Olivine megacrysts in mantle peridotites

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Mineral grain size in the upper mantle affects many geological processes, such as mantle flow, fluid/melt migration and so on. Olivine grain size in the upper mantle conditions is generally less than 1 cm (Ave Lallemant et al, 1980; Karato, 2011). However, olivines, which are larger than 1 cm in grain size (olivine megacryst hereafter), often occur in peridotites. Therefore, understanding of the conditions of olivine megacrysts is critical to understand the upper mantle processes. In this study, peridotite samples with olivine magacrysts from the Horoman peridotite complex, Japan, and the Western Gneiss Region of Norway (WGR) are studied by crystallographic orientation analysis, ICP-MS and EPMA.

One peridotite sample is from MHL (Main Harzburgite-Lherzolite) suite in the Lower Zone of the Horoman peridotite complex. Olivine magacryst occurs subparallels to the foliation and looks darker than fine-grained olivines. Fine-giraned layer show porphyroclastic texture. Olivine megacryst and porphyroclast olivine in fine-grained layer developed subgrain boundaries and include lamellae of chromian spinel, clinopyroxene and amphibole.

Slip systems of olivine [001](100) and [100](001) are observed in the central part and the edge of olivine megacryst respectively, based on the U-stage measurements of subgrain boundaries and crystal orientations. Olivines in fine-grained layers show A-type fabric resulting from the dominance of [100](010) slip system (Jung et al., 2006). A-type fabric peridotite was reported in the Horoman peridotite complex and interpreted as the A-type fabric formed during uplifting of the Horoman peridotite complex from the upper mantle to the crust (Sawaguchi, 2004). Fine-grained olivine fabric near megacryst and slip system of olivine megacryst edge suggest that olivine megacryst would exist before the formation of A-type fabric in fine-grained layer.

Original olivine megacryst compositions before exsolution might relatively higher in Al, Cr, Na, Ti and Ca contents than fine-grained olivine. Adittion to this, presence of amphibole lamellae in olivine megacryst suggest that olivine megacryst was either originally hydrous olivine or hydrated after exsolution of unhydrous silicate minerals such as clinopyroxne. In the presentation, we will present results of chemical and structural observations of olivine megacrysts from the Horoman and WGR.

