# Formation of secondary olivine after orthopyroxene during serpentinization: Evidence from the Hantaishir ophiolite, western Mongolia

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Serpentinization plays a crucial role on global water circulation, and causes significant decrease in density and seismic velocity of mantle peridotite. Typically, it advances along slow-spreading ridges, in bending faults during the onset of subduction zone, and wedge mantle in the subduction zone. Serpentine minerals brought into deep part of subducting zone, are broken down to release $H_2O$, which is thought to associate with intermediate-depth earthquakes and arc magmatism. Secondary olivine, which is usually interpreted to be formed by dehydration of serpentine, has been reported in several serpentinites from subduction zone. Recently, Plümper et al., (2012) found that a novel texture of the secondary olivine which formed after orthopyroxene via bastite formation. Although the hydration and dehydration processes of ultramafic rock are important on the $H_2O$ budget within the subduction zone, the detail mechanism of secondary olivine formation is still poorly understood. In this study, we investigate serpentinization processes of ultramafic rocks from the Hantaishir ophiolite in Mongolia, and propose a new mechanism for secondary olivine formation after orthopyroxenes.
The Hantaishir ophiolite is located within the Central Asian Orogenic Belt (CAOB). It is located at the north of the Main Mongolian Lineament in the western Mongolia. The ophiolite composed of ultramafic rocks, pyroxenites and gabbro, sheeted dikes, pillow lavas, and pelagic sediments is strongly sheared and thrusted, but well-preserved ophiolitic sequence is partly preserved. It contains two ultramafic complexes, the Taishir and the Naran massifs. Geochemical study of igneous rocks indicates suprasubduction-zone origin (Matsumoto and Tomurtogoo, 2003).
Eighteen ultramafic rock samples were analyzed in detail by using optical microscope, EPMA, and raman spectroscopy. Most of the ultramafic bodies are intensively deformed, and completely serpentinized. Three samples in Naran massif preserve olivine as well as serpentines, spinel, magnetite, and brucite. Serpentine in these samples shows three occurrences; First one is fine-grained lizardite as a mixture with brucite in veins of primary olivine, Second one is chrysotile veins, cutting the all textures, and Third one is antigorite, which dominantly exists in matrix. We found the primary and secondary olivine. Primary and secondary olivine show contrasting Mg#, the former (0.92-0.93) and the latter (0.94-0.98). A plot Mg# of primary olivine vs Cr# (0.70-0.82) of spinel suggests that the ophiolite was formed at fore-arc setting within the subduction zone. It is noted that some secondary olivine exists as fine-grained aggregates. This aggregate looks replace large grain aligned fractures filled with antigorite which shows relatively high Al- and Cr-content. These observations suggest that secondary olivine aggregate was originated from orthopyroxene. Based on the similar textures, Plümper et al., (2012) suggested that bastite is formed after orthopyroxene and then a dehydration reaction occurs to the secondary olivine. In contrast, our sample does not the evidence for formation of bastite, and the secondary olivine and antigorite look formed at the similar stage. Therefore, we propose that the secondary olivine is directly formed by silica-releasing reaction after orthopyroxene, and the releasing silica is reacted with primary olivine to produce antigorite. In this mechanism, the secondary olivine could be formed during the hydration stage within subduction zone.

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