

Unusual high-Ti corundum recovered from the Horoman peridotites, Hokkaido, Japan

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Oceanic and continental crust are recycled into the mantle due to subduction of oceanic plate in the mantle, and the crustal materials are thought to be mixed in the mantle through mantle convection (W.Xu et al., 2008). However, the mode and process of crustal mixing in peridotites are unknown, and constraints using recycled crust minerals are needed for elucidating the mantle-crust circulations. Horoman peridotites, located in the Hidaka Mountains of Hokkaido, is known as a fresh peridotite that is less serpentinized. By the metasomatism of the melt-mantle reaction, the harzburgite-lherzolite shows a remarkable stratigraphic structure. Recently, the occurrence of crustal minerals has been reported by Li et al., (2017) from the Horoman peridotites, such as zircon, rutile, diamond with a low carbon isotopic ratio, suggesting that these crustal minerals in the Horoman peridotites have recycled origin due to the past subduction and mixing in the mantle. However, the origin of crustal minerals in the Horoman peridotite are unclear, and few recovered cases. To better understand the origin of crustal minerals in the Horoman peridotites, we improve the mineral separation techniques and recovered unusual Ti-rich corundum from the Horoman peridotite. describe the separated minerals in details.

In this study, peridotite samples collected from the quarry of Toho Olivine Industry Co., Ltd., were employed for the heavy mineral separations. Each peridotite samples, 764 kg of harzburgite and 954 kg of lherzolite, were cut to a plate shape and transported to the Yokohama National University. Using a jaw crusher and a continuous crusher, it was crushed to 0.1 mm in size and then subjected to sieving, gravity, and magnetic separations, and finally hand picking the remaining minerals, which embedded in epoxy resin and polished. Six zircons, one rutile (TiO_2) were recovered from within the lherzolite. On the other hand, grains recovered from nonmagnetic fraction harzburgite were embedded for mineral exploration using EPMA, and as a result, twelve corundum (Al_2O_3) grains were discovered. Inclusions and attached minerals coexisted in corundum were observed under the stereoscopic microscope. SEM-EDS analysis of six corundum grains confirmed that inclusions and attached phase consisting of (1) Si-Al-K rich silicate, (2) Ti-Zr oxide, and (3) Si-Ti alloy.

Morishita et al., (1998; 2000) previously reported the corundum xenocryst containing a trace amount of Cr from the gabbro boulder in the Ponsanushibetsu river in Samani town. This corundum is interpreted as a metamorphic product of gabbro protolith or xenocrust from the Hidaka crust. The characteristics of corundum obtained in this study is (1) almost no Cr, (2) unusual high-Ti content (maximum 2.3 wt% of TiO_2), (3) unique inclusions such as Ti-Zr oxide and Si-Ti alloys. Therefore, it is thought that a corundum recovered from the Horoman peridotite have different origin from that of Morishita et al. (1998; 2000). In another case, corundum with high TiO_2 concentration and specific inclusion (Ti-Zr oxide, Ti-Si alloy) has been reported from xenocrysts related from alkaline basalts of Israel Mt. Carmel (Griffine et al., 2016; 2018). Origin of Mt. Carmel corundum is still unclear, but tentatively proposed to be crystallized from mafic to ultramafic melt near the crust-mantle boundary under the highly reducing conditions (Griffine et al., 2018) The discovery of unusual high-Ti corundum from the Horoman peridotites will shed light on significant petrological issue on peridotite studies.

Reference

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