Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)
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SGC55-08 Room:101B Time:May 23 11:00-11:15

Contribution of anciently depleted mantle and slab derived components to boninite magma genesis

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Boninite is a volcanic rock derived from highly depleted hydrous mantle that melted at a shallower depth with water derived from the subducted slab. Boninite occurred at the inception stage of the Izu-Bonin-Mariana arc (~48-45 Ma), and thus, may record less modified upper mantle composition with the subducted slab components. In order to improve the understanding of Os recycling in the subduction setting, Cr-spinels from boninites, Cr-spinel/magnetite mixtures from tholeiites which erupted subsequently after boninites (<45 Ma), and the whole rock of those lavas were analyzed for Os isotopes. The initial Os isotope ratios of the Cr-spinel from the boninites show highly unradiogenic to unradiogenic values (187Os/188Os(i) = 0.1179~0.1256), whereas those in the Cr-spinel/magnetite mixtures from the tholeiites (187Os/188Os(i) = 0.1270 and 0.1369) are slightly radiogenic. The initial Os isotope ratios of the whole rock samples are more radiogenic and have larger variety than those of Cr-spinel and Cr-spinel/magnetite mixtures, possibly because of contamination with the crustal materials during magma ascent or alteration after emplacement. Based on highly unradiogenic initial Os isotope ratios of the Cr-spinels from boninites, the source of the boninites should be highly depleted mantle with a small amount of the slab flux composed of altered oceanic crust (AOC) and unradiogenic components such as oceanic island basalt (OIB) volcanoclastics or very young mid-oceanic ridge basalt (MORB). In contrast, the Os isotopic compositions of Cr-spinel/magnetite mixtures of tholeiites are clearly higher than those of Cr-spinels of boninites and slightly higher or similar to chondrites and primitive upper mantle (PUM) values. They were possibly affected by radiogenic slab components such as pelagic sediments and AOC with depleted mantle.

Keywords: Os isotope ratio, boninite