

Gabbroic insights into mafic magmatism in the Taupō Volcanic Zone (TVZ), New Zealand

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The central Taupō Volcanic Zone (cTVZ) is the most frequently active silicic region on Earth, hosting two active caldera volcanoes (Taupō and Okataina). The ultimate driver of this abundant silicic volcanism is proposed to be extraordinary fluxes of mantle melts, but exactly how these melts generate rhyolites remains controversial. Rare mafic plutonic fragments occur in eruptions of all compositions in the cTVZ and provide petrogenetic insights into the deeper roots of magmatic systems. Textural, geochemical, and isotopic data for a unique suite of gabbroic xenoliths from the K-Trig basaltic centre (on the edge of Lake Taupō) are presented here, alongside data from previously studied cTVZ mafic xenoliths. These provide insight into the nature of mafic cTVZ magmatism at depths below those of the silicic magmatic systems.

K-Trig is one of four aligned late Pleistocene monogenetic basaltic centres located NE of Lake Taupō. Gabbroic xenoliths were collected *ex-situ* from a quarry site, along with non-oxidised, early erupted scoria samples. The gabbros range from olivine+pyroxene+mafic melt-bearing to olivine+pyroxene+silicic melt-bearing gabbros. These gabbros are the most mafic rocks recorded in the TVZ (~45 wt. % SiO₂), where the lowest SiO₂ contents relate to gabbros with the highest mafic melt proportion. Gabbroic REE patterns vary between samples, with REE totals ($\sum\text{REE}_N$) ranging from 97 – 299 and (La/Yb)_N ratios ranging from 1.4-3.5. The low REE totals suggest these gabbros have crystallised from a depleted mantle source and the low (La/Yb)_N ratios are interpreted to reflect prior melt extraction. The samples with higher REE totals and (La/Yb)_N ratios reflect interaction with silicic melt, as can be observed texturally. The scoria is more enriched, with $\sum\text{REE}_N$ of 310 – 314.

An overlap and narrow range in ⁸⁷Sr/⁸⁶Sr isotopic compositions (for the gabbros (0.704853 – 0.704886) versus scoria (0.704865 – 0.704870) indicate a cogenetic relationship and/or a highly homogeneous source over time. The silicic melt-bearing sample has an ⁸⁷Sr/⁸⁶Sr isotope composition of 0.705096, indicative of mixing with a more radiogenic melt. The range of textures observed in these gabbros and their associated geochemical differences provide insights into the physical magmatic processes occurring underneath the K-Trig mafic centre.