Oxygen isotopes in olivine from primitive Icelandic tholeiites reveal crust-magma interaction

A.A. GURENKO[1], I.A. SIGURDSSON[2]

[1] CRPG, UMR 7358, Université de Lorraine, 54501 Vandoeuvre-lès-Nancy, France (*correspondence: agurenko@crpg.cnrs-nancy.fr)

[2] Icelandic Institute of Natural History, Urridaholtsstraeti 6-8, 210 Gardabaer, Iceland

Primitive basaltic magmas are the best source for direct information about magma generation at depth, but this information could be obscured by processes of melt-rock interaction during magma transport to the surface. A central focus of the present study is to explore how extensively chemical compositions of very primitive mantle-derived Icelandic magmas can be modified during their migration through the gabbroic crustal rocks.

We have studied oxygen isotopes in olivine hosts and their trace element enriched and depleted melt inclusions from Midfell and Maelifell picrites, SW Iceland [1], as well as in clinopyroxene, plagioclase and interstitial and host matrix glasses of the associated gabbro nodules [2], using the CRPG-Nancy CAMECA IMS 1270 E7 and 1280 HR ion microprobes. The olivines from the picrites were systematically analyzed (1) at ~100-µm-distance from melt inclusions, (2) at the centre of olivine grains and (3) at the grain boundaries. A distinctive feature of these olivines and their inclusion glasses is strongly varying $\delta^{18}O$ (3.3–5.8‰ in olivine, also within individual olivines, and 4.2–6.4‰ in melt inclusions) at nearly constant, similar mantle-like $\delta^{18}O$ values of the host matrix glasses (5.2–5.5‰). This observation was firstly reported in [3] and now confirmed based on the extended number of crystals and glasses. Similar variations (4.8–6.2‰), but generally grouping around the higher $\delta^{18}O$ values, were found in the mineral phases and interstitial glasses composing the nodules.

In contrast to the $\delta^{18}O$ values lying below the canonical "mantle olivine range" of 4.8–5.2‰, being common for Icelandic lavas and traditionally ascribed to melt interaction with crustal rocks altered by meteoric waters, those values exceeding the mantle range towards higher values are modeled and interpreted in a favor of magma interaction with partially melted gabbroic rocks. The melting is thought to be caused by hot primitive basaltic magmas percolating through the gabbroic crust. Our new data suggest that many Icelandic mafic rocks, which were originally thought to reflect chemical composition of primitive, mantle-derived magmas, could have been significantly affected by interaction with crustal rocks.

[1] Gurenko and Chaussidon (1995) *GCA* **59**, 2905–2917. [2] Gurenko and Sobolev (2006) *CMP* **151**, 495–520. [3] Gurenko and Chaussidon (2002) *EPSL* **205**, 63–79.