Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SIT05-P06 Room:Convention Hall Time:May 21 18:15-19:30

Comparison of the CPO of antigorite serpentinite by U-stage, EBSD and synchrotron X-rays

Yusuke Soda[1*], WENK, Rudolf[2]

[1]School of Natural System, College of Science and Engineering, Kanazawa University, [2]University of California, Berkeley

Crystallographic preferred orientation (CPO) of antigorite is the cause for seismic anisotropy observed in subduction zones. Antigorite CPO is a key to understanding deformation in subduction zone. Phyllosilicates, including antigorite, are mechanically weak minerals compared with olivine or quartz. Antigorite CPO has been measured by several methods, U-stage, EBSD and synchrotron X-rays.

We measured antigorite CPO of foliated antigorite serpentinites from Toba, Saganoseki and Nagasaki areas in Southwest Japan. A serpentinite sample from Toba contains olivine and shows mylonitic textures. Microstructures around olivine porphyroclasts indicate that antigorite grew synchronous with the shear deformation. Serpentinite mylonite from Saganoseki is serpentinized completely. Chemical composition maps of serpentinite from Saganoseki show that the Fe-content of antigorite is inhomogeneous and Fe-rich antigorite crystallized along grain-boundaries and in fractures of Fe-poor antigorite. Serpentinite schist from the Nagasaki area develops a weak foliation and lineation, defined by arrays of bastite (altered phases of pyroxenes).

In the case of U-stage (optic microscope), we could measure relatively coarse-grained antigorite with needle shape. The CPO pattern of antigorite from Saganoseki and Toba is that [010] of antigorite is parallel to the lineation, [001] of antigorite is normal to the foliation, [100] of antigorite is normal to the lineation on the foliation. EBSD measurements from Saganoseki and Toba gave the same antigorite CPO patterns as the U-stage measurements. Compared with olivine, Kikuchi patterns of antigorite are weaker. We could not get the fabric pattern from fine-grained aggregates by U-stage or EBSD. Synchrotron X-ray measurements performed at the high-energy beamline ID-11-C of APS, Argonne National Laboratory on serpentinites from Saganoseki and Nagasaki also provided the same fabric patterns, averaging also over fine-grained crystallites.

Three measurement methods fundamentally give the same antigorite CPO pattern. However, the strength of the fabric patterns decreases in following order: U-stage>EBSD>X-rays. This is due to the selection of well-crystallized antigorite by the former two methods. Calculated elastic velocity anisotropy from X-rays results are lower (anisotropy of P-wave (AVp); 11-15%, anisotropy of S-wave (AVs); 10-15%) than from EBSD results (AVp; 12-19%, AVs; 18-21%). EBSD measurement and U-stage thus over-estimate elastic velocity anisotropy, since both methods only measure relatively coarse-grained and well crystalized antigorite.

Keywords: antigorite, CPO, elastic velocity anisotropy, synchrotron X-ray