American Mineralogist, Volume 102, pages 341–346, 2017

Adakite metasomatism in a back-arc mantle peridotite xenolith from the Sea of Japan

Yuji Ichiyama[1,*], Tomoaki Morishita[2], Akihiro Tamura[2], and Shoji Arai[2]

[1]Earth Science Department, Chiba University, Yayoi 1-33, Inage, Chiba 263-8522, Japan
[2]School of Natural System, Kanazawa University, Kakuma, Kanazawa 920-1192, Japan

Abstract

Secondary orthopyroxenes occur as veinlets (<0.1 mm thick) cutting an olivine grain in a two-pyroxene peridotite xenolith from the Shiribeshi Seamount in the Sea of Japan. These orthopyroxenes are characterized by low Al_2O_3 (0.4–1.7 wt%), Cr_2O_3 (<0.1 wt%), and CaO (0.3–0.4 wt%) contents, which are the same signatures of the secondary orthopyroxenes in peridotite xenoliths from island arcs. The trace-element patterns of the melts in equilibrium with the secondary orthopyroxenes show enrichment in light rare earth elements and Sr and depletion in heavy rare earth elements, Nb and Ti. These trace-element characteristics are highly consistent with those of slab-derived adakites. The involvement of slab-derived melts in the mantle beneath the Sea of Japan has been inferred from the geochemical characteristics of the volcanic rocks formed during opening of the Sea of Japan. The source mantle of the enriched basalts in the Sea of Japan is likely to have been metasomatized by adakitic melts in the same manner as the peridotite-hosted veinlet. The secondary orthopyroxenes in the peridotite xenolith from the Shiribeshi Seamount provide direct evidence for the metasomatic influx of adakitic melts into the back-arc mantle beneath the Sea of Japan. Adakitic metasomatism, as documented in the Sea of Japan, potentially plays an important role in mantle evolution and magma generation beneath global back-arc basins.

Keywords: Mantle xenolith, secondary orthopyroxene, Sea of Japan, adakite