Hydration and Ca-metasomatism in Mantle Wedge: An evidence from the Alag Khadny Accretionary Wedge, Western Mongolia

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Hydration and metasomatic reactions of mantle wedge play important roles on global material circulation and changes in physical properties along the plate interface within the subduction zone. Metasomatism is caused by specific components of fluids such as silica; however, our understanding on the relationship between hydration and metasomatism in mantle wedge is still limited. In this study, we report outstanding alteration textures of orthopyroxene as an evidence for significant Ca metasomatism within the mantle wedge, and its relation to the hydration processes.

The Alag Khadny accretionary wedge is located in the Chandman area, western Mongolia, Central Asian Orogenic Belt. The accretionary wedge is subdivided into northern and southern belts. The northern belt is consisted of orthogneiss bodies with layers of mica schists and paragneisses, including amphibolized eclogite, marble, and serpentinite bodies. The southern belt is composed mainly of serpentinized peridotite with minor ophicarbonates and limestone layer including lenses of epidote amphibolites. The ultramafic body mainly consists of harzburgite and lherzolite with minor dunite and its origin is interpreted as mantle wedge.

We collected 17 samples from the ultramafic body in southern belt of the Alag Khadny accretionary wedge in the Chandman area. The peridotites contain primary olivine (Ol), orthopyroxene (Opx), clinopyroxene (Cpx), and spinel. The peridotites were suffered from various extents of metasomatism and hydration. P-Olivine was replaced by antigorite with various extent, whereas primary Cpx was preserved without reactions. One of the notable features that is common in the peridotite is intense replacement of orthopyroxene (>60 vol.% was replaced). The mineralogy of the orthopyroxene replacement is divided into three types: secondary Cpx (S-Cpx) + tremolite (Tr), S-Cpx + tremolite (Tr) + S-olivine, S-Cpx. S-olivine shows lower Mg# (0.85-0.91) than the primary ones (Mg#=0.90-0.91), and S-Cpx shows the lower Al content and higher Mg# than the primary Cpx. Mass-balance calculation for the Opx pseudomorph showed the gains of Ca and water, and losses of silica, Mg and Fe. Due to the lack of Ca source in the primary minerals, significant amount of Ca metasomatism occurred induced by infiltration of the external fluids. The products of Ca metasomatism (S-Cpx, Tr) are commonly cut by antigorite veins, indicating that main hydration (antigorite formation) occurred after Ca metasomatism. The stability field of mineral assemblage of the Opx replacement was consistent with the P-T conditions of eclogite bodies in the Chandman area (T= 590-630 ˚C and P=11-16 kbar), implying that the hydration and metasomatism were caused by mantle wedge due to a supply of fluids derived from dehydration of the subducting slab.

Keywords: Ca metasomatism, Mantle Wedge, Orthopyroxene, Alag Khadny accretionary wedge

