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Melt generation, storage and ascent below Tongariro Volcanic Complex, Southern Taupo Volcanic Zone

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Maria Carmencita B. Arpa
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Abstract

The study of Tongariro Volcanic Complex in New Zealand gives an opportunity to view arc magmatism from a setting where the classic arc structure is overprinted by the regional tectonic setting. Instead of viewing the volcano (and associated magmatic processes) as a component of a volcanic arc to determine the origin of andesitic magmas, focus was given on magmatic processes within the volcanic complex. Processes within the plumbing system of the volcanic complex and their implications on andesitic magmatism and volcanic hazards were determined by tracking magma, of selected eruptive products, from their reservoirs to the surface. By focusing on processes that may determine the petrological characteristics of specific deposits (from known eruptions), the influence of local structures associated with eruptive centres within the complex and the diversity of resultant eruption styles may be interpreted as magmatic processes are evaluated.

The deposits for this study are from the last 16 ka history of Tongariro, majority are from the last 10 ka. These are from known eruptions and the deposits were mapped, dated and studied by previous researchers. Lava flow eruptions are from Te Maari and Red Crater, and Plinian to vulcanian eruptions are represented by the Mangamate Tephra and Ngauruhoe deposits. For each eruptive deposit, whole rock major, trace and isotope compositions were determined. Groundmass and mineral components were analysed for major elements. Major element and volatile (H₂O, CO₂, S, Cl) compositions of melt inclusions in component olivine and pyroxene crystals were also determined.

The deposits from the recent history of Tongariro Volcano can be related to a common source. The basalts can differentiate to more evolved andesitic to dacitic compositions by crystallization and/or melting. Magmatic differentiation takes place in different reservoirs, at different depths, within the complex. Differences were observed in the volatile contents of the

magmas and these may be related to magma storage and ascent processes. Magmatic processes for the deposits in this study, interpreted from compositions, considered and are consistent with eruption styles.

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Tongariro Alpine Crossing trail from Ketetahi, a view of North Crater and Ketetahi fumaroles

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