

A lithospheric mantle source for Etna magmatism

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Mt. Etna has important geochemical and petrologic similarities with other sodic volcanics in the region. We compared the chemistry of rocks from Mt. Etna with those from other nearby volcanoes (e.g., Pantelleria and Ustica) which have the least contribution from the subducted slabs, in order to better understand the nature of the regional mantle source that is supplying melts for Mt. Etna. We obtained Sr-Nd-Pb-O isotopes, as well as trace and major element data for rocks spanning the ages and compositions of these volcanoes. Among them, lavas from Etna, Pantelleria and Ustica have more radiogenic Pb-isotopes than MORBs. Their mantle-like oxygen isotope composition indicates that the radiogenic component might originate directly from the mantle. Moreover, the isolation of a high- μ (HIMU = old material with initially high U/Pb ratio) source for ~500 Ma is required to generate the Pb isotope compositions in these lavas. Interestingly, these melts are similar to experimental melts of amphibole in peridotite [1]. However, amphibole and most other hydrous silicates are unstable above ~1100 °C, which is significantly below asthenospheric temperatures, requiring that the source veins were frozen into the lithospheric mantle during ingrowth of radiogenic Pb. We suggest that the source of Mt. Etna magmatism might be related to extensional decompression, or alternatively, heating by a hot plume, resulting in melting of a metasomatized sub-continental lithospheric mantle.

[1] Medard *et al.*, 2006, *J. of Petrology*, 47: 481-504

Cerium sequestration in fractures in the upper kilometer of granitoids, SE, Sweden

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This study seeks to define geochemical processes governing the accumulation and sequestration of Ce in granitoid fractures down to >700 m depth, revealing past intrusions of oxygenated waters. The fracture coatings (secondary mineral precipitates in open fractures) gathered from the study area (Laxemar, SE Sweden) are characterized by high levels of Ce (Fig. 1b) compared to host rock coccentration (average: 86 ppm, n=65) and show a striking feature of distinct positive Ce anomalies ($Ce_{WN}^* = 1.21-3.95$, n=8) in the uppermost 20 m of the bedrock (Fig. 1a).

Cerium and Mn X-ray absorption spectroscopy (XAS) of selected fracture coatings, together with existing data (e.g. fracture mineralogy and groundwater chemistry), indicate that: (1) Ce(IV) occurs down to c.a. 70 m depth and is exclusively associated with Mn oxides which occur as todorokite and triclinic birnessite as suggested by Mn EXAFS spectra; (2) Since Mn is largely speciated as Mn^{2+} in the present bedrock groundwaters, the Ce(IV)-bearing Mn oxides most probably resulted from oxidative weathering of wall rock and fracture coating minerals when oxygenated waters intruded into the bedrock (down to several hundred meters depth) during deglaciation events (>13000 BP); (3) Unlike other samples, clear XAS features of a poorly-crystalline hexagonal-birnessite-like phase and larger proportion of aqueous Mn^{2+} were observed in the sample with strikingly positive Ce anomaly ($Ce_{WN}^* = 3.95$) (Fig. 1b) at the depth of 0.87 m, suggesting an ongoing dynamic accumulation of Ce(IV), i.e. dissolution and reprecipitation of Mn oxides while Ce(IV)-enriched residue largely remained.

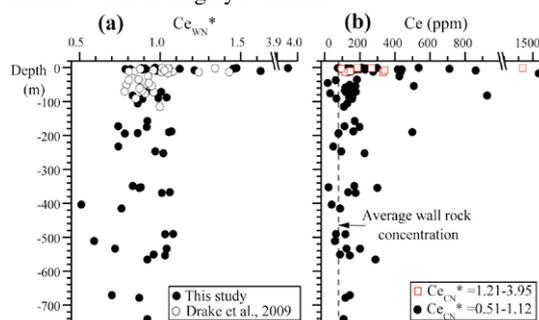


Fig. 1. Distribution of Ce anomalies ($Ce^* = Ce / (La * Pr)^{1/2}$ in WN WN WN WN fracture coatings (a), where WN denotes normalization to average wall rock; and concentrations in the fracture coatings (b).

[1] Drake *et al.* (2009) *Appl Geochem* **24**, 1023–1039.