Mantle Wedge Metasomatic Hydration; Evidence from the Khantaishir Ophiolite, Western Mongolia

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Hydration and metasomatism of mantle wedge are thought to cause drastic changes of mechanical properties of plate interfaces and to cause melting associated with arc volcanism. However, our understanding on the relationship between mass transfer during hydration of mantle wedge is still limited. In this study, we report outstanding alteration textures of orthopyroxene as an evidence for significant Ca metasomatism from the ultramafic bodies in the Khantaishir ophiolite, the Chandman area.

The Khantaishir ophiolite is located in the western Mongolia, Central Asian Orogenic Belt. Geochemical studies revealed that the volcanic rocks are boninite and/or high Mg andesite, indicating suprasubduction-zone setting related to the subduction initiation (Matsumoto and Tomurtogoo, 2003; Gianola et al., 2017). In the Chandman area, it is notable that several eclogite bodies exist close to ultramafic bodies and volcanic sequences (Stipska, et al., 2010). The ultramafic body mainly consists of harzburgite and lherzolite, and the chemical compositions of primary olivine and spinel indicates residual after 15-23% of melting (Gornova et al., 2017). Gornova et al., (2017) found that formation of secondary and tremolite after orthopyroxene; however, the detailed reaction mechanism is unclear.

We collected 17 samples from the ultramafic body in the Chandman area. The most samples contain primary olivine (Ol), orthopyroxene (Opx), clinopyroxene (Cpx), and spinel. The samples were suffered from various extent of hydration to produce serpentines, amphibole, magnetite, as well as locally chlorite and epidote. Secondary olivine shows lower Mg# (0.85-0.91) than the primary ones (Mg#=0.90-0.91). Cpx is classified into three types based on the mode of occurrence; large primary grain, exsolution of Opx, and fibrous aggregates replacing Opx. All types of Cpx show diopside composition, but the exsolution and fibrous types are lower Al content and higher Mg# than the primary Cpx. Antigorite is the dominant serpentine mineral, and lizardite and crysotile occur locally as vein. Amphibole occurs as large columnar grain or fibrous crystals replacing Opx. The composition of amphibole varies from tremolite to magnesiohornblende.

Metamorphic processes are dominantly observed in the Opx grains. Opx is divided into coarse type (1.5-6.0 mm) and fine type (200-300 μm). Rims of fine type Opx were replaced by fibrous Cpx grains, whereas the coarse type Opx, which has the exsolution of Cpx, possesses thin pseudomorphic rim consisting of secondary olivine, amphibole and fibrous Cpx. Bastite is composed of antigorite core and diopside or amphibole rim. Although the original Opx was preserved, the replacement of Opx by amphibole and Cpx indicates that significant Ca metasomatism occurred. Since the primary Cpx grains were well preserved, the source of Ca could not be Cpx, but derived from the external sources. The nature of hydration of the ultramafic body in the Chanman area is quite different form the serpentinized harzburgite in the Naran massif, where no signature of Ca metasomatism. We will discuss the relationship between the eclogite bodies and mass transport of the mantle wedge in the Chandman area.

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