Geophysical Research Abstracts, Vol. 9, 04613, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04613

Experimental constraints on the origin of OIBs

S. Pilet (1), M. B. Baker (1), E. M. Stolper (1)
(1) California Institute of Technology, Pasadena, USA

The trace-element and isotopic ratios of mafic alkaline magmas (e.g., basanites and alkali basalts) from oceanic islands and continental alkaline massifs are often explained by the presence of subducted/recycled oceanic crust in their sources. Alternatively, these ratios could reflect oceanic or continental lithosphere-bearing sources into which amphibole- and/or pyroxene-rich metasomatic veins have been emplaced. The major-element compositions of alkaline magmas provide important tests of these hypotheses and constraints on possible source compositions and their petrologic evolution. To date, high-pressure melting experiments on peridotites, eclogites, and peridotite/eclogite mixtures have not fully reproduced the major- and trace-element compositions of basanites and the spectrum of composition from basanite to alkali basalt observed in alkaline massifs worldwide.

Here we present the results of high-pressure melting experiments (1.5 GPa, 1150-1350˚C) on natural hornblendite and clinopyroxene hornblendite lithologies that occur as metasomatic veins in the French Pyrenees. All experiments were run in Pt+graphite capsules. The compositions of low-degree melts in experiments on both lithologies are controlled by kaersutite breakdown and the quenched glasses are strongly *ne*-normative (*Ne*+*Le*>18 wt%) and silica-poor (SiO_2 <42 wt%). K_2O/Na_2O, Al_2O_3/TiO_2, and CaO/Al_2O_3 ratios in the experimental partial melts do not vary significantly from 1165 to 1275˚C and are similar to silica-poor basanites that occur on oceanic islands and in continental alkaline massifs. Moreover, the incompatible trace-element patterns of the quenched glasses overlap those of silica-poor OIBs. These trace-element patterns reflect primarily the enriched trace-element patterns of the hydrous veins used as starting materials; this enriched character is a universally observed feature of such hydrous veins.

A second set of experiments was done using a layer of hornblendite sandwiched between layers of moderately depleted peridotite at 1.5 GPa and 1225-1325˚C in order to simulate interaction between melting hornblendite and adjacent mantle. At the same temperature, the SiO_2 contents of partial melts produced in the sandwich runs are up to 4-5 wt% higher than liquids from the hornblendite-only and clinopyrene-honblendite-only experiments (although some are still *ne* normative). This difference reflects the dissolution of orthopyroxene in the peridotite layers in the sandwich runs. For both major and trace elements, the compositional trends from glasses from the hornblendite-only and clinopyroxene-hornblendite-only melting experiments to glasses from the sandwich experiments are similar to trends observed in natural basanite $\rightarrow$ alkali basalt suites.

Our results show that partial melting of metasomatized lithosphere (i.e,. peridotite + amphibole-bearing veins) could generate liquids similar to alkaline lavas in continental settings and that recycling (e.g., via subduction or/and delamination) and partial melting of such veined lithosphere could likewise contribute to the compositional characteristics of oceanic alkaline lavas. The same source types could also explain compositional trends from basanite to alkali basalt observed in both oceanic island and continental massif settings provided that reaction occurs between basanitic liquids and the surrounding peridotite (most likely during the melting process, but perhaps during transport to the surface). Furthermore, the isotopic characteristics of alkaline HIMU and EM-type OIBs are consistent with models of amphibole-bearing vein formation and resultant element fractionations [1]. Our results are thus consistent with the hypothesis that alkaline OIBs are dominantly produced by large degrees of melting of small volumes of trace-element-rich and volatile-rich material (e.g., originally metasomatic veins) present within the upper mantle rather than less enriched but volumetrically more abundant recycled oceanic crust. We conclude that partial melting of amphibole-bearing veins in metasomatized lithosphere can account for the major-element, trace–element, and isotopic compositions of alkaline OIBs and should be considered a testable alternative to more widely accepted models of their formation that invoke recycling of oceanic crust$\pm$sediments.

[1] Pilet et al. (2005) EPSL 236, 148-166