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**LATE QUATERNARY VOLCANIC STRATIGRAPHY  
WITHIN A PORTION OF THE NORTHEASTERN  
TONGARIRO VOLCANIC CENTRE**

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

Doctor of Philosophy in Soil Science

By

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Mount Ruapehu viewed from the east, July 1996.  
Fresh tephra covers snow on the northern sector of the volcano.

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## ABSTRACT

Investigation of the Late Quaternary volcanic stratigraphy within the andesitic Tongariro Volcanic Centre has elucidated the history of construction of the northeastern Ruapehu and eastern Tongariro ring plains and provided a lahar record for the Tongariro catchment. Volcaniclastic ring-plain sequences were correlated and dated using rhyolitic and andesitic marker tephtras.

The identification of distal rhyolitic tephtras in the area was improved by the application of discriminant function analysis (DFA) to their electron microprobe-determined glass chemistry. The Okaia, Omataroa and Hauparu Tephtras and the Rotoehu Ash were identified for the first time in this area, providing a chronology for pre-22.6 ka ring-plain sequences not previously investigated.

DFA of ferromagnesian mineral chemistry proved useful for discrimination of andesitic tephtras, with titanomagnetite being the most useful phase. Development of an andesitic tephrostratigraphy in pre-22.6 ka sequences was aided by clustering analysis and DFA. Seven andesitic marker tephtras were identified using a range of parameters to supplement the rhyolitic tephrostratigraphy.

Using the tephrochronologic framework, 15 packages of lahar deposits were identified on the northeastern Ruapehu ring plain (from >64 to c. 5.2 ka) and six on the eastern Tongariro ring plain (from >22.6 to 11.9 ka). Lahar deposition on both ring plains was most voluminous and widespread during the last (Ohakean) and antepenultimate (Porewan) stadials of the last glacial (Otiran). Holocene lahars were restricted to a narrow sector of the northeastern Ruapehu ring plain. They appear to have been triggered mostly in response to large-scale tephra eruptions of Ruapehu and Tongariro, and mostly occurred along the path of the Mangatoetoenui Stream.

Lahar deposits and surfaces beside the Tongariro River were mapped in eight lahar hazard zones, with lahar recurrence intervals ranging from 1 in >15 000 years to 1 in 35 years. The largest number and volume of lahars in this catchment occurred in the period from 14.7 to 10 ka. The greatest population risk identified in the Tongariro catchment is part of Turangi, built within a 1 in 1000 year lahar-hazard zone. Other property and infrastructure at greater risk include the State Highway 1 bridge across the Mangatoetoenui Stream and the Rangipo Dam and Power Station, within a 1 in 35 year hazard zone.

The landscape of the northeastern Ruapehu and eastern Tongariro ring plains has developed in relation to late Quaternary climate changes in addition to volcanic activity. During the last and antepenultimate stadials of the last glacial, major ring-plain aggradation by lahars and streams occurred. This was probably in response to greater physical weathering and glacier action on the volcanic cones providing abundant sediment for lahars. During the warmer interstadials of the last glacial, soil development within andesitic ring plain material was greatest, particularly when the rate of soil accretion was low.

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