Metasomatism of mantle xenoliths from Avach, the Kamchatka arc: constraint on Li isotopes and trace element geochemistry

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Li isotopic system has been suggested as a significant tracer on the heterogeneity and material recycling in the mantle by its large relative mass fractionation. Even if the subduction zone is the key place for understanding the mantle heterogeneity of Li isotopes, it has not been revealed clearly the behavior of Li isotopes during arc-related mantle metasomatism and/or partial melting. Mantle xenoliths from Avacha volcano, the southern Kamchatka arc are mainly depleted harzburgites, and derived from the mantle wedge in the subduction zone. Thus, in order to elucidate the behavior of Li isotopes during subduction-related mantle matasomatism, we report here the result of Li isotopes and trace element analyses of mantle xenoliths from Avacha volcano.

Trace elements and Li isotopic ratios of powdered mantle xenoliths are determined by quadropole-type and Multicollector-type ICP-MS at the Earthquake Research Institute, the University of Tokyo, respectively. First-step chemical separation procedure was adopted and modified mainly after that by Nisho and Nakai (2002), and second-step column procedure was prepared to minimize the effect of matrix ions and organic matters. For MC-ICP-MS analysis of Li, the intensity of 7Li ions for 50 ng g-1 Li solution was 11 pA, and for background 0.4 pA, respectively. The d^7Li values of samples were calculated by normalization with isotopic ratios of Li standard solution (NIST L-SVEC).

The d^7Li values of mantle xenoliths range from +3.5 to 5.6 permil, and the Li contents represent little variation about 1.2 ppm (1.13 ppm to 1.25 ppm). Metasomatized Sample, 626 has slightly heavier Li isotopic ratio (+5.6) than primary xenoliths and average MORB (the depleted mantle), ca. +4 permil. Trace elements geochemistry also indicates the enrichment of Ba, Rb and LREE in metasomatized xenolith. Although there is little variation in the Li contents, the result of Li isotopic ratios is well consistent with Ba, and Sr abundances.

Metasomatism of modally depleted xenolith from Avacha volcano is attributed to the fluid released from the subducting slab below the Kamchatka arc (Kepzhinskas et al, 1996; Arai et al, 2003). The presence of amphibole phase in the metasomatized xenolith also indicates the metasomatism by hydrous fluids from the slab. A slight elevation of the d^7Li may result from metasomatism dominated by the fluid from slab devolatilization. Therefore, the Li isotopic ratios of mantle xenoliths are suggestive of the sub-arc process of mantle wedge including the depletion by partial melting, and metasomatism by fluid from the slab.