New lattice preferred orientation (LPO) of amphibole experimentally found in simple shear

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In order to understand seismic anisotropy, it is necessary to study the CPO of the minerals in the rocks. Amphibole is a major constituent rock of the middle to lower crust. Amphibole which is a major constituent mineral of amphibole is elastically anisotropic and has a great effect on seismic anisotropy in the crust. However, there is very little experimental research on what CPO appears in amphibole at certain temperature and pressures. In this work we performed shear deformation of amphibole under the pressure of 0.5GPa and temperatures of 500-700°C.

Methods

The experimental conditions were temperature 500 – 700°C and pressure 0.5 GPa used and used apparatus is modified Griggs apparatus in Seoul national university. For shear strain measurements, thin nickel foil was inserted between samples perpendicular to shear plane. Confining pressure was raised for over 14 hours. After reaching pressure of 0.5 GPa, sample was annealed at least 1 hour to remove possible defects generated during pressurization. Temperature was raised for about 1 hour. After reaching target temperature, sample was deformed by moving the alumina piston with constant speed. After deformation, confining pressure was depressurized for over 14 hours.

CPOs of amphibole were determined by using electron backscattered diffraction (EBSD) attached on FE-SEM (LEO 7100F) with HKL system with channel software in SNU. Seismic velocity and anisotropy were calculated by solving Christoffel equation using FORTRAN program (Malecic, 1990) with 3-D data and the elastic constants of hornblende (Alekseevskiy and Ryzhova, 1961).

Summary

In this study, we deformed amphibolite by simple shear at the pressure 0.5GPa. We found four CPO types of amphibole. In particular, type – IV CPO of amphibole was first observed by experiment. The type – IV CPO of amphibole appeared at low temperature and high strain. The cause of type – IV CPO appears to be the mixing of fine-grained amphibole due to high strain and coarse-grained amphibole due to low strain. The fast shear wave polarization directions were subnormal to shear direction and the flow dipping angle at 45°. This result is same result as at 1GPa and can explain the trench-parallel fast shear wave polarization direction in the subduction zone.