Crystal Preferred Orientation Development of Secondary Olivine Formed by Hydration of Orthopyroxene: Implication to Anisotropy of Shallow Mantle Wedge during Initiation Stage of Subduction

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Crystal preferred orientation (CPO) of olivine (Ol) provides significant effects on physical properties of the upper mantle, and the comparison of the Ol CPO analyses and observations of seismic anisotropy make it possible to simulate the flow pattern of upper mantle. The CPO analyses on naturally or experimentally deformed Ol samples have shown the relationship between deformation conditions (stress, temperature and H_2O content) and CPO patterns produced by the plastic deformation [e.g. 1]. In contrast, some studies have suggested specific topotactic relationships between Ol and serpentine minerals [e.g. 2, 3]. Therefore, the metamorphic reactions provide crucial controls on the physical properties of mantle. However, our understanding on their effects for mantle wedge anisotropy is still limited. In this study, we show the characteristic features of CPO of secondary olivine (S-Ol) formed after orthopyroxene (Opx) in metaharzburgite from the Naran massif, the Khantaishir ophiolite, western Mongolia and discuss seismic anisotropy of S-Ol-bearing mantle wedge during initiation stage of subduction.

Metaharzburgite in the Naran massif is composed of primary olivine (P-Ol), S-Ol, antigorite, and Cr-Spinel. S-Ol mainly occurs as mm-scale aggregates. S-Ol aggregate is composed of 10-50 μm Mg-rich olivines, magnetite, and sub-parallel bands of antigorite (B-Atg). Our previous study revealed that these S-Ol+B-Atg formed by pseudomorphic replacement of Opx during hydration of mantle wedge although primary Opx was not preserved [4]. P-Ol, S-Ol and B-Atg, and antigorite in matrix (M-Atg) show contrasting CPOs, respectively. P-Ol CPO shows the strong concentration of the *b*- and *c*-axes normal to the foliation and parallel to the lineation. It suggests plastic deformation by dislocation creep under relatively low stress and high-water condition. CPOs of M-Atg and P-Ol reveal clear crystallographic relationships between Atg and P-Ol: the concentrations of the *a*-, *b*- and *c*-axes of M-Atg are sub-parallel to the *b*-, *c*- and *a*-axes of P-Ol, respectively (topotactiv growth of M-Atg after P-Ol). In contrast to P-Ol, S-Ol aggregate does not show a strong CPO in an entire thin section, but the weak CPOs are developed in individual S-Ol aggregates. This indicates that the S-Ol CPO was developed not by deformation processes but was affected by the orientation of pre-exisiting Opx grains. The distribution of B-Atg in S-Ol aggregates could represent the cleavage of P-Opx, and the (001) plane of B-Atg is oriented sub-normal to the P-Opx cleavage. Assuming that Atg bands present the cleavage of P-Opx, the *c*- and *b*-axes of Atg are likely to be sub-parallel and normal to the Opx cleavages, respectively. These features suggest that high-T hydration of mantle wedge of the Naran massif proceeded without intense deformation and anisotropy development during initial stage of subduction zone development.

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