

Experimental constrain on the origin of OIB: evidence for a metasomatized lithospheric source.

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The source of alkali basalts erupted in oceanic island and continental alkali massif settings is commonly assumed to contain a component of recycling oceanic crust. High-pressure melting experiments on silica-deficient garnet clinopyroxenite compositions (formed by silica extraction from the oceanic crust during subduction or hybridization of MORB-eclogite with peridotite) produce ne-normative liquids that are close to alkali basalt compositions (Hirschmann *et al.*, 2003), but are unable to reproduce low silica basanite compositions and the transitional compositions between basanite and alkali basalt that are observed in alkali massif worldwide (Keshav *et al.*, 2004). Moreover, melting of oceanic crust seems unlikely to reproduce the high trace element content observe in OIBs.

Here, we present the results of high-pressure melting experiments on natural amphibole-clinopyroxenite and hornblendite lithologies from the French Pyrenees (1.5 GPa, 1150–1350°C, Pt–graphite capsules) and explore the alternative hypothesis for the origin of OIBs — that these basalts result from the partial melting of recycled metasomatized continental or oceanic lithosphere. The compositions of initial melts in our experiments are controlled by Kaersutite amphibole breakdown and are strongly ne-normative and silica-poor ($\text{SiO}_2 < 42 \text{ wt}\%$). These melt compositions are similar to silica-poor basanites found in oceanic and continental alkali massifs. The volatile content of these melts ($\sim 6 - 1.8 \text{ wt}\%$ and $\sim 1 - 0.7 \text{ wt}\%$ for H_2O and CO_2 , respectively) are in agreement with volatile contents estimated for undegassed alkali lavas. $\text{K}_2\text{O}/\text{Na}_2\text{O}$, $\text{Al}_2\text{O}_3/\text{TiO}_2$ and $\text{CaO}/\text{Al}_2\text{O}_3$ ratios was compatible with OIB compositions and do not varied significantly as melt temperatures increase from 1165° to 1275° C. Moreover, the incompatible trace element patterns of the experimental melts (normalized to primitive mantle and measured by LA-ICP-MS), overlap with OIB patterns. The composition of our partial melts mainly reflects the enriched character of the metasomatized hydrous vein used as starting material (this enriched character is a universally observed feature of such hydrous veins).

Experiments using a layer of hornblendite sandwiched between two layers of moderately depleted peridotite were performed at 1.5 GPa and temperature of 1225° and 1325° C in order to simulate the reaction between melting hornblendite and adjacent mantle. At the same temperature, the silica contents of partial melts produced in the sandwich runs are higher (by $\sim 4\text{-}5 \text{ wt}\%$ SiO_2) relative to the liquids from the hornblendite experiments. This difference reflects the dissolution of opx in the peridotite layers in the sandwich runs. For both major and trace elements, the combined liquid compositional trends defined by the hornblendite melting experiments and our sandwich experiments are similar to the trends observed in natural basanite to alkali basalt suites. This suggests that the transition from basanite to alkali basalt observed in ocean island and continental massif settings may be related to reaction between an initial basanitic liquid and the surrounding peridotite

rather than a pressure effect and/or an increase in the degree of partial melting of the source.

Thus the partial melting of metasomatized lithosphere is able to explain the major and trace element compositions of alkali basalts in continental settings, and the recycling and partial melting of such metasomatized lithosphere may also explain the compositional characteristics of oceanic alkaline lavas. Further, the isotopic characteristics of both HIMU and EM-type OIBs are consistent with the model of vein formation and its resulting element fractionations (Pilet *et al.*, 2005). Thus, unlike models involving the recycling of oceanic crust \pm sediments, the metasomatized lithosphere recycling hypothesis appears to reconcile major element, trace element, and isotopic compositions observed in OIBs.

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