Internal structure of two-pyroxene spinel symplectites: EBSD study on Horoman peridotites and its implication in mantle processes

Norihiro Odashima[1]; Tomoaki Morishita[2]; # Kazuhito Ozawa[3]; Hiroko Nagahara[4]; Akira Tsuchiyama[5]; Ryoko Nagashima[6]

[1] Earth and Planetary Sci.The University of Tokyo; [2] Earth Science, Kanazawa Univ.; [3] Univ. Tokyo, EPS; [4] Dept. Earth Planet. Sci., Univ. Tokyo; [5] Earth and Space Sci., Osaka Univ.; [6] Earthscience, Kanazawa Univ.

Crystallographic orientation of minerals in symplectite from the Horoman Peridotite Complex, Japan was examined with electron backscattered diffraction (EBSD) attached to a field-emission gun SEM (FE-SEM). The symplectite is composed of a fine intergrowth (smaller than 10 microns) of orthopyroxene, clinopyroxene, and spinel, and is a product of decompression reaction between garnet and olivine. Detailed EBSD observation on a symplectite shows that it is composed of two segments with misorientation for spinel as large as 55 degrees around the axis nearly perpendicular to the lineation and parallel to the foliation. The two crystals are in mirror symmetry with the segment boundary approximately parallel to the mirror plane. The segment boundary is interpreted as spinel law twin formed during the phase transition because the misorientation angles for pyroxenes are as small as 5-10 degrees. The two segments are further subdivided into several sectors mostly with gradual lattice distortion smaller than a few degrees/mm and intra-sector misorientation mostly smaller than 25 degrees. These sectors coincide with those of pyroxenes identified with optical microscope and EBSD. Such sector boundaries are inferred to be subgrain boundaries formed by dislocation creep, because the misorientation axes of subgrain boundaries and those of gradual lattice distortion for all constituent minerals are similar. The symplectite minerals in each sector show systematic crystallographic orientations (topotaxy) with each other. The orientations of the (100) and (010) planes and [001] axis of orthopyroxene and clinopyroxene coincide. The (100) planes of pyroxenes are parallel to one of the $\{111\}$ planes of spinel, and (010) of pyroxenes to one of $\{101\}$. The symplectite minerals acquired the systematic crystallographic orientations when they nucleated in a single crystal of garnet upon decompression, and the orientation was later modified by deformation during the ascent of the complex forming the subgrain structure. The internal structure of symplectite may provide useful information on ascent process of the upper mantle.