Isotopically heterogeneous mantle diapir in Yokota Alkali Basalt Province and its origin

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Yokota Alkali Basalt Province located to the East of Daisen volcano, SW Japan, was active between 2.3 and 0.9 Ma. Twenty-five monogenetic alkali basalt centers occur within a area about 40 by 40 km square. The activity begun at the cluster center and spread outwards with time. Such the geological occurrence has been thought to be generated by a rising and then flattened mantle diapir existed at the base of the lithosphere. The Yokota basalts have MgO greater than 8wt.% and rich in Cr and Ni, therefore regarded as primitive. High norm-ne alkali lavas occur at the center and lower norm-ne lavas occur at the perimeters of the cluster. LREE/HREE are also high in cluster center and lower in perimeter basalts. All above observation suggest deeper sources for the former basalts.

We have analyzed Nd-Sr isotopes on 40 basalt samples from the Yokota Province. The results show clear two mixing lines between (a) low NdI-low SrI and low NdI-high SrI end members for cluster center basalts and (b) high NdI-low SrI and low NdI-high SrI end members for perimeter basalts. The depleted-end of the (a) mixing-line plots below the MORB-Bulk Earth join. The depleted-end of the (b) falls intermediate of the MORB-Bulk Earth join. Enriched ends are directed to the EMII component perhaps contamination of a crustal component. This suggests that the shallow perimeter basalt and deep center basalt have been derived from isotopically different mantle domains, and both of them have interacted similar crustal material en-route to the surface.

The Ueno Basalt Province in central Japan is also thought to have derived a rising and incubating mantle diair. The basalts from the province were classified into alkali and sub-alkali basalts. The former were erupted in the cluster center alone and were derived from MORB-like source, in terms of Nd-Sr isotopes, The latter were erupted in the perimeters and from a source, which is isotopically intermediate between MORB and BE. The two types of basalts were derived from discrete sources and may have interacted various crustal materials.

The similarities between the Ueno and Yokota provinces are (1) in their 1.5 my long life-span and (2) distinctive mantle domains for deeper and shallower basalt sources. It is suggested that the mantle sources in the two different provinces are heterogeneous in relation to depths. Such the phenomena are not explained well by fluid fluxed melting, but rather, explained well by penetration of the upper mantle lithosphere into overlying mantle lithosphere. Raised upper mantle asthenosphere could have melted the lithosphere and basalts derived from isotopically different those two mantle domains produced such the volcanisms.