PALEOSEISMOLOGY, SEISMIC HAZARD AND VOLCANO-TECTONIC INTERACTIONS IN THE TONGARIRO VOLCANIC CENTRE, NEW ZEALAND

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By

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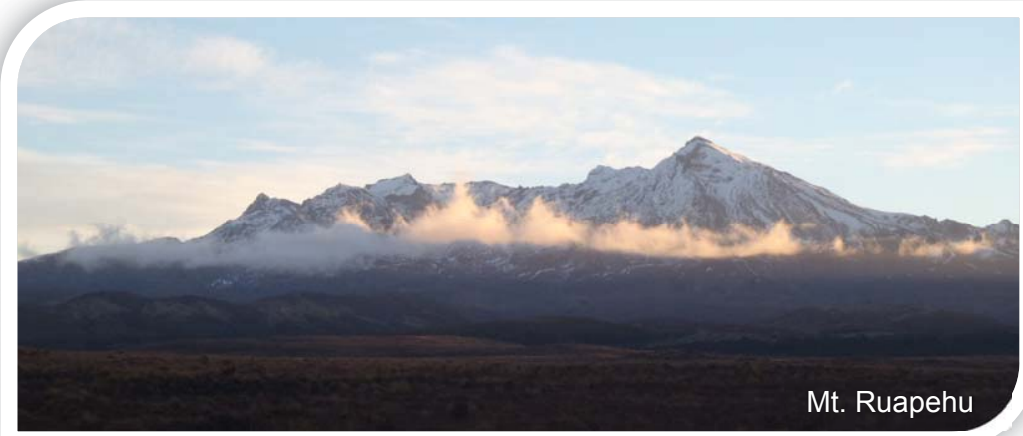
To my family and Denis Avellán, who stand by me, no matter what.

I love you!



Mt. Ruapehu

'It is not the mountain we conquer, **but ourselves'**. Sir Edmund Hillary

With passion, patience and persistence…

Abstract

At the southern part of the Taupo Rift, crustal extension is accommodated by a combination of normal faults and dike intrusions, and the Tongariro Volcanic Centre coexists with faults from the Ruapehu and Tongariro grabens. This close coexistence and volcanic vent alignment parallel to the regional faults has always raised the question of their possible interaction. Further, many periods of high fault slip-rate seem to coincide with explosive volcanic eruptions. For some periods these coincidences are shown to be unrelated; however, it remains important to evaluate the potential link between them. In the Tongariro Graben, the geological extension was quantified and compared to the total geodetic extension, showing that 78 to 95% of the extension was accommodated by tectonic faults and only 5 to 22% by dike intrusions. Within the latter, 4 to 5% was accommodated by volcanic eruptions and 18 to 19% by arrested dike intrusions, with an unknown percentage of hybrid extension. Short-term variations in fault slip-rates and volcanic activity for the last 100 ka in the Tongariro Volcanic Centre may have been influenced by static stress transfer between adjacent faults (within <20 km from the source) and dike intrusions (within <10 km), or by fluctuations in magma input through time. The amount of magma involved in the rifting process will condition the predominant extension mechanism and thus influence the predominant type of volcano-tectonic interaction. A record of volcanic and seismic activity for the last 250 ka was assembled, from new and published studies. This was used to analyse the spatio-temporal associations between volcanic and seismic activity in the southern Taupo Rift. Data on the faulting history, slip-rate variation and seismic hazard of the Upper Waikato Stream, Wahianoa, Waihi and Poutu faults formed the core of the analysis. These faults are capable of producing a M_W 7.2 earthquake with a single-event displacement of 2.9 m, posing an important hazard to the region. Data gathered in this study provides an update to the National Seismic Hazard Model for New Zealand.

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List of abbreviations

BP	Before Present
cal	calibrated
CFC	Coulomb failure criterion
DSM	Digital Surface Model
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences
GPa	Gigapascal
GPS	Global Positioning System
ka	Thousand years
Ma	Million years
m a.s.l.	Metres above the sea level
Mt.	Mount
M_W	Moment magnitude
PM	Pahoka-Mangamate
RTK	Real Time Kinematic
TgVC	Tongariro Volcanic Centre
TVC	Tongariro Volcanic Complex
TLS	Terrestrial Laser Scanning
TVZ	Taupo Volcanic Zone
UWS	Upper Waikato Stream
VEI	Volcanic Explosivity Index