VOLCANOLOGY

Mantle control on silicic volcanism

The largest and most destructive volcanic eruptions are typically associated with the presence of large silica-rich magma storage regions ($>1,000 \text{ km}^3$) in the mid- to upper-crust. Silica-rich (dacite to rhyolite) magma bodies are constructed over 1,000s to 100,000s of years from a complex interplay of magmatic processes, including fractional crystallisation, magma mixing and host-rock assimilation. However, owing to magma homogenisation and crystallisation in the crust, deeper magmatic processes such as mantle melting and magma generation, which may

influence the location of large silicic magma reservoirs, are commonly inaccessible to volcanologists.

Simon Barker from Victoria University of Wellington, New Zealand, and colleagues, use olivine-hosted melt inclusions (pockets of melt trapped in a crystal) from mafic enclaves within silica-rich volcanics to investigate deep magmatic processes beneath the Taupo Volcanic Zone (TVZ), New Zealand. The chemical composition of these ‘inherited’ melt inclusions reveals spatial heterogeneity in the volume of melt produced in the underlying mantle: beneath the Taupo and Okataina

calderas, where large silica-rich eruptions have occurred, the extent of mantle melting is 20–30%, far higher than in the intercaldera regions (3–10%). As a result, the volume of magma ascending into the crust beneath the Taupo and Okataina calderas is 4–10 times higher than beneath other areas of the TVZ, which indicates that silica-rich magma storage can only be maintained in regions where the flux of magma (and heat) into the crust is high.

The observed relationship between the flux of mantle-derived magma and the formation of mid- to upper-crustal magma reservoirs in the TVZ demonstrates that subtle shifts in the location or extent of mantle melting may lead to migration of the focus of silicic magmatism in volcanic arcs. In addition, the use of melt-inclusions to understand the mantle driving-force behind silicic-volcanism in the TVZ demonstrates that inherited olivine crystals could be used to access deeper magmatic processes at other silicic volcanic systems globally.

Matthew Gleeson

ORIGINAL ARTICLE Barker, S. J. et al. What lies beneath? Reconstructing the primitive magmas fueling voluminous silicic volcanism using olivine-hosted melt inclusions. *Geology* <https://doi.org/10.1130/G47422.1> (2020)

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