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**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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June
1991



Mt Ruapehu viewed from the east, overlooking Whangaehu River and Rangipo Desert

*'In the shadow of these cones, we face mystery and cataclysm
where nature is met on its own terms'*

Bill Hackett

ACKNOWLEDGEMENTS

I extend my sincere thanks and appreciation to my supervisors, Dr V.E. Neall, Dr A.S. Palmer, and Dr R.B. Stewart (Massey University) for the opportunity to embark on a particularly interesting area of study, and for their help and encouragement throughout.

I wish to thank the following people for their assistance and hospitality during the term of my field work:

- Captain G. Pullen, and staff of Operations Branch Headquarters, Army Training Group, Waikouru
- Sergeant W. Richards (Q Store HQ Coy.), Warrant Officer K. Haami, Corporal T. Kanara, Lance Corporal D. Baker, and Mrs M. Gunn (Barrack Section HQ Coy), Army Training Group, Waikouru
- Lyell Irwin, Teresa Chapman, and staff of Tongariro National Park Headquarters, Ohakune
- Mr D. Brown (Superintendent), Timberlands, Karioi Forest
- Constable Greg Whyte and Constable Keith O'Donnell, Waikouru Police Station

I would also like to thank the following people for their valuable contributions to this thesis:

- Dr J. Gamble, Victoria University of Wellington (XRF data, and discussion)
- Dr P. Froggatt, Victoria University of Wellington (EMP data, and discussion)
- Dr M. M^cGlone, Botany Division, DSIR, Christchurch (Palynological data)
- Mr D. Hopcroft (SEM micrographs)
- Dr D. Lowe, Waikato University (Olivine data)
- Dr C. Wallace, Massey University (Valuable discussion)
- Dr M. Ames (Levin) for his generous provision of printing facilities
- Paul Vautier for his technical assistance in the reproduction of the charts

Permission to reproduce the topographical maps was provided by the Department of Survey and Land Information.

Funding for this study was provided in part by a Helen E. Akers Scholarship, and the Ministry of Civil Defence.

Special thanks are also extended to Dr J. Kirkman, Cleland Wallace, Beth Palmer, Anne Rouse, Malcolm Boag, and Alan and Julie Palmer.

Finally, a very special thanks to Scott Bell and my family for their unfailing support, encouragement and understanding in all aspects of this project. I particularly thank Scott and my parents for their invaluable assistance with the presentation – thanks for the long hours and late nights endured in helping to produce this thesis!

ABSTRACT

Mt Ruapehu is an active composite strato-volcano situated within the Tongariro Volcanic Centre, North Island, New Zealand. It is surrounded by an extensive ring plain built principally from laharic deposits, capped by late Pleistocene and Holocene-aged tephra.

Stratigraphic studies and geologic mapping on the southeastern sector of the Mt Ruapehu ring plain have identified six andesitic tephra formations (Tufa Trig Formation, Ngauruhoe Formation, Mangatawai Tephra, Mangamate Tephra, Pahoka Tephra, Bulot Formation) erupted from Mt Ruapehu, Mt Tongariro and Mt Ngauruhoe during the past c. 22 500 years. A seventh formation, Papakai Formation, comprises both andesitic tephra and tephric loess.

Most of the tephra erupted from Mt Ruapehu are grouped into the Bulot and Tufa Trig formations which are of late Pleistocene to Holocene age. Other intermittent eruptions during the Holocene have contributed tephra to the Papakai Formation.

The Bulot Formation tephra represent a period of active and widespread tephra deposition from subplinian eruptions. Most of the tephra have been deposited to the east of the volcano under the influence of prevailing westerly winds, with an average eruption interval of approximately one event every 200 years. Tephra of Tufa Trig Formation are the products of small hydrovolcanic eruptions and, although erupted more frequently (one event approximately every 100 years), have contributed comparatively little tephra to the ring plain.

Tephra erupted from Mt Tongariro (Mangamate Tephra, Pahoka Tephra) comprise most of the Holocene tephra record on the Mt Ruapehu ring plain, being deposited during a period of quiescence at Mt Ruapehu. Their eruption is coincident with the introduction of mixed magmas beneath Mt Tongariro.

Fourteen rhyolitic tephra formations (Kaharoa Tephra, Mapara Tephra, Taupo Pumice, Waimihia Tephra, Hinemaiaia Tephra, Whakatane Tephra, Motutere Tephra, Poronui Tephra, Karapiti Tephra, Waiohau Tephra, ?Rotorua Tephra, Rerewhakaaitu Tephra, Okareka Tephra, Kawakawa Tephra Formation) erupted from the Okataina and Taupo volcanic centres of the central North Island have also been identified. They are important marker beds used to date andesitic tephra and laharic deposits preserved on the southeastern ring plain.

The stratigraphic relationships between these distal rhyolitic tephra, and their relationship to local andesitic tephra is discussed, and the stratigraphy of some rhyolitic tephra identified by Topping and Kohn (1973) revised. The tephra have been identified from their stratigraphic positions, ferromagnesian mineral assemblages and glass shard chemistries.

The mineralogy and chemistry of selected andesitic marker beds has been detailed for purposes of regional identification and correlation. A database for Tongariro Centre tephra is established using ferromagnesian mineral assemblages and major element chemistry of ferromagnesian phenocrysts, and glass determined by electron microprobe analysis. The potential for use of andesitic tephra mineralogy in stratigraphic studies is evaluated.

The ferromagnesian mineral assemblage of Tongariro Volcanic Centre tephra comprises orthopyroxene + clinopyroxene $\pm$ olivine $\pm$ hornblende. Orthopyroxene compositions project mostly as hypersthene, and clinopyroxenes as augite. Olivine and hornblende are valuable marker minerals to the identification of some tephra. The olivines are forsteritic, some of which show distinctive skeletal morphology. The hornblende phenocrysts are calcic amphiboles and project mostly as pargasitic hornblende. Groundmass glass compositions of some pumice lapilli range between andesite and rhyolite. Bulk rock compositions are andesite.

The deposits of debris flows and hyperconcentrated flood flows comprise much of the prehistoric stratigraphy of the southeastern Ruapehu ring plain, with minor fluvial lithologies, indicating lahars are common events at Mt Ruapehu. The deposits are grouped into five formations (Onetapu Formation, Manutahi Formation, Mangaio Formation, Tangatu Formation, Te Heuheu Formation) on the basis of lithology.

The stratigraphic relationships between these formations is discussed and their distributions mapped. These formations form the major constructional surfaces of the southeastern ring plain. They are envisaged as having been generated following large scale sector collapses of the southeastern flanks of Mt Ruapehu, and by snow and ice melt associated with eruption of hot pyroclastic ejecta, the ejection of Crater Lake waters, or by heavy rains inducing widespread flood events, capable of eroding flank and ring plain materials. Much of the erosion and aggradation that has occurred within the Rangipo Desert in the last c. 1800 years is attributable to lahars.

At least 35 lahatic events are recorded on the southeastern ring plain within the last c. 22 500 years. The most active period of lahar generation is the present day, with an average incidence of one event every 11 years. Many of the recent lahars have been confined within Whangaehu Valley.

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LIST OF ABBREVIATIONS

TVZ	Taupo Volcanic Zone
RVC	Rotorua Volcanic Centre
OVC	Okataina Volcanic Centre
MVC	Maroa Volcanic Centre
TVC	Taupo Volcanic Centre
TgVC	Tongariro Volcanic Centre
T.L.	Type locality
T.S.	Type section
R.S.	Reference section
S.	Section
Opx.	Orthopyroxene
Cpx.	Clinopyroxene
Oliv.	Olivine
Hbe.	Hornblende
Bio.	Biotite
Cmgt.	Cummingtonite
Wo/Wo%	Wollastonite
En/En%	Enstatite
Fs/Fs%	Ferrosilite
Mg N°	Magnesium number
MGMT	MgO <i>vs</i> (MnO + TiO ₂)
NCMT	Na ₂ O/(Na ₂ O + CaO) <i>vs</i> (MnO + TiO ₂)
MNCA	MnO <i>vs</i> CaO
C.V.	Coefficient of variation
S.C.	Similarity coefficient
EMP	Electron microprobe
XRF	X-ray fluorescence
TAS	Total alkali silica
HFF	Hyperconcentrated flood flow
DF	Debris flow
SF	Stream flow