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

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by

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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

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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 tephras.

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, Bullot 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 tephras erupted from Mt Ruapehu are grouped into the Bullot 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 Bullot Formation tephras represent a period of active and widespread tephra deposition from subplinian eruptions. Most of the tephras 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. Tephras 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.

Tephras 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 tephras and laharic deposits preserved on the southeastern ring plain.

The stratigraphic relationships between these distal rhyolitic tephras, and their relationship to local andesitic tephras is discussed, and the stratigraphy of some rhyolitic tephras identified by Topping and Kohn (1973) revised. The tephras 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 tephras 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 tephras comprises orthopyroxene + clinopyroxene ± olivine ± hornblende. Orthopyroxene compositions project mostly as hypersthene, and clinopyroxenes as augite. Olivine and hornblende are valuable marker minerals to the identification of some tephras. 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 laharic 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 №	Magnesium number
MGMT	MgO *vs* $(MnO + TiO_2)$
NCMT	$Na_2O/(Na_2O + CaO)$ *vs* $(MnO + TiO_2)$
MNCA	MnO *vs* 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