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**Small-volume volcanism associated with  
polygenetic volcanoes, Taupo Volcanic Zone, New  
Zealand**

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

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**Szabolcs Kósik**

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*Panoramic view of the west shore of Lake Taupo with three lava domes from the Motuoaapa Peninsula*

*“Each volcano is an independent machine—nay, each vent and monticule is for the time being engaged in its own peculiar business, cooking as it were its special dish, which in due time is to be separately served. We have instances of vents within hailing distance of each other pouring out totally different kinds of lava, neither sympathizing with the other in any discernible manner nor influencing other in any appreciable degree.”*

*Clarence Edward Dutton*



## **Abstract**

In the past 350 ky, the Taupo Volcanic Zone (TVZ) has been the most productive silicic volcanic region in the world, with 12 silicic large-volume (35-2200 km<sup>3</sup> DRE) caldera-forming eruptions and hundreds of predominantly silicic smaller-volume eruptions. These spatially and temporally scattered small-volume events are characterised by relatively short-lasting single eruptive episodes that may have been strongly influenced by location-specific environmental factors. The aim of this study is to evaluate the volcanic hazards associated with the activity of these small-volume volcanoes using two different approaches. At the local scale, possible eruption scenarios were defined through three example localities (Ohakune, Motuoapa, Puketerata) that are characterised by different chemical compositions, eruption styles, as well as distinct environmental conditions representative of the entire TVZ. At the field scale, evaluation of small-volume activity was focused on the spatio-temporal and volumetric distribution of vents and their relationship to the structural elements of the TVZ. The most common small-volume eruptions form lava domes that were originally thought to be rarely associated with explosive activity. In contrast, this study shows that dome emplacement is often accompanied by explosive activity. However, the associated pyroclastic deposits are characterised by a low preservation potential. The most likely scenario for future eruptions is a rhyolitic eruption with an initial phreatomagmatic phase followed by the effusive emplacement of lava with or without associated explosive activity. Based on the average eruptive volumes (0.2-0.3 km<sup>3</sup>) of single TVZ events and typical eruption rates of dome-forming activity (2-5 m<sup>3</sup>/s), future eruptions are expected to last for several months to a few years. TVZ-scale spatio-temporal analysis of eruptive vents indicates that small-volume volcanism is not entirely limited to active calderas. Instead, frequent fissural activity indicates a strong linkage to the fault system of the TVZ. The temporal and volumetric pattern of small-volume volcanism displays a sudden increase of activity at 45 ka, producing at least 130 km<sup>3</sup> of volcanic material to date. The random occurrence, great variability of eruption styles, small but significant volumes, prolonged duration and relatively high frequency of small-volume volcanism pose a significant threat within the entire TVZ, which New Zealand will have to face in the near future.



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