Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10050

Insights into Magma Evolution Beneath Mt Taranaki, New Zealand: A Uranium-Series Isotopic Perspective

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Rear arc volcanism is typically potassic in composition but its origins are not well understood. In New Zealand, Mount Taranaki stratovolcano is most commonly attributed to subduction-related magmatism but is located 400 km behind the Hikurangi arc-trench system where seismic evidence for a Wadati-Benioff zone is ambiguous. Thus, an alternative model for magmatism invokes convective removal of lower lithosphere and resulting mantle inflow. In order to distinguish between these competing models, we have undertaken the first Uranium-series disequilibria analysis for a range of high-K andesitic Taranaki eruptives aged between 0.35 to 22 ka. All but one of these have ^{230}Th excesses (up to 45%) and form a broad horizontal array on the U-Th equiline diagram. The ^{230}Th excesses cannot be explained by crystal fractionation or crustal assimilation, and may be indicative of decompression melting and/or an eclogitic source, atypical for subduction-related magmas. However, they do resemble lavas from northern Tibet inferred to be generated by the convective removal of lower lithosphere. This remains to be tested further with other isotope data and, irrespective of the ultimate origin of the magmas, the horizontal U-Th isotope array constrains the total time elapsed from partial melting to eruption at the surface to be 4.5 ± 0.59 kyr. This requires short residence times and rapid magma ascent that are likely to be important for predictions of future activity and improving the resilience of affected communities from future eruptions.