06	(0.32)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Oturere Lapilli, Mangamate Tephra
EMP analyses: orthopyroxene

Oturere Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	Mean†	Std. Dev.†
SiO_2	53.21	51.18	53.20	52.70	52.42	52.11	51.99	53.01	53.47	52.59	(0.70)
Al_2O_3	2.44	4.33	2.82	2.81	2.11	3.17	1.38	2.09	2.37	2.59	(0.78)
TiO_2	0.18	0.27	0.20	0.22	0.20	0.29	0.31	0.19	0.16	0.23	(0.05)
FeO	13.17	16.44	12.34	14.94	16.53	16.38	21.17	16.82	14.82	15.85	(2.40)
MnO	0.30	0.28	0.27	0.39	0.36	0.38	0.54	0.45	0.23	0.35	(0.09)
MgO	27.54	25.17	27.94	28.08	25.20	25.44	22.17	25.94	26.82	25.81	(1.59)
CaO	1.62	1.77	1.48	1.84	1.63	2.01	1.84	1.81	1.48	1.67	(0.16)
Na_2O	*0.01	*0.01	*0.00	*0.02	*0.07	*0.01	*0.02	*0.00	*0.00	-	-
K_2O	*0.00	*0.02	*0.02	*0.00	*0.00	*0.01	*0.00	*0.01	*0.00	-	-
NiO	*0.08	*0.00	*0.08	*0.00	*0.03	*0.03	*0.01	*0.00	*0.01	-	-
Cr_2O_3	*0.14	0.16	*0.11	*0.00	*0.10	*0.06	*0.00	*0.00	*0.05	0.16	(0.00)
Total	98.48	99.57	98.26	98.78	98.45	99.78	99.19	100.10	99.36	99.11	(0.61)
Cations on the basis of 6 oxygens											
Si	1.931	1.872	1.927	1.928	1.935	1.901	1.951	1.930	1.937	1.924	(0.022)
Al	0.104	0.187	0.120	0.113	0.092	0.136	0.061	0.089	0.101	0.111	(0.033)
Ti	0.005	0.007	0.005	0.006	0.006	0.008	0.009	0.005	0.004	0.006	(0.002)
Fe	0.400	0.503	0.374	0.457	0.510	0.500	0.665	0.512	0.449	0.486	(0.079)
Mn	0.009	0.009	0.008	0.012	0.011	0.012	0.017	0.014	0.007	0.011	(0.003)
Mg	1.490	1.373	1.509	1.422	1.387	1.383	1.240	1.408	1.448	1.407	(0.074)
Ca	0.083	0.069	0.058	0.072	0.064	0.079	0.088	0.063	0.058	0.066	(0.006)
Na	*0.001	*0.001	*0.000	*0.001	*0.005	*0.001	*0.002	*0.000	*0.000	-	-
K	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.002	*0.000	*0.002	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	-	-
Cr	*0.004	0.005	*0.003	*0.000	*0.003	*0.002	*0.000	*0.000	*0.001	0.005	(0.000)
Total	4.002	4.025	4.001	4.010	4.005	4.019	4.009	4.021	4.004	4.011	(0.008)
Mg N°	78.84	73.19	80.14	75.88	73.12	73.45	65.09	73.33	76.33	74.35	(4.08)
En%	76.29	70.59	77.74	72.89	70.73	70.49	62.91	71.00	74.07	71.86	(4.02)
Fs%	20.48	25.88	19.27	23.42	26.01	25.48	33.74	25.82	22.97	24.78	(3.92)
Wo%	3.23	3.55	2.99	3.89	3.26	4.03	3.35	3.18	2.97	3.36	(0.32)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Te Rato Lapilli, Mangamate Tephra
EMP analyses: orthopyroxene

Te Rato Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	Mean[†]	Std. Dev.[†]
SiO_2	52.82	53.00	52.12	53.16	52.33	52.39	53.25	53.37	53.04	52.87	53.11	53.56	53.19	52.82	52.70	52.91	(0.39)
Al_2O_3	1.16	0.92	1.47	1.48	1.43	1.25	0.83	0.72	0.90	0.99	1.04	0.88	0.91	1.08	0.85	1.06	(0.24)
TiO_2	0.29	0.21	0.32	0.37	0.30	0.36	0.29	0.22	0.18	0.21	0.21	0.24	0.28	0.32	0.26	0.27	(0.06)
FeO	20.21	16.96	19.67	18.09	18.93	22.05	18.16	19.82	20.16	20.27	19.61	19.62	20.04	19.52	19.26	19.49	(1.12)
MnO	0.40	0.48	0.54	0.37	0.41	0.44	0.40	0.43	0.45	0.42	0.49	0.42	0.47	0.42	0.50	0.44	(0.04)
MgO	23.19	25.74	23.79	24.99	24.62	21.93	24.67	23.35	23.37	22.54	23.27	23.79	22.87	23.34	23.73	23.68	(0.95)
CaO	1.53	1.63	1.44	1.93	1.56	1.73	1.63	1.61	1.59	1.66	1.52	1.54	1.53	1.62	1.59	1.61	(0.11)
Na_2O	*0.00	*0.06	*0.00	*0.04	*0.00	*0.03	*0.04	*0.01	*0.00	*0.02	*0.02	*0.05	*0.00	*0.00	*0.02	-	-
K_2O	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.03	*0.00	-	-
NiO	*0.07	*0.00	*0.03	*0.01	*0.01	*0.01	*0.09	*0.02	*0.00	*0.03	*0.01	*0.00	*0.06	*0.01	*0.03	-	-
Cr_2O_3	*0.10	*0.03	*0.10	*0.00	*0.10	*0.04	*0.00	*0.00	*0.00	*0.00	*0.00	*0.04	*0.00	*0.00	*0.09	-	-
Total	99.62	98.95	99.36	100.40	99.58	100.13	99.21	99.52	99.70	98.95	99.25	100.05	99.28	99.12	98.89	99.47	(0.44)
Cations on the basis of 6 oxygens																	
Si	1.959	1.954	1.938	1.941	1.953	1.953	1.966	1.976	1.968	1.976	1.973	1.971	1.978	1.965	1.963	1.962	(0.012)
Al	0.051	0.040	0.064	0.064	0.062	0.055	0.036	0.031	0.039	0.044	0.046	0.038	0.040	0.048	0.037	0.046	(0.010)
Ti	0.008	0.008	0.009	0.010	0.008	0.010	0.008	0.006	0.005	0.006	0.006	0.007	0.008	0.009	0.007	0.008	(0.001)
Fe	0.627	0.524	0.612	0.552	0.585	0.687	0.561	0.615	0.626	0.634	0.609	0.604	0.623	0.607	0.600	0.604	(0.037)
Mn	0.013	0.015	0.017	0.011	0.013	0.014	0.012	0.014	0.014	0.013	0.015	0.013	0.015	0.013	0.016	0.014	(0.001)
Mg	1.282	1.415	1.319	1.360	1.357	1.218	1.357	1.290	1.292	1.256	1.288	1.305	1.268	1.295	1.318	1.308	(0.047)
Ca	0.061	0.064	0.057	0.076	0.062	0.069	0.064	0.064	0.063	0.066	0.061	0.061	0.061	0.065	0.064	0.064	(0.004)
Na	*0.000	*0.004	*0.000	*0.003	*0.000	*0.002	*0.003	*0.001	*0.000	*0.001	*0.001	*0.004	*0.000	*0.000	*0.002	-	-
K	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.002	*0.000	*0.001	*0.000	*0.000	*0.000	*0.003	*0.001	*0.000	*0.001	*0.000	*0.000	*0.002	*0.000	*0.001	-	-
Cr	*0.003	*0.001	*0.003	*0.000	*0.003	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.003	-	-
Total	4.001	4.018	4.016	4.014	4.040	4.006	4.004	3.998	4.007	3.995	3.998	3.999	3.993	4.002	4.005	4.006	(0.011)
Mg N[a]	67.16	72.98	68.31	71.13	69.88	63.94	70.75	67.72	67.36	66.46	67.90	68.36	67.05	68.09	68.72	68.39	(2.08)
En%	65.08	70.64	66.35	66.41	67.71	61.70	68.47	65.52	65.22	64.21	65.78	66.24	64.96	65.84	66.50	66.18	(2.01)
Fs%	31.83	26.16	30.78	27.77	29.19	34.80	28.30	31.23	31.60	32.41	31.10	30.66	31.92	30.86	30.27	30.59	(2.02)
Wo%	3.10	3.20	2.87	3.82	3.09	3.50	3.23	3.25	3.18	3.37	3.12	3.10	3.13	3.30	3.23	3.23	(0.21)

* Indicates value was below the detection limit.

† Means and standard deviations are for core values above detection limit only.

Pahoka Tephra
EMP analyses: orthopyroxene

Pahoka Tephra	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	Mean†	Std. Dev.†
SiO_2	52.20	52.32	52.81	52.97	52.84	51.66	52.47	(0.46)
Al_2O_3	3.45	3.43	0.86	0.84	1.05	1.41	1.84	(1.15)
TiO_2	0.26	0.18	0.22	0.25	0.24	0.28	0.24	(0.03)
FeO	16.03	15.31	21.15	20.77	21.11	22.45	19.47	(2.74)
MnO	0.30	0.34	0.51	0.52	0.47	0.56	0.45	(0.10)
MgO	25.50	25.94	22.67	22.47	22.72	20.83	23.35	(1.79)
CaO	1.13	1.25	1.49	1.38	1.47	1.55	1.38	(0.15)
Na_2O	*0.00	*0.03	*0.00	*0.03	*0.00	*0.02	-	-
K_2O	*0.00	*0.00	*0.01	*0.00	*0.00	*0.05	-	-
NiO	*0.03	*0.00	*0.00	*0.00	*0.00	*0.06	-	-
Cr_2O_3	*0.04	*0.07	*0.00	*0.02	*0.02	*0.01	-	-
Total	98.87	98.76	99.72	99.20	99.89	98.75	99.20	(0.46)
Cations on the basis of 6 oxygens								
Si	1.912	1.912	1.968	1.978	1.964	1.958	1.949	(0.027)
Al	0.149	0.148	0.038	0.037	0.046	0.063	0.080	(0.049)
Ti	0.007	0.005	0.006	0.007	0.007	0.008	0.007	(0.001)
Fe	0.491	0.468	0.659	0.649	0.656	0.712	0.606	(0.092)
Mn	0.009	0.010	0.016	0.016	0.015	0.018	0.014	(0.003)
Mg	1.392	1.413	1.259	1.251	1.259	1.177	1.292	(0.083)
Ca	0.044	0.049	0.059	0.055	0.058	0.063	0.055	(0.006)
Na	*0.000	*0.002	*0.000	*0.002	*0.000	*0.001	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	-	-
Ni	*0.001	*0.000	*0.000	*0.000	*0.000	*0.002	-	-
Cr	*0.001	*0.002	*0.000	*0.001	*0.001	*0.000	-	-
Total	4.004	4.005	4.005	3.993	4.005	3.999	4.002	(0.004)
Mg N°	73.92	75.12	65.64	65.84	65.74	62.31	68.10	(4.72)
En%	72.24	73.21	63.68	63.98	63.81	60.30	66.20	(4.79)
Fs%	25.48	24.25	33.33	33.20	33.25	36.48	31.00	(4.50)
Wo%	2.28	2.54	2.98	2.81	2.94	3.23	2.80	(0.31)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Okupata Tephra
EMP analyses: orthopyroxene *(continued ...)*

Okupata Tephra	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	18 Core	19 Core	20 Core
SiO_2	51.23	50.67	51.76	53.06	51.39	50.93	51.22	51.24	51.24	51.29	51.45	51.34	51.34	52.13	52.30	52.12	51.41	51.44	52.49	51.58
Al_2O_3	1.97	1.12	1.12	1.50	2.40	1.12	1.21	1.44	2.14	1.33	1.36	1.35	1.75	0.88	2.51	2.09	2.20	1.46	0.73	1.30
TiO_2	0.27	0.23	0.28	0.20	0.24	0.26	0.24	0.27	0.27	0.31	0.34	0.33	0.38	0.25	0.23	0.27	0.24	0.21	0.22	0.37
FeO	20.09	23.10	21.22	16.89	17.41	21.80	21.47	21.68	19.60	21.98	20.85	20.50	21.52	20.99	15.70	17.17	18.54	21.54	18.56	21.46
MnO	0.47	0.63	0.50	0.31	0.36	0.52	0.53	0.26	0.46	0.55	0.44	0.50	0.45	0.51	0.46	0.29	0.42	0.46	0.51	0.42
MgO	22.83	21.63	22.59	26.28	25.15	21.99	22.03	21.98	23.82	21.14	22.94	23.10	22.42	22.87	26.41	25.63	24.38	22.16	24.38	22.60
CaO	1.53	1.61	1.50	1.28	1.35	1.55	1.65	1.56	1.45	1.62	1.68	1.70	1.52	1.57	1.32	1.25	1.34	1.57	1.34	1.74
Na_2O	*0.02	*0.00	*0.01	*0.03	*0.02	*0.02	*0.08	*0.00	*0.00	*0.01	*0.04	*0.07	*0.00	*0.03	*0.00	*0.05	*0.04	*0.00	*0.02	*0.00
K_2O	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	*0.00	*0.01	*0.01	*0.00	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.01
NiO	*0.00	*0.00	*0.00	*0.05	*0.04	*0.00	*0.00	*0.03	*0.00	*0.05	*0.01	*0.00	*0.00	*0.00	*0.02	*0.01	*0.07	*0.00	*0.00	*0.00
Cr_2O_3	*0.00	*0.01	*0.00	*0.06	*0.05	*0.00	*0.01	*0.00	*0.01	*0.00	*0.05	*0.12	*0.06	*0.01	*0.08	*0.00	*0.09	*0.09	*0.13	*0.00
Total	98.38	98.99	98.97	99.52	98.30	98.17	98.34	98.43	98.98	98.22	99.06	98.81	99.38	99.20	98.94	98.82	98.53	98.85	98.24	99.48
Cations on the basis of 8 oxygens																				
Si	1.930	1.930	1.948	1.939	1.912	1.942	1.945	1.943	1.915	1.953	1.933	1.930	1.927	1.955	1.916	1.924	1.917	1.941	1.962	1.936
Al	0.088	0.050	0.050	0.065	0.105	0.050	0.054	0.064	0.094	0.060	0.060	0.060	0.077	0.039	0.108	0.091	0.097	0.065	0.032	0.058
Ti	0.008	0.007	0.008	0.005	0.007	0.007	0.007	0.008	0.008	0.009	0.010	0.009	0.011	0.007	0.006	0.008	0.007	0.006	0.006	0.010
Fe	0.633	0.736	0.668	0.516	0.542	0.695	0.682	0.688	0.613	0.700	0.655	0.645	0.676	0.658	0.481	0.530	0.578	0.680	0.560	0.674
Mn	0.015	0.020	0.016	0.009	0.011	0.017	0.017	0.008	0.015	0.018	0.014	0.016	0.014	0.016	0.014	0.009	0.013	0.015	0.016	0.013
Mg	1.283	1.228	1.268	1.432	1.395	1.250	1.247	1.242	1.327	1.200	1.285	1.295	1.255	1.279	1.442	1.410	1.355	1.247	1.359	1.264
Ca	0.062	0.066	0.060	0.050	0.054	0.063	0.067	0.064	0.059	0.066	0.068	0.068	0.061	0.063	0.052	0.049	0.054	0.064	0.053	0.070
Na	*0.002	*0.000	*0.000	*0.002	*0.002	*0.002	*0.006	*0.000	*0.000	*0.001	*0.003	*0.005	*0.000	*0.002	*0.000	*0.004	*0.003	*0.000	*0.002	*0.000
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000
Ni	*0.000	*0.000	*0.000	*0.002	*0.001	*0.000	*0.000	*0.001	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	*0.000	*0.000
Cr	*0.000	*0.000	*0.000	*0.002	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.004	*0.002	*0.000	*0.002	*0.000	*0.003	*0.003	*0.004	*0.000
Total	4.019	4.037	4.018	4.016	4.026	4.024	4.019	4.017	4.030	4.006	4.025	4.023	4.021	4.017	4.019	4.021	4.021	4.018	4.008	4.025
Mg N°	66.96	62.53	65.50	73.51	72.02	64.27	64.64	64.35	68.40	63.16	66.24	66.75	64.99	66.03	74.99	72.68	70.10	64.71	70.09	65.22
En%	64.86	60.49	63.53	71.67	70.07	62.25	62.47	62.29	66.42	61.04	63.99	64.49	63.00	63.95	73.01	70.89	68.19	62.63	68.22	62.95
Fs%	32.00	36.26	33.47	25.83	27.22	34.61	34.17	34.50	30.68	35.61	32.62	32.12	33.94	32.90	24.35	26.65	29.09	34.15	29.12	33.57
Wo%	3.13	3.25	3.01	2.50	2.71	3.14	3.36	3.21	2.90	3.36	3.39	3.39	3.06	3.15	2.63	2.46	2.72	3.21	2.66	3.49

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Okupata Tephra
EMP analyses: orthopyroxene *(... continued)*

Okupata Tephra	21 Core	22 Core	Mean†	Std. Dev.†
SiO_2	52.07	51.61	51.60	(0.54)
Al_2O_3	1.10	1.82	1.54	(0.49)
TiO_2	0.30	0.34	0.27	(0.05)
FeO	21.31	17.70	20.05	(1.98)
MnO	0.44	0.40	0.45	(0.09)
MgO	22.26	24.97	23.34	(1.51)
CaO	1.47	1.44	1.50	(0.14)
Na_2O	*0.01	*0.04	-	-
K_2O	*0.00	*0.00	-	-
NiO	*0.04	*0.03	-	-
Cr_2O_3	*0.04	*0.00	-	-
Total	98.95	98.28	98.76	(0.42)
Cations on basis of 6 oxygens				
Si	1.958	1.924	1.935	(0.014)
Al	0.049	0.080	0.068	(0.021)
Ti	0.008	0.009	0.008	(0.001)
Fe	0.670	0.552	0.630	(0.068)
Mn	0.014	0.013	0.014	(0.003)
Mg	1.248	1.388	1.305	(0.070)
Ca	0.059	0.057	0.060	(0.006)
Na	*0.001	*0.003	-	-
K	*0.000	*0.000	-	-
Ni	*0.001	*0.001	-	-
Cr	*0.001	*0.000	-	-
Total	4.006	4.023	4.020	(0.007)
Mg N°	65.07	71.55	67.44	(3.54)
En%	63.13	69.50	65.41	(3.61)
Fs%	33.89	27.64	31.56	(3.36)
Wo%	2.98	2.85	3.03	(0.30)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [BT1], Bullot Formation
EMP analyses: orthopyroxene *(continued ...)*

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13a Core	13b Rim	14 Core	15 Core	16 Core	17 Core	18 Core
SiO_2	52.51	52.06	52.47	51.49	52.71	51.85	52.48	51.89	52.24	52.25	52.30	52.20	52.97	52.12	52.47	52.04	52.44	52.11	51.78
Al_2O_3	1.60	1.20	0.99	2.34	1.27	1.81	0.98	1.14	1.17	1.25	1.35	1.98	0.96	0.96	0.91	1.17	1.05	1.47	2.92
TiO_2	0.28	0.27	0.23	0.30	0.23	0.47	0.22	0.28	0.28	0.23	0.33	0.15	0.21	0.28	0.18	0.25	0.27	0.30	0.23
FeO	20.10	22.02	20.88	18.67	18.35	19.01	21.79	21.71	21.48	22.56	20.39	19.81	20.86	21.77	21.11	20.73	20.99	21.89	19.26
MnO	0.44	0.58	0.54	0.43	0.30	0.36	0.52	0.58	0.50	0.50	0.40	0.49	0.53	0.47	0.62	0.53	0.56	0.42	0.49
MgO	24.11	22.70	23.27	24.78	25.67	24.11	23.01	22.21	22.77	22.08	23.78	24.50	23.19	22.55	23.17	23.17	23.22	22.51	24.45
CaO	1.43	1.49	1.56	1.19	1.27	1.75	1.54	1.54	1.44	1.51	1.59	1.26	1.39	1.44	1.47	1.53	1.51	1.66	1.37
Na_2O	*0.04	*0.05	*0.00	*0.00	*0.03	*0.04	*0.00	*0.02	*0.01	*0.00	*0.01	*0.06	*0.00	*0.01	*0.00	*0.04	*0.00	*0.01	*0.02
K_2O	*0.01	*0.00	*0.01	*0.01	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.01	*0.02	*0.01	*0.00	*0.02	*0.01	*0.00	*0.00
NiO	*0.01	*0.00	*0.00	*0.00	*0.00	*0.04	*0.00	*0.03	*0.00	*0.00	*0.05	*0.00	*0.05	*0.00	*0.07	*0.00	*0.06	*0.09	*0.02
Cr_2O_3	*0.00	*0.00	*0.00	*0.04	*0.03	0.28	*0.00	*0.00	*0.00	*0.04	*0.01	*0.08	*0.00	*0.00	*0.00	*0.00	*0.04	*0.03	*0.02
Total	100.46	100.33	99.94	99.20	99.79	99.63	100.53	99.35	99.86	100.37	100.13	100.38	100.11	99.57	99.93	99.42	100.03	100.36	100.49
Cations on the basis of 6 oxygens																			
Si	1.933	1.939	1.952	1.909	1.937	1.920	1.948	1.950	1.949	1.948	1.936	1.920	1.962	1.953	1.953	1.945	1.948	1.937	1.899
Al	0.069	0.053	0.043	0.102	0.055	0.079	0.043	0.050	0.051	0.055	0.059	0.086	0.042	0.043	0.040	0.052	0.046	0.064	0.126
Ti	0.008	0.008	0.006	0.008	0.006	0.013	0.006	0.008	0.008	0.066	0.009	0.004	0.006	0.008	0.005	0.007	0.007	0.008	0.006
Fe	0.619	0.666	0.649	0.579	0.564	0.589	0.676	0.682	0.670	0.703	0.631	0.609	0.646	0.682	0.657	0.648	0.652	0.680	0.591
Mn	0.014	0.018	0.017	0.013	0.009	0.011	0.016	0.018	0.016	0.016	0.012	0.015	0.017	0.015	0.020	0.017	0.018	0.013	0.015
Mg	1.323	1.261	1.290	1.370	1.406	1.331	1.273	1.244	1.266	1.227	1.312	1.343	1.281	1.259	1.286	1.291	1.286	1.248	1.337
Ca	0.056	0.060	0.062	0.047	0.050	0.069	0.061	0.062	0.058	0.060	0.063	0.050	0.055	0.058	0.059	0.061	0.060	0.066	0.054
Na	*0.003	*0.004	*0.000	*0.000	*0.002	*0.003	*0.000	*0.001	*0.001	*0.000	*0.001	*0.004	*0.000	*0.001	*0.000	*0.003	*0.001	*0.001	*0.002
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000
Ni	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.002	*0.000	*0.001	*0.000	*0.002	*0.000	*0.002	*0.003	*0.000
Cr	*0.000	*0.000	*0.000	*0.001	*0.001	0.008	*0.000	*0.000	*0.000	*0.001	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.001
Total	4.022	4.025	4.019	4.028	4.027	4.020	4.023	4.014	4.018	4.075	4.022	4.027	4.009	4.018	4.020	4.021	4.017	4.016	4.028
Mg N°	68.13	64.77	66.53	70.29	71.37	69.32	65.32	64.59	65.39	63.58	67.52	68.80	66.49	64.86	66.19	66.58	66.36	64.73	69.35
En%	66.22	62.83	64.47	69.64	69.80	66.92	63.33	62.58	63.49	61.66	65.40	67.08	64.63	62.98	64.24	64.55	64.36	62.59	67.46
Fs%	30.98	34.18	32.43	29.01	27.92	29.61	33.63	34.31	33.60	35.33	31.46	30.42	32.59	34.12	32.82	32.40	32.63	34.10	29.82
Wo%	2.80	2.99	3.10	2.35	2.48	3.47	3.03	3.12	2.91	3.02	3.14	2.50	2.77	2.90	2.95	3.05	3.00	3.31	2.72

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [BT1], Bullot Formation
EMP analyses: orthopyroxene *(... continued)*

Pourahu Member	Mean[†]	Std. Dev.[†]
SiO_2	52.23	(0.35)
Al_2O_3	1.42	(0.52)
TiO_2	0.26	(0.07)
FeO	20.64	(1.19)
MnO	0.49	(0.08)
MgO	23.48	(0.93)
CaO	1.47	(0.14)
Na_2O	-	-
K_2O	-	-
NiO	-	-
Cr_2O_3	0.28	(0.00)
Total	100.02	(0.40)
Cations		
Si	1.938	(0.016)
Al	0.062	(0.022)
Ti	0.011	(0.014)
Fe	0.641	(0.040)
Mn	0.015	(0.003)
Mg	1.299	(0.045)
Ca	0.059	(0.006)
Na	-	-
K	-	-
Ni	-	-
Cr	0.008	(0.000)
Total	4.024	(0.013)
Mg N[a]	66.96	(2.11)
En%	65.00	(2.16)
Fs%	32.07	(2.00)
Wo%	2.93	(0.28)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [WS1], Bullot Formation
EMP analyses: orthopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	Mean†	Std. Dev.†
SiO_2	51.94	52.34	51.91	52.47	52.15	52.57	52.71	51.89	51.39	52.15	(0.39)
Al_2O_3	1.73	1.00	1.46	1.11	1.32	0.99	0.80	1.17	1.34	1.21	(0.27)
TiO_2	0.26	0.31	0.31	0.26	0.30	0.25	0.27	0.29	0.25	0.28	(0.02)
FeO	20.11	20.81	21.37	21.29	21.68	21.79	21.09	20.59	21.45	21.13	(0.51)
MnO	0.40	0.48	0.46	0.52	0.49	0.55	0.60	0.50	0.46	0.50	(0.06)
MgO	23.05	22.72	22.16	22.27	22.17	22.26	22.60	22.22	22.32	22.42	(0.29)
CaO	1.44	1.62	1.58	1.57	1.74	1.55	1.40	1.57	1.48	1.55	(0.10)
Na_2O	*0.00	*0.01	*0.00	*0.03	*0.02	*0.00	*0.00	*0.00	*0.03	-	-
K_2O	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
NiO	*0.00	*0.01	*0.02	*0.01	*0.00	*0.04	*0.02	*0.06	*0.02	-	-
Cr_2O_3	*0.00	*0.06	*0.02	*0.00	*0.02	*0.01	*0.00	*0.03	*0.04	-	-
Total	99.93	99.28	99.25	99.48	99.86	99.96	99.46	98.23	98.68	99.24	(0.52)
Cations on the basis of 6 oxygens											
Si	1.943	1.958	1.948	1.962	1.948	1.961	1.969	1.960	1.942	1.955	(0.009)
Al	0.076	0.044	0.064	0.049	0.058	0.043	0.035	0.052	0.060	0.053	(0.012)
Ti	0.007	0.009	0.009	0.007	0.008	0.007	0.008	0.008	0.007	0.008	(0.001)
Fe	0.629	0.651	0.671	0.666	0.677	0.680	0.659	0.651	0.678	0.662	(0.016)
Mn	0.013	0.015	0.015	0.016	0.015	0.018	0.019	0.016	0.015	0.016	(0.002)
Mg	1.285	1.267	1.240	1.242	1.235	1.238	1.259	1.251	1.257	1.253	(0.015)
Ca	0.058	0.065	0.064	0.063	0.070	0.062	0.056	0.063	0.060	0.062	(0.004)
Na	*0.000	*0.001	*0.000	*0.002	*0.001	*0.000	*0.000	*0.000	*0.002	-	-
K	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.001	*0.002	*0.001	-	-
Cr	*0.000	*0.002	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	-	-
Total	4.011	4.009	4.011	4.005	4.011	4.009	4.005	4.001	4.019	4.009	(0.005)
Mg N°	67.14	66.06	64.89	65.09	64.59	64.55	65.64	65.77	64.96	65.41	(0.79)
En%	65.16	63.89	62.78	63.01	62.31	62.53	63.78	63.66	63.01	63.35	(0.83)
Fs%	31.90	32.83	33.97	33.79	34.16	34.34	33.38	33.13	33.98	33.50	(0.73)
Wo%	2.94	3.28	3.24	3.20	3.53	3.13	2.84	3.21	3.01	3.15	(0.19)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [DR16], Bullot Formation
EMP analyses: orthopyroxene

Pourahu Member	1 Core	2 Core	3a Core	3b Rim	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11a Core	11b Rim	12 Core	13 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.21	52.01	52.78	52.64	52.47	52.07	52.28	51.35	52.41	52.48	53.15	52.21	54.49	52.82	52.37	52.34	(0.41)
Al_2O_3	1.13	1.07	0.85	0.96	1.00	1.05	1.17	1.51	1.09	1.25	0.78	1.23	1.10	0.84	0.80	1.04	(0.22)
TiO_2	0.30	0.34	0.26	0.29	0.25	0.28	0.32	0.29	0.30	0.33	0.28	0.23	0.07	0.31	0.24	0.29	(0.03)
FeO	21.76	22.27	21.37	21.00	21.64	21.61	22.72	22.32	20.92	21.28	21.85	22.77	14.56	20.86	21.08	21.73	(0.61)
MnO	0.38	0.56	0.53	0.51	0.45	0.52	0.54	0.49	0.45	0.52	0.50	0.57	0.31	0.51	0.58	0.51	(0.05)
MgO	22.43	21.99	22.78	22.63	22.08	22.05	21.71	21.44	22.69	22.78	22.78	21.72	27.87	23.23	22.36	22.31	(0.51)
CaO	1.74	1.14	1.67	1.62	1.48	1.58	1.62	1.68	1.82	1.48	1.51	1.45	1.73	1.58	1.50	1.54	(0.14)
Na_2O	*0.04	*0.04	*0.02	*0.01	*0.02	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.04	*0.01	*0.05	-	-
K_2O	*0.00	*0.00	*0.00	*0.01	*0.01	*0.02	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.01	*0.02	*0.00	-	-
NiO	*0.03	*0.01	*0.01	*0.00	*0.06	*0.00	*0.04	*0.01	*0.00	*0.02	*0.02	*0.05	*0.00	*0.03	*0.02	-	-
Cr_2O_3	*0.00	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.02	*0.04	*0.04	*0.00	*0.00	*0.08	*0.03	*0.00	-	-
Total	99.95	99.36	100.23	99.64	99.37	99.17	100.35	99.07	99.47	100.12	100.86	100.17	100.13	99.74	98.92	99.75	(0.56)
Cations on the basis of 8 oxygens																	
Si	1.949	1.955	1.960	1.963	1.966	1.959	1.952	1.942	1.957	1.950	1.964	1.953	1.958	1.960	1.968	1.957	(0.007)
Al	0.050	0.047	0.037	0.042	0.044	0.047	0.051	0.067	0.048	0.055	0.034	0.054	0.047	0.026	0.035	0.046	(0.010)
Ti	0.008	0.010	0.007	0.008	0.007	0.008	0.009	0.008	0.008	0.009	0.008	0.006	0.002	0.008	0.007	0.008	(0.001)
Fe	0.679	0.700	0.664	0.655	0.678	0.680	0.709	0.706	0.653	0.661	0.675	0.712	0.437	0.650	0.663	0.679	(0.021)
Mn	0.012	0.018	0.017	0.016	0.014	0.017	0.017	0.016	0.014	0.016	0.016	0.018	0.009	0.016	0.019	0.016	(0.002)
Mg	1.248	1.233	1.261	1.258	1.233	1.237	1.208	1.208	1.263	1.262	1.255	1.211	1.493	1.289	1.253	1.243	(0.024)
Ca	0.069	0.046	0.066	0.065	0.059	0.064	0.065	0.068	0.065	0.059	0.060	0.058	0.066	0.063	0.060	0.062	(0.006)
Na	*0.003	*0.003	*0.002	*0.001	*0.001	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	*0.003	*0.000	*0.004	-	-
K	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.001	*0.000	*0.000	*0.000	*0.002	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.001	*0.000	-	-
Cr	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.001	*0.000	*0.000	*0.002	*0.001	*0.000	-	-
Total	4.015	4.009	4.012	4.007	4.001	4.012	4.011	4.015	4.008	4.012	4.012	4.012	4.012	4.014	4.005	4.011	(0.004)
Mg N[a]	64.76	63.79	65.51	65.76	64.52	64.53	63.02	63.11	65.92	65.63	65.03	62.97	77.36	66.48	65.40	64.67	(1.11)
En%	62.53	62.30	63.34	63.60	62.59	62.44	60.95	60.95	63.76	63.67	63.07	61.13	74.80	64.39	63.41	62.65	(1.07)
Fs%	34.02	35.37	33.35	33.11	34.42	34.33	35.77	35.62	32.96	33.35	33.92	35.94	21.89	32.47	33.55	34.24	(1.09)
Wo%	3.46	2.32	3.31	3.29	2.99	3.23	3.28	3.43	3.28	2.98	3.02	2.93	3.31	3.15	3.04	3.11	(0.28)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [OT], Bullot Formation
EMP analyses: orthopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	Mean†	Std. Dev.†
SiO_2	53.27	52.25	52.58	51.84	52.86	52.56	(0.49)
Al_2O_3	0.73	1.42	1.01	1.08	3.34	1.52	(0.94)
TiO_2	0.25	0.29	0.26	0.32	0.21	0.26	(0.04)
FeO	20.79	21.75	21.87	22.00	14.11	20.10	(3.03)
MnO	0.62	0.52	0.57	0.61	0.37	0.54	(0.09)
MgO	23.22	22.17	22.39	22.26	27.53	23.51	(2.04)
CaO	1.55	1.64	1.36	1.51	1.38	1.49	(0.11)
Na_2O	*0.00	*0.03	*0.00	*0.00	*0.00	-	-
K_2O	*0.00	*0.00	*0.00	*0.00	*0.01	-	-
NiO	*0.03	0.13	*0.00	*0.00	*0.00	0.13	(0.00)
Cr_2O_3	*0.00	*0.02	*0.00	*0.00	0.09	0.09	(0.00)
Total	100.44	100.17	100.04	99.61	99.88	100.03	(0.28)
Cations on the basis of 6 oxygens							
Si	1.968	1.947	1.960	1.947	1.903	1.945	(0.022)
Al	0.032	0.062	0.045	0.048	0.142	0.066	(0.039)
Ti	0.007	0.008	0.007	0.009	0.006	0.007	(0.001)
Fe	0.642	0.678	0.682	0.691	0.425	0.624	(0.101)
Mn	0.019	0.017	0.018	0.019	0.011	0.017	(0.003)
Mg	1.278	1.232	1.244	1.246	1.478	1.296	(0.092)
Ca	0.062	0.066	0.054	0.061	0.053	0.059	(0.005)
Na	*0.000	*0.002	*0.000	*0.000	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	0.004	*0.000	*0.000	*0.000	0.004	(0.000)
Cr	*0.000	*0.001	*0.000	*0.000	0.002	0.002	(0.000)
Total	4.008	4.014	4.010	4.021	4.020	4.015	(0.005)
Mg N°	66.58	64.50	64.59	64.33	77.67	67.53	(5.13)
En%	64.48	62.35	62.83	62.38	75.56	65.52	(5.08)
Fs%	32.39	34.31	34.44	34.58	21.73	31.49	(4.95)
Wo%	3.13	3.34	2.73	3.05	2.71	2.99	(0.24)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [ignimbrite unit] [CT], Bullot Formation
EMP analyses: orthopyroxene in banded lapilli

Pourahu Member	1 Core	2 Rim	3 Core	4 Core	5a Core	5b Rim	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.39	52.34	52.28	52.01	51.96	51.63	52.83	51.99	52.60	52.43	51.99	52.85	51.39	51.62	52.21	53.52	51.67	51.78	52.22	(0.53)
Al_2O_3	1.27	1.03	1.04	1.27	1.23	1.39	1.06	1.30	0.96	1.26	1.18	0.93	1.46	1.52	0.80	0.97	1.28	1.32	1.18	(0.19)
TiO_2	0.29	0.13	0.29	0.25	0.15	0.28	0.27	0.28	0.29	0.24	0.33	0.28	0.24	0.31	0.28	*0.08	0.27	0.30	0.27	(0.04)
FeO	21.54	21.35	21.60	21.43	21.53	22.30	21.62	20.92	20.61	20.87	21.97	20.96	21.68	21.47	21.27	17.69	21.72	22.41	21.21	(1.00)
MnO	0.51	0.57	0.51	0.49	0.46	0.55	0.52	0.48	0.38	0.47	0.45	0.58	0.47	0.49	0.62	0.34	0.44	0.57	0.49	(0.07)
MgO	22.29	22.77	22.70	23.04	22.67	22.40	22.58	23.04	23.10	23.15	22.68	23.50	22.23	22.77	22.88	26.31	22.27	22.35	22.97	(0.93)
CaO	1.51	1.61	1.50	1.58	1.50	1.57	1.62	1.54	1.48	1.49	1.60	1.46	1.49	1.60	1.46	1.40	1.72	1.53	1.53	(0.07)
Na_2O	*0.01	*0.01	*0.02	*0.03	*0.04	*0.00	*0.04	0.07	*0.06	*0.00	*0.03	*0.01	*0.02	*0.04	*0.00	*0.02	*0.02	*0.01	0.07	(0.00)
K_2O	*0.00	*0.00	*0.02	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.03	*0.00	*0.00	*0.00	-	-
NiO	*0.00	*0.00	*0.02	*0.00	*0.00	*0.01	*0.01	*0.08	*0.04	*0.00	*0.10	*0.00	*0.03	*0.00	*0.00	*0.00	*0.04	*0.01	-	-
Cr_2O_3	*0.05	*0.00	*0.00	*0.00	*0.12	*0.11	*0.00	*0.04	*0.04	*0.00	*0.04	*0.00	*0.01	*0.08	*0.01	0.33	*0.03	*0.00	0.33	(0.00)
Total	99.80	99.79	99.91	100.08	99.51	100.12	100.50	99.61	99.42	99.90	100.19	100.56	98.96	99.77	99.53	100.55	99.36	100.26	99.87	(0.45)
Cations on the basis of 6 oxygens																				
Si	1.954	1.954	1.951	1.937	1.945	1.931	1.958	1.940	1.960	1.949	1.938	1.953	1.939	1.929	1.955	1.945	1.942	1.935	1.946	(0.009)
Al	0.056	0.045	0.046	0.056	0.054	0.061	0.046	0.057	0.042	0.055	0.052	0.040	0.065	0.067	0.035	0.041	0.056	0.058	0.052	(0.009)
Ti	0.008	0.004	0.008	0.007	0.004	0.008	0.008	0.008	0.008	0.007	0.009	0.008	0.007	0.009	0.008	*0.002	0.008	0.008	0.008	(0.001)
Fe	0.672	0.667	0.674	0.668	0.674	0.697	0.670	0.653	0.642	0.649	0.685	0.648	0.684	0.671	0.666	0.538	0.682	0.700	0.661	(0.035)
Mn	0.016	0.018	0.016	0.015	0.015	0.018	0.016	0.015	0.012	0.015	0.014	0.018	0.015	0.015	0.020	0.010	0.014	0.018	0.015	(0.002)
Mg	1.240	1.267	1.263	1.280	1.265	1.248	1.247	1.282	1.263	1.283	1.260	1.295	1.250	1.268	1.277	1.426	1.248	1.245	1.276	(0.042)
Ca	0.060	0.065	0.060	0.063	0.060	0.063	0.064	0.061	0.059	0.059	0.064	0.058	0.060	0.064	0.059	0.055	0.069	0.061	0.061	(0.003)
Na	*0.000	*0.001	*0.001	*0.002	*0.003	*0.000	*0.003	0.005	*0.004	*0.000	*0.002	*0.001	*0.002	*0.003	*0.000	*0.001	*0.001	*0.000	0.005	(0.000)
K	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.001	*0.000	*0.003	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Cr	*0.001	*0.000	*0.000	*0.000	*0.003	*0.003	*0.000	*0.001	*0.001	*0.000	*0.001	*0.000	*0.000	*0.002	*0.000	0.009	*0.001	*0.000	0.009	(0.000)
Total	4.006	4.020	4.018	4.026	4.017	4.026	4.009	4.021	4.006	4.017	4.022	4.020	4.020	4.023	4.020	4.024	4.019	4.025	4.018	(0.006)
Mg N[a]	64.85	65.51	65.20	65.71	65.24	64.16	65.05	66.25	66.65	66.41	64.78	66.65	64.63	65.39	65.72	72.61	64.66	64.01	65.86	(1.90)
En%	62.88	63.38	63.24	63.65	63.28	62.15	62.95	64.23	64.67	64.44	62.72	64.72	62.69	63.31	63.79	70.63	62.43	62.06	63.85	(1.91)
Fs%	34.08	33.37	33.75	33.22	33.72	34.71	33.82	32.72	32.36	32.60	34.10	32.38	34.30	33.50	33.27	26.65	34.12	34.90	33.09	(1.81)
Wo%	3.04	3.25	3.00	3.13	3.00	3.14	3.23	3.06	2.97	2.96	3.19	2.90	3.01	3.20	2.95	2.72	3.45	3.04	3.05	(0.16)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Pourahu Member [ignimbrite unit] [MQ], Bullot Formation
EMP analyses: orthopyroxene

Pourahu Member	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	Mean†	Std. Dev.†
SiO_2	52.10	53.13	51.14	52.14	52.08	51.97	52.77	52.67	52.34	52.26	(0.54)
Al_2O_3	1.34	1.57	1.68	1.85	0.95	1.28	0.64	0.81	1.14	1.25	(0.38)
TiO_2	0.25	0.30	0.32	0.26	0.25	0.20	0.20	0.24	0.27	0.25	(0.04)
FeO	21.87	18.03	23.41	20.92	20.37	21.81	22.82	23.42	21.30	21.55	(1.60)
MnO	0.55	0.37	0.51	0.45	0.55	0.55	0.52	0.46	0.46	0.49	(0.06)
MgO	21.94	24.95	20.58	22.88	22.39	21.91	21.89	21.83	22.48	22.32	(1.11)
CaO	1.65	1.58	1.59	1.56	1.60	1.64	1.15	1.17	1.59	1.60	(0.18)
Na_2O	0.06	*0.05	*0.04	*0.00	*0.01	*0.01	*0.04	*0.00	*0.01	0.06	(0.00)
K_2O	*0.01	*0.01	*0.00	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	-	-
NiO	*0.05	*0.05	0.12	*0.07	*0.01	*0.00	*0.00	*0.01	*0.02	0.12	(0.00)
Cr_2O_3	*0.02	*0.05	*0.03	*0.01	*0.03	*0.02	*0.03	*0.01	*0.00	-	-
Total	99.75	99.90	99.34	100.06	98.18	99.36	99.98	100.59	99.58	99.64	(0.63)
Cations on the basis of 6 oxygens											
Si	1.950	1.945	1.938	1.935	1.967	1.953	1.974	1.964	1.956	1.954	(0.012)
Al	0.059	0.068	0.075	0.081	0.042	0.057	0.028	0.035	0.050	0.055	(0.017)
Ti	0.007	0.008	0.009	0.007	0.007	0.006	0.006	0.006	0.008	0.007	(0.001)
Fe	0.685	0.552	0.742	0.649	0.643	0.685	0.714	0.731	0.666	0.674	(0.054)
Mn	0.018	0.011	0.016	0.014	0.017	0.018	0.016	0.014	0.015	0.015	(0.002)
Mg	1.225	1.362	1.163	1.266	1.261	1.227	1.220	1.214	1.253	1.243	(0.051)
Ca	0.066	0.062	0.065	0.062	0.065	0.066	0.046	0.047	0.064	0.060	(0.008)
Na	0.004	*0.004	*0.003	*0.000	*0.001	*0.001	*0.003	*0.000	*0.001	0.004	(0.000)
K	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.001	0.004	*0.002	*0.000	*0.000	*0.000	*0.000	*0.001	0.004	(0.000)
Cr	*0.001	*0.001	*0.001	*0.000	*0.001	*0.001	*0.001	*0.000	*0.000	-	-
Total	4.014	4.008	4.012	4.014	4.002	4.012	4.004	4.011	4.012	4.010	(0.004)
Mg N°	64.14	71.16	61.05	66.11	66.23	64.17	63.08	62.42	65.29	64.86	(2.75)
En%	61.99	68.93	59.04	64.04	64.04	62.03	61.62	60.94	63.19	62.87	(2.60)
Fs%	34.67	27.94	37.66	32.83	32.66	34.63	36.06	36.70	33.59	34.08	(2.71)
Wo%	3.34	3.14	3.30	3.14	3.30	3.34	2.32	2.36	3.23	3.05	(0.39)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Ngamatea lapilli-1, Bullot Formation
EMP analyses: orthopyroxene

Ngamatea lapilli-1	1 Rim	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8a Core	8b Rim	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.78	52.13	52.03	51.40	52.53	51.67	51.93	52.49	53.33	51.57	52.70	52.00	52.25	52.72	52.64	52.31	52.38	52.38	52.20	(0.39)
Al_2O_3	0.93	1.15	1.28	1.37	0.76	1.14	1.01	1.14	1.40	1.48	1.46	1.30	1.15	1.56	1.31	1.15	0.93	1.26	1.22	(0.20)
TiO_2	0.32	0.26	0.25	0.20	0.20	0.30	0.23	0.22	0.17	0.29	0.18	0.31	0.31	0.21	0.26	0.29	0.18	0.27	0.25	(0.05)
FeO	20.40	21.08	20.91	21.95	20.26	20.50	19.71	20.92	17.25	21.75	19.22	20.67	21.81	19.33	20.79	20.95	20.84	19.97	20.65	(0.77)
MnO	0.38	0.51	0.52	0.58	0.53	0.52	0.48	0.58	0.38	0.48	0.40	0.51	0.50	0.39	0.48	0.45	0.46	0.50	0.49	(0.05)
MgO	23.80	23.23	23.17	22.05	23.48	23.38	23.90	23.62	26.31	22.28	24.79	22.38	22.37	24.81	23.68	23.32	22.82	23.82	23.31	(0.77)
CaO	1.50	1.51	1.56	1.58	1.38	1.48	1.23	1.44	1.68	1.59	1.34	1.43	1.54	1.45	1.30	1.56	1.52	1.42	1.46	(0.10)
Na_2O	*0.01	*0.00	*0.00	*0.02	*0.03	*0.00	*0.02	*0.03	*0.00	*0.03	*0.02	*0.03	*0.06	*0.00	*0.05	*0.00	*0.01	*0.02	-	-
K_2O	*0.01	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	*0.01	*0.02	*0.00	*0.01	*0.01	*0.01	*0.03	*0.00	*0.00	*0.01	-	-
NiO	*0.00	*0.02	*0.00	*0.01	*0.00	*0.00	*0.00	*0.09	*0.04	*0.01	*0.02	*0.07	*0.00	*0.11	*0.00	*0.01	*0.00	*0.01	-	-
Cr_2O_3	*0.02	*0.01	*0.07	*0.00	*0.00	*0.00	*0.02	*0.06	*0.00	*0.05	*0.00	*0.03	*0.02	*0.04	*0.01	*0.06	*0.07	*0.01	-	-
Total	100.09	99.85	99.72	99.11	99.15	98.98	98.49	100.41	100.54	99.44	100.09	98.60	99.73	100.27	100.45	100.01	99.13	99.61	99.57	(0.59)
Cations on the basis of 6 oxygens																				
Si	1.953	1.943	1.940	1.940	1.962	1.940	1.949	1.941	1.937	1.936	1.939	1.956	1.952	1.936	1.943	1.943	1.961	1.945	1.945	(0.008)
Al	0.040	0.050	0.056	0.061	0.033	0.051	0.045	0.050	0.060	0.066	0.063	0.058	0.051	0.068	0.057	0.050	0.041	0.055	0.053	(0.009)
Ti	0.009	0.007	0.007	0.006	0.006	0.008	0.006	0.006	0.005	0.008	0.005	0.009	0.009	0.006	0.007	0.008	0.005	0.008	0.007	(0.001)
Fe	0.631	0.657	0.652	0.693	0.633	0.644	0.619	0.647	0.524	0.683	0.591	0.650	0.675	0.594	0.642	0.651	0.653	0.620	0.644	(0.027)
Mn	0.012	0.016	0.017	0.019	0.017	0.017	0.015	0.018	0.012	0.015	0.012	0.016	0.016	0.012	0.015	0.014	0.015	0.016	0.016	(0.002)
Mg	1.313	1.291	1.288	1.241	1.308	1.308	1.337	1.302	1.424	1.247	1.359	1.255	1.246	1.347	1.303	1.292	1.274	1.319	1.295	(0.035)
Ca	0.059	0.060	0.062	0.063	0.055	0.059	0.050	0.057	0.066	0.064	0.053	0.058	0.062	0.057	0.051	0.062	0.061	0.056	0.058	(0.004)
Na	*0.001	*0.000	*0.000	*0.000	*0.002	*0.000	*0.001	*0.002	*0.000	*0.002	*0.001	*0.002	*0.004	*0.000	*0.003	*0.000	*0.001	*0.001	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.003	*0.001	*0.000	*0.001	*0.002	*0.000	*0.003	*0.000	*0.000	*0.000	*0.000	-	-
Cr	*0.000	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	*0.002	*0.000	*0.001	*0.001	*0.001	*0.000	*0.002	*0.002	*0.000	-	-
Total	4.017	4.024	4.022	4.023	4.014	4.027	4.021	4.021	4.028	4.019	4.022	4.002	4.011	4.020	4.018	4.020	4.010	4.019	4.018	(0.006)
Mg N[a]	67.54	66.27	66.39	64.17	67.39	67.01	68.35	66.80	73.10	64.81	69.69	65.88	64.86	69.40	66.99	66.50	68.11	68.02	66.78	(1.52)
En%	65.55	64.29	64.34	62.14	65.53	65.04	66.85	64.91	70.71	62.54	67.85	63.93	62.83	67.42	65.28	64.44	64.08	66.12	64.84	(1.58)
Fs%	31.50	32.72	32.57	34.70	31.71	32.02	30.86	32.25	26.02	34.25	29.51	33.11	34.04	29.73	32.18	32.47	32.85	31.08	32.25	(1.42)
Wo%	2.95	2.99	3.10	3.15	2.78	2.93	2.49	2.84	3.28	3.21	2.85	2.95	3.13	2.85	2.58	3.09	3.07	2.81	2.91	(0.21)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Helwan lapilli, Bullot Formation
EMP analyses: orthopyroxene

Helwan lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	Mean[1]	Std. Dev.[1]
SiO_2	51.38	52.80	51.98	51.14	51.85	50.50	51.33	51.13	50.81	51.76	52.19	51.53	(0.63)
Al_2O_3	1.27	1.08	1.10	1.62	1.00	2.81	1.77	1.30	2.24	1.30	1.04	1.50	(0.55)
TiO_2	0.35	*0.00	0.31	0.19	0.24	*0.05	0.29	0.27	0.26	0.27	0.25	0.27	(0.04)
FeO	21.37	18.03	20.72	21.59	21.29	21.95	22.24	20.86	18.92	22.34	21.27	20.96	(1.28)
MnO	0.43	0.30	0.49	0.49	0.45	0.47	0.61	0.57	0.38	0.51	0.41	0.47	(0.08)
MgO	22.43	25.78	23.41	22.53	23.15	21.40	22.48	22.57	24.45	22.35	23.12	23.06	(1.13)
CaO	1.61	1.64	1.75	1.58	1.49	1.33	1.50	1.59	1.52	1.40	1.43	1.53	(0.11)
Na_2O	*0.02	*0.00	*0.00	*0.00	*0.00	*0.10	*0.00	*0.00	*0.10	*0.02	*0.09	-	-
K_2O	*0.01	*0.00	*0.01	*0.00	*0.00	*0.02	*0.02	*0.00	*0.00	*0.00	*0.01	-	-
NiO	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.03	*0.00	*0.02	*0.00	*0.00	-	-
Cr_2O_3	*0.06	*0.00	0.17	*0.11	*0.01	*0.00	*0.00	*0.05	0.15	*0.09	0.14	0.15	(0.01)
Total	98.84	99.62	99.94	99.14	99.47	98.45	100.22	98.30	98.73	99.92	99.84	99.32	(0.63)
Cations on the basis of 6 oxygens													
Si	1.939	1.943	1.936	1.926	1.943	1.915	1.919	1.938	1.900	1.938	1.945	1.931	(0.014)
Al	0.056	0.047	0.048	0.072	0.044	0.125	0.078	0.058	0.099	0.057	0.046	0.066	(0.024)
Ti	0.010	*0.000	0.009	0.005	0.007	*0.001	0.008	0.008	0.007	0.008	0.007	0.008	(0.001)
Fe	0.674	0.555	0.645	0.680	0.667	0.696	0.695	0.661	0.591	0.899	0.663	0.657	(0.043)
Mn	0.014	0.009	0.016	0.015	0.014	0.015	0.019	0.018	0.012	0.016	0.013	0.015	(0.003)
Mg	1.262	1.414	1.300	1.265	1.293	1.210	1.253	1.275	1.363	1.247	1.285	1.288	(0.054)
Ca	0.065	0.065	0.070	0.064	0.060	0.054	0.060	0.065	0.061	0.056	0.057	0.062	(0.005)
Na	*0.001	*0.000	*0.000	*0.000	*0.000	*0.007	*0.000	*0.000	*0.007	*0.002	*0.007	-	-
K	*0.001	*0.000	*0.001	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	-	-
Cr	*0.002	*0.000	0.005	*0.003	*0.000	*0.000	*0.000	*0.002	0.004	*0.003	0.004	0.004	(0.000)
Total	4.020	4.033	4.029	4.027	4.028	4.015	4.032	4.023	4.037	4.021	4.020	4.026	(0.006)
Mg N°	65.19	71.81	66.84	65.04	65.97	63.48	64.32	65.86	69.75	64.08	65.97	66.21	(2.38)
En%	63.07	69.52	64.52	62.97	64.01	61.73	62.40	63.72	67.64	62.29	64.09	64.18	(2.26)
Fs%	33.68	27.29	32.01	33.85	33.02	35.51	34.61	33.03	29.33	34.92	33.07	32.76	(2.34)
Wo%	3.25	3.20	3.47	3.19	2.97	2.76	2.99	3.25	3.03	2.80	2.84	3.07	(0.21)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L17, Bullot Formation
EMP analyses: orthopyroxene

Member L17	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	Mean[1]	Std. Dev.[1]
SiO_2	51.17	52.19	52.29	51.10	52.04	50.88	51.56	51.58	51.92	51.51	51.82	51.64	(0.44)
Al_2O_3	1.66	2.72	1.17	1.89	0.88	1.07	1.35	1.14	1.04	1.16	1.30	1.40	(0.50)
TiO_2	0.37	0.17	0.38	0.26	0.19	0.24	0.33	0.32	0.26	0.25	0.28	0.28	(0.06)
FeO	21.26	17.04	21.52	20.83	20.50	22.72	21.98	21.78	20.82	21.24	20.38	20.92	(1.39)
MnO	0.48	0.36	0.47	0.45	0.49	0.50	0.58	0.49	0.53	0.47	0.51	0.48	(0.05)
MgO	21.72	25.26	22.09	22.06	22.60	21.55	21.34	21.43	22.54	22.24	22.33	22.29	(1.03)
CaO	1.54	1.27	1.76	1.58	1.64	1.59	1.73	1.66	1.65	1.63	1.65	1.61	(0.12)
Na_2O	*0.00	*0.03	*0.04	*0.05	*0.06	*0.03	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
K_2O	*0.00	*0.00	*0.00	*0.00	*0.02	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	-	-
NiO	*0.01	*0.00	*0.04	*0.06	*0.00	*0.00	*0.04	*0.00	*0.00	*0.00	*0.02	-	-
Cr_2O_3	*0.00	*0.03	*0.12	*0.03	*0.04	*0.07	*0.02	*0.05	*0.09	*0.00	*0.00	-	-
Total	98.21	99.01	99.69	98.18	96.34	98.55	98.87	98.40	98.77	98.50	98.27	98.62	(0.43)
Cations on the basis of 6 oxygens													
Si	1.942	1.920	1.953	1.935	1.963	1.940	1.951	1.956	1.954	1.950	1.957	1.948	(0.012)
Al	0.074	0.118	0.052	0.084	0.039	0.048	0.060	0.051	0.046	0.052	0.058	0.062	(0.022)
Ti	0.011	0.005	0.010	0.007	0.005	0.007	0.009	0.009	0.007	0.007	0.008	0.008	(0.002)
Fe	0.675	0.524	0.672	0.660	0.647	0.724	0.695	0.691	0.655	0.672	0.643	0.660	(0.048)
Mn	0.015	0.011	0.015	0.014	0.016	0.016	0.019	0.016	0.017	0.015	0.016	0.015	(0.002)
Mg	1.229	1.385	1.231	1.245	1.271	1.225	1.203	1.212	1.265	1.255	1.257	1.253	(0.047)
Ca	0.063	0.050	0.071	0.064	0.066	0.065	0.070	0.068	0.066	0.066	0.067	0.065	(0.005)
Na	*0.000	*0.002	*0.003	*0.004	*0.004	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.001	*0.002	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	-	-
Cr	*0.000	*0.001	*0.004	*0.001	*0.001	*0.002	*0.001	*0.002	*0.003	*0.000	*0.000	-	-
Total	4.009	4.013	4.004	4.009	4.007	4.025	4.007	4.005	4.010	4.017	4.006	4.010	(0.006)
Mg N°	64.55	72.55	64.89	65.35	66.27	62.85	63.38	63.69	65.89	65.13	66.16	65.50	(2.48)
En%	62.48	70.70	62.36	63.23	64.06	60.82	61.13	61.49	63.70	62.97	63.90	63.35	(2.55)
Fs%	34.32	26.75	34.04	33.52	32.61	35.95	35.32	35.06	32.98	33.72	32.69	33.36	(2.33)
Wo%	3.20	2.55	3.80	3.25	3.33	3.23	3.58	3.45	3.32	3.31	3.41	3.29	(0.26)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L16, Bullot Formation
EMP analyses: orthopyroxene

Member L16	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	Mean†	Std. Dev.†
SiO_2	52.10	51.82	52.21	52.74	52.59	51.67	51.95	52.47	52.07	52.18	(0.34)
Al_2O_3	1.39	1.50	1.02	0.88	1.63	1.85	1.05	1.10	1.20	1.29	(0.30)
TiO_2	0.34	0.30	0.26	0.16	0.28	0.32	0.26	0.26	0.24	0.27	(0.05)
FeO	20.64	21.46	21.28	21.47	19.70	20.29	22.08	21.54	21.26	21.08	(0.69)
MnO	0.52	0.51	*0.00	0.52	0.44	0.46	0.53	0.51	0.46	0.49	(0.03)
MgO	22.49	21.69	21.99	22.42	23.82	22.76	22.30	22.48	22.19	22.46	(0.56)
CaO	1.73	1.50	1.68	1.59	1.76	1.51	1.61	1.69	1.55	1.62	(0.09)
Na_2O	*0.02	*0.04	*0.00	*0.02	*0.01	*0.00	*0.02	*0.00	*0.06	-	-
K_2O	*0.01	*0.01	*0.00	*0.00	*0.00	*0.03	*0.03	*0.00	*0.00	-	-
NiO	*0.01	*0.00	*0.04	*0.01	*0.03	*0.05	*0.01	*0.05	*0.06	-	-
Cr_2O_3	*0.00	*0.14	*0.00	*0.10	*0.06	*0.00	*0.00	*0.00	*0.04	-	-
Total	99.21	98.77	98.43	99.77	100.21	98.87	99.78	100.05	98.96	99.34	(0.59)
Cations on the basis of 6 oxygens											
Si	1.950	1.952	1.970	1.966	1.938	1.937	1.947	1.954	1.957	1.952	(0.011)
Al	0.061	0.066	0.045	0.039	0.071	0.082	0.047	0.048	0.053	0.057	(0.013)
Ti	0.009	0.009	0.007	0.004	0.008	0.009	0.007	0.007	0.007	0.007	(0.001)
Fe	0.646	0.676	0.671	0.669	0.607	0.636	0.692	0.671	0.668	0.660	(0.024)
Mn	0.017	0.016	*0.000	0.016	0.014	0.015	0.017	0.016	0.015	0.016	(0.001)
Mg	1.255	1.218	1.237	1.246	1.309	1.272	1.246	1.248	1.243	1.253	(0.024)
Ca	0.069	0.061	0.068	0.064	0.069	0.060	0.065	0.067	0.062	0.065	(0.003)
Na	*0.001	*0.003	*0.000	*0.002	*0.001	*0.000	*0.001	*0.000	*0.005	-	-
K	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	-	-
Ni	*0.000	*0.000	*0.001	*0.000	*0.001	*0.001	*0.000	*0.001	*0.002	-	-
Cr	*0.000	*0.004	*0.000	*0.003	*0.002	*0.000	*0.000	*0.000	*0.001	-	-
Total	4.007	3.998	3.998	4.004	4.016	4.011	4.021	4.011	4.005	4.008	(0.007)
Mg N°	66.02	64.31	64.83	65.07	68.32	66.67	64.29	65.03	65.04	65.51	(1.23)
En%	63.71	62.30	62.60	62.96	65.94	64.63	62.21	62.84	63.00	63.36	(1.16)
Fs%	32.79	34.58	33.96	33.80	30.58	32.32	34.55	33.79	33.86	33.36	(1.20)
Wo%	3.50	3.12	3.44	3.23	3.48	3.05	3.25	3.37	3.14	3.29	(0.16)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Shawcroft Tephra, Bullot Formation

EMP analyses: orthopyroxene *(continued ...)*

Shawcroft Tephra	1a Core	1b Rim	2 Core	3 Core	4 Core	5 Core	6a Core	6b Rim	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	18 Core
SiO_2	51.70	51.52	51.41	52.01	51.80	51.95	51.64	51.72	51.79	52.19	52.59	52.17	51.80	51.83	51.75	51.79	52.14	51.73	51.44	52.06
Al_2O_3	1.18	0.98	1.21	1.17	1.87	1.06	2.25	2.16	1.27	1.15	1.09	0.98	1.16	1.73	1.10	1.37	1.60	1.93	1.71	1.05
TiO_2	0.16	0.24	0.30	0.29	0.29	0.22	0.15	0.17	0.24	0.22	0.15	0.20	0.21	0.21	0.20	0.20	0.24	0.25	0.22	0.17
FeO	21.65	22.50	21.79	21.50	18.42	20.90	19.31	19.37	22.79	22.02	21.23	21.30	21.68	18.84	22.09	20.77	18.94	19.45	19.32	21.59
MnO	0.49	0.59	0.56	0.53	0.39	0.55	0.36	0.40	0.55	0.47	0.45	0.56	0.49	0.43	0.60	0.37	0.36	0.41	0.44	0.52
MgO	21.88	21.15	21.62	21.38	23.88	22.67	24.28	23.90	21.74	22.29	22.93	22.83	22.13	23.72	22.01	22.50	23.53	23.55	23.50	22.65
CaO	1.32	1.38	1.56	1.63	1.40	1.49	1.28	1.56	1.70	1.59	1.54	1.41	1.51	1.59	1.52	1.52	1.73	1.50	1.39	1.48
Na_2O	*0.00	*0.03	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.06	*0.01	*0.00	*0.00	*0.04	*0.00	*0.01	*0.00	*0.04	*0.03	*0.00	*0.05
K_2O	*0.02	*0.01	*0.01	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.03	*0.00	*0.01	*0.00	*0.00	*0.02	*0.00	*0.00	*0.01	*0.03	*0.00
NiO	*0.00	*0.05	*0.00	*0.00	*0.05	*0.00	*0.03	*0.04	*0.00	*0.04	*0.03	*0.00	*0.09	*0.00	*0.03	*0.01	*0.03	*0.05	*0.02	*0.03
Cr_2O_3	*0.06	*0.00	*0.00	*0.00	*0.03	*0.00	*0.02	*0.07	*0.07	*0.00	*0.05	*0.01	*0.01	*0.05	*0.00	*0.07	*0.06	*0.05	*0.09	*0.07
Total	98.39	98.35	98.45	98.51	98.05	98.85	99.27	99.27	100.07	99.93	99.98	99.45	98.98	98.36	99.27	98.52	98.53	98.81	98.00	99.51
Cations on the basis of 6 oxygens																				
Si	1.959	1.962	1.952	1.969	1.939	1.955	1.918	1.922	1.941	1.950	1.955	1.954	1.952	1.940	1.950	1.951	1.947	1.932	1.936	1.949
Al	0.053	0.044	0.054	0.052	0.083	0.047	0.098	0.094	0.056	0.051	0.048	0.043	0.051	0.076	0.049	0.061	0.070	0.085	0.076	0.046
Ti	0.005	0.007	0.009	0.008	0.008	0.006	0.004	0.005	0.007	0.006	0.004	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.006	0.005
Fe	0.686	0.717	0.692	0.680	0.577	0.658	0.600	0.602	0.714	0.688	0.660	0.667	0.683	0.590	0.696	0.654	0.592	0.607	0.608	0.676
Mn	0.016	0.019	0.018	0.017	0.012	0.018	0.011	0.013	0.017	0.015	0.014	0.018	0.016	0.014	0.019	0.012	0.011	0.013	0.014	0.016
Mg	1.236	1.201	1.224	1.206	1.333	1.272	1.344	1.324	1.215	1.242	1.271	1.275	1.243	1.324	1.236	1.264	1.310	1.311	1.319	1.264
Ca	0.054	0.056	0.063	0.066	0.056	0.060	0.051	0.062	0.068	0.064	0.061	0.057	0.061	0.064	0.061	0.062	0.069	0.060	0.056	0.059
Na	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.005	*0.001	*0.000	*0.000	*0.003	*0.000	*0.001	*0.000	*0.003	*0.002	*0.000	*0.004
K	*0.001	*0.001	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.002	*0.000
Ni	*0.000	*0.002	*0.000	*0.000	*0.002	*0.000	*0.001	*0.001	*0.000	*0.001	*0.001	*0.000	*0.003	*0.000	*0.001	*0.000	*0.001	*0.001	*0.001	*0.001
Cr	*0.002	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.002	*0.002	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.002	*0.002	*0.002	*0.003	*0.002
Total	4.009	4.006	4.012	3.997	4.008	4.016	4.026	4.022	4.018	4.016	4.013	4.020	4.012	4.014	4.017	4.010	4.006	4.015	4.015	4.015
Mg N°	64.31	62.62	63.88	63.94	69.79	65.91	69.14	68.74	62.99	64.35	65.82	65.65	64.54	69.17	63.98	65.90	69.87	68.35	68.45	65.15
En%	62.55	60.94	61.85	61.78	67.80	63.92	67.37	66.60	60.84	62.29	63.81	63.78	62.56	66.94	62.02	63.84	66.46	66.28	66.52	63.23
Fs%	34.72	36.32	34.97	34.84	29.35	33.07	30.08	30.28	35.75	34.50	33.13	33.37	34.37	29.83	34.92	33.03	30.04	30.69	30.66	33.92
Wo%	2.73	2.84	3.18	3.38	2.85	3.02	2.56	3.12	3.41	3.21	3.06	2.85	3.07	3.24	3.06	3.13	3.50	3.03	2.82	2.95

* Indicates value was below the detection limit.

† Means and standard deviations are for core values above detection limit only.

Shawcroft Tephra, Bullot Formation
EMP analyses: orthopyroxene *(... continued)*

Shawcroft Tephra	Mean†	Std. Dev.†
SiO_2	51.88	(0.28)
Al_2O_3	1.38	(0.36)
TiO_2	0.22	(0.04)
FeO	20.75	(1.30)
MnO	0.47	(0.07)
MgO	22.73	(0.84)
CaO	1.51	(0.12)
Na_2O	-	-
K_2O	-	-
NiO	-	-
Cr_2O_3	-	-
Total	98.94	(0.63)
Cations		
Si	1.947	(0.011)
Al	0.061	(0.016)
Ti	0.006	(0.001)
Fe	0.652	(0.042)
Mn	0.015	(0.002)
Mg	1.272	(0.042)
Ca	0.061	(0.005)
Na	-	-
K	-	-
Ni	-	-
Cr	-	-
Total	4.013	(0.006)
Mg N°	66.12	(2.16)
En%	64.10	(2.15)
Fs%	32.84	(2.08)
Wo%	3.06	(0.24)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Rotoaira Lapilli
EMP analyses: orthopyroxene

Rotoaira Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.42	52.62	52.92	52.66	52.35	52.31	53.03	52.66	52.09	52.32	52.50	52.53	(0.26)
Al_2O_3	0.94	1.00	1.00	1.04	1.24	0.91	1.10	0.94	0.93	0.91	0.99	1.00	(0.10)
TiO_2	0.25	0.21	0.16	0.16	0.18	0.25	*0.10	*0.13	0.16	0.17	0.19	0.19	(0.03)
FeO	19.10	18.78	20.01	19.15	19.55	20.56	17.51	18.92	20.72	19.79	19.87	19.45	(0.86)
MnO	0.52	0.49	0.55	0.44	0.46	0.51	0.35	0.49	*0.00	0.47	0.53	0.48	(0.06)
MgO	24.29	24.44	23.65	23.97	23.61	22.77	25.02	24.06	22.84	23.33	23.27	23.75	(0.66)
CaO	1.68	1.75	1.70	1.68	1.63	1.69	1.87	1.83	1.62	1.71	1.68	1.71	(0.07)
Na_2O	*0.05	*0.00	*0.00	*0.04	*0.00	*0.07	*0.03	*0.00	*0.03	*0.01	*0.01	-	-
K_2O	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	-	-
NiO	*0.00	*0.00	*0.04	*0.02	*0.02	*0.00	*0.04	*0.00	*0.00	*0.09	*0.00	-	-
Cr_2O_3	*0.08	*0.00	*0.06	*0.02	*0.06	*0.00	*0.03	*0.01	*0.00	*0.05	*0.08	-	-
Total	99.19	99.29	99.97	99.11	99.03	99.01	98.87	98.89	98.36	98.70	99.03	99.04	(0.38)
Cations on the basis of 6 oxygens													
Si	1.948	1.952	1.957	1.957	1.952	1.961	1.958	1.959	1.963	1.960	1.960	1.957	(0.004)
Al	0.041	0.044	0.043	0.048	0.055	0.040	0.048	0.041	0.041	0.040	0.043	0.044	(0.004)
Ti	0.007	0.006	0.005	0.005	0.005	0.007	*0.003	*0.004	0.005	0.005	0.005	0.006	(0.001)
Fe	0.594	0.583	0.619	0.595	0.609	0.644	0.541	0.589	0.653	0.620	0.620	0.606	(0.029)
Mn	0.018	0.015	0.017	0.014	0.015	0.016	0.011	0.015	*0.000	0.015	0.017	0.015	(0.002)
Mg	1.346	1.352	1.304	1.328	1.312	1.273	1.378	1.335	1.283	1.303	1.295	1.319	(0.030)
Ca	0.067	0.069	0.067	0.067	0.065	0.068	0.074	0.073	0.066	0.069	0.067	0.068	(0.003)
Na	*0.004	*0.000	*0.000	*0.003	*0.000	*0.005	*0.002	*0.000	*0.002	*0.001	*0.001	-	-
K	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Ni	*0.000	*0.000	*0.001	*0.001	*0.001	*0.000	*0.001	*0.000	*0.000	*0.003	*0.000	-	-
Cr	*0.002	*0.000	*0.002	*0.001	*0.002	*0.000	*0.001	*0.000	*0.000	*0.002	*0.002	-	-
Total	4.019	4.021	4.012	4.012	4.013	4.009	4.010	4.012	4.011	4.012	4.007	4.013	(0.004)
Mg N[a]	69.38	69.87	67.81	69.08	68.30	66.41	71.81	69.39	66.27	67.78	67.62	68.52	(1.53)
En%	67.07	67.47	65.53	66.73	68.08	64.13	69.14	66.85	64.09	65.41	65.34	66.16	(1.42)
Fs%	29.60	29.09	31.11	29.90	30.66	32.44	27.15	29.49	32.62	31.12	31.28	30.41	(1.51)
Wo%	3.34	3.44	3.37	3.37	3.27	3.43	3.71	3.66	3.30	3.46	3.38	3.43	(0.13)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L8, Bullot Formation
EMP analyses: orthopyroxene

Member L8	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	Mean†	Std. Dev.†
SiO_2	51.66	52.53	52.42	52.35	52.10	52.60	52.81	53.04	52.29	52.36	53.13	52.85	52.07	53.56	52.56	(0.47)
Al_2O_3	1.12	0.82	0.98	0.91	1.01	0.84	0.96	0.82	0.99	0.89	0.80	0.79	1.27	1.14	0.95	(0.14)
TiO_2	0.32	0.22	0.25	0.26	*0.08	0.19	0.13	0.29	0.28	0.29	0.29	0.22	0.35	0.16	0.25	(0.06)
FeO	20.48	20.01	19.60	20.68	20.92	20.83	19.13	19.34	21.48	21.04	19.72	19.21	22.27	16.24	20.07	(1.38)
MnO	0.52	0.54	0.49	0.66	0.63	0.58	0.46	0.53	0.71	0.47	0.53	0.66	0.58	0.48	0.56	(0.08)
MgO	22.41	23.13	23.53	22.70	23.20	22.32	23.69	23.98	22.21	22.46	24.07	23.60	21.44	24.47	23.09	(0.83)
CaO	1.64	1.59	1.60	1.62	0.82	1.57	1.61	1.54	1.62	1.54	1.84	1.63	1.81	2.24	1.60	(0.28)
Na_2O	*0.04	*0.00	*0.00	*0.02	*0.01	*0.00	*0.02	*0.00	*0.00	*0.00	*0.08	*0.03	*0.00	0.27	0.27	(0.00)
K_2O	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.01	*0.00	*0.03	*0.01	*0.00	*0.00	*0.00	*0.00	-	-
NiO	*0.04	*0.00	*0.06	*0.09	*0.00	*0.05	*0.00	*0.00	*0.00	*0.00	*0.11	*0.00	*0.03	*0.00	-	-
Cr_2O_3	*0.10	*0.00	*0.00	*0.06	*0.09	*0.00	*0.01	*0.00	*0.01	*0.00	*0.11	*0.02	*0.08	0.24	0.24	(0.00)
Total	98.15	98.84	98.86	99.15	98.68	98.93	98.78	99.54	99.58	99.05	100.19	98.96	99.79	98.80	99.09	(0.50)
Cations on the basis of 6 oxygens																
Si	1.953	1.967	1.959	1.960	1.957	1.974	1.968	1.965	1.958	1.965	1.956	1.969	1.952	1.974	1.963	(0.007)
Al	0.050	0.036	0.042	0.040	0.045	0.037	0.042	0.036	0.044	0.039	0.035	0.035	0.056	0.050	0.042	(0.006)
Ti	0.009	0.006	0.007	0.007	*0.002	0.005	0.004	0.008	0.008	0.008	0.008	0.006	0.010	0.004	0.007	(0.002)
Fe	0.648	0.627	0.612	0.647	0.657	0.654	0.596	0.589	0.673	0.681	0.607	0.598	0.698	0.500	0.627	(0.046)
Mn	0.017	0.017	0.016	0.021	0.020	0.018	0.014	0.017	0.023	0.015	0.017	0.021	0.018	0.015	0.018	(0.003)
Mg	1.263	1.291	1.311	1.287	1.299	1.249	1.317	1.324	1.240	1.257	1.321	1.311	1.198	1.345	1.285	(0.039)
Ca	0.088	0.064	0.064	0.065	0.033	0.063	0.064	0.061	0.065	0.062	0.065	0.065	0.073	0.089	0.064	(0.011)
Na	*0.003	*0.000	*0.000	*0.002	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.006	*0.002	*0.000	0.019	0.019	(0.000)
K	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.000	*0.002	*0.003	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.003	*0.000	*0.001	*0.000	-	-
Cr	*0.003	*0.000	*0.000	*0.002	*0.003	*0.000	*0.000	*0.000	*0.000	*0.000	*0.003	*0.001	*0.002	0.007	0.007	(0.000)
Total	4.006	4.008	4.011	4.007	4.011	4.000	4.005	4.010	4.011	4.007	4.009	4.005	4.005	4.003	4.007	(0.003)
Mg N°	66.09	67.31	68.17	68.20	66.41	65.63	68.84	68.85	64.82	65.54	68.52	68.67	63.19	72.90	67.22	(2.28)
En%	63.88	65.14	65.98	64.02	65.31	63.53	66.62	66.73	62.69	63.48	66.28	66.41	60.84	69.54	65.03	(2.07)
Fs%	32.78	31.63	30.80	32.69	33.03	33.27	30.15	30.19	34.02	33.38	30.48	30.29	35.45	25.85	31.71	(2.27)
Wo%	3.34	3.23	3.22	3.28	1.66	3.20	3.24	3.07	3.29	3.13	3.28	3.29	3.71	4.60	3.25	(0.57)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L7b, Bullot Formation
EMP analyses: orthopyroxene

Member L7b	1 Core	2 Core	3 Core	4a Core	4b Rim	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	Mean†	Std. Dev.†
SiO_2	51.41	52.43	52.95	53.38	52.37	52.15	53.13	52.97	52.58	52.78	52.82	52.14	52.89	53.54	52.70	(0.55)
Al_2O_3	1.44	1.04	0.92	0.93	1.48	1.28	0.79	0.80	1.07	0.84	1.09	1.16	0.79	0.71	0.99	(0.21)
TiO_2	0.28	0.24	0.29	0.22	0.29	0.23	0.22	0.28	0.33	0.24	0.23	0.23	0.25	0.22	0.25	(0.03)
FeO	20.98	19.11	19.18	18.30	18.38	21.28	20.13	19.00	20.34	19.41	18.73	20.00	18.78	17.62	19.45	(1.01)
MnO	0.52	0.49	0.48	0.43	0.49	0.53	0.54	0.48	0.50	0.49	0.50	0.41	0.41	0.34	0.47	(0.05)
MgO	22.04	24.08	24.55	25.09	24.22	22.58	23.77	24.09	23.59	23.84	24.88	23.58	24.72	25.36	23.99	(0.90)
CaO	1.51	1.48	1.52	1.85	1.84	1.49	1.54	1.79	1.65	1.41	1.33	1.32	1.46	1.59	1.52	(0.13)
Na_2O	*0.01	*0.00	*0.00	*0.00	*0.02	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.04	*0.00	-	-
K_2O	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.02	*0.01	*0.00	*0.00	*0.01	*0.01	-	-
NiO	*0.00	*0.05	*0.00	*0.07	*0.01	*0.00	*0.01	*0.05	*0.04	*0.00	*0.00	*0.01	*0.00	*0.00	-	-
Cr_2O_3	*0.02	*0.02	*0.00	*0.00	*0.01	*0.08	*0.00	*0.00	*0.05	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
Total	98.13	98.83	99.87	100.00	98.84	99.53	100.12	99.38	100.05	98.98	99.35	98.84	99.30	99.39	99.37	(0.55)
Cations on the basis of 6 oxygens																
Si	1.950	1.955	1.954	1.957	1.946	1.950	1.963	1.963	1.947	1.965	1.954	1.951	1.958	1.968	1.957	(0.006)
Al	0.064	0.046	0.040	0.040	0.065	0.056	0.035	0.035	0.047	0.037	0.047	0.051	0.034	0.031	0.043	(0.009)
Ti	0.007	0.007	0.008	0.008	0.008	0.006	0.008	0.007	0.009	0.007	0.006	0.006	0.007	0.006	0.007	(0.001)
Fe	0.665	0.596	0.591	0.561	0.571	0.665	0.622	0.589	0.830	0.605	0.580	0.626	0.581	0.542	0.604	(0.035)
Mn	0.017	0.016	0.015	0.013	0.015	0.017	0.017	0.015	0.016	0.015	0.016	0.013	0.013	0.011	0.015	(0.002)
Mg	1.246	1.337	1.350	1.371	1.342	1.259	1.310	1.331	1.303	1.324	1.360	1.315	1.365	1.390	1.328	(0.040)
Ca	0.081	0.058	0.060	0.065	0.065	0.060	0.061	0.071	0.065	0.056	0.053	0.053	0.058	0.063	0.060	(0.005)
Na	*0.001	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.003	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.000	*0.001	*0.000	*0.002	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Cr	*0.001	*0.001	*0.000	*0.000	*0.000	*0.002	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Total	4.010	4.015	4.018	4.013	4.012	4.013	4.014	4.011	4.017	4.009	4.018	4.015	4.018	4.011	4.014	(0.003)
Mg N°	65.20	69.17	69.55	70.96	70.15	65.44	67.81	69.32	67.41	68.64	70.10	67.75	70.14	71.95	68.73	(1.91)
En%	63.18	67.15	67.47	68.65	67.85	63.46	65.73	66.85	65.22	66.70	68.24	65.95	68.11	69.67	66.64	(1.85)
Fs%	33.72	29.93	29.54	28.09	28.87	33.52	31.21	29.68	31.53	30.48	29.10	31.39	28.99	27.17	30.33	(1.85)
Wo%	3.09	2.91	3.00	3.25	3.29	3.02	3.06	3.57	3.25	2.82	2.66	2.66	2.89	3.16	3.03	(0.24)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L6 (pink lapilli), Bullot Formation
EMP analyses: orthopyroxene

Member L6	1 Core	2 Core	3 Core	4 Core	5a Core	5b Rim	6a Core	6b Rim	7 Core	8 Core	9 Core	10 Core	11 Rim	12 Core	Mean†	Std. Dev.†
SiO_2	51.52	52.73	53.42	52.58	52.39	52.44	52.75	52.72	52.51	52.89	52.47	52.71	52.44	51.57	52.50	(0.52)
Al_2O_3	1.32	0.81	0.72	1.10	1.16	1.23	1.86	0.95	1.42	0.95	1.34	1.04	2.45	1.82	1.23	(0.35)
TiO_2	0.38	0.14	0.22	0.20	0.31	0.35	0.32	0.27	0.21	0.29	0.36	0.31	0.25	0.29	0.28	(0.07)
FeO	21.75	19.77	18.74	20.04	20.34	20.05	17.38	20.22	18.55	19.51	20.20	18.79	16.50	20.45	19.59	(1.12)
MnO	0.45	0.54	0.46	0.46	0.49	0.37	0.33	0.59	0.40	0.49	0.51	0.48	0.44	0.41	0.46	(0.06)
MgO	21.87	23.74	24.68	23.47	23.05	22.98	25.28	23.35	24.21	24.44	23.04	24.39	25.77	22.30	23.68	(1.00)
CaO	1.62	1.47	1.55	1.56	1.62	1.61	1.52	1.61	1.54	1.57	1.70	1.55	1.74	1.93	1.60	(0.12)
Na_2O	*0.07	*0.00	*0.00	*0.01	*0.04	*0.05	*0.02	*0.00	*0.00	*0.04	*0.00	*0.00	*0.04	*0.00	-	-
K_2O	*0.00	*0.01	*0.00	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.01	*0.01	*0.00	-	-
NiO	*0.04	*0.00	*0.00	*0.00	*0.00	*0.00	*0.08	*0.00	*0.00	*0.09	*0.00	*0.13	*0.12	*0.00	-	-
Cr_2O_3	*0.01	*0.06	*0.11	*0.00	*0.00	*0.02	*0.11	*0.06	*0.00	*0.01	*0.08	*0.00	*0.06	*0.12	-	-
Total	98.90	99.20	99.78	99.42	99.36	99.04	99.44	99.71	98.84	100.14	99.61	99.26	99.59	98.78	99.34	(0.39)
Cations on the basis of 6 oxygens																
Si	1.945	1.963	1.965	1.957	1.954	1.958	1.934	1.958	1.952	1.949	1.950	1.953	1.918	1.939	1.951	(0.009)
Al	0.059	0.035	0.031	0.048	0.051	0.054	0.081	0.041	0.062	0.041	0.059	0.045	0.106	0.081	0.054	(0.016)
Ti	0.011	0.004	0.006	0.006	0.009	0.010	0.009	0.007	0.006	0.008	0.010	0.008	0.007	0.008	0.008	(0.002)
Fe	0.687	0.616	0.576	0.624	0.634	0.628	0.533	0.628	0.577	0.601	0.628	0.582	0.505	0.643	0.609	(0.040)
Mn	0.014	0.017	0.014	0.015	0.016	0.012	0.010	0.018	0.013	0.015	0.016	0.015	0.014	0.013	0.014	(0.002)
Mg	1.230	1.318	1.354	1.302	1.282	1.279	1.382	1.293	1.341	1.342	1.276	1.347	1.405	1.250	1.311	(0.045)
Ca	0.065	0.058	0.061	0.062	0.065	0.084	0.060	0.064	0.081	0.062	0.067	0.062	0.088	0.078	0.064	(0.005)
Na	*0.005	*0.000	*0.000	*0.000	*0.003	*0.003	*0.001	*0.000	*0.000	*0.003	*0.000	*0.000	*0.010	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	-	-
Ni	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	*0.000	*0.003	*0.000	*0.004	*0.014	*0.000	-	-
Cr	*0.000	*0.002	*0.003	*0.000	*0.000	*0.001	*0.003	*0.002	*0.000	*0.000	*0.002	*0.000	*0.007	*0.013	-	-
Total	4.011	4.011	4.007	4.014	4.011	4.003	4.009	4.009	4.012	4.018	4.008	4.012	4.023	4.012	4.011	(0.003)
Mg N°	64.16	68.15	70.16	67.60	66.91	67.14	72.17	67.31	69.92	69.07	67.02	69.83	73.56	66.03	68.27	(2.14)
En%	62.08	66.18	68.01	65.49	64.71	64.98	69.97	65.14	67.76	66.93	64.74	67.85	71.03	63.42	66.08	(2.18)
Fs%	34.68	30.92	28.93	31.39	32.00	31.79	26.99	31.64	29.16	29.98	31.86	29.23	25.53	32.62	30.70	(2.02)
Wo%	3.28	2.91	3.06	3.12	3.28	3.25	3.04	3.22	3.08	3.09	3.40	3.11	3.44	3.96	3.21	(0.27)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L4, Bullot Formation
EMP analyses: orthopyroxene

Member L4	1a Core	1b Rim	2 Core	3 Core	4a Core	4b Rim	5a Core	5b Rim	6 Core	7 Core	8 Core	9a Core	9b Rim	10 Core	11 Core	Mean†	Std. Dev.†
SiO_2	53.14	51.56	52.06	52.50	52.12	52.71	51.53	52.27	53.17	52.76	52.50	51.70	53.70	52.51	51.22	52.29	(0.60)
Al_2O_3	2.52	1.19	1.56	0.96	1.60	1.61	2.21	1.45	0.72	0.93	1.29	1.38	1.15	1.10	3.05	1.58	(0.70)
TiO_2	0.21	0.29	0.33	0.31	0.34	0.24	0.36	0.28	0.20	0.21	0.30	*0.03	0.16	0.28	0.36	0.29	(0.06)
FeO	14.92	20.85	19.40	19.94	19.01	17.17	18.82	18.26	19.53	19.76	18.95	18.96	14.86	18.90	18.81	18.82	(1.29)
MnO	0.29	0.52	0.49	0.51	0.48	0.37	0.46	0.44	0.49	0.40	0.51	0.42	0.38	*0.00	0.42	0.45	(0.07)
MgO	27.13	22.30	23.38	22.81	23.83	24.83	23.74	23.73	23.83	23.70	23.67	23.90	26.50	23.80	23.46	23.93	(1.05)
CaO	1.19	1.45	1.47	1.63	1.73	1.70	1.75	1.67	1.51	1.56	1.53	1.46	1.78	1.48	1.51	1.53	(0.14)
Na_2O	*0.04	*0.00	*0.00	*0.04	*0.02	*0.00	*0.01	*0.00	*0.07	*0.03	*0.02	*0.04	*0.01	*0.00	*0.10	-	-
K_2O	*0.01	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.03	*0.00	*0.00	-	-
NiO	*0.03	*0.00	*0.10	*0.05	*0.06	*0.00	*0.07	*0.02	*0.00	*0.09	*0.00	*0.00	*0.08	*0.05	*0.02	-	-
Cr_2O_3	*0.00	*0.09	*0.00	*0.12	*0.04	*0.00	*0.08	*0.03	*0.00	*0.03	*0.10	*0.00	*0.06	*0.04	*0.07	-	-
Total	99.39	98.16	98.68	98.67	99.11	98.62	98.87	98.08	99.44	99.31	98.75	97.82	98.53	98.07	98.82	98.81	(0.49)
Cations on the basis of 6 oxygens																	
Si	1.926	1.952	1.946	1.966	1.938	1.951	1.920	1.956	1.971	1.960	1.956	1.947	1.965	1.965	1.906	1.946	(0.020)
Al	0.108	0.053	0.069	0.042	0.070	0.070	0.097	0.064	0.031	0.041	0.057	0.061	0.050	0.049	0.134	0.069	(0.030)
Ti	0.006	0.008	0.009	0.009	0.010	0.007	0.010	0.008	0.005	0.006	0.008	*0.001	0.004	0.008	0.010	0.008	(0.002)
Fe	0.452	0.660	0.606	0.624	0.591	0.531	0.586	0.571	0.605	0.614	0.590	0.597	0.455	0.592	0.585	0.586	(0.044)
Mn	0.009	0.017	0.015	0.016	0.015	0.012	0.015	0.014	0.015	0.012	0.016	0.014	0.012	*0.000	0.013	0.014	(0.002)
Mg	1.466	1.259	1.303	1.273	1.321	1.370	1.318	1.324	1.317	1.313	1.315	1.341	1.446	1.328	1.302	1.327	(0.047)
Ca	0.046	0.059	0.059	0.065	0.069	0.067	0.070	0.067	0.060	0.062	0.061	0.059	0.070	0.059	0.060	0.061	(0.006)
Na	*0.003	*0.000	*0.000	*0.003	*0.002	*0.000	*0.001	*0.000	*0.005	*0.002	*0.001	*0.003	*0.001	*0.000	*0.007	-	-
K	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	-	-
Ni	*0.001	*0.000	*0.003	*0.001	*0.002	*0.000	*0.002	*0.001	*0.000	*0.003	*0.000	*0.000	*0.002	*0.001	*0.001	-	-
Cr	*0.000	*0.003	*0.000	*0.003	*0.001	*0.000	*0.002	*0.001	*0.000	*0.001	*0.003	*0.000	*0.002	*0.001	*0.002	-	-
Total	4.013	4.008	4.007	3.995	4.014	4.008	4.016	4.004	4.004	4.008	4.003	4.019	4.002	4.001	4.010	4.008	(0.007)
Mg N°	76.43	65.61	68.26	67.11	69.09	72.07	69.22	69.87	68.52	68.14	69.03	69.20	76.07	69.17	69.00	69.38	(2.31)
En%	74.64	63.65	66.21	64.88	66.68	69.61	66.77	67.48	66.45	66.01	66.89	67.15	73.36	67.10	66.87	67.24	(2.42)
Fs%	23.01	33.37	30.79	31.80	29.83	28.98	29.89	29.10	30.52	30.87	30.01	29.89	23.08	29.91	30.05	29.67	(2.19)
Wo%	2.34	2.98	3.00	3.31	3.48	3.40	3.55	3.41	3.03	3.12	3.10	2.95	3.55	2.98	3.08	3.09	(0.30)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L3 (hokey pokey lapilli), Bullot Formation
EMP analyses: orthopyroxene

Member L3	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9a Core	9b Rim	10 Core	11a Core	11b Rim	12a Core	12b Rim	13a Core	13b Rim	14 Core	Mean†	Std. Dev.†
SiO_2	54.44	52.37	53.79	52.37	53.77	52.45	52.55	54.16	52.20	52.44	52.00	55.09	52.74	53.30	55.02	53.44	55.18	51.41	53.10	(1.02)
Al_2O_3	1.70	2.87	1.82	1.00	3.09	1.06	1.28	1.73	1.10	1.03	1.33	1.94	0.85	1.09	1.75	1.22	1.01	3.00	1.72	(0.72)
TiO_2	0.13	0.17	0.19	0.23	0.15	0.32	0.34	0.18	0.31	0.27	0.40	0.12	0.40	0.18	0.14	0.27	0.12	*0.09	0.23	(0.09)
FeO	11.01	15.85	13.81	20.08	11.70	21.01	20.28	12.08	21.51	21.22	19.88	8.28	16.74	17.71	10.19	17.12	9.15	18.75	16.36	(4.13)
MnO	0.30	0.35	0.27	0.47	0.25	0.40	0.47	0.23	0.50	0.34	0.38	0.22	0.48	0.44	0.38	0.30	0.23	0.31	0.35	(0.09)
MgO	29.88	25.55	26.97	22.78	29.01	22.71	23.25	28.90	22.18	22.57	22.74	31.27	23.49	25.18	30.33	25.40	31.30	24.06	25.69	(2.90)
CaO	1.50	1.75	1.47	1.52	1.84	1.80	1.77	1.81	1.83	1.71	1.91	2.48	1.68	1.75	2.15	1.84	2.11	0.61	1.65	(0.37)
Na_2O	*0.01	*0.07	*0.03	*0.04	*0.03	*0.00	*0.02	*0.00	*0.00	*0.01	*0.05	*0.01	*0.02	*0.05	*0.00	*0.04	*0.03	*0.01	-	-
K_2O	*0.01	*0.01	*0.00	*0.00	*0.01	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.02	*0.00	*0.01	*0.01	*0.01	*0.00	-	-
NiO	*0.10	*0.07	*0.08	*0.00	*0.00	*0.07	*0.01	*0.07	*0.00	*0.00	*0.12	*0.03	*0.01	*0.07	*0.12	*0.00	*0.07	*0.00	-	-
Cr_2O_3	0.71	0.20	*0.05	*0.00	*0.13	0.15	*0.05	0.49	*0.01	*0.00	0.28	0.82	*0.07	0.22	0.41	0.22	0.28	*0.11	0.36	(0.20)
Total	99.45	99.12	98.12	98.43	99.60	99.70	99.93	99.56	99.42	99.58	98.91	99.98	98.36	99.85	100.34	99.80	99.38	98.14	99.27	(0.61)
Cations on the basis of 8 oxygens																				
Si	1.941	1.916	1.983	1.966	1.916	1.955	1.948	1.939	1.957	1.959	1.946	1.934	1.991	1.953	1.939	1.956	1.953	1.918	1.944	(0.017)
Al	0.071	0.124	0.070	0.044	0.130	0.047	0.056	0.073	0.048	0.045	0.059	0.080	0.038	0.047	0.073	0.052	0.042	0.132	0.074	(0.031)
Ti	0.003	0.005	0.005	0.007	0.004	0.009	0.009	0.005	0.009	0.008	0.011	0.003	0.011	0.005	0.004	0.007	0.003	*0.002	0.006	(0.002)
Fe	0.328	0.485	0.421	0.630	0.349	0.655	0.628	0.361	0.675	0.683	0.622	0.243	0.528	0.543	0.300	0.524	0.271	0.585	0.504	(0.135)
Mn	0.009	0.011	0.008	0.015	0.007	0.013	0.015	0.007	0.016	0.011	0.012	0.007	0.015	0.014	0.011	0.009	0.007	0.010	0.011	(0.003)
Mg	1.576	1.394	1.467	1.276	1.541	1.262	1.265	1.542	1.239	1.257	1.268	1.636	1.322	1.375	1.593	1.388	1.652	1.337	1.399	(0.127)
Ca	0.057	0.069	0.058	0.061	0.063	0.064	0.070	0.070	0.066	0.068	0.078	0.093	0.067	0.089	0.081	0.084	0.080	0.024	0.065	(0.014)
Na	*0.001	*0.005	*0.002	*0.003	*0.002	*0.000	*0.002	*0.000	*0.000	*0.001	*0.004	*0.001	*0.002	*0.004	*0.000	*0.003	*0.002	*0.001	-	-
K	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.003	*0.002	*0.002	*0.000	*0.000	*0.002	*0.000	*0.002	*0.000	*0.000	*0.004	*0.001	*0.000	*0.002	*0.003	*0.000	*0.002	*0.000	-	-
Cr	0.020	0.006	*0.001	*0.000	*0.004	0.004	*0.001	0.014	*0.000	*0.000	0.008	0.017	*0.002	0.006	0.011	0.008	0.008	*0.003	0.010	(0.006)
Total	4.005	4.010	3.992	4.001	4.010	4.009	4.011	4.011	4.010	4.011	4.002	4.013	3.972	4.012	4.012	4.004	4.018	4.006	4.007	(0.006)
Mg N°	82.77	74.19	77.70	66.95	81.53	65.83	67.17	81.03	64.73	65.47	67.09	87.07	71.48	71.89	84.15	72.57	85.91	69.56	73.56	(7.01)
En%	80.37	71.58	75.39	64.87	78.90	63.71	64.80	78.18	62.58	63.23	64.50	82.98	68.98	69.20	80.70	70.21	82.48	68.71	71.14	(6.63)
Fs%	16.73	24.90	21.63	32.03	17.87	33.08	31.87	16.30	34.09	33.35	31.84	12.32	27.54	27.33	15.20	26.55	13.53	30.06	25.58	(6.82)
Wo%	2.91	3.54	2.98	3.10	3.23	3.23	3.53	3.55	3.33	3.42	3.67	4.72	3.50	3.47	4.10	3.24	3.99	1.23	3.28	(0.71)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L1 (green ash), Bullot Formation
EMP analyses: orthopyroxene

Member L1	1a Core	1b Rim	2a Core	2b Rim	3 Core	4a Core	4b Rim	5a Core	5b Rim	6 Core	7 Core	8 Core	9 Core	10 Core	Mean[1]	Std. Dev.[1]
SiO_2	52.51	53.90	53.82	52.42	52.90	53.03	53.30	51.94	52.85	53.28	52.89	52.32	51.77	52.41	52.69	(0.59)
Al_2O_3	1.09	0.87	1.12	0.58	1.33	1.20	0.92	0.89	0.85	1.55	0.82	0.93	1.43	1.54	1.19	(0.25)
TiO_2	0.34	0.19	0.25	0.26	0.36	0.16	0.24	0.18	0.28	0.24	0.27	0.24	0.16	0.11	0.23	(0.08)
FeO	20.92	18.21	16.47	19.97	18.48	17.19	17.60	22.17	18.12	18.10	19.45	21.02	22.79	20.99	19.76	(2.03)
MnO	0.41	0.39	0.31	0.61	0.36	0.37	0.44	0.50	0.46	0.38	0.50	0.49	0.42	0.39	0.41	(0.06)
MgO	22.57	25.25	26.54	21.92	24.59	25.76	24.81	21.71	24.71	24.53	24.11	23.26	22.03	23.36	23.85	(1.49)
CaO	1.64	1.51	1.50	1.55	1.64	1.35	1.61	1.37	1.43	1.39	1.55	1.64	0.75	0.57	1.34	(0.36)
Na_2O	*0.01	*0.02	*0.03	*0.01	*0.02	*0.00	*0.00	*0.00	*0.00	*0.02	*0.02	*0.00	*0.00	*0.03	-	-
K_2O	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.01	*0.02	*0.00	*0.00	*0.02	*0.00	-	-
NiO	*0.03	*0.03	*0.04	*0.00	*0.00	*0.01	*0.01	*0.00	*0.09	*0.06	0.13	*0.03	*0.04	*0.00	0.13	(0.00)
Cr_2O_3	*0.03	*0.03	0.09	*0.03	*0.06	*0.04	*0.00	0.16	*0.04	0.09	*0.00	*0.00	*0.00	0.09	0.11	(0.03)
Total	99.47	100.33	100.11	97.31	99.67	99.06	96.92	98.91	98.69	99.56	99.71	99.89	99.35	99.46	99.52	(0.34)
Cations on the basis of 6 oxygens																
Si	1.960	1.966	1.952	1.992	1.948	1.952	1.969	1.964	1.962	1.957	1.958	1.949	1.949	1.951	1.954	(0.005)
Al	0.048	0.037	0.048	0.026	0.058	0.052	0.040	0.039	0.037	0.067	0.036	0.041	0.063	0.068	0.052	(0.011)
Ti	0.009	0.005	0.007	0.007	0.010	0.004	0.007	0.005	0.008	0.007	0.008	0.007	0.004	0.003	0.006	(0.002)
Fe	0.653	0.555	0.500	0.635	0.569	0.529	0.544	0.701	0.562	0.556	0.602	0.655	0.718	0.654	0.614	(0.070)
Mn	0.013	0.012	0.010	0.020	0.011	0.012	0.014	0.016	0.014	0.012	0.016	0.015	0.013	0.012	0.013	(0.002)
Mg	1.258	1.373	1.435	1.242	1.350	1.414	1.366	1.224	1.367	1.343	1.331	1.292	1.236	1.296	1.318	(0.067)
Ca	0.065	0.059	0.058	0.063	0.064	0.053	0.064	0.056	0.057	0.055	0.061	0.065	0.030	0.023	0.053	(0.014)
Na	*0.001	*0.001	*0.002	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.002	*0.001	*0.000	*0.000	*0.002	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.004	*0.000	-	-
Ni	*0.001	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.003	*0.002	0.004	*0.001	*0.005	*0.000	0.004	(0.000)
Cr	*0.001	*0.001	0.003	*0.001	*0.002	*0.001	*0.000	0.005	*0.001	0.003	*0.000	*0.000	*0.000	0.003	0.004	(0.001)
Total	4.004	4.007	4.013	3.985	4.010	4.016	4.004	4.010	4.007	4.000	4.016	4.024	4.013	4.010	4.012	(0.006)
Mg N°	65.79	71.21	74.16	66.17	70.35	72.77	71.52	63.58	70.87	70.72	68.86	66.36	63.25	66.46	68.23	(3.55)
En%	63.63	69.10	72.00	64.02	68.08	70.84	69.20	61.79	68.83	68.73	66.75	64.21	62.30	65.69	66.40	(3.33)
Fs%	33.08	27.93	25.09	32.73	28.69	26.50	27.56	35.39	28.30	28.45	30.19	32.55	36.19	33.15	30.93	(3.54)
Wo%	3.29	2.97	2.91	3.25	3.23	2.66	3.24	2.83	2.87	2.81	3.06	3.23	1.51	1.17	2.67	(0.70)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Poutu Lapilli, Mangamate Tephra
EMP analyses: olivine

Poutu Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	Mean†	Std. Dev.†
SiO_2	38.23	37.99	38.31	38.82	38.63	38.77	38.41	38.84	38.57	38.74	37.72	39.12	37.81	38.46	(0.41)
Al_2O_3	*0.08	*0.07	*0.06	*0.00	*0.07	*0.06	*0.21	*0.07	*0.11	*0.00	*0.00	*0.05	*0.00	-	-
TiO_2	*0.02	*0.01	*0.04	*0.02	*0.00	*0.02	*0.00	*0.02	*0.02	*0.02	*0.01	*0.01	*0.01	-	-
FeO	18.47	19.04	19.08	19.10	19.04	19.98	18.51	19.40	19.10	19.20	21.98	19.44	20.50	19.45	(0.90)
MnO	0.27	0.31	0.25	0.28	0.29	0.30	0.32	0.33	0.24	0.23	0.34	0.30	0.40	0.30	(0.05)
MgO	41.70	41.06	41.99	42.25	42.65	41.34	42.25	42.19	41.96	41.63	38.65	41.12	40.28	41.47	(1.02)
CaO	0.16	0.15	0.17	0.16	0.16	0.19	0.18	0.16	0.15	0.16	0.19	0.16	0.23	0.17	(0.02)
Na_2O	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
K_2O	*0.01	*0.01	*0.00	*0.03	*0.01	*0.01	*0.01	*0.00	*0.00	*0.00	*0.01	*0.00	*0.01	-	-
NiO	*0.15	*0.12	*0.07	*0.04	*0.03	*0.06	*0.06	*0.06	*0.06	*0.05	*0.04	*0.04	*0.12	-	-
Cr_2O_3	*0.00	*0.03	*0.01	*0.01	*0.04	*0.03	*0.00	*0.00	*0.00	*0.00	*0.02	*0.04	*0.00	-	-
Total	98.82	98.56	99.80	100.60	100.78	100.67	99.68	100.92	100.01	99.95	98.87	100.13	99.22	99.84	(0.75)
Cations on the basis of 4 oxygens															
Si	0.990	0.990	0.985	0.989	0.983	0.992	0.986	0.988	0.989	0.994	0.993	1.002	0.986	0.990	(0.005)
Al	*0.002	*0.002	*0.002	*0.000	*0.002	*0.002	*0.006	*0.002	*0.003	*0.000	*0.000	*0.002	*0.000	-	-
Ti	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Fe	0.400	0.415	0.410	0.407	0.405	0.428	0.398	0.413	0.410	0.412	0.484	0.416	0.447	0.419	(0.022)
Mn	0.006	0.007	0.005	0.006	0.006	0.006	0.007	0.007	0.005	0.005	0.008	0.006	0.009	0.006	(0.001)
Mg	1.610	1.594	1.609	1.604	1.618	1.577	1.617	1.600	1.604	1.591	1.517	1.569	1.566	1.590	(0.027)
Ca	0.004	0.004	0.005	0.004	0.004	0.005	0.005	0.004	0.004	0.004	0.005	0.004	0.006	0.004	(0.001)
Na	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.003	*0.002	*0.001	*0.001	*0.001	*0.001	*0.001	*0.001	*0.001	*0.001	*0.001	*0.001	*0.002	-	-
Cr	*0.000	*0.001	*0.000	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.001	*0.000	-	-
Total	3.010	3.010	3.014	3.010	3.016	3.008	3.013	3.012	3.012	3.006	3.007	2.997	3.014	3.010	(0.005)
Fo%	80.10	79.34	79.69	79.76	79.98	78.65	80.25	79.48	79.64	79.43	75.81	79.04	77.79	79.15	(1.15)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Waihohonu Lapilli, Mangamate Tephra

EMP analyses: olivine (analyses 1-20 type [I] non-skeletal; analyses 21-29 type [II] skeletal) *(continued ...)*

Waihohonu Lapilli	1 Core	2 Core	3 Rim	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Rim	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	18 Core	19 Rim
SiO_2	39.13	39.07	39.09	38.75	38.74	39.16	39.26	38.65	39.35	39.00	39.12	38.93	39.06	39.03	39.17	38.33	39.64	39.37	38.71
Al_2O_3	*0.03	*0.00	*0.02	*0.05	*0.01	*0.02	*0.01	*0.03	*0.00	*0.04	*0.00	*0.02	*0.02	*0.01	*0.00	*0.01	0.07	*0.01	*0.01
TiO_2	*0.00	*0.03	*0.00	*0.00	*0.03	*0.01	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.01	*0.00	*0.01	*0.01	*0.00	*0.01
FeO	12.72	13.15	12.83	14.44	14.77	14.57	12.52	13.71	12.07	12.91	12.94	13.18	11.40	14.49	15.44	16.22	11.86	12.71	14.44
MnO	0.22	0.19	0.24	0.36	0.23	0.50	0.18	0.24	*0.00	0.22	0.22	0.32	0.21	0.25	0.24	0.22	0.16	0.18	0.21
MgO	46.03	45.51	45.78	44.84	44.63	44.87	46.55	45.24	46.85	45.62	45.91	45.89	46.97	45.00	44.44	43.58	47.21	46.48	44.48
CaO	0.17	0.17	0.20	0.16	0.13	0.13	0.16	0.15	0.17	0.17	0.15	0.17	0.16	0.15	0.15	0.16	0.15	0.16	0.15
Na_2O	*0.00	*0.01	*0.00	*0.00	*0.02	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00
K_2O	*0.02	*0.00	*0.00	*0.04	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01
NiO	0.18	*0.12	0.16	*0.15	*0.10	*0.08	*0.14	0.16	*0.09	0.16	0.17	*0.00	0.29	*0.11	*0.15	*0.04	0.25	*0.07	*0.00
Cr_2O_3	*0.00	*0.00	*0.01	*0.02	*0.10	*0.00	*0.10	*0.06	*0.05	*0.05	*0.06	*0.13	*0.01	*0.00	*0.10	*0.00	*0.03	*0.05	0.21
Total	98.44	98.09	98.29	98.54	98.50	99.22	98.68	98.14	98.43	98.07	98.51	98.49	98.08	98.92	99.45	98.51	99.34	98.89	98.18
Cations on the basis of 4 oxygens																			
Si	0.990	0.992	0.991	0.986	0.987	0.991	0.988	0.986	0.990	0.991	0.990	0.986	0.986	0.990	0.991	0.985	0.990	0.991	0.990
Al	*0.001	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.001	*0.000	*0.001	*0.000	*0.001	*0.001	*0.000	*0.000	*0.000	0.002	*0.000	*0.000
Ti	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000
Fe	0.269	0.279	0.272	0.307	0.315	0.308	0.263	0.292	0.254	0.274	0.274	0.279	0.241	0.307	0.327	0.349	0.248	0.268	0.309
Mn	0.005	0.004	0.005	0.008	0.005	0.011	0.004	0.005	*0.000	0.005	0.005	0.007	0.004	0.005	0.005	0.005	0.003	0.004	0.004
Mg	1.736	1.723	1.731	1.702	1.695	1.693	1.746	1.720	1.758	1.728	1.732	1.733	1.768	1.701	1.676	1.670	1.767	1.743	1.696
Ca	0.004	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Na	*0.000	*0.001	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000
K	*0.001	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000
Ni	0.004	*0.002	0.003	*0.003	*0.002	*0.002	*0.003	0.003	*0.002	0.003	0.003	*0.000	0.006	*0.002	*0.003	*0.001	0.005	*0.002	*0.000
Cr	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	*0.002	*0.001	*0.001	*0.001	*0.001	*0.003	*0.002	*0.000	*0.002	*0.000	*0.001	*0.001	0.004
Total	3.008	3.003	3.007	3.007	3.006	3.007	3.005	3.010	3.006	3.006	3.008	3.010	3.009	3.007	3.003	3.013	3.013	3.013	3.013
Fo%	86.58	86.06	86.42	84.72	84.33	84.61	86.91	85.49	87.38	86.31	86.34	86.13	88.00	84.71	83.67	82.71	87.63	86.67	84.59

* Indicates value was below the detection limit.

' Means and standard deviations are for core values above detection limit only.

Waihohonu Lapilli, Mangamate Tephra

EMP analyses: olivine (analyses 1-20 type [I] non-skeletal; analyses 21-29 type [II] skeletal) *(... continued)*

Waihohonu Lapilli	20 Core	21 Core	22 Core	23 Core	24 Core	25 Core	26 Core	27 Core	28 Core	29 Rim	Mean[1]	Std. Dev.[1]
SiO_2	38.88	38.82	38.25	38.70	39.02	38.73	38.85	38.38	38.33	38.56	38.91	(0.34)
Al_2O_3	*0.00	*0.03	*0.02	*0.02	*0.00	*0.01	*0.00	*0.01	*0.05	*0.00	0.07	(0.00)
TiO_2	*0.00	*0.00	*0.01	*0.00	*0.00	*0.04	*0.00	*0.00	*0.02	*0.02	-	-
FeO	12.10	15.33	18.25	15.19	15.38	15.96	15.41	15.94	15.92	15.93	14.23	(1.68)
MnO	0.20	0.23	0.25	0.30	*0.12	0.33	0.29	0.22	0.21	0.24	0.25	(0.07)
MgO	45.76	44.40	41.84	44.02	44.01	43.56	43.99	43.83	43.44	43.52	44.99	(1.30)
CaO	0.17	0.21	0.18	0.14	0.17	0.20	0.16	0.20	0.24	0.21	0.17	(0.02)
Na_2O	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.04	*0.01	-	-
K_2O	*0.00	*0.00	*0.00	*0.01	*0.02	*0.01	*0.03	*0.01	*0.02	*0.01	-	-
NiO	*0.12	*0.07	*0.08	*0.04	*0.08	*0.08	*0.11	*0.10	0.16	*0.00	0.20	(0.05)
Cr_2O_3	*0.00	0.15	*0.00	*0.04	0.17	*0.00	0.20	*0.09	*0.10	*0.01	0.17	(0.02)
Total	97.08	99.14	98.77	98.35	98.75	98.77	98.89	98.56	98.29	98.46	98.59	(0.47)
Cations on the basis of 4 oxygens												
Si	0.989	0.987	0.989	0.991	0.994	0.991	0.990	0.984	0.985	0.990	0.989	(0.003)
Al	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	0.002	(0.000)
Ti	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	-	-
Fe	0.279	0.326	0.395	0.325	0.327	0.341	0.328	0.342	0.342	0.342	0.303	(0.037)
Mn	0.004	0.005	0.008	0.007	*0.003	0.007	0.006	0.005	0.005	0.005	0.005	(0.002)
Mg	1.735	1.683	1.613	1.680	1.671	1.661	1.672	1.675	1.665	1.666	1.704	(0.037)
Ca	0.005	0.008	0.005	0.004	0.005	0.006	0.004	0.005	0.007	0.006	0.005	(0.001)
Na	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.001	*0.000	*0.001	*0.000	-	-
Ni	*0.003	*0.001	*0.002	*0.001	*0.002	*0.002	*0.002	*0.002	0.003	*0.000	0.004	(0.001)
Cr	*0.000	0.003	*0.000	*0.001	0.003	*0.000	0.004	*0.002	*0.002	*0.000	0.001	(0.001)
Total	3.013	3.010	3.008	3.007	3.003	3.006	3.004	3.011	3.007	3.009	3.008	(0.003)
Fo%	86.15	83.77	80.33	83.79	83.63	82.97	83.60	83.04	82.96	82.97	84.89	(1.84)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for core values above detection limit only.

Oturere Lapilli, Mangamate Tephra
EMP analyses: olivine

Oturere Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	Mean†	Std. Dev.†
SiO_2	38.47	38.32	38.02	38.58	38.97	38.42	38.63	38.42	38.62	37.86	38.43	38.84	38.00	38.43	(0.31)
Al_2O_3	*0.00	*0.04	*0.02	*0.01	*0.05	0.07	*0.05	*0.02	*0.00	*0.05	*0.04	*0.02	*0.02	0.07	(0.00)
TiO_2	*0.01	*0.06	*0.00	*0.00	*0.01	*0.03	*0.00	*0.01	*0.00	*0.00	*0.02	*0.01	*0.00	-	-
FeO	17.63	19.02	19.51	17.58	18.60	18.23	18.61	19.05	19.25	20.92	19.63	18.55	21.56	19.09	(1.10)
MnO	0.29	0.33	0.37	0.35	0.34	0.25	0.30	0.34	0.30	0.41	0.30	0.23	0.30	0.32	(0.05)
MgO	41.62	41.47	40.00	42.00	42.37	42.14	42.23	41.97	41.45	39.44	41.11	42.32	39.53	41.36	(1.00)
CaO	0.19	0.16	0.16	0.18	0.22	0.14	0.16	0.18	0.16	0.13	0.18	0.15	0.14	0.16	(0.02)
Na_2O	*0.00	*0.00	*0.01	*0.08	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	-	-
K_2O	*0.00	*0.03	*0.00	*0.01	*0.00	*0.00	*0.03	*0.00	*0.00	*0.00	*0.01	*0.01	*0.00	-	-
NiO	*0.07	*0.06	*0.03	*0.02	*0.00	*0.05	*0.04	*0.00	*0.05	*0.03	*0.03	*0.09	*0.00	-	-
Cr_2O_3	*0.03	*0.03	*0.08	*0.01	*0.00	*0.08	*0.06	*0.07	*0.01	*0.02	*0.04	*0.08	*0.00	-	-
Total	98.20	99.30	98.05	98.68	100.50	99.24	99.94	99.97	99.78	98.76	99.65	100.08	99.54	99.36	(0.72)
Cations on the basis of 4 oxygens															
Si	0.998	0.990	0.998	0.995	0.991	0.988	0.988	0.985	0.993	0.992	0.990	0.991	0.991	0.992	(0.004)
Al	*0.000	*0.001	*0.001	*0.000	*0.002	0.002	*0.001	*0.001	*0.000	*0.001	*0.001	*0.001	*0.000	0.002	(0.000)
Ti	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Fe	0.383	0.411	0.428	0.379	0.396	0.392	0.398	0.409	0.414	0.458	0.423	0.396	0.470	0.412	(0.026)
Mn	0.006	0.007	0.008	0.008	0.007	0.006	0.007	0.007	0.006	0.009	0.007	0.005	0.007	0.007	(0.001)
Mg	1.610	1.597	1.564	1.615	1.606	1.615	1.610	1.605	1.588	1.541	1.580	1.609	1.537	1.591	(0.026)
Ca	0.005	0.004	0.005	0.005	0.006	0.004	0.004	0.005	0.005	0.004	0.005	0.004	0.004	0.005	(0.001)
Na	*0.000	*0.000	*0.000	*0.004	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
K	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.001	*0.001	*0.000	*0.000	*0.001	*0.001	*0.000	*0.001	*0.001	*0.001	*0.002	*0.000	-	-
Cr	*0.001	*0.001	*0.002	*0.000	*0.000	*0.002	*0.001	*0.001	*0.000	*0.000	*0.001	*0.002	*0.000	-	-
Total	3.002	3.009	3.003	3.002	3.006	3.007	3.007	3.011	3.006	3.004	3.005	3.005	3.009	3.006	(0.003)
Fo%	80.78	79.53	78.51	80.99	80.22	80.47	80.18	79.69	79.32	77.09	78.88	80.25	76.58	79.42	(1.30)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [OT], Bullot Formation
EMP analyses: olivine

Pourahu Member	1 Core	Mean†	Std. Dev.†
SiO_2	39.02	39.02	(0.00)
Al_2O_3	*0.01	-	-
TiO_2	*0.01	-	-
FeO	17.02	17.02	(0.00)
MnO	0.22	0.22	(0.00)
MgO	44.05	44.05	(0.00)
CaO	0.12	0.12	(0.00)
Na_2O	*0.02	-	-
K_2O	*0.01	-	-
NiO	0.14	0.14	(0.00)
Cr_2O_3	*0.00	-	-
Total	100.56	100.56	(0.00)
Cations on the basis		of 4 oxygens	
Si	0.986	0.986	(0.000)
Al	*0.000	-	-
Ti	*0.000	-	-
Fe	0.359	0.359	(0.000)
Mn	0.005	0.005	(0.000)
Mg	1.658	1.658	(0.000)
Ca	0.003	0.003	(0.000)
Na	*0.001	-	-
K	*0.000	-	-
Ni	0.003	0.003	(0.000)
Cr	*0.000	-	-
Total	3.014	3.014	(0.000)
Fo%	82.20	82.20	(0.00)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Shawcroft Tephra, Bullot Formation
EMP analyses: olivine

Shawcroft Tephra	1 Rim	2a Rim	2b Core	3a Rim	3b Core	4 Rim	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	Mean[†]	Std. Dev.[†]
SiO_2	37.77	38.15	37.31	37.89	38.07	37.64	37.65	38.08	37.87	38.56	37.37	37.86	37.54	38.08	38.18	38.42	37.62	37.88	(0.37)
Al_2O_3	*0.03	0.67	0.08	*0.02	*0.01	*0.00	*0.03	*0.03	0.05	0.04	*0.01	*0.02	*0.00	0.05	*0.00	*0.02	*0.04	0.05	(0.02)
TiO_2	*0.01	0.06	*0.03	*0.00	*0.00	*0.00	*0.02	*0.02	*0.02	*0.03	*0.01	*0.01	*0.01	*0.00	*0.02	*0.01	*0.01	-	-
FeO	18.56	22.69	22.85	19.74	18.65	22.31	21.71	19.34	22.60	20.33	22.66	20.23	23.06	18.05	19.48	18.41	22.94	20.79	(1.83)
MnO	0.26	0.37	0.39	0.20	0.29	0.32	0.28	0.28	0.39	0.26	0.42	0.28	0.40	0.32	0.34	0.32	0.34	0.33	(0.05)
MgO	42.05	36.25	38.52	40.32	41.66	38.61	38.92	41.30	38.70	41.22	38.40	40.46	37.95	41.67	40.94	42.26	38.74	40.06	(1.48)
CaO	0.15	0.49	0.20	0.16	0.17	0.15	0.14	0.13	0.17	0.11	0.16	0.12	0.17	0.13	0.15	0.15	0.16	0.15	(0.02)
Na_2O	*0.03	*0.00	*0.00	*0.00	*0.03	*0.00	*0.03	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	-	-
K_2O	*0.00	0.10	*0.03	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.01	*0.00	*0.01	*0.01	*0.01	*0.00	*0.00	-	-
NiO	*0.03	*0.05	*0.02	*0.08	*0.00	*0.03	*0.00	*0.03	*0.05	*0.03	*0.04	*0.03	*0.01	*0.00	*0.01	*0.00	*0.06	-	-
Cr_2O_3	*0.00	*0.03	*0.00	*0.00	*0.02	*0.04	*0.02	*0.02	*0.00	*0.05	*0.00	*0.00	*0.04	*0.06	*0.04	0.09	*0.00	0.09	(0.00)
Total	98.80	98.78	99.34	98.31	98.84	99.03	98.69	99.13	99.58	100.51	98.99	98.95	99.12	98.30	99.09	99.66	99.80	99.23	(0.54)
Cations on the basis of 4 oxygens																			
Si	0.980	1.007	0.983	0.992	0.987	0.991	0.992	0.987	0.988	0.989	0.987	0.988	0.992	0.993	0.999	0.985	0.986	0.989	(0.004)
Al	*0.001	0.021	0.003	*0.001	*0.000	*0.000	*0.001	*0.001	0.002	0.001	*0.000	*0.001	*0.000	0.002	*0.000	*0.001	*0.001	0.002	(0.001)
Ti	*0.000	0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Fe	0.403	0.501	0.503	0.432	0.404	0.491	0.478	0.419	0.496	0.436	0.500	0.442	0.509	0.391	0.420	0.502	0.503	0.462	(0.042)
Mn	0.006	0.008	0.009	0.005	0.006	0.007	0.006	0.006	0.009	0.006	0.009	0.006	0.009	0.007	0.007	0.008	0.008	0.007	(0.001)
Mg	1.626	1.427	1.512	1.574	1.610	1.515	1.528	1.596	1.512	1.576	1.512	1.573	1.494	1.610	1.571	1.512	1.513	1.548	(0.041)
Ca	0.004	0.014	0.006	0.004	0.005	0.004	0.004	0.004	0.005	0.003	0.004	0.003	0.005	0.003	0.004	0.005	0.005	0.004	(0.001)
Na	*0.002	*0.000	*0.000	*0.000	*0.002	*0.000	*0.002	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
K	*0.000	0.003	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	-	-
Ni	*0.001	*0.001	*0.000	*0.002	*0.000	*0.001	*0.000	*0.001	*0.001	*0.001	*0.001	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	-	-
Cr	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.001	*0.001	0.002	*0.000	0.002	(0.000)
Total	3.019	2.982	3.016	3.007	3.012	3.008	3.008	3.012	3.012	3.011	3.012	3.012	3.009	3.006	3.001	3.014	3.015	3.011	(0.004)
Fo%	80.14	74.01	75.04	78.46	79.94	75.52	76.17	79.21	75.30	78.33	75.15	78.06	74.59	80.46	78.91	75.07	75.05	77.02	(2.08)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Rotoaira Lapilli
EMP analyses: olivine

Rotoaira Lapilli	1 Core	2 Core	3 Core	Mean[1]	Std. Dev.[1]
SiO_2	39.50	39.09	38.18	38.92	(0.55)
Al_2O_3	*0.01	*0.02	*0.02	-	-
TiO_2	*0.00	*0.00	*0.00	-	-
FeO	14.66	13.89	21.70	16.75	(3.51)
MnO	0.22	0.29	0.30	0.27	(0.04)
MgO	45.15	46.04	39.57	43.59	(2.87)
CaO	0.15	0.16	0.13	0.15	(0.01)
Na_2O	*0.00	*0.00	*0.00	-	-
K_2O	*0.00	*0.01	*0.00	-	-
NiO	0.18	0.18	0.20	0.19	(0.01)
Cr_2O_3	*0.02	*0.00	*0.04	-	-
Total	99.85	99.64	100.07	99.86	(0.18)
Cations on the basis of 4 oxygens					
Si	0.993	0.984	0.991	0.989	(0.004)
Al	*0.000	*0.001	*0.001	-	-
Ti	*0.000	*0.000	*0.000	-	-
Fe	0.308	0.292	0.471	0.357	(0.081)
Mn	0.005	0.006	0.007	0.006	(0.001)
Mg	1.693	1.726	1.531	1.650	(0.085)
Ca	0.004	0.004	0.004	0.004	0.000
Na	*0.000	*0.000	*0.000	-	-
K	*0.000	*0.000	*0.000	-	-
Ni	0.004	0.004	0.004	0.004	0.000
Cr	*0.000	*0.000	*0.001	-	-
Total	3.007	3.016	3.008	3.010	(0.004)
Fo%	84.61	85.53	76.47	82.20	(4.07)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.

Member L3 (hokey pokey lapilli), Bullot Formation
EMP analyses: olivine

Member L3	1 Core	2 Core	3 Core	4 Rim	5 Core	6a Core	6b Rim	7 Core	8 Core	9 Core	10a Core	10b Rim	11 Core	12 Core	13 Core	14 Core	15 Core	Mean[1]	Std. Dev.[1]
SiO_2	39.16	38.22	39.05	38.53	38.96	38.98	38.55	38.23	38.99	38.97	38.84	38.88	38.92	39.08	39.02	38.84	39.16	38.89	(0.29)
Al_2O_3	*0.05	*0.01	*0.01	*0.01	*0.01	*0.01	*0.02	*0.02	*0.00	*0.00	*0.03	*0.06	*0.00	*0.04	*0.00	0.07	*0.01	0.07	(0.00)
TiO_2	*0.00	*0.01	*0.01	*0.01	*0.01	*0.00	*0.06	*0.00	*0.01	*0.02	*0.00	*0.05	*0.00	*0.00	*0.00	*0.04	*0.00	-	-
FeO	16.56	16.55	16.84	16.87	16.48	16.54	16.84	16.77	15.62	16.38	16.29	16.26	16.94	16.66	16.67	15.66	16.03	16.43	(0.39)
MnO	0.34	0.24	*0.17	*0.20	0.22	0.25	0.23	0.28	0.31	*0.18	0.29	0.23	0.22	0.25	0.26	0.26	0.27	0.26	(0.03)
MgO	43.65	43.34	43.38	42.74	43.04	43.21	43.21	42.96	43.56	43.13	43.57	42.35	43.32	43.20	43.41	43.85	43.27	43.35	(0.24)
CaO	*0.00	0.17	0.17	0.16	0.15	0.15	0.15	0.16	0.14	0.17	0.16	0.12	0.14	0.17	0.16	0.17	0.16	0.16	(0.01)
Na_2O	*0.00	*0.02	*0.00	*0.00	*0.04	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.04	*0.00	*0.00	-	-
K_2O	*0.01	*0.01	*0.00	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.02	*0.00	*0.00	*0.00	-	-
NiO	*0.00	0.25	0.28	0.27	0.28	0.24	0.31	0.27	0.34	*0.05	0.26	0.26	0.26	0.29	0.30	0.25	0.25	0.27	(0.03)
Cr_2O_3	*0.03	*0.00	*0.02	*0.01	*0.01	*0.03	*0.02	*0.00	*0.01	*0.00	*0.02	*0.00	*0.01	*0.00	*0.00	*0.00	*0.09	-	-
Total	99.71	98.76	99.72	98.58	99.13	99.37	99.28	98.67	98.95	98.62	99.39	98.09	99.81	99.66	99.81	99.11	99.14	99.28	(0.41)
Cations on the basis of 4 oxygens																			
Si	0.994	0.983	0.992	0.991	0.996	0.994	0.986	0.985	0.995	0.997	0.990	1.002	0.991	0.994	0.992	0.990	0.998	0.992	(0.004)
Al	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.001	*0.002	*0.000	*0.001	*0.000	0.002	*0.000	0.002	(0.000)
Ti	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.00	*0.000	*0.001	*0.000	-	-
Fe	0.351	0.356	0.358	0.363	0.352	0.353	0.360	0.362	0.333	0.350	0.347	0.350	0.361	0.354	0.354	0.334	0.342	0.351	(0.009)
Mn	0.007	0.005	*0.004	*0.004	0.005	0.005	0.005	0.006	0.007	*0.004	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.006	(0.001)
Mg	1.651	1.662	1.643	1.639	1.640	1.643	1.648	1.651	1.658	1.645	1.655	1.627	1.644	1.639	1.645	1.668	1.644	1.649	(0.008)
Ca	*0.000	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.003	0.004	0.005	0.004	0.005	0.004	0.004	(0.000)
Na	*0.000	*0.001	*0.000	*0.000	*0.002	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	*0.000	*0.000	-	-
K	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	-	-
Ni	*0.000	0.005	0.008	0.008	0.006	0.005	0.008	0.006	0.007	*0.001	0.005	0.005	0.005	0.006	0.008	0.005	0.005	0.006	(0.001)
Cr	*0.001	*0.000	*0.000	*0.000	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.000	*0.002	-	-
Total	3.003	3.016	3.004	3.003	3.003	3.004	3.009	3.014	3.004	2.997	3.007	2.992	3.010	3.003	3.007	3.008	2.999	3.006	(0.005)
Fo%	82.47	82.38	82.11	81.87	82.33	82.31	82.07	82.02	83.27	82.46	82.87	82.30	82.00	82.24	82.29	83.30	82.78	82.47	(0.39)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for core values above detection limit only.

Oturere Lapilli, Mangamate Tephra
EMP analyses: hornblende

Oturere Lapilli	1 Core	2 Core	3 Core	Mean[1]	Std. Dev.[1]
SiO_2	41.56	41.61	41.65	41.60	(0.04)
Al_2O_3	11.70	11.79	11.83	11.77	(0.05)
TiO_2	2.75	3.04	2.62	2.81	(0.17)
FeO	12.88	12.83	12.90	12.87	(0.03)
MnO	0.16	0.25	0.18	0.20	(0.04)
MgO	12.93	13.23	13.44	13.20	(0.21)
CaO	11.73	11.57	11.54	11.61	(0.09)
Na_2O	2.29	2.34	2.33	2.32	(0.02)
K_2O	0.49	0.49	0.42	0.47	(0.03)
Total	96.49	97.13	96.90	96.84	(0.26)
Cations on the basis of 23 oxygens					
Si	6.237	6.202	6.219	6.219	(0.014)
Al	2.069	2.071	2.081	2.074	(0.005)
Ti	0.311	0.341	0.295	0.316	(0.019)
Fe	1.616	1.599	1.611	1.609	(0.007)
Mn	0.020	0.031	0.023	0.025	(0.005)
Mg	2.894	2.939	2.991	2.941	(0.040)
Ca	1.887	1.847	1.846	1.860	(0.019)
Na	0.667	0.676	0.673	0.672	(0.003)
K	0.094	0.093	0.080	0.089	(0.006)
Total	15.795	15.798	15.819	15.804	(0.011)
Mg N^a	64.17	64.76	64.99	64.64	(0.35)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for core values above detection limit only.

Te Rato Lapilli, Mangamate Tephra
EMP analyses: hornblende *(continued ...)*

Te Rato Lapilli	1 Core	2 Core	3 Core	4 Core	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Rim	15 Core	16 Core	17 Core	18 Core	19 Core	20 Core
SiO_2	42.92	43.46	43.16	43.67	42.74	42.82	42.55	42.39	42.05	43.08	42.76	41.85	42.73	43.35	42.75	41.58	43.19	42.73	44.17	42.99
Al_2O_3	11.45	11.18	11.02	11.16	11.17	11.73	11.15	11.16	11.36	10.71	10.78	12.06	11.03	10.27	10.96	11.78	10.92	11.41	10.43	11.06
TiO_2	1.43	1.69	1.54	1.78	1.79	1.77	1.63	1.86	1.53	1.69	1.58	1.52	1.73	1.51	1.78	1.85	1.49	1.71	1.53	1.64
FeO	14.69	14.52	14.39	14.15	14.61	14.14	14.34	12.59	14.40	14.51	14.11	14.35	13.94	12.96	14.69	13.85	14.23	14.14	13.85	14.54
MnO	0.33	0.51	0.45	0.47	0.42	0.31	0.62	0.24	0.26	0.59	0.54	0.34	*0.00	0.15	0.57	0.22	0.42	0.47	0.54	0.51
MgO	12.21	12.63	12.47	12.47	12.37	12.62	12.40	14.12	12.26	12.94	12.80	12.18	12.65	14.01	12.55	12.50	12.96	12.81	13.35	12.77
CaO	10.94	10.93	10.82	10.87	10.78	11.40	11.14	11.09	11.03	10.70	10.65	11.45	11.13	11.56	10.79	11.49	10.98	10.94	10.75	10.85
Na_2O	1.96	2.03	1.88	2.10	1.95	2.04	1.85	2.00	1.99	1.78	1.82	1.94	1.94	1.97	2.08	1.97	0.57	0.60	0.45	0.57
K_2O	0.40	0.42	0.37	0.39	0.42	0.43	0.31	0.35	0.36	0.36	0.29	0.45	0.36	0.34	0.37	0.46	0.35	0.38	0.34	0.37
Total	96.32	97.35	96.08	97.04	96.25	97.27	95.98	95.79	95.24	96.36	95.33	96.14	95.50	96.10	96.53	95.70	95.10	95.19	95.40	95.31
Cations on the basis of 23 oxygens																				
Si	6.457	6.467	6.497	6.500	6.437	6.378	6.426	6.362	6.401	6.474	6.485	6.323	6.462	6.496	6.427	6.302	6.535	6.462	6.629	6.500
Al	2.031	1.961	1.955	1.957	1.983	2.059	1.985	1.973	2.038	1.898	1.926	2.147	1.965	1.814	1.942	2.104	1.946	2.034	1.845	1.971
Ti	0.161	0.189	0.175	0.200	0.203	0.198	0.185	0.210	0.175	0.191	0.181	0.173	0.196	0.170	0.201	0.211	0.170	0.195	0.172	0.187
Fe	1.848	1.806	1.812	1.761	1.840	1.762	1.812	1.579	1.833	1.823	1.789	1.813	1.762	1.624	1.847	1.756	1.800	1.789	1.738	1.839
Mn	0.042	0.064	0.058	0.059	0.054	0.040	0.080	0.030	0.033	0.076	0.070	0.044	*0.000	0.019	0.073	0.028	0.054	0.060	0.068	0.066
Mg	2.738	2.802	2.798	2.768	2.778	2.802	2.791	3.158	2.781	2.899	2.893	2.743	2.862	3.129	2.812	2.825	2.922	2.888	2.986	2.879
Ca	1.763	1.742	1.745	1.733	1.739	1.820	1.803	1.783	1.798	1.723	1.731	1.853	1.802	1.856	1.738	1.866	1.779	1.772	1.728	1.758
Na	0.572	0.587	0.549	0.604	0.568	0.590	0.542	0.583	0.586	0.519	0.534	0.567	0.570	0.571	0.607	0.580	0.166	0.177	0.132	0.168
K	0.076	0.080	0.071	0.074	0.081	0.081	0.059	0.067	0.071	0.070	0.056	0.087	0.069	0.064	0.071	0.089	0.067	0.073	0.065	0.072
Total	15.688	15.698	15.660	15.656	15.683	15.730	15.683	15.745	15.716	15.673	15.665	15.750	15.678	15.743	15.718	15.761	15.439	15.450	15.363	15.440
Mg N^a	59.70	60.81	60.69	61.12	60.16	61.39	60.63	66.67	60.27	61.39	61.79	60.21	61.81	65.83	60.36	61.67	61.88	61.75	63.21	61.02

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Te Rato Lapilli, Mangamate Tephra
EMP analyses: hornblende *(... continued)*

Te Rato Lapilli	21 Core	22 Core	23 Core	24 Core	25 Core	26 Core	27 Core	28 Core	29a Core	29b Rim	Mean†	Std. Dev.†
SiO_2	42.77	43.04	43.40	42.83	42.72	43.11	42.59	43.29	43.03	43.19	42.87	(0.51)
Al_2O_3	10.80	11.26	11.04	11.50	11.59	10.99	12.01	11.15	11.58	12.07	11.23	(0.38)
TiO_2	1.80	1.72	1.79	1.30	1.73	1.74	1.68	1.32	1.40	1.88	1.64	(0.15)
FeO	14.82	14.15	13.94	15.56	14.23	12.75	13.17	13.32	15.29	12.67	14.19	(0.64)
MnO	0.59	0.43	0.51	0.49	0.42	0.20	0.33	*0.04	0.60	0.15	0.44	(0.12)
MgO	12.77	12.88	13.10	12.37	12.82	14.17	12.74	13.60	12.59	14.80	12.79	(0.49)
CaO	10.32	10.87	10.80	10.62	10.92	11.13	10.96	11.34	10.14	11.11	10.92	(0.30)
Na_2O	1.10	1.40	1.28	1.58	1.70	1.71	1.74	1.62	2.05	2.05	1.63	(0.50)
K_2O	0.39	0.38	0.42	0.36	0.41	0.35	0.44	0.31	0.37	0.29	0.38	(0.04)
Total	95.36	96.13	96.27	96.60	96.53	96.15	95.66	95.94	97.04	98.19	96.06	(0.63)
Cations on the basis of 23 oxygens												
Si	6.485	6.459	6.494	6.441	6.399	6.437	6.405	6.479	6.433	6.310	6.448	(0.063)
Al	1.931	1.992	1.947	2.037	2.046	1.935	2.129	1.967	2.041	2.007	1.991	(0.067)
Ti	0.206	0.194	0.201	0.147	0.194	0.196	0.191	0.148	0.157	0.204	0.186	(0.017)
Fe	1.879	1.776	1.744	1.957	1.782	1.593	1.656	1.667	1.912	1.548	1.785	(0.083)
Mn	0.075	0.055	0.065	0.062	0.053	0.025	0.042	*0.004	0.076	0.019	0.056	(0.016)
Mg	2.887	2.882	2.921	2.773	2.862	3.154	2.955	3.035	2.907	3.224	2.868	(0.106)
Ca	1.677	1.748	1.731	1.711	1.753	1.781	1.767	1.818	1.624	1.739	1.760	(0.049)
Na	0.322	0.409	0.372	0.461	0.493	0.494	0.508	0.470	0.593	0.580	0.476	(0.146)
K	0.075	0.072	0.081	0.069	0.079	0.066	0.093	0.059	0.070	0.054	0.073	(0.008)
Total	15.537	15.587	15.556	15.658	15.661	15.681	15.636	15.643	15.713	15.685	15.638	(0.102)
Mg Nº	60.57	61.87	62.62	58.63	61.63	66.44	63.29	64.55	59.49	67.56	61.63	(1.82)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pahoka Tephra

EMP analyses: hornblende *(continued ...)*

Pahoka Tephra	1a Core	1b Rim	2 Core	3 Core	4 Rim	5 Core	6 Core	7 Core	8 Core	9 Core	10 Core	11 Core	12 Core	13 Core	14 Core	15 Core	16 Core	17 Core	18 Core
SiO_2	42.87	43.11	41.53	40.88	41.99	41.86	42.19	41.64	41.36	42.24	41.16	42.68	42.55	42.75	44.45	41.56	42.29	42.84	41.41
Al_2O_3	11.01	10.69	12.29	12.34	11.79	11.98	11.57	12.56	12.27	12.11	13.04	12.23	11.97	11.51	10.59	12.25	11.82	12.04	12.34
TiO_2	1.55	1.87	1.68	1.70	1.70	1.58	1.32	0.95	2.00	1.61	1.42	1.36	1.51	1.42	0.93	1.97	1.72	1.60	0.76
FeO	12.88	12.42	14.04	15.04	11.97	14.58	14.47	16.18	12.57	15.14	16.13	15.14	15.25	14.46	14.73	14.02	14.22	14.17	14.38
MnO	*0.00	0.23	0.29	0.46	0.16	0.29	2.75	0.42	*0.12	0.41	0.46	0.38	0.39	0.25	0.43	0.27	0.39	0.39	0.35
MgO	13.82	14.33	12.79	11.50	14.40	12.45	12.24	11.20	13.30	12.01	11.33	11.95	11.73	12.43	12.78	12.48	12.21	12.14	11.89
CaO	11.30	11.32	11.60	11.58	11.75	11.14	11.02	10.63	11.21	10.44	10.87	10.82	11.18	11.13	10.39	11.30	11.16	11.28	11.41
Na_2O	1.84	1.87	2.16	2.15	2.07	2.06	1.81	2.09	2.33	1.93	2.01	2.02	2.08	2.20	1.87	2.29	2.05	2.03	2.06
K_2O	0.25	0.30	0.42	0.43	0.37	0.36	0.58	0.31	0.39	0.37	0.36	0.45	0.37	0.40	0.30	0.36	0.36	0.32	0.41
Total	95.51	96.14	96.80	96.06	96.18	96.29	97.94	95.98	95.42	96.24	96.76	97.03	97.02	96.53	96.47	96.50	96.23	96.80	95.01
Cations on the basis of 23 oxygens																			
Si	6.447	6.437	6.236	6.225	6.279	6.314	6.324	6.337	6.244	6.369	6.225	6.388	6.375	6.418	6.643	6.253	6.371	6.403	6.337
Al	1.952	1.882	2.175	2.215	2.077	2.129	2.043	2.253	2.182	2.152	2.324	2.157	2.114	2.036	1.865	2.173	2.099	2.120	2.225
Ti	0.175	0.210	0.190	0.194	0.192	0.179	0.149	0.109	0.227	0.182	0.161	0.153	0.170	0.016	0.105	0.223	0.195	0.180	0.086
Fe	1.619	1.561	1.763	1.915	1.497	1.839	1.814	2.060	1.586	1.909	2.040	1.895	1.910	1.816	1.841	1.764	1.792	1.771	1.840
Mn	*0.000	0.029	0.037	0.059	0.020	0.037	0.349	0.054	*0.015	0.052	0.058	0.048	0.049	0.031	0.055	0.034	0.049	0.049	0.046
Mg	3.097	3.191	2.863	2.610	3.209	2.799	2.736	2.542	2.994	2.700	2.554	2.667	2.619	2.782	2.847	2.800	2.743	2.705	2.711
Ca	1.820	1.811	1.867	1.889	1.682	1.801	1.770	1.733	1.813	1.686	1.760	1.735	1.794	1.789	1.664	1.822	1.802	1.806	1.871
Na	0.536	0.540	0.630	0.633	0.599	0.602	0.526	0.616	0.680	0.564	0.590	0.587	0.604	0.640	0.543	0.667	0.598	0.587	0.612
K	0.047	0.057	0.080	0.083	0.071	0.069	0.111	0.059	0.075	0.071	0.069	0.086	0.070	0.076	0.058	0.069	0.070	0.060	0.081
Total	15.693	15.708	15.841	15.823	15.826	15.769	15.822	15.763	15.801	15.685	15.781	15.716	15.705	15.604	15.621	15.805	15.719	15.681	15.809
Mg N°	65.67	67.29	61.89	57.68	68.19	60.35	60.13	55.24	65.37	58.58	55.59	58.46	57.83	60.50	60.73	61.35	60.49	60.43	59.57

* Indicates value was below the detection limit.

† Means and standard deviations are for core values above detection limit only.

Pahoka Tephra
EMP analyses: hornblende *(... continued)*

Pahoka Tephra	Mean[1]	Std. Dev.[1]
SiO_2	42.13	(0.86)
Al_2O_3	12.02	(0.57)
TiO_2	1.48	(0.34)
FeO	14.56	(0.94)
MnO	0.37	(0.07)
MgO	12.25	(0.68)
CaO	11.09	(0.36)
Na_2O	2.07	(0.13)
K_2O	0.37	(0.05)
Total	96.29	(0.57)
Cations		
Si	6.349	(0.104)
Al	2.136	(0.108)
Ti	0.169	(0.053)
Fe	1.835	(0.122)
Mn	0.047	(0.009)
Mg	2.752	(0.146)
Ca	1.791	(0.061)
Na	0.606	(0.038)
K	0.070	(0.010)
Total	15.739	(0.069)
Mg N[a]	59.88	(2.79)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for core values above detection limit only.
The anomalous analysis giving the MnO wt. % value of 2.75 is excluded from theses statistics.

Ngamatea lapilli-1, Bullot Formation
EMP analyses: hornblende

Ngamatea lapilli-1	1 Core	2 Core	Mean†	Std. Dev.†
SiO_2	42.18	42.43	42.31	(0.13)
Al_2O_3	12.21	11.50	11.86	(0.36)
TiO_2	2.13	3.21	2.67	(0.54)
FeO	11.88	12.43	12.16	(0.27)
MnO	*0.09	0.23	0.23	(0.00)
MgO	14.47	13.95	14.21	(0.26)
CaO	11.02	10.86	10.94	(0.08)
Na_2O	2.20	2.17	2.19	(0.01)
K_2O	0.43	0.49	0.46	(0.03)
Total	96.52	97.26	96.89	(0.37)
Cations on basis of 23 oxygens				
Si	6.251	6.270	6.261	(0.010)
Al	2.133	2.003	2.068	(0.065)
Ti	0.247	0.357	0.302	(0.055)
Fe	1.473	1.536	1.505	(0.032)
Mn	*0.012	0.028	0.028	(0.000)
Mg	3.195	3.072	3.134	(0.062)
Ca	1.750	1.719	1.735	(0.016)
Na	0.632	0.623	0.628	(0.005)
K	0.082	0.092	0.087	(0.005)
Total	15.763	15.700	15.732	(0.032)
Mg N^a	68.44	66.67	67.56	(0.89)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [OT], Bullot Formation
EMP analyses: hornblende

Pourahu Member	1a Core	1b Rim	2a Core	2b Rim	3 Core	4 Core	5 Core	6 Core	7 Rim	8 Rim	Mean†	Std. Dev.†
SiO_2	43.69	41.62	42.25	41.68	45.39	45.67	43.50	45.24	43.77	43.53	44.29	(1.23)
Al_2O_3	10.88	13.43	11.81	11.70	7.78	7.81	11.64	8.28	11.56	12.00	9.70	(1.77)
TiO_2	1.56	1.43	2.49	2.50	2.11	1.98	1.65	1.92	1.65	1.62	1.95	(0.31)
FeO	10.40	13.92	12.89	12.40	14.64	14.78	11.55	15.14	12.02	10.87	13.23	(1.78)
MnO	0.15	0.17	0.19	0.11	0.26	0.23	0.16	0.30	0.18	0.13	0.22	(0.06)
MgO	15.71	13.17	13.29	13.36	13.48	13.45	14.59	13.07	14.79	15.43	13.93	(0.93)
CaO	10.50	10.69	11.18	10.85	11.05	11.19	11.21	10.92	11.34	11.27	11.01	(0.25)
Na_2O	1.86	2.31	2.36	2.37	1.90	1.83	1.90	1.70	1.98	2.23	1.93	(0.20)
K_2O	0.33	0.24	0.24	0.24	0.47	0.45	0.35	0.53	0.36	0.26	0.40	(0.10)
Total	95.09	96.88	96.69	95.20	97.10	97.40	96.55	97.10	97.64	97.35	96.66	(0.75)
Cations on the basis of 23 oxygens												
Si	6.499	6.202	6.294	6.290	6.767	6.795	6.421	6.752	6.412	6.352	6.586	(0.191)
Al	1.909	2.358	2.074	2.081	1.368	1.367	2.025	1.456	1.995	2.064	1.700	(0.308)
Ti	0.174	0.161	0.279	0.283	0.237	0.222	0.183	0.216	0.182	0.177	0.219	(0.036)
Fe	1.294	1.723	1.605	1.565	1.825	1.837	1.426	1.890	1.472	1.326	1.646	(0.224)
Mn	0.019	0.022	0.024	0.014	0.033	0.029	0.020	0.038	0.022	0.016	0.027	(0.007)
Mg	3.483	2.925	2.952	3.007	2.995	2.979	3.210	2.907	3.231	3.356	3.088	(0.201)
Ca	1.674	1.706	1.784	1.755	1.766	1.782	1.772	1.746	1.780	1.763	1.754	(0.038)
Na	0.537	0.667	0.680	0.693	0.550	0.528	0.543	0.492	0.561	0.632	0.555	(0.059)
K	0.063	0.046	0.045	0.046	0.090	0.085	0.066	0.100	0.067	0.049	0.075	(0.019)
Total	15.651	15.810	15.737	15.734	15.631	15.614	15.666	15.597	15.722	15.735	15.649	(0.045)
Mg Nº	72.91	62.93	64.78	65.77	62.14	61.86	69.24	60.60	68.70	71.68	65.25	(4.43)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Pourahu Member [tephra unit] [DR16], Bullot Formation
EMP analyses: hornblende

Pourahu Member	1 Core	2 Rim	3 Core	4 Core	Mean[†]	Std. Dev.[†]
SiO_2	41.78	44.73	42.85	43.40	42.68	(0.67)
Al_2O_3	12.62	10.57	12.88	10.14	11.88	(1.24)
TiO_2	1.69	1.58	1.53	2.15	1.79	(0.26)
FeO	12.47	10.98	11.03	15.16	12.89	(1.71)
MnO	0.18	0.26	0.15	0.27	0.20	(0.05)
MgO	13.63	16.16	15.25	12.38	13.75	(1.18)
CaO	11.28	10.75	11.01	11.13	11.14	(0.11)
Na_2O	2.23	2.02	2.20	2.05	2.16	(0.08)
K_2O	0.29	0.32	0.26	0.55	0.36	(0.13)
Total	96.17	97.37	97.15	97.21	96.84	(0.47)
Cations on the basis of 23 oxygens						
Si	6.250	6.519	6.279	6.500	6.343	(0.112)
Al	2.225	1.816	2.224	1.789	2.079	(0.205)
Ti	0.190	0.173	0.168	0.242	0.200	(0.031)
Fe	1.560	1.338	1.352	1.899	1.604	(0.225)
Mn	0.023	0.032	0.018	0.034	0.025	(0.007)
Mg	3.040	3.511	3.332	2.763	3.045	(0.232)
Ca	1.809	1.678	1.728	1.786	1.774	(0.034)
Na	0.647	0.571	0.624	0.595	0.622	(0.021)
K	0.055	0.059	0.048	0.104	0.069	(0.025)
Total	15.799	15.697	15.773	15.712	15.761	(0.036)
Mg N°	66.09	72.41	71.14	59.27	65.50	(4.86)

* Indicates value was below the detection limit.

† Means and standard deviations are for core values above detection limit only.

Member L17, Bullot Formation
EMP analyses: hornblende

Member L17	1 Core	Mean†	Std. Dev.†
SiO_2	41.00	41.00	(0.00)
Al_2O_3	12.55	12.55	(0.00)
TiO_2	1.45	1.45	(0.00)
FeO	14.51	14.51	(0.00)
MnO	0.37	0.37	(0.00)
MgO	11.99	11.99	(0.00)
CaO	11.30	11.30	(0.00)
Na_2O	2.00	2.00	(0.00)
K_2O	0.45	0.45	(0.00)
Total	95.63	95.63	(0.00)
Cations on the basis		of 23 oxygens	
Si	6.242	6.242	(0.000)
Al	2.252	2.252	(0.000)
Ti	0.166	0.166	(0.000)
Fe	1.848	1.848	(0.000)
Mn	0.048	0.048	(0.000)
Mg	2.721	2.721	(0.000)
Ca	1.843	1.843	(0.000)
Na	0.590	0.590	(0.000)
K	0.088	0.088	(0.000)
Total	15.798	15.798	(0.000)
Mg N^a	59.55	59.55	(0.00)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L6 (pink lapilli), Bullot Formation
EMP analyses: hornblende

Member L6	1 Core	2 Core	3a Core	3b Rim	4 Core	Mean†	Std. Dev.†
SiO_2	43.33	41.80	41.14	40.99	41.87	41.78	(0.83)
Al_2O_3	10.58	13.91	13.71	13.88	13.54	13.08	(1.26)
TiO_2	1.57	1.81	1.69	1.83	1.76	1.73	(0.09)
FeO	14.01	10.58	12.24	11.08	10.65	11.71	(1.30)
MnO	0.22	*0.07	0.18	*0.00	0.15	0.11	(0.09)
MgO	13.15	14.85	14.38	14.48	15.25	14.42	(0.70)
CaO	11.17	11.73	11.07	11.78	11.87	11.52	(0.33)
Na_2O	1.90	2.43	2.28	2.38	2.40	2.28	(0.19)
K_2O	0.60	0.24	0.40	0.28	0.25	0.35	(0.14)
Total	96.53	97.14	97.09	98.43	97.73	96.98	(0.47)
Cations on the basis of 23 oxygens							
Si	6.495	6.105	6.096	6.086	6.120	6.180	(0.158)
Al	1.870	2.406	2.394	2.395	2.332	2.279	(0.206)
Ti	0.177	0.199	0.188	0.204	0.194	0.192	(0.009)
Fe	1.756	1.298	1.517	1.374	1.302	1.449	(0.173)
Mn	0.028	*0.009	0.022	*0.000	0.018	0.014	(0.012)
Mg	2.940	3.249	3.178	3.201	3.323	3.178	(0.129)
Ca	1.793	1.844	1.767	1.874	1.859	1.825	(0.044)
Na	0.553	0.692	0.655	0.684	0.681	0.653	(0.052)
K	0.114	0.044	0.076	0.049	0.046	0.066	(0.027)
Total	15.726	15.837	15.883	15.887	15.875	15.838	(0.058)
Mg N^a	82.81	71.45	67.69	69.97	71.85	68.71	(3.38)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Member L1 (green ash), Bullot Formation
EMP analyses: hornblende

Member L1	1 Core	Mean†	Std. Dev.†
SiO_2	42.40	42.40	(0.00)
Al_2O_3	11.04	11.04	(0.00)
TiO_2	2.95	2.95	(0.00)
FeO	14.04	14.04	(0.00)
MnO	0.18	0.18	(0.00)
MgO	12.36	12.36	(0.00)
CaO	11.00	11.00	(0.00)
Na_2O	2.30	2.30	(0.00)
K_2O	0.41	0.41	(0.00)
Total	96.68	96.68	(0.00)
Cations on the basis		of 23 oxygens	
Si	6.359	6.359	(0.000)
Al	1.951	1.951	(0.000)
Ti	0.332	0.332	(0.000)
Fe	1.761	1.761	(0.000)
Mn	0.023	0.023	(0.000)
Mg	2.763	2.763	(0.000)
Ca	1.768	1.768	(0.000)
Na	0.670	0.670	(0.000)
K	0.079	0.079	(0.000)
Total	15.706	15.706	(0.000)
Mg N°	61.07	61.07	(0.00)

* Indicates value was below the detection limit.
† Means and standard deviations are for core values above detection limit only.

Ngamatea lapilli-1, Bullot Formation
EMP analyses: Fe – Ti oxides

Ngamatea lapilli-1	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	11 Tmag	Mean†	Std. Dev.†	12 Ilm	13 Ilm	14 Ilm	15 Ilm	16 Ilm	17 Ilm	18 Ilm
SiO_2	0.10	0.16	0.11	0.11	0.14	0.12	0.11	0.24	0.18	0.19	0.25	0.16	(0.05)	0.05	0.08	*0.05	0.08	0.07	0.07	0.18
Al_2O_3	2.89	3.66	2.85	2.95	2.96	2.86	3.08	2.48	2.90	3.88	3.02	3.05	(0.37)	0.51	0.45	0.55	0.48	0.56	0.54	0.58
TiO_2	11.17	10.18	10.78	10.69	11.71	11.02	10.88	12.20	10.70	8.90	10.25	10.77	(0.81)	36.91	39.26	37.51	38.77	36.83	36.79	36.17
FeO	76.05	76.03	77.38	77.10	74.08	77.02	77.08	75.53	77.02	78.47	74.25	76.18	(1.10)	55.52	52.92	55.03	51.93	54.35	55.22	53.57
MnO	0.42	0.36	0.30	0.29	0.28	0.26	0.30	0.36	0.41	0.34	0.22	0.32	(0.06)	0.24	0.30	0.22	0.30	0.20	0.22	0.30
MgO	3.14	3.29	2.95	3.16	3.34	2.43	2.53	2.64	2.89	3.19	3.14	2.97	(0.30)	3.19	3.73	3.31	3.48	3.45	3.06	3.43
CaO	*0.00	*0.01	*0.03	*0.02	*0.05	*0.01	*0.02	*0.00	*0.05	*0.02	*0.03	-	-	*0.00	*0.00	*0.04	*0.04	*0.00	*0.00	*0.01
NiO	*0.00	*0.08	*0.12	*0.12	*0.02	*0.09	*0.01	*0.04	*0.07	*0.06	*0.02	-	-	*0.06	*0.00	*0.01	*0.00	*0.02	*0.00	*0.07
Cr_2O_3	0.33	0.67	0.49	0.57	0.29	0.44	0.34	0.33	0.53	0.69	0.50	0.47	(0.13)	*0.08	*0.00	*0.13	*0.12	0.21	*0.13	*0.00
Total	94.09	94.34	94.84	94.87	92.79	94.14	94.31	93.79	94.62	93.66	91.63	93.92	(0.92)	96.41	96.74	96.62	95.04	95.67	95.90	94.21
Cations on the basis of 32 oxygens																				
Si	0.035	0.056	0.038	0.037	0.048	0.041	0.039	0.086	0.063	0.067	0.092	0.055	(0.019)	0.015	0.023	*0.013	0.024	0.022	0.020	0.053
Al	1.194	1.505	1.174	1.214	1.232	1.190	1.275	1.029	1.195	1.616	1.280	1.264	(0.155)	0.176	0.155	0.189	0.167	0.196	0.190	0.206
Ti	2.950	2.670	2.834	2.805	3.107	2.924	2.879	3.224	2.817	2.365	2.775	2.850	(0.213)	8.222	8.582	8.296	8.609	8.240	8.235	8.211
Fe	22.335	22.175	22.628	22.493	21.858	22.723	22.684	22.199	22.559	22.608	22.361	22.420	(0.262)	13.753	12.866	13.535	12.822	13.521	13.744	13.523
Mn	0.126	0.106	0.088	0.086	0.083	0.076	0.088	0.108	0.121	0.102	0.068	0.096	(0.018)	0.060	0.073	0.056	0.074	0.051	0.054	0.076
Mg	1.642	1.709	1.535	1.644	1.758	1.276	1.328	1.381	1.509	1.681	1.687	1.559	(0.158)	1.407	1.618	1.449	1.531	1.530	1.359	1.542
Ca	*0.00	*0.004	*0.010	*0.006	*0.018	*0.002	*0.006	*0.001	*0.019	*0.009	*0.011	-	-	*0.000	*0.000	*0.012	*0.013	*0.000	*0.000	*0.004
Ni	*0.00	*0.021	*0.034	*0.033	*0.006	*0.025	*0.002	*0.012	*0.020	*0.018	*0.006	-	-	*0.015	*0.000	*0.002	*0.000	*0.005	*0.000	*0.018
Cr	0.091	0.183	0.134	0.156	0.080	0.121	0.095	0.091	0.145	0.193	0.144	0.130	(0.037)	*0.018	*0.000	*0.029	*0.029	0.050	*0.032	*0.000
Total	28.373	28.404	28.431	28.435	28.166	28.351	28.388	28.118	28.409	28.632	28.407	28.374	(0.130)	23.633	23.317	23.525	23.227	23.610	23.602	23.611

* Indicates value was below the detection limit.
† Means and standard deviations are for titanomagnetite values above detection limit only.

Pourahu Member [tephra unit] [BT1], Bullot Formation
EMP analyses: Fe – Ti oxides

Pourahu Member	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	11 Tmag	12 Tmag	13 Tmag	14 Tmag	Mean[1]	Std. Dev.[1]	15 Ilm	16 Ilm	17 Ilm
SiO_2	0.14	0.10	0.09	0.20	0.12	0.09	0.09	0.11	0.11	0.11	0.10	0.11	0.13	0.12	0.11	(0.03)	0.06	*0.04	0.05
Al_2O_3	2.29	2.28	2.20	2.65	2.23	2.28	2.29	2.19	2.22	2.29	2.23	2.25	2.21	2.25	2.28	(0.11)	0.28	0.26	0.28
TiO_2	12.93	12.46	12.78	12.43	12.63	13.01	12.42	12.73	12.92	12.89	12.64	13.05	12.60	13.12	12.76	(0.23)	43.28	43.01	43.87
FeO	75.82	76.99	76.22	74.83	76.28	75.63	76.68	76.59	77.39	75.31	76.08	75.84	76.49	76.13	76.15	(0.67)	49.18	49.67	49.47
MnO	0.36	0.42	0.37	0.38	0.31	0.31	0.31	0.44	0.41	0.39	0.36	0.32	0.29	0.42	0.36	(0.05)	0.42	0.37	0.35
MgO	2.16	1.96	2.03	2.49	1.97	2.11	2.20	2.15	2.12	2.02	1.93	2.06	1.97	2.11	2.09	(0.14)	3.10	3.11	3.07
CaO	*0.01	*0.01	*0.04	*0.03	*0.04	*0.04	*0.01	*0.00	*0.00	*0.00	*0.02	*0.00	*0.00	*0.02	-	-	*0.02	*0.00	*0.02
NiO	*0.07	*0.02	*0.05	*0.00	*0.06	*0.07	*0.06	*0.00	*0.09	*0.00	*0.03	*0.00	*0.02	*0.04	-	-	*0.01	*0.03	*0.04
Cr_2O_3	0.30	0.29	0.27	0.28	0.24	0.41	0.30	0.56	0.25	0.18	0.26	0.20	*0.06	0.22	0.29	(0.09)	*0.00	*0.04	*0.03
Total	93.99	94.49	93.94	93.05	93.77	93.83	94.28	94.77	95.41	93.20	93.60	93.83	93.69	94.38	94.02	(0.60)	96.31	96.42	97.09
Cations on the basis of 32 oxygens																			
Si	0.048	0.036	0.032	0.069	0.042	0.030	0.031	0.040	0.037	0.039	0.035	0.039	0.045	0.043	0.040	(0.009)	0.016	*0.014	0.015
Al	0.948	0.946	0.913	1.102	0.927	0.945	0.949	0.904	0.909	0.959	0.933	0.933	0.921	0.929	0.944	(0.047)	0.093	0.087	0.094
Ti	3.414	3.294	3.388	3.303	3.358	3.440	3.285	3.347	3.373	3.439	3.368	3.458	3.357	3.453	3.377	(0.056)	9.314	9.259	9.350
Fe	22.269	22.644	22.473	22.051	22.548	22.241	22.557	22.391	22.470	22.341	22.545	22.347	22.655	22.282	22.415	(0.166)	11.769	11.890	11.725
Mn	0.107	0.125	0.111	0.114	0.092	0.092	0.092	0.129	0.120	0.118	0.109	0.095	0.087	0.124	0.108	(0.014)	0.102	0.090	0.083
Mg	1.130	1.025	1.066	1.310	1.036	1.106	1.151	1.120	1.097	1.070	1.017	1.080	1.039	1.101	1.096	(0.071)	1.324	1.325	1.297
Ca	*0.004	*0.005	*0.016	*0.011	*0.015	*0.013	*0.002	*0.00	*0.000	*0.001	*0.009	*0.001	*0.002	*0.006	-	-	*0.005	*0.000	*0.006
Ni	*0.019	*0.004	*0.015	*0.000	*0.018	*0.020	*0.018	*0.00	*0.025	*0.000	*0.008	*0.000	*0.005	*0.010	-	-	*0.001	*0.007	*0.009
Cr	0.083	0.079	0.074	0.079	0.067	0.113	0.082	0.154	0.070	0.051	0.072	0.056	*0.018	0.061	0.080	(0.026)	*0.000	*0.009	*0.006
Total	27.999	28.149	28.057	28.028	28.070	27.967	28.147	28.085	28.076	28.017	28.079	28.008	28.104	27.993	28.056	(0.054)	22.618	22.651	22.564

* Indicates value was below the detection limit.

[1] Means and standard deviations are for titanomagnetite values above detection limit only.

Pourahu Member [ignimbrite unit] [CT], Bullot Formation
EMP analyses: Fe – Ti oxides

Pourahu Member	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	11 Tmag	12 Tmag	13 Tmag	Mean'	Std. Dev.'	14 Ilm	15 Ilm	16 Ilm	17 Ilm	18 Ilm
SiO_2	0.11	0.09	0.12	0.10	0.15	0.13	0.11	0.09	0.21	0.14	0.15	0.13	0.09	0.12	(0.03)	*0.05	0.06	0.05	0.14	0.07
Al_2O_3	2.34	2.28	2.24	2.31	2.34	2.28	2.29	2.30	2.30	2.24	2.35	2.34	2.28	2.30	(0.04)	0.27	0.28	0.30	0.27	0.29
TiO_2	12.33	12.80	12.77	12.60	13.05	13.12	12.93	13.09	12.88	12.86	12.74	12.88	12.64	12.81	(0.22)	43.25	43.34	44.30	44.42	43.59
FeO	76.58	76.49	76.24	74.95	76.41	76.16	76.69	75.29	76.54	77.03	75.89	75.85	75.78	76.15	(0.56)	49.20	48.69	50.15	48.28	50.14
MnO	0.38	0.39	0.31	0.38	0.42	0.48	0.38	0.36	0.34	0.40	0.37	0.36	0.34	0.38	(0.04)	0.46	0.37	0.39	0.38	0.45
MgO	1.89	2.09	2.10	2.11	1.99	2.02	2.08	2.11	2.01	1.92	2.10	1.97	2.04	2.04	(0.06)	2.87	3.05	3.11	2.85	3.10
CaO	*0.03	*0.03	*0.00	*0.01	*0.01	*0.00	*0.03	*0.01	*0.00	*0.01	*0.03	*0.02	*0.00	-	-	*0.01	*0.01	*0.00	*0.00	*0.02
NiO	*0.10	*0.11	*0.03	*0.03	*0.04	*0.00	*0.00	*0.09	*0.07	*0.04	*0.02	*0.00	*0.00	-	-	*0.00	*0.00	*0.03	*0.00	*0.02
Cr_2O_3	0.29	0.27	0.38	0.21	0.38	0.22	0.48	0.21	*0.00	0.34	0.27	0.20	*0.00	0.30	(0.09)	*0.04	*0.05	*0.08	*0.06	*0.01
Total	94.02	94.41	94.17	92.55	94.75	94.42	94.96	93.45	94.27	94.92	93.87	93.72	93.16	94.05	(0.68)	96.15	95.78	98.30	96.34	97.64
Cations on the basis of 32 oxygens																				
Si	0.038	0.032	0.042	0.036	0.052	0.047	0.038	0.030	0.072	0.047	0.054	0.046	0.032	0.044	(0.011)	*0.013	0.016	0.015	0.041	0.021
Al	0.974	0.942	0.928	0.971	0.963	0.941	0.939	0.957	0.950	0.921	0.974	0.973	0.954	0.953	(0.017)	0.092	0.095	0.098	0.089	0.097
Ti	3.272	3.373	3.376	3.360	3.421	3.455	3.387	3.475	3.398	3.377	3.373	3.418	3.383	3.390	(0.047)	9.323	9.358	9.329	9.495	9.267
Fe	22.599	22.416	22.411	22.411	22.276	22.297	22.342	22.218	22.462	22.495	22.345	22.380	22.556	22.401	(0.105)	11.793	11.691	11.744	11.476	11.853
Mn	0.114	0.117	0.093	0.114	0.124	0.142	0.111	0.108	0.100	0.118	0.111	0.107	0.101	0.112	(0.012)	0.112	0.091	0.092	0.090	0.107
Mg	1.048	1.091	1.099	1.123	1.036	1.056	1.080	1.111	1.052	1.000	1.100	1.035	1.082	1.070	(0.034)	1.269	1.305	1.296	1.209	1.308
Ca	*0.011	*0.011	*0.000	*0.005	*0.005	*0.000	*0.010	*0.003	*0.000	*0.005	*0.010	*0.007	*0.000	-	-	*0.000	*0.003	*0.000	*0.000	*0.006
Ni	*0.029	*0.031	*0.008	*0.009	*0.011	*0.000	*0.000	*0.026	*0.020	*0.012	*0.007	*0.000	*0.000	-	-	*0.000	*0.000	*0.007	*0.000	*0.003
Cr	0.079	0.075	0.107	0.059	0.105	0.060	0.132	0.059	*0.000	0.093	0.075	0.055	*0.000	0.082	(0.024)	*0.008	*0.012	*0.017	*0.013	*0.002
Total	28.124	28.046	28.056	28.074	27.977	27.998	28.029	27.958	28.034	28.051	28.032	28.014	28.108	28.039	(0.045)	22.589	22.556	22.574	22.400	22.653

* Indicates value was below the detection limit.

' Means and standard deviations are for titanomagnetite values above detection limit only.

Member L17, Bullot Formation
EMP analyses: Fe – Ti oxides

Member L17	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	11 Tmag	Mean[1]	Std. Dev.[1]	12 Ilm	13 Ilm	14 Ilm
SiO_2	0.10	0.10	0.09	0.12	0.12	0.09	0.08	0.10	0.11	0.11	0.12	0.10	(0.01)	*0.03	0.06	*0.04
Al_2O_3	2.57	2.59	3.12	2.98	2.95	2.48	2.59	2.59	2.64	2.33	2.63	2.68	(0.22)	0.38	0.33	0.32
TiO_2	13.54	13.69	11.53	11.84	10.81	13.18	13.71	13.75	13.53	13.58	13.44	12.96	(1.00)	42.85	42.53	41.84
FeO	73.61	74.29	75.73	74.25	76.33	74.94	75.59	73.90	75.13	74.32	74.20	74.75	(0.82)	48.16	48.36	51.42
MnO	0.37	0.30	0.37	0.36	0.37	0.32	0.37	0.35	0.40	0.36	0.36	0.36	(0.03)	0.35	0.47	0.59
MgO	3.29	3.16	3.05	3.14	3.06	3.35	3.25	3.25	2.72	3.09	3.08	3.13	(0.16)	4.77	4.44	2.97
CaO	*0.00	*0.01	*0.00	*0.02	*0.00	*0.01	*0.00	*0.00	*0.02	*0.00	*0.01	-	-	*0.02	*0.01	*0.00
NiO	*0.00	*0.10	*0.09	*0.01	*0.00	*0.00	*0.02	*0.04	*0.00	*0.00	*0.04	-	-	*0.04	*0.06	*0.06
Cr_2O_3	0.27	0.33	0.42	0.36	0.26	0.26	0.22	0.18	0.23	0.27	0.25	0.28	(0.06)	*0.02	*0.02	*0.00
Total	93.75	94.46	94.31	93.04	93.91	94.61	95.80	94.12	94.76	94.05	94.08	94.26	(0.66)	96.50	96.20	97.14
Cations on the basis of 32 oxygens																
Si	0.034	0.035	0.033	0.041	0.042	0.032	0.025	0.033	0.039	0.039	0.042	0.036	(0.005)	*0.008	0.017	*0.011
Al	1.051	1.051	1.279	1.236	1.227	1.009	1.039	1.055	1.075	0.953	1.075	1.095	(0.099)	0.128	0.111	0.110
Ti	3.534	3.545	3.022	3.136	2.867	3.425	3.509	3.571	3.510	3.546	3.500	3.379	(0.237)	9.134	9.120	9.025
Fe	21.362	21.388	22.076	21.874	22.611	21.649	21.521	21.345	21.676	21.585	21.494	21.680	(0.338)	11.415	11.533	12.336
Mn	0.107	0.087	0.110	0.108	0.111	0.093	0.107	0.102	0.118	0.105	0.105	0.105	(0.008)	0.083	0.114	0.143
Mg	1.704	1.621	1.586	1.650	1.610	1.723	1.650	1.675	1.396	1.599	1.588	1.618	(0.083)	2.013	1.889	1.269
Ca	*0.000	*0.005	*0.000	*0.007	*0.000	*0.004	*0.001	*0.000	*0.006	*0.000	*0.002	-	-	*0.000	*0.002	*0.000
Ni	*0.000	*0.027	*0.026	*0.003	*0.000	*0.000	*0.006	*0.011	*0.000	*0.000	*0.012	-	-	*0.008	*0.014	*0.015
Cr	0.075	0.090	0.115	0.099	0.072	0.070	0.058	0.050	0.062	0.075	0.068	0.076	(0.018)	*0.003	*0.004	*0.00
Total	27.867	27.817	28.221	28.144	28.440	28.001	27.909	27.831	27.876	27.902	27.872	27.989	(0.189)	22.773	22.784	22.883

* Indicates value was below the detection limit.

[1] Means and standard deviations are for titanomagnetite values above detection limit only.

Member L16, Bullot Formation
EMP analyses: Fe – Ti oxides

Member L16	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	11 Tmag	12 Tmag	13 Tmag	14 Tmag	15 Tmag	16 Tmag	Mean†	Std. Dev.†	17 Ilm	18 Ilm
SiO_2	0.12	0.35	0.11	0.09	0.10	0.12	0.12	0.09	0.09	0.11	0.10	0.12	0.12	0.10	0.12	0.11	0.12	(0.06)	0.08	*0.04
Al_2O_3	3.11	3.92	2.79	2.82	3.65	3.27	3.42	2.92	3.05	3.31	3.42	3.55	3.26	3.13	3.49	3.43	3.28	(0.30)	0.58	0.56
TiO_2	11.63	12.38	13.87	12.38	10.23	10.98	10.76	12.40	12.20	10.67	11.48	11.16	10.54	11.77	10.96	10.41	11.49	(0.94)	37.54	37.82
FeO	74.46	70.13	74.20	74.14	76.10	74.83	74.33	73.17	74.94	76.37	73.11	74.89	76.20	74.98	74.17	76.12	74.51	(1.48)	52.76	52.96
MnO	*0.00	0.30	0.41	0.22	0.33	0.28	0.27	0.25	0.34	0.20	0.28	0.29	0.27	0.26	0.34	0.36	0.29	(0.05)	0.23	*0.13
MgO	3.53	4.58	2.68	3.61	3.12	3.63	3.41	3.71	3.73	3.37	3.71	3.57	3.62	3.65	3.51	3.30	3.55	(0.37)	3.62	3.59
CaO	*0.01	0.11	*0.00	*0.01	*0.00	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.03	0.11	(0.00)	*0.00	*0.01
NiO	*0.08	*0.03	*0.03	*0.01	*0.01	*0.00	*0.00	*0.00	*0.00	*0.00	*0.00	*0.04	*0.02	*0.00	*0.02	*0.05	-	-	na	*0.03
Cr_2O_3	0.35	*0.07	0.21	*0.17	*0.00	0.27	0.29	0.24	0.36	0.35	0.33	0.39	0.25	0.24	0.19	0.27	0.29	(0.06)	na	*0.13
Total	93.21	91.75	94.27	93.25	93.53	93.39	92.60	92.78	94.72	94.37	92.42	93.96	94.26	94.14	92.79	94.01	93.46	(0.81)	94.81	94.92
Cations on the basis of 32 oxygens																				
Si	0.042	0.120	0.039	0.032	0.035	0.043	0.044	0.033	0.032	0.037	0.034	0.042	0.040	0.037	0.043	0.038	0.043	(0.020)	0.027	*0.011
Al	1.286	1.603	1.136	1.161	1.520	1.354	1.429	1.207	1.237	1.362	1.422	1.456	1.344	1.280	1.451	1.419	1.354	(0.126)	0.203	0.196
Ti	3.067	3.232	3.601	3.253	2.716	2.901	2.867	3.270	3.162	2.803	3.042	2.919	2.771	3.072	2.907	2.747	3.021	(0.232)	8.411	8.436
Fe	21.836	20.360	21.424	21.669	22.475	21.982	22.031	21.468	21.592	22.318	21.546	21.787	22.287	21.792	21.888	22.330	21.799	(0.487)	13.147	13.138
Mn	*0.000	0.087	0.120	0.064	0.097	0.084	0.080	0.076	0.099	0.059	0.082	0.084	0.081	0.080	0.101	0.107	0.087	(0.016)	0.059	*0.032
Mg	1.845	2.368	1.379	1.880	1.642	1.900	1.802	1.942	1.918	1.755	1.948	1.852	1.885	1.893	1.845	1.727	1.849	(0.192)	1.611	1.588
Ca	*0.004	0.041	*0.000	*0.005	*0.000	*0.004	*0.00	*0.000	*0.001	*0.000	*0.001	*0.000	*0.000	*0.000	*0.000	*0.010	0.041	(0.000)	*0.000	*0.004
Ni	*0.022	*0.008	*0.008	*0.001	*0.003	*0.000	*0.00	*0.000	*0.000	*0.000	*0.000	*0.011	*0.004	*0.000	*0.000	*0.014	-	-	na	*0.007
Cr	0.098	*0.019	0.057	*0.046	*0.000	0.074	0.081	0.065	0.098	0.097	0.092	0.106	0.070	0.064	0.053	0.076	0.079	(0.017)	na	*0.030
Total	28.172	27.811	27.756	28.059	28.485	28.338	28.334	28.061	28.137	28.431	28.166	28.246	28.478	28.219	28.288	28.444	28.214	(0.211)	23.456	23.358

na indicates the oxide was not analysed.
* Indicates value was below the detection limit.
† Means and standard deviations are for titanomagnetite values above detection limit only.

Member L8, Bullot Formation
EMP analyses: Fe – Ti oxides

Member L8	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	11 Tmag	12 Tmag	Mean†	Std. Dev.†
SiO_2	0.12	0.11	0.10	0.09	0.13	0.11	0.11	0.10	0.12	0.12	0.12	0.11	0.11	(0.01)
Al_2O_3	3.03	2.97	2.87	3.01	2.99	2.91	2.95	3.27	3.02	3.01	2.89	3.05	3.00	(0.10)
TiO_2	11.96	12.16	12.61	12.31	11.98	12.27	11.75	11.06	11.79	11.85	12.67	11.73	12.01	(0.42)
FeO	76.37	75.91	74.68	74.69	75.36	75.25	75.95	75.89	75.17	74.78	74.48	76.37	75.41	(0.65)
MnO	0.28	0.34	0.35	0.31	0.33	0.35	0.28	0.35	0.30	0.35	0.41	0.32	0.33	(0.03)
MgO	2.66	2.98	2.91	3.08	2.86	2.92	2.96	3.02	3.02	2.80	3.04	3.18	2.95	(0.13)
CaO	*0.00	*0.02	*0.02	*0.03	*0.02	*0.02	*0.02	*0.02	*0.02	*0.02	*0.01	*0.01	-	-
NiO	*0.07	*0.09	*0.05	*0.05	*0.00	*0.05	*0.03	*0.05	*0.00	*0.02	*0.03	*0.10	-	-
Cr_2O_3	*0.09	0.19	*0.15	*0.16	0.28	*0.14	0.18	0.23	*0.11	0.17	0.31	0.28	0.24	(0.05)
Total	94.42	94.66	93.51	93.50	93.94	93.61	94.19	93.91	93.42	93.07	93.92	95.02	93.95	(0.53)
Cations on the basis of 32 oxygens														
Si	0.041	0.040	0.033	0.033	0.045	0.037	0.039	0.034	0.042	0.042	0.040	0.037	0.039	(0.004)
Al	1.246	1.212	1.182	1.238	1.234	1.196	1.214	1.353	1.249	1.251	1.185	1.241	1.233	(0.043)
Ti	3.134	3.170	3.314	3.233	3.151	3.224	3.090	2.918	3.115	3.146	3.316	3.050	3.155	(0.106)
Fe	22.261	22.011	21.830	21.824	22.045	21.982	22.205	22.269	22.085	22.084	21.673	22.088	22.030	(0.174)
Mn	0.084	0.100	0.104	0.092	0.098	0.103	0.084	0.104	0.090	0.103	0.120	0.094	0.098	(0.010)
Mg	1.380	1.542	1.514	1.605	1.490	1.522	1.543	1.578	1.583	1.472	1.577	1.637	1.537	(0.066)
Ca	*0.000	*0.008	*0.006	*0.010	*0.007	*0.006	*0.006	*0.006	*0.006	*0.008	*0.002	*0.002	-	-
Ni	*0.020	*0.024	*0.015	*0.013	*0.000	*0.014	*0.008	*0.014	*0.000	*0.006	*0.009	*0.029	-	-
Cr	*0.024	0.052	*0.042	*0.044	0.079	*0.038	0.050	0.063	*0.031	0.049	0.085	0.077	0.065	(0.014)
Total	28.146	28.127	27.977	28.025	28.142	28.064	28.225	28.319	28.164	28.147	27.996	28.224	28.130	(0.097)

* Indicates value was below the detection limit.
† Means and standard deviations are for titanomagnetite values above detection limit only.

Member L6 (pink lapilli), Bullot Formation
EMP analyses: Fe – Ti oxides

Member L6	1 Tmag	2 Tmag	3 Tmag	4 Tmag	5 Tmag	6 Tmag	7 Tmag	8 Tmag	9 Tmag	10 Tmag	Mean†	Std. Dev.†	11 Ilm	12 Ilm	13 Ilm
SiO_2	0.07	0.10	0.12	0.13	0.12	0.12	0.09	0.13	0.08	0.11	0.10	(0.02)	*0.04	*0.00	*0.05
Al_2O_3	2.51	2.58	2.66	2.68	2.86	2.76	2.64	2.65	2.62	2.82	2.68	(0.10)	0.39	0.41	0.36
TiO_2	12.37	12.42	12.76	13.20	11.93	12.69	12.85	12.82	13.06	12.09	12.62	(0.39)	42.41	42.43	42.64
FeO	75.14	75.33	75.02	73.65	75.20	73.97	75.94	75.86	75.88	75.34	75.13	(0.73)	49.62	50.20	50.64
MnO	0.40	0.38	0.39	0.31	0.39	0.28	0.38	0.33	0.33	0.36	0.36	(0.04)	0.33	0.42	0.26
MgO	2.87	2.79	2.84	2.75	3.13	2.76	2.81	3.06	2.63	2.68	2.83	(0.15)	3.78	3.75	3.80
CaO	*0.03	*0.03	*0.00	*0.00	*0.02	*0.01	*0.01	*0.05	*0.02	*0.02	-	-	*0.03	*0.00	*0.00
NiO	*0.02	*0.09	*0.06	*0.07	*0.05	*0.06	*0.10	*0.10	*0.04	*0.08	-	-	*0.00	*0.00	*0.00
Cr_2O_3	0.41	0.23	0.41	0.62	0.59	0.53	0.52	0.40	0.42	0.60	0.47	(0.11)	*0.02	*0.00	*0.12
Total	93.76	93.83	94.19	93.33	94.20	93.11	95.22	95.25	95.02	93.99	94.19	(0.72)	96.50	97.21	97.68
Cations on the basis of 32 oxygens															
Si	0.032	0.035	0.040	0.045	0.041	0.041	0.029	0.044	0.027	0.038	0.037	(0.006)	*0.011	*0.000	*0.014
Al	1.038	1.065	1.092	1.105	1.172	1.144	1.070	1.074	1.066	1.162	1.099	(0.043)	0.132	0.139	0.118
Ti	3.265	3.274	3.338	3.468	3.124	3.351	3.330	3.314	3.391	3.180	3.304	(0.094)	9.114	9.066	9.063
Fe	22.068	22.079	21.832	21.520	21.908	21.729	21.880	21.805	21.918	22.042	21.877	(0.161)	11.858	11.929	11.969
Mn	0.118	0.113	0.115	0.092	0.114	0.084	0.110	0.097	0.097	0.108	0.105	(0.011)	0.080	0.102	0.062
Mg	1.502	1.459	1.472	1.431	1.627	1.443	1.442	1.566	1.356	1.396	1.469	(0.075)	1.600	1.587	1.600
Ca	*0.001	*0.001	*0.000	*0.000	*0.009	*0.004	*0.002	*0.107	*0.009	*0.006	-	-	*0.008	*0.000	*0.000
Ni	*0.005	*0.024	*0.018	*0.019	*0.013	*0.018	*0.028	*0.028	*0.011	*0.021	-	-	*0.000	*0.000	*0.000
Cr	0.114	0.064	0.112	0.170	0.161	0.148	0.143	0.108	0.116	0.166	0.130	(0.032)	*0.005	*0.000	*0.027
Total	28.127	28.089	28.001	27.831	28.147	27.940	28.004	28.008	27.971	28.092	28.021	(0.091)	22.784	22.823	22.812

* Indicates value was below the detection limit.
† Means and standard deviations are for titanomagnetite values above detection limit only.

Member Tf14, Tufa Trig Formation
EMP analyses: glass

Member Tf14	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	11 Gms	12 Gms	13 Gms	14 Gms	Mean[1]	Std. Dev.[1]
SiO_2	63.46	63.29	63.40	62.75	62.17	62.38	63.38	62.73	62.32	62.98	63.46	62.45	63.46	62.69	62.92	(0.47)
Al_2O_3	14.61	14.91	14.79	14.72	14.71	14.87	14.72	14.70	14.77	14.25	14.51	14.70	14.65	14.78	14.71	(0.16)
TiO_2	0.89	1.03	1.04	1.11	1.08	1.15	0.97	1.07	1.10	1.19	1.03	1.08	1.16	1.07	1.07	(0.07)
FeO	6.39	6.89	6.87	6.30	6.43	6.85	6.75	6.77	6.02	6.46	6.68	6.58	6.34	6.50	6.51	(0.20)
MnO	*0.04	*0.07	*0.10	*0.00	*0.03	*0.00	*0.18	*0.10	0.28	*0.02	*0.06	*0.01	*0.05	*0.12	0.28	(0.00)
MgO	2.17	2.22	2.31	2.16	1.99	2.04	2.21	2.29	2.07	2.15	2.35	2.19	2.05	2.36	2.18	(0.11)
CaO	4.90	4.98	5.12	5.41	5.06	4.58	5.12	5.02	4.85	4.95	4.93	5.14	4.72	4.98	4.98	(0.19)
Na_2O	3.76	3.45	3.81	3.95	3.81	3.82	3.86	3.47	3.74	3.81	3.66	4.04	4.07	3.74	3.77	(0.18)
K_2O	2.78	2.18	2.69	2.15	2.59	2.91	2.82	2.63	2.70	2.74	2.79	2.79	2.71	2.84	2.67	(0.22)
Cl	*0.03	0.08	*0.02	0.08	0.07	*0.07	0.09	0.10	0.12	*0.03	0.08	0.13	*0.03	0.14	0.10	(0.03)
Total	99.16	98.81	99.83	98.82	97.90	98.16	99.92	98.77	97.96	98.51	99.51	99.09	99.17	99.08	98.89	(0.61)
Analyses above detection limit normalised to 100% loss free																
SiO_2	64.00	64.05	63.51	63.63	63.50	63.54	63.43	63.51	63.62	63.91	63.60	63.02	64.01	63.27	63.63	(0.29)
Al_2O_3	14.93	15.09	14.82	14.92	15.03	15.14	14.73	14.88	15.08	14.46	14.58	14.84	14.77	14.92	14.87	(0.19)
TiO_2	0.90	1.04	1.04	1.12	1.10	1.17	0.97	1.08	1.12	1.21	1.04	1.08	1.17	1.08	1.08	(0.08)
FeO	6.44	6.77	6.68	6.39	6.56	6.77	6.75	6.85	6.15	6.56	6.71	6.64	6.39	6.58	6.59	(0.19)
MnO	-	-	-	-	-	-	-	-	0.28	-	-	-	-	-	0.28	(0.00)
MgO	2.19	2.25	2.31	2.19	2.03	2.08	2.21	2.32	2.11	2.18	2.36	2.21	2.06	2.38	2.21	(0.11)
CaO	4.94	5.04	5.13	5.48	5.17	4.64	5.12	5.08	4.95	5.02	4.95	5.18	4.78	5.02	5.04	(0.19)
Na_2O	3.79	3.49	3.82	4.00	3.89	3.89	3.87	3.52	3.82	3.87	3.67	4.08	4.10	3.77	3.81	(0.18)
K_2O	2.81	2.21	2.70	2.18	2.64	2.97	2.82	2.66	2.76	2.76	2.80	2.82	2.73	2.86	2.70	(0.22)
Cl	-	0.08	-	0.08	0.07	-	0.09	0.10	0.12	-	0.08	0.13	-	0.14	0.10	(0.03)
Water[2]	0.85	1.19	0.17	1.38	2.10	1.83	0.08	1.23	2.05	1.49	0.49	0.91	0.83	0.92	1.11	(0.61)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for groundmass values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Member Tf8, Tufa Trig Formation
EMP analyses: glass

Member Tf8	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	11 Gms	12 Gms	Mean[1]	Std. Dev.[1]
SiO_2	63.29	62.70	63.03	64.87	63.09	63.11	62.96	62.45	64.44	62.97	63.04	63.32	63.27	(0.66)
Al_2O_3	14.31	14.91	15.10	14.34	14.29	15.15	15.22	14.62	14.03	15.09	15.30	14.76	14.76	(0.41)
TiO_2	1.13	1.03	1.04	1.14	1.09	1.10	1.06	0.98	1.23	1.01	1.01	1.07	1.07	(0.07)
FeO	6.41	6.67	6.20	5.52	6.11	6.73	6.22	6.37	6.25	6.58	5.84	6.46	6.28	(0.33)
MnO	na	*0.07	*0.07	*0.08	*0.12	*0.12	*0.15	*0.07	*0.01	*0.03	*0.08	0.19	0.19	(0.00)
MgO	2.05	2.74	2.43	1.85	2.46	2.32	2.41	2.55	1.46	2.40	2.57	2.20	2.29	(0.34)
CaO	4.76	5.44	5.40	4.36	4.98	5.22	5.37	5.11	4.08	5.21	5.48	5.11	5.04	(0.42)
Na_2O	4.08	3.28	3.58	3.90	3.87	3.48	4.06	3.76	3.87	3.93	4.03	4.02	3.82	(0.24)
K_2O	2.86	2.10	2.48	3.07	2.58	2.66	2.30	2.58	3.56	2.45	2.35	2.72	2.64	(0.37)
Cl	*0.03	0.07	0.06	0.08	0.08	*0.06	0.09	0.09	0.09	0.07	0.10	0.06	0.08	(0.01)
Total	98.89	98.93	99.31	99.12	98.56	99.78	99.69	98.52	99.01	99.71	99.71	99.92	99.26	(0.47)
Analyses above detection limit normalised to 100% loss free														
SiO_2	64.00	63.38	63.47	65.45	64.02	63.25	63.15	63.39	65.08	63.15	63.23	63.37	63.74	(0.74)
Al_2O_3	14.47	15.08	15.20	14.46	14.50	15.19	15.27	14.84	14.17	15.13	15.34	14.77	14.87	(0.37)
TiO_2	1.14	1.04	1.04	1.15	1.11	1.10	1.06	0.99	1.24	1.02	1.01	1.07	1.08	(0.07)
FeO	6.49	6.74	6.24	5.56	6.20	6.75	6.24	6.47	6.32	6.60	5.86	6.47	6.33	(0.33)
MnO	-	-	-	-	-	-	-	-	-	-	-	0.19	0.19	(0.00)
MgO	2.07	2.77	2.44	1.86	2.50	2.32	2.42	2.59	1.47	2.41	2.57	2.21	2.30	(0.34)
CaO	4.81	5.49	5.44	4.40	5.05	5.23	5.38	5.18	4.12	5.22	5.50	5.12	5.08	(0.42)
Na_2O	4.13	3.31	3.61	3.93	3.93	3.50	4.07	3.82	3.91	3.94	4.04	4.02	3.86	(0.24)
K_2O	2.90	2.12	2.50	3.10	2.62	2.67	2.31	2.62	3.59	2.46	2.35	2.73	2.68	(0.38)
Cl	-	0.07	0.06	0.08	0.08	-	0.09	0.10	0.09	0.07	0.10	0.06	0.08	(0.01)
Water[2]	1.11	1.07	0.69	0.88	1.44	0.22	0.31	1.48	0.99	0.29	0.29	0.08	0.74	(0.47)

* Indicates value was below the detection limit, na = not analysed.
[1] Means and standard deviations are for groundmass values above detection limit only.
[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Member Tf5, Tufa Trig Formation
EMP analyses: glass

Member Tf5	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	11 Gms	12 Gms	Mean[†]	Std. Dev.[†]	1 Inclpx
SiO_2	65.69	65.01	63.14	64.65	61.60	62.01	63.70	63.85	63.49	64.81	64.37	63.88	63.85	(1.14)	66.79
Al_2O_3	14.34	14.15	16.22	14.65	15.00	15.95	15.99	14.44	15.41	15.00	14.07	15.33	15.05	(0.71)	14.64
TiO_2	1.16	1.25	0.95	1.08	0.87	0.74	0.87	1.07	1.04	1.06	1.04	1.11	1.02	(0.13)	1.04
FeO	6.34	6.39	5.66	6.19	6.07	5.36	4.98	5.91	6.00	5.52	5.31	5.82	5.80	(0.42)	4.85
MnO	0.13	0.19	0.12	0.10	*0.11	*0.22	*0.03	*0.12	*0.10	*0.05	*0.17	*0.16	0.14	(0.04)	*0.02
MgO	1.66	1.84	1.51	1.58	2.73	2.55	1.20	1.47	1.55	1.72	1.93	1.88	1.80	(0.42)	1.09
CaO	4.48	4.56	5.41	4.80	5.49	5.68	5.27	4.19	5.28	4.53	4.32	5.16	4.93	(0.49)	3.73
Na_2O	2.58	3.82	4.27	4.04	3.64	4.00	3.54	3.94	3.70	4.02	3.56	3.99	3.76	(0.41)	3.82
K_2O	2.84	2.66	2.18	2.65	2.16	2.13	2.31	2.93	3.38	3.01	2.98	2.45	2.64	(0.38)	3.63
Cl	0.15	0.12	0.12	0.12	0.11	0.08	0.13	0.18	0.09	0.08	0.14	0.13	0.12	(0.03)	0.20
Total	99.37	99.99	99.59	99.84	97.67	98.49	97.98	97.97	99.94	99.75	97.71	99.74	99.00	(0.91)	99.77
Analyses above detection limit normalised to 100% loss free															
SiO_2	66.10	65.02	63.40	64.75	63.07	62.95	65.02	65.17	63.53	64.98	65.87	64.05	64.49	(1.02)	66.94
Al_2O_3	14.43	14.15	16.28	14.67	15.36	16.20	16.32	14.74	15.42	15.04	14.39	15.37	15.20	(0.73)	14.67
TiO_2	1.16	1.25	0.95	1.08	0.89	0.75	0.88	1.09	1.04	1.06	1.06	1.11	1.03	(0.13)	1.05
FeO	6.38	6.39	5.69	6.20	6.22	5.44	5.08	6.03	6.00	5.53	5.44	5.83	5.85	(0.40)	4.86
MnO	0.13	0.19	0.12	0.10	-	-	-	-	-	-	-	-	0.14	(0.03)	-
MgO	1.67	1.84	1.52	1.58	2.79	2.59	1.22	1.50	1.55	1.72	1.98	1.88	1.82	(0.44)	1.09
CaO	4.51	4.56	5.44	4.80	5.62	5.76	5.38	4.28	5.29	4.54	4.42	5.17	4.98	(0.50)	3.74
Na_2O	2.60	3.82	4.29	4.04	3.72	4.06	3.61	4.02	3.70	4.03	3.64	4.00	3.79	(0.41)	3.83
K_2O	2.86	2.66	2.19	2.65	2.21	2.16	2.36	2.99	3.38	3.02	3.05	2.45	2.66	(0.38)	3.63
Cl	0.15	0.12	0.12	0.12	0.12	0.08	0.13	0.18	0.09	0.08	0.14	0.13	0.12	(0.03)	0.20
Water[‡]	0.63	0.01	0.41	0.16	2.33	1.51	2.02	2.03	0.06	0.25	2.29	0.27	1.00	(0.91)	0.23

* Indicates value was below the detection limit.
† Means and standard deviations are for groundmass values above detection limit only.
‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Poutu Lapilli, Mangamate Tephra
EMP analyses: glass inclusions in skeletal olivines

Poutu Lapilli	1 Inclol	2 Inclol	3 Inclol	4 Inclol	5 Inclol	6 Inclol	7 Inclol	8 Inclol	Mean[1]	Std. Dev.[1]
SiO_2	54.42	53.42	57.08	54.52	55.13	51.84	52.52	54.13	54.13	(1.51)
Al_2O_3	17.01	15.18	15.97	16.88	17.28	16.12	16.56	17.00	16.50	(0.65)
TiO_2	0.69	0.68	0.64	0.82	0.65	0.77	0.77	0.73	0.72	(0.06)
FeO	6.60	9.85	8.10	7.55	7.53	8.30	6.81	7.40	7.77	(0.95)
MnO	*0.07	0.33	*0.09	*0.06	0.15	*0.09	0.13	0.29	0.23	(0.09)
MgO	2.83	8.69	2.97	2.85	2.78	4.23	3.11	3.55	3.87	(1.87)
CaO	8.85	7.40	7.87	8.88	8.84	8.75	8.33	8.90	8.48	(0.53)
Na_2O	3.12	2.54	2.96	3.04	3.23	2.95	2.84	2.90	2.95	(0.19)
K_2O	1.07	0.94	1.44	1.25	1.28	1.03	1.11	0.98	1.14	(0.16)
Cl	0.17	0.26	0.14	*0.05	0.14	0.15	0.23	0.21	0.19	(0.04)
Total	94.76	99.28	97.17	95.79	97.02	94.12	92.41	96.08	95.83	(1.97)
Analyses above detection limit normalised to 100% loss free										
SiO_2	57.43	53.81	58.74	56.92	56.83	55.08	56.83	56.34	56.50	(1.40)
Al_2O_3	17.95	15.29	16.43	17.63	17.81	17.12	17.93	17.69	17.23	(0.87)
TiO_2	0.73	0.69	0.66	0.86	0.67	0.81	0.83	0.76	0.75	(0.07)
FeO	6.96	9.92	8.34	7.88	7.76	8.81	7.37	7.70	8.09	(0.87)
MnO	-	0.33	-	-	0.15	-	0.14	0.30	0.23	(0.08)
MgO	2.99	8.75	3.06	2.97	2.87	4.49	3.36	3.69	4.02	(1.86)
CaO	9.34	7.45	8.10	9.27	9.11	9.30	9.02	9.27	8.86	(0.65)
Na_2O	3.29	2.55	3.04	3.17	3.33	3.13	3.07	3.01	3.08	(0.22)
K_2O	1.13	0.94	1.48	1.30	1.32	1.09	1.20	1.02	1.19	(0.17)
Cl	0.18	0.26	0.15	-	0.15	0.16	0.25	0.22	0.19	(0.04)
Water[2]	5.24	0.72	2.84	4.21	2.98	5.88	7.59	3.92	4.17	(1.97)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for groundmass values above detection limit only.
[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Pourahu Member [tephra unit] [BT1], Bullot Formation
EMP analyses: glass

Pourahu Member	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	Mean[†]	Std. Dev.[†]	1 Inclpl	2 Inclpl	1 Inclpx	2 Inclpx	3 Inclpx	4 Inclpx
SiO_2	72.15	72.75	71.30	73.24	72.25	71.06	72.44	72.51	70.94	72.07	(0.75)	69.82	70.44	68.32	70.74	68.84	68.99
Al_2O_3	13.44	13.59	13.65	13.39	13.31	13.24	13.06	13.21	13.27	13.35	(0.18)	13.88	13.07	14.11	12.99	14.06	14.05
TiO_2	0.52	0.56	0.49	0.59	0.56	0.55	0.52	0.58	0.52	0.54	(0.03)	0.64	0.68	0.70	0.63	0.63	0.70
FeO	3.01	2.75	2.67	2.48	2.75	2.80	2.51	2.60	2.61	2.69	(0.16)	3.03	2.63	2.92	2.70	3.05	2.99
MnO	*0.00	*0.00	*0.00	*0.07	*0.02	*0.06	*0.01	*0.07	*0.07	-	-	*0.00	*0.10	*0.11	*0.00	*0.00	*0.04
MgO	0.40	0.44	0.51	0.57	0.49	0.41	0.44	0.48	0.50	0.47	(0.05)	0.48	0.47	0.67	0.35	0.58	0.58
CaO	1.92	1.88	2.52	2.00	1.95	2.02	1.83	1.86	1.85	1.98	(0.20)	2.69	2.13	2.62	1.98	2.44	2.52
Na_2O	3.70	3.42	3.86	3.19	3.54	2.70	3.49	3.72	3.54	3.46	(0.32)	3.62	3.49	3.73	3.44	3.51	3.57
K_2O	4.06	4.02	3.91	3.98	3.93	3.89	3.38	3.37	3.62	3.80	(0.25)	3.32	3.87	3.53	3.81	3.61	3.46
Cl	0.18	0.25	0.19	0.23	0.24	0.18	0.27	0.23	0.17	0.21	(0.03)	0.25	0.22	0.21	0.23	0.16	0.16
Total	99.38	99.66	99.09	99.65	99.02	96.86	97.94	98.57	97.02	98.58	(1.01)	97.73	96.98	96.81	96.85	96.88	97.02
Analyses above detection limit normalised to 100% loss free																	
SiO_2	72.59	73.00	71.95	73.49	72.96	73.36	73.97	73.56	73.12	73.11	(0.56)	71.44	72.64	70.57	73.04	71.05	71.11
Al_2O_3	13.53	13.64	13.78	13.44	13.44	13.67	13.33	13.40	13.68	13.54	(0.14)	14.21	13.48	14.58	13.41	14.51	14.49
TiO_2	0.52	0.56	0.50	0.59	0.57	0.57	0.53	0.59	0.54	0.55	(0.03)	0.65	0.70	0.72	0.65	0.65	0.72
FeO	3.03	2.76	2.69	2.48	2.78	2.89	2.56	2.64	2.69	2.73	(0.16)	3.10	2.71	3.02	2.78	3.15	3.08
MnO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MgO	0.40	0.44	0.51	0.57	0.49	0.42	0.45	0.48	0.52	0.48	(0.05)	0.49	0.48	0.69	0.36	0.60	0.60
CaO	1.93	1.89	2.55	2.00	1.97	2.09	1.87	1.89	1.91	2.01	(0.20)	2.76	2.20	2.71	2.04	2.52	2.59
Na_2O	3.72	3.43	3.90	3.20	3.57	2.79	3.57	3.78	3.64	3.51	(0.32)	3.71	3.59	3.85	3.55	3.62	3.68
K_2O	4.09	4.04	3.94	4.00	3.97	4.02	3.45	3.42	3.73	3.85	(0.24)	3.39	3.99	3.65	3.93	3.73	3.57
Cl	0.18	0.25	0.19	0.23	0.24	0.19	0.27	0.23	0.18	0.22	(0.03)	0.25	0.22	0.22	0.24	0.17	0.16
Water[‡]	0.62	0.34	0.91	0.35	0.98	3.14	2.06	1.43	2.99	1.42	(1.01)	2.27	3.02	3.19	3.15	3.12	2.98

* Indicates value was below the detection limit.

† Means and standard deviations are for groundmass values above detection limit only.

‡ Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Pourahu Member [tephra unit] [DR16], Bullot Formation
EMP analyses: glass

Pourahu Member	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	Mean[1]	Std. Dev.[1]
SiO_2	68.11	68.58	71.92	72.83	71.06	68.78	69.81	73.40	67.22	69.74	70.14	(1.98)
Al_2O_3	12.92	13.05	14.58	13.25	13.76	13.49	13.60	14.06	13.10	14.60	13.64	(0.58)
TiO_2	0.52	0.56	0.62	0.64	0.58	0.61	0.54	0.51	0.57	0.60	0.57	(0.04)
FeO	2.51	2.58	2.65	2.77	2.66	2.48	2.81	2.61	2.56	2.66	2.63	(0.10)
MnO	*0.04	0.14	*0.04	*0.09	*0.05	*0.08	0.13	*0.05	0.09	*0.00	0.12	(0.02)
MgO	0.53	0.44	0.55	0.52	0.55	0.54	0.57	0.54	0.49	0.52	0.53	(0.03)
CaO	2.10	1.84	1.89	1.95	2.19	2.18	2.05	2.08	2.16	2.17	2.06	(0.12)
Na_2O	3.34	3.44	3.47	3.18	3.42	3.84	3.64	2.67	3.07	3.65	3.37	(0.32)
K_2O	3.36	3.47	3.51	3.41	3.89	3.78	3.66	3.78	3.53	3.92	3.63	(0.19)
Cl	0.35	0.38	0.33	0.26	0.22	0.18	0.15	0.23	0.29	0.23	0.26	(0.07)
Total	93.73	94.49	99.51	98.80	98.33	95.89	96.95	99.88	93.09	98.08	96.88	(2.33)
Analyses above detection limit normalised to 100% loss free												
SiO_2	72.67	72.58	72.27	73.72	72.26	71.73	72.00	73.49	72.21	71.10	72.40	(0.73)
Al_2O_3	13.78	13.81	14.65	13.41	13.99	14.07	14.02	14.08	14.08	14.89	14.08	(0.40)
TiO_2	0.55	0.60	0.62	0.65	0.59	0.64	0.56	0.51	0.61	0.61	0.59	(0.04)
FeO	2.67	2.73	2.66	2.80	2.71	2.68	2.90	2.61	2.75	2.72	2.71	(0.09)
MnO	-	0.14	-	-	-	-	0.13	-	0.10	-	0.13	(0.02)
MgO	0.56	0.47	0.56	0.53	0.56	0.56	0.59	0.54	0.53	0.53	0.54	(0.03)
CaO	2.24	1.95	1.90	1.97	2.23	2.27	2.11	2.09	2.32	2.22	2.13	(0.14)
Na_2O	3.56	3.64	3.49	3.22	3.48	4.01	3.75	2.67	3.30	3.72	3.48	(0.35)
K_2O	3.59	3.68	3.52	3.45	3.95	3.94	3.77	3.79	3.79	3.99	3.75	(0.18)
Cl	0.38	0.40	0.34	0.26	0.22	0.19	0.15	0.23	0.31	0.23	0.27	(0.08)
Water[2]	6.28	5.51	0.49	1.20	1.67	4.11	3.05	0.12	6.91	1.92	3.12	(2.33)

* Indicates value was below the detection limit.
[1] Means and standard deviations are for groundmass values above detection limit only.
[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Pourahu Member [ignimbrite unit] [CT], Bullot Formation
EMP analyses: glass in unbanded lapilli

Pourahu Member	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	11 Gms	12 Gms	Mean[1]	Std. Dev.[1]	1 Inclpx	2 Inclpx	3 Inclpx	4 Inclpx	5 Inclpx
SiO_2	69.74	69.04	69.10	71.78	69.88	69.25	70.84	72.06	71.99	67.42	70.16	72.45	70.31	(1.47)	67.10	67.56	66.67	69.34	69.79
Al_2O_3	13.38	12.74	13.81	14.06	13.90	13.48	13.40	13.72	13.63	13.84	14.05	14.43	13.70	(0.41)	11.10	11.44	13.52	13.54	13.43
TiO_2	0.55	0.47	0.40	0.48	0.50	0.56	0.50	0.54	0.54	0.53	0.57	0.49	0.51	(0.05)	0.50	0.43	0.66	0.43	0.54
FeO	2.43	2.59	2.40	2.73	2.46	2.51	2.52	2.68	2.64	2.54	2.51	2.36	2.53	(0.11)	4.16	3.69	4.45	2.62	2.81
MnO	*0.00	*0.07	*0.04	*0.08	*0.03	*0.07	*0.05	*0.07	*0.02	*0.09	*0.07	*0.05	-	-	*0.03	*0.00	*0.11	0.10	*0.03
MgO	0.49	0.48	0.49	0.50	0.54	0.40	0.53	0.51	0.47	0.47	0.53	0.47	0.49	(0.03)	3.14	2.91	2.58	0.53	0.51
CaO	1.76	2.01	1.85	2.17	2.01	1.92	1.95	1.97	2.10	1.91	1.95	1.78	1.95	(0.11)	5.87	5.19	2.18	1.93	1.87
Na_2O	3.23	3.31	3.50	1.97	3.55	3.64	3.64	3.63	3.56	3.59	3.39	3.52	3.38	(0.44)	3.93	4.06	3.50	3.73	3.78
K_2O	3.75	3.98	3.73	3.96	3.79	3.66	3.96	3.82	3.92	3.62	3.71	3.97	3.84	(0.11)	2.92	3.17	3.28	3.82	3.91
Cl	0.18	0.25	0.29	0.17	0.17	0.20	0.17	0.23	0.16	0.21	0.18	0.15	0.20	(0.04)	0.18	*0.09	0.20	0.21	0.20
Total	95.51	94.87	95.56	97.82	96.81	95.82	97.49	99.15	99.00	94.14	97.07	99.62	96.90	(1.70)	98.90	98.43	97.03	96.25	96.82
Analyses above detection limit normalised to 100% loss free																			
SiO_2	73.02	72.77	72.31	73.38	72.19	72.27	72.66	72.68	72.72	71.62	72.28	72.73	72.55	(0.43)	67.85	68.63	68.71	72.04	72.08
Al_2O_3	14.01	13.43	14.45	14.37	14.36	14.07	13.75	13.84	13.77	14.71	14.48	14.48	14.14	(0.37)	11.22	11.62	13.93	14.06	13.87
TiO_2	0.58	0.49	0.42	0.49	0.52	0.56	0.51	0.55	0.55	0.56	0.59	0.49	0.53	(0.05)	0.51	0.44	0.68	0.45	0.56
FeO	2.55	2.73	2.51	2.79	2.64	2.62	2.58	2.70	2.67	2.70	2.59	2.37	2.61	(0.11)	4.21	3.75	4.59	2.73	2.90
MnO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-
MgO	0.51	0.51	0.51	0.52	0.55	0.42	0.54	0.51	0.47	0.50	0.54	0.47	0.50	(0.04)	3.17	2.95	2.66	0.55	0.53
CaO	1.84	2.12	1.94	2.22	2.08	2.00	2.00	1.98	2.12	2.03	2.01	1.79	2.01	(0.11)	5.93	5.27	2.24	2.01	1.93
Na_2O	3.39	3.49	3.66	2.02	3.67	3.80	3.73	3.66	3.59	3.81	3.50	3.54	3.49	(0.46)	3.98	4.12	3.61	3.87	3.88
K_2O	3.93	4.19	3.90	4.04	3.92	4.03	4.06	3.86	3.96	3.85	3.83	3.98	3.96	(0.10)	2.96	3.22	3.38	3.97	4.04
Cl	0.18	0.26	0.30	0.18	0.17	0.21	0.17	0.23	0.16	0.22	0.19	0.15	0.20	(0.04)	0.18	-	0.21	0.21	0.21
Water[2]	4.49	5.13	4.44	2.18	3.20	4.18	2.51	0.85	1.00	5.86	2.93	0.38	3.10	(1.70)	1.10	1.57	2.97	3.75	3.19

* Indicates value was below the detection limit.

[1] Means and standard deviations are for groundmass values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Pourahu Member [ignimbrite unit] [CT], Bullot Formation
EMP analyses: glass in banded lapilli *(continued ...)*

Pourahu Member	1 Gms Band 2	2 Gms Band 2	3 Gms Band 2	4 Gms Band 2	5 Gms Band 2	6 Gms Band 2	Mean[1]	Std. Dev.[1]	1 Gms Band 5	2 Gms Band 5	3 Gms Band 5	4 Gms Band 5	5 Gms Band 5	Mean[1]	Std. Dev.[1]	1 Inclpx Band 5
SiO_2	66.92	64.27	61.69	68.62	67.08	66.02	65.77	(2.24)	63.21	64.93	68.68	61.19	61.87	63.97	(2.68)	69.85
Al_2O_3	13.46	13.24	11.48	13.58	13.61	16.18	13.59	(1.37)	14.01	13.22	12.99	13.39	17.95	14.31	(1.85)	14.06
TiO_2	0.69	0.71	0.65	0.50	0.69	0.51	0.62	(0.09)	0.68	0.64	0.60	0.81	0.70	0.69	(0.07)	0.56
FeO	4.01	5.27	7.50	2.55	3.81	2.98	4.32	(1.66)	5.16	4.62	3.40	7.68	3.67	4.90	(1.53)	2.89
MnO	*0.07	0.16	0.15	*0.04	*0.10	*0.05	0.16	(0.01)	*0.07	0.19	*0.09	*0.09	*0.03	0.19	0.00	*0.07
MgO	1.38	3.18	6.05	0.50	1.13	0.78	2.17	(1.93)	2.61	2.79	0.66	3.65	0.90	2.12	(1.15)	0.67
CaO	3.07	3.90	3.97	2.20	2.78	4.45	3.40	(0.77)	3.75	2.87	2.34	4.44	5.63	3.81	(1.16)	2.26
Na_2O	3.54	2.15	2.64	3.55	3.71	3.42	3.17	(0.57)	3.56	3.36	3.28	3.40	4.10	3.53	(0.30)	4.12
K_2O	3.14	2.64	2.20	3.76	3.34	2.74	2.97	(0.51)	2.40	2.33	3.47	1.89	2.06	2.43	(0.55)	3.75
Cl	0.16	0.17	0.18	0.22	0.11	0.17	0.17	(0.03)	0.16	0.12	0.17	0.08	0.18	0.14	(0.04)	0.20
Total	96.37	95.68	96.51	95.48	96.05	97.25	96.22	(0.58)	95.53	95.07	95.57	96.51	97.04	95.94	(0.72)	98.37
Analyses above detection limit normalised to 100% loss free																
SiO_2	69.44	67.18	63.92	71.87	69.83	67.89	68.36	(2.48)	66.17	68.30	71.86	63.41	63.75	66.70	(3.13)	71.01
Al_2O_3	13.97	13.84	11.90	14.23	14.17	16.64	14.12	(1.38)	14.67	13.91	13.59	13.87	18.50	14.91	(1.83)	14.29
TiO_2	0.72	0.74	0.68	0.52	0.72	0.52	0.65	(0.09)	0.71	0.67	0.63	0.83	0.72	0.71	(0.07)	0.57
FeO	4.16	5.50	7.77	2.67	3.76	3.06	4.49	(1.72)	5.40	4.85	3.55	7.96	3.78	5.11	(1.58)	2.94
MnO	-	0.17	0.16	-	-	-	0.16	(0.01)	-	0.20	-	-	-	0.20	(0.00)	-
MgO	1.43	3.33	6.26	0.53	1.17	0.81	2.25	(2.01)	2.73	2.94	0.69	3.78	0.92	2.21	(1.20)	0.68
CaO	3.18	4.07	4.11	2.31	2.90	4.58	3.53	(0.79)	3.93	3.02	2.45	4.60	5.80	3.96	(1.18)	2.30
Na_2O	3.68	2.24	2.73	3.71	3.86	3.52	3.29	(0.59)	3.73	3.53	3.41	3.52	4.22	3.68	(0.29)	4.19
K_2O	3.26	2.76	2.28	3.94	3.47	2.81	3.09	(0.54)	2.51	2.45	3.63	1.95	2.12	2.53	(0.59)	3.81
Cl	0.16	0.17	0.19	0.23	0.12	0.18	0.17	(0.03)	0.17	0.13	0.18	0.08	0.18	0.15	(0.04)	0.21
Water[2]	3.63	4.32	3.49	4.52	3.95	2.75	3.78	(0.58)	4.47	4.93	4.43	3.49	2.96	4.06	(0.72)	1.63

* Indicates value was below the detection limit.

[1] Means and standard deviations are for groundmass values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Pourahu Member [ignimbrite unit] [CT], Bullot Formation
EMP analyses: glass in banded lapilli *(... continued)*

Pourahu Member	1 Gms Band 7	2 Gms Band 7	3 Gms Band 7	4 Gms Band 7	5 Gms Band 7	6 Gms Band 7	Mean[1]	Std. Dev.[1]	1 Inclpx Band 6	2 Inclpx Band 6
SiO_2	72.77	69.56	71.26	73.06	72.93	73.37	72.16	(1.34)	67.04	68.54
Al_2O_3	13.65	15.21	12.73	12.67	13.03	13.39	13.44	(0.86)	14.45	14.25
TiO_2	0.44	0.57	0.37	0.37	0.39	0.37	0.42	(0.07)	0.76	0.68
FeO	2.41	2.73	2.09	2.10	2.00	2.03	2.23	(0.26)	3.36	2.97
MnO	*0.01	*0.08	*0.01	*0.06	*0.03	*0.00	-	-	*0.07	*0.05
MgO	0.34	0.48	0.27	0.30	0.24	0.26	0.31	(0.08)	0.62	0.48
CaO	1.72	3.05	1.49	1.50	1.48	1.54	1.80	(0.57)	2.54	1.94
Na_2O	3.13	3.33	2.96	3.06	3.49	3.67	3.27	(0.25)	3.97	3.90
K_2O	4.06	3.55	4.10	4.04	4.21	4.40	4.06	(0.26)	3.47	3.74
Cl	0.19	0.19	0.19	0.15	0.16	0.23	0.18	(0.02)	0.20	0.19
Total	98.71	98.66	95.45	97.25	97.92	99.26	97.87	(1.26)	96.41	96.69
Analyses above detection limit normalised to 100% loss free										
SiO_2	73.72	70.51	74.65	75.13	74.48	73.92	73.73	(1.52)	69.54	70.89
Al_2O_3	13.82	15.41	13.34	13.03	13.30	13.49	13.73	(0.79)	14.98	14.73
TiO_2	0.45	0.58	0.39	0.38	0.40	0.37	0.43	(0.07)	0.79	0.71
FeO	2.44	2.76	2.19	2.16	2.04	2.05	2.27	(0.25)	3.48	3.07
MnO	-	-	-	-	-	-	-	-	-	-
MgO	0.34	0.49	0.28	0.31	0.24	0.26	0.32	(0.08)	0.64	0.50
CaO	1.74	3.09	1.56	1.54	1.52	1.55	1.83	(0.67)	2.64	2.01
Na_2O	3.17	3.38	3.10	3.15	3.56	3.70	3.34	(0.22)	4.12	4.03
K_2O	4.12	3.60	4.29	4.15	4.30	4.43	4.15	(0.27)	3.60	3.87
Cl	0.19	0.19	0.19	0.16	0.16	0.23	0.19	(0.02)	0.21	0.20
Water[2]	1.29	1.34	4.55	2.75	2.08	0.74	2.13	(1.26)	3.59	3.31

* Indicates value was below the detection limit.

[1] Means and standard deviations are for groundmass values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Member L6 (pink lapilli), Bullot Formation
EMP analyses: glass

Member L6	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	11 Gms	12 Gms	13 Gms	14 Gms	15 Gms	16 Gms	Mean[1]	Std. Dev.[1]
SiO_2	65.99	69.26	67.71	69.10	67.30	67.21	65.68	66.25	68.37	67.01	69.24	66.96	69.26	69.14	67.63	68.41	67.75	(1.12)
Al_2O_3	13.69	14.77	14.20	14.56	14.62	14.64	16.11	14.01	14.50	14.21	14.47	14.84	14.53	14.65	14.25	14.42	14.53	(0.50)
TiO_2	0.78	0.65	0.67	0.76	0.74	0.77	0.80	0.68	0.68	0.67	0.76	0.80	0.74	0.79	0.73	0.65	0.73	(0.07)
FeO	3.55	3.42	3.48	3.65	3.97	3.73	3.26	3.71	3.70	3.57	3.95	4.01	3.62	3.50	3.44	3.40	3.63	(0.21)
MnO	*0.07	*0.00	*0.03	0.10	*0.03	*0.00	*0.08	*0.09	*0.06	*0.01	*0.04	*0.08	*0.08	*0.04	*0.01	*0.06	0.10	(0.00)
MgO	0.91	0.94	0.89	0.99	1.68	1.09	1.14	1.03	0.98	0.83	1.07	1.11	0.93	1.03	0.89	0.90	1.04	(0.23)
CaO	3.21	3.04	2.93	3.26	3.65	3.42	4.56	3.34	3.02	2.98	3.12	3.50	2.93	2.87	2.90	2.97	3.23	(0.42)
Na_2O	3.68	3.88	4.00	3.73	3.80	3.81	3.78	3.42	3.57	3.82	3.82	2.36	3.79	3.98	3.89	3.75	3.66	(0.37)
K_2O	2.90	0.60	3.08	3.08	2.79	3.07	2.88	2.71	3.20	3.00	3.13	3.06	3.30	3.12	3.41	3.11	2.89	(0.62)
Cl	0.28	0.18	0.21	0.19	0.11	0.20	0.23	0.24	0.22	0.24	0.19	0.19	0.23	0.14	0.21	0.16	0.20	(0.04)
Total	94.91	98.75	97.34	99.46	98.67	97.94	98.24	95.37	98.19	96.22	98.76	98.84	99.53	99.20	97.33	97.78	97.66	(1.34)
Analyses above detection limit normalised to 100% loss free																		
SiO_2	69.52	71.61	69.56	69.46	68.21	68.63	67.05	69.46	69.63	69.84	69.10	69.16	69.60	69.69	69.69	69.96	69.38	(0.91)
Al_2O_3	14.42	15.27	14.59	14.64	14.82	14.95	16.39	14.69	14.76	14.77	14.65	15.33	14.60	14.77	14.64	14.75	14.88	(0.45)
TiO_2	0.80	0.67	0.90	0.78	0.75	0.79	0.61	0.71	0.67	0.69	0.79	0.82	0.74	0.80	0.75	0.67	0.75	(0.07)
FeO	3.74	3.53	3.55	3.67	4.02	3.81	3.34	3.69	3.76	3.71	4.00	4.14	3.83	3.53	3.53	3.48	3.72	(0.22)
MnO	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-	-	-	0.10	(0.00)
MgO	0.96	0.97	0.92	1.00	1.90	1.11	1.16	1.08	0.98	0.86	1.09	1.14	0.94	1.04	0.92	0.92	1.06	(0.23)
CaO	3.38	3.14	3.01	3.30	3.70	3.49	4.64	3.50	3.07	3.00	3.16	3.61	2.94	2.90	2.98	3.04	3.30	(0.42)
Na_2O	3.85	4.01	4.11	3.75	3.65	3.89	3.85	3.59	3.64	3.97	3.88	2.43	3.80	3.99	3.79	3.83	3.75	(0.37)
K_2O	3.08	0.62	3.15	3.09	2.83	3.14	2.72	2.84	3.26	3.11	3.18	3.16	3.31	3.14	3.50	3.18	2.95	(0.63)
Cl	0.27	0.19	0.22	0.20	0.11	0.20	0.23	0.25	0.23	0.25	0.19	0.19	0.23	0.14	0.22	0.17	0.21	(0.04)
Water[2]	5.09	3.25	2.66	0.54	1.33	2.06	1.76	4.63	1.81	3.78	1.24	3.16	0.47	0.80	2.68	2.22	2.34	(1.34)

* Indicates value was below the detection limit.

[1] Means and standard deviations are for groundmass values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Member L3 (hokey pokey lapilli), Bullot Formation
EMP analyses: glass

Member L3	1 Gms	2 Gms	3 Gms	4 Gms	5 Gms	6 Gms	7 Gms	8 Gms	9 Gms	10 Gms	11 Gms	Mean[1]	Std. Dev.[1]	1 Inclpl	1 Inclpx	2 Inclpx	3 Inclpx
SiO_2	58.85	59.28	59.23	59.26	59.28	58.91	59.70	58.98	59.14	58.93	59.37	59.17	(0.24)	57.86	55.19	55.06	56.68
Al_2O_3	17.39	17.09	16.81	16.88	16.89	16.65	16.67	17.00	16.77	17.01	16.67	16.89	(0.21)	16.89	17.83	17.43	17.58
TiO_2	0.80	0.95	0.83	0.83	0.74	0.88	0.88	0.97	0.77	0.72	0.78	0.83	(0.08)	0.78	0.70	0.76	0.56
FeO	5.26	5.88	5.68	5.96	5.78	5.70	5.56	5.66	5.55	5.85	5.94	5.71	(0.20)	5.86	6.65	6.66	6.50
MnO	*0.13	*0.00	*0.02	*0.00	*0.03	*0.12	0.29	*0.14	*0.02	*0.12	*0.05	0.29	(0.00)	0.22	*0.02	0.24	*0.09
MgO	3.49	3.74	3.32	3.71	3.80	3.42	3.61	3.46	3.67	3.47	3.82	3.59	(0.16)	2.60	3.10	3.62	3.06
CaO	7.39	7.03	7.33	7.31	7.18	7.15	7.16	7.14	7.22	7.27	6.94	7.19	(0.13)	7.28	8.88	8.38	8.14
Na_2O	3.89	3.67	3.65	3.43	3.50	3.68	3.47	3.72	3.36	3.55	3.35	3.57	(0.16)	3.98	3.39	3.07	3.65
K_2O	1.77	1.77	1.79	1.90	1.65	1.80	1.78	1.77	1.72	1.69	1.77	1.76	(0.06)	1.96	1.25	1.32	1.60
Cl	0.07	0.07	*0.05	*0.00	0.09	0.14	0.07	0.09	0.13	0.08	0.08	0.09	(0.03)	0.15	0.12	0.15	0.15
Total	98.89	99.48	98.64	99.27	98.90	98.33	99.18	98.79	98.33	98.57	98.70	98.82	(0.35)	97.58	97.10	96.68	97.92
Analyses above detection limit normalised to 100% loss free																	
SiO_2	59.50	59.60	60.05	59.69	59.94	59.91	60.19	59.70	60.14	59.79	60.15	59.88	(0.23)	59.29	56.84	56.95	57.88
Al_2O_3	17.58	17.18	17.04	17.00	17.08	16.93	16.81	17.21	17.06	17.25	16.89	17.09	(0.20)	17.31	18.36	18.03	17.95
TiO_2	0.81	0.95	0.85	0.84	0.75	0.89	0.87	0.98	0.78	0.73	0.79	0.84	(0.08)	0.80	0.72	0.79	0.57
FeO	5.31	5.91	5.76	6.01	5.85	5.80	5.61	5.72	5.64	5.93	6.01	5.78	(0.20)	6.01	6.85	6.89	6.64
MnO	-	-	-	-	-	-	0.30	-	-	-	-	0.30	(0.00)	0.22	-	0.25	-
MgO	3.53	3.76	3.36	3.73	3.84	3.48	3.64	3.50	3.73	3.52	3.87	3.63	(0.16)	2.67	3.19	3.74	3.13
CaO	7.47	7.06	7.43	7.36	7.26	7.27	7.22	7.22	7.34	7.38	7.03	7.28	(0.13)	7.46	9.14	8.66	8.31
Na_2O	3.93	3.69	3.70	3.45	3.53	3.74	3.50	3.76	3.42	3.61	3.39	3.61	(0.16)	4.07	3.49	3.17	3.72
K_2O	1.79	1.78	1.81	1.91	1.67	1.83	1.80	1.79	1.75	1.71	1.79	1.78	(0.06)	2.01	1.29	1.36	1.63
Cl	0.07	0.07	-	-	0.09	0.15	0.07	0.09	0.14	0.08	0.08	0.09	(0.03)	0.16	0.12	0.15	0.16
Water[2]	1.11	0.52	1.36	0.73	1.10	1.67	0.83	1.21	1.67	1.43	1.30	1.18	(0.35)	2.42	2.90	3.32	2.08

* Indicates value was below the detection limit.

[1] Means and standard deviations are for groundmass values above detection limit only.

[2] Assumed water = the difference between original analytical total (of analyses above detection limit) and 100.

Bullot Formation

XRF bulk rock analyses: pumice lapilli (major elements)

Pumice Lapilli	Ph [T] [BT1]	Ph [lg]* [CT]	Ph [lg]† [CT]	Ph [lg]† [CT]	Ph [lg]† [CT]	L8	L6	L3
SiO_2	58.62	59.70	59.77	60.01	57.06	49.62	54.71	50.97
Al_2O_3	16.51	16.16	17.01	17.07	17.68	19.77	17.67	16.75
TiO_2	0.69	0.70	0.67	0.68	0.73	0.83	0.75	0.72
FeO	6.43	6.46	6.54	6.51	6.68	6.25	7.65	7.65
MnO	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12
MgO	3.46	3.59	3.51	3.41	3.68	3.69	4.29	5.77
CaO	5.63	5.90	5.90	6.12	6.23	6.19	6.56	6.15
Na_2O	3.07	3.16	3.37	3.43	3.13	2.17	2.66	2.03
K_2O	1.68	1.95	1.66	1.67	1.63	0.68	1.27	0.69
P_2O_5	0.14	0.13	0.14	0.14	0.14	0.10	0.12	0.10
L.O.I.	2.66	1.64	1.40	0.76	2.64	6.04	3.58	6.25
Analyses normalised to 100% loss free								
SiO_2	60.67	61.00	60.45	60.40	58.55	54.16	57.00	55.92
Al_2O_3	17.03	16.53	17.20	17.16	16.12	21.58	16.62	16.38
TiO_2	0.71	0.72	0.68	0.68	0.75	0.91	0.78	0.79
FeO	6.63	6.60	6.61	6.55	7.06	9.01	7.97	8.39
MnO	0.10	0.10	0.11	0.11	0.11	0.12	0.11	0.13
MgO	3.59	3.67	3.55	3.43	3.98	4.03	4.47	6.33
CaO	6.01	6.03	5.97	6.16	6.39	6.76	6.83	6.75
Na_2O	3.17	3.23	3.41	3.45	3.21	2.37	2.77	2.23
K_2O	1.94	1.99	1.68	1.68	1.67	0.98	1.32	0.98
P_2O_5	0.14	0.13	0.14	0.14	0.14	0.11	0.13	0.11

L.O.I. = loss on ignition

* unbanded

† banded

Bulk rock analyses courtesy of Dr J. Gamble, Victoria Research School of Earth Sciences.

Samples were processed on a Philips PW1404 Automatic Sequential X-Ray Spectrometer by analyst K. Palmer.

APPENDIX IV

MISCELLANEOUS

IVa	Lithic:Pumiceous:Scoriaceous Lapilli Ratios	*p. A295*
IVb	Palynological Results	*p. A296*

Proportions of lithic, pumiceous and scoriaceous lapilli in some Tongariro Volcanic Centre tephras (determined by point count of 400 lapilli in > 2 mm fraction)

Tephra	Composition			Tephra	Composition			Tephra	Composition		
	Lithic %	Pumiceous %	Scoriaceous %		Lithic %	Pumiceous %	Scoriaceous %		Lithic %	Pumiceous %	Scoriaceous %
Member Tf1 (Tf)	31	55	14	Oturere Lapilli (Mm)	18	34	48	Ngamatea lapilli-1 (Bt)	11	78	11
Poutu Lapilli (Mm)	18	33	49		23	23	54	Pourahu Member (Bt)	20	72	8
	5	32	63		11	55	34		19	77	4
	13	53	34		25	42	33		46	48	6
	14	28	58		22	16	62	Member L16 (Bt)	24	63	13
	16	52	32		32	45	23		28	54	18
	4	14	82		16	19	65	Shawcroft Tephra (Bt)	22	62	16
	24	52	24	Te Rato Lapilli (Mm)	9	21	70		11	64	25
Waihohonu Lapilli (Mm)	30	28	42		9	18	73		8	60	32
	35	20	45	Pahoka Tephra	11	71	18	Member L8 (Bt)	11	87	2
	26	19	55		12	45	43	Member L7b (Bt)	3	97	-
	27	56	17		23	70	7	Member L6 (Bt)	7	90	3
	32	38	30		9	70	21	Member L4 (Bt)	4	94	2
					19	60	21	Member L3 (Bt)	6	90	4
					11	48	41	Rotoaira Lapilli (Bt)	6	94	-
					23	62	15		8	92	-

Tf = Tufa Trig Formation
Mm = Mangamate Tephra
Bt = Bullot Formation

POLLEN ANALYSIS
SOIL SAMPLE FROM RANGIPO DESERT, X88/19

analysis by:
Dr M. M^{c}Glone
Botany Division
DSIR[1]

The sample contained abundant, well preserved pollen. Results are as follows:

Nothofagus fusca type	93.6
Nothofagus menzieii	0.3
Dacrydium cupressinum	1.5
Dacrycarpus dacrydioides	trace
Prumnopitys ferruginea (= *Podocarpus ferrugineus*)	0.8
P. taxifolia (= *Podocarpus spicatus*)	2.3
Podocarpus (= *Podocarpus totara* type)	0.8
Ascarina lucida	trace
Halocarpus (= *Dacrydium bidwillii* type)	0.3
Phyllocladus	0.3
Coprosma	trace
Coriaria	0.3
Psuedowintera	trace
Cyathea dealbata type	0.3
Cyathea smithii	0.8
Dicksonia lanata	trace
D. squarrosa	trace
Histiopteris	trace
Hymenophyllum	0.3
Lycopodium fastigiatum	trace
Phymatosorus	trace

Total Pollen Counted = 390

POLLEN SUM all woody plants

Dr M^{c}Glone concludes:

The sample came from within a pure stand of *Nothofagus fusca* type forest – probably, at that location [*Rangipo Desert*], *N. solandri* var. *cliffortioides*. There is little indication of any other forest trees close to the site, or even of understorey small trees and shrubs. The total of about 6% of podocarp pollen, and the few tree fern spores, probably came from relatively distant sites. There is no indication of any disturbance of the forest, nor of charcoal.

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