Basalt alkalinity modulated by a lithospheric “filter”: thermobarometry of a complex plumbing system

PONTESILLI A. [1], BRENNA M. [1], UBIDE T. [2], MOLLO S. [3], MASOTTA M. [4], CAULFIELD J. [2,5], LE ROUX P. [6], NAZZARI M. [7], SCARLATO P. [7]

[1] University of Otago, 360 Leith St. Dunedin 9016 (NZ) (corresponding: alessio.pontesilli@postgrad.otago.ac.nz)
[2] The University of Queensland, Brisbane (AUS)
[3] Sapienza Università di Roma, Rome (IT)
[4] University of Pisa, Pisa (IT)
[5] Queensland University of Technology, Brisbane (AUS)
[6] University of Cape Town, Cape Town (RSA)
[7] Istituto Nazionale di Geofisica e Vulcanologia, Rome (IT)

Primitive intraplate magmas typically display significant chemical variability, including subalkaline basalts to basanites and nephelinites. Contrasting geochemical affinites have been attributed to variable asthenospheric/lithospheric mantle contributions and/or crustal contamination. Different parental magmas are responsible for liquid lines of descent leading to either phonolites or trachytes, that can feed either effusive or highly explosive eruptions. Accordingly, understanding the source characteristics, magma transport and storage conditions in continental intraplate alkaline volcanoes has key petrological and hazard implications. In this study we investigate basaltic magmas of the Dunedin Volcano (DV; NZ), the intraplate volcanic system where distinct alkaline liquid lines of descent were originally proposed. Most DV magmas have HIMU-like isotopic characteristics, inherited from the lithospheric mantle, known to have a homogeneous isotopic composition after extensive xenolith-based studies in the area. Highly radiogenic $^{87}Sr/^{86}Sr$ in subalkaline lavas cannot be accounted by crustal contamination according to trace element modeling, and imply the presence of an EMII-like signature within the asthenospheric source. A detailed micro-chemical study of the crystal cargo facilitates the reconstruction of the physico-chemical conditions of storage and differentiation at upper mantle to lower crustal depths. Multi-stage ascent in the central part of the volcano feeds subalkaline magmas, whereas highly alkaline basalts erupted in the peripheral part of the DV ascend directly from lower crustal depths, as recorded by complexly zoned phenocrysts. Integration of whole rock and mineral-scale data is a powerful approach to disentangle complex magmatic histories. Primitive magma compositions at DV are modulated by processes occurring in the mantle source, that ultimately play a crucial role in shaping the magma transport pathways that govern the architecture of the plumbing system.