



## **Geochemical characteristics of highly depleted harzburgite from mantle wedge beneath Avacha volcano, the southern Kamchatka arc, Russia**

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Avacha volcano is a stratovolcano and belongs the volcanic chain of the southern Kamchatka, and has erupted calc-alkaline series magma since late Pleistocene. Large amount of mantle peridotite xenoliths were brought up to the surface by the calc-alkaline andesite and basaltic andesite. Spinel harzburgite is predominant and olivine orthopyroxenite, clinopyroxenite and dunite are subordinate. The harzburgite has highly depleted characters, high Fo content of olivine (90 to 92), high Cr# of spinel (up to 0.7) and low amounts of modal clinopyroxene.

The harzburgite has lower Fo of olivine content than ordinary peridotite at a given Cr# of spinel. There are no correlations between degree of metasomatism, amounts of secondary phases, and mineral compositions, although some contain metasomatically formed secondary orthopyroxene at the expense of olivine. There is a discrepancy between the relatively low Fo content of olivine and other petrological features, e.g., high Cr# of spinel, low abundance of HREE, and high LREE. Thus, the Avacha harzburgite is residue after melting assisted by LREE and FeO\*-rich fluid. It has been unclear which phase controls bulk-rock geochemical features in the highly depleted harzburgite. We revealed the enrichment of LREE and LILE along olivine-olivine grain boundary, which is a quite important for their repository in the highly depleted harzburgite.

There are two types of secondary orthopyroxene in texture and chemical characters; one has complicated texture and sometimes forms radial aggregates (Opx II-1), and the other has subhedral to euhedral shape and is associated with secondary clinopyroxene, hornblende and silicic glass (Opx II-2). HREE concentrations are relatively low in Opx II-1 than in the other orthopyroxenes (Opx II-2 and primary), and most of

incompatible trace elements are below the detection limits in Opx II-1. These indicate that the metasomatic agent involving in formation of Opx II-1 was silicate-bearing aqueous fluid. On the other hand, the secondary clinopyroxene associated with opx II-2 vein has a LREE-enriched pattern and weak Sr positive anomaly, suggesting a hydrous melt of adakitic affinity for the metasomatic agent.