A combined Earth-Moon Si isotopes model to track rocks petrogenesis

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Silicon is after oxygen the second most abundant element in the Earth's crust. As such, its stable isotope variations in geological materials may represent important mass transfer between terrestrial reservoirs. Despite early analytical limitations and although Si isotopes were not expected to fractionate significantly during high temperature magmatism, studies conducted more than 15 years ago [1, 2] hinted that Si isotope compositions of granitoids may be heavier than that of mafic igneous rocks.

In this study, we determined the silicon isotope signatures of a set of igneous terrestrial rocks that includes andesites, monzogranites, granites of different types, as well as 8 lunar samples including basalts and highlands anorthosites. Analytical methods involved alkaline fusion of the powdered samples, cationic exchange chromatography and high resolution MC-ICP-MS in the wet plasma mode. Long-term (3 years) external reproducibility for δ^{30}Si and δ^{29}Si was given by repeated measurements of BHVO-2. It yielded 2 standard deviations (2SD) of 0.076‰ and 0.047‰, respectively, for individual measurements.

A comparison between lunar and terrestrial bulk igneous rocks reveals that Si isotope composition become slightly, thought significantly enriched in heavy isotopes as a function of felsic mineral abundances. We interpret this in terms of global planetary differentiation processes. However, the terrestrial trend is more scattered, which reveal the occurrence of sources and processes that do not exist on the Moon, probably because they involve water. Terrestrial andesites may be isotopically heavier than other lunar and terrestrial igneous rocks with similar silicon contents whereas S-type granites are isotopically much lighter than other granite types. These results are interpreted as the influence of seawater or hydrothermal fluids on andesitic sources and the occurrence of sediments containing the products of aqueous weathering in S-type granite protoliths. The fact that Si is a major element in igneous rocks, but not a major constituent of water like O, makes its isotopic composition likely more robust against alteration and weathering of the studied rocks, yet delivering significant information in terms of source of the magmatic bodies studied.

[1] Douthitt (1982) *Geochim. Cosmochim. Acta* **46**, 1449-1458. [2] Ding *et al.* (1996) *Geol. Publish. House, Beijing, China*, 125 pp.

Melting condition and evolution of fissural volcanism in the island of Faial (Azores archipelago)

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Two WNW-ESE-trending fissure zones, which are separated by NNW-SSE transtensional faults, are the expression of the regional extensional tectonics in the island of Faial. Several monogenetic centres and a large stratovolcano were generated along these faults.

Erupted magmas are nepheline- to hypersthene normative basalts to hawaiites, generated at about 2110-1600 MPa (~63 km deep, in the spinel facies) and 1367-1407°C.

Mafic rocks of the westernmost fissure zone have lower MgO and HREE, and higher Na_2O, P_2O_5, TiO_2, Zr, Nb, Th, LILE and LREE than those from the easternmost fissure zone. All these differences are related to slightly different melting degrees (between 3 and 5%), which also reflect the different silica saturation degrees. However, near-primary melts of these two fissure zones show LILE contents, particularly Ba, which are among the highest in the whole Atlantic area. This feature, together with the common presence of fluid inclusions in many ultramafic xenoliths sampled, evidence the occurrence of a metasomatic event prior to mantle source melting.

Hawaiites evolved from basalts by 18-25% fractional crystallization of Mg-olivine, diopside and Ca-plagioclase, at 560-700 MPa (~17-21 km deep). There is no evidence for magma ponding at intracrustal depths.

Fractionation of mafic phases generated cumulate layers at the crust-mantle boundary. Ascending basaltic melts sampled these olivine-and-clinopyroxene bearing layers to generate ankaramites which show MgO content lower than primary melts. These peculiar lithologies crop out along the western margin of the stratovolcano, possibly along faults that directly tapped the cumulate layers.