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Experimental study on the deformation fabrics of chlorite at high pressure and high temperature

Dohyun Kim and Haemyeong Jung

Tectonophysics laboratory, School of Earth and Environmental Sciences, Seoul National University, Korea, Republic Of (jet0330@gmail.com)

Deformation experiments of chlorite peridotite were conducted in simple shear at high pressure and high temperature to understand the lattice preferred orientation (LPO) of chlorite and resultant seismic anisotropy. Natural chlorite peridotite which consists of olivine 60%, chlorite 31%, and minor content of pyroxenes was used as a starting material. The experimental conditions were pressure (0.5–2.5 GPa), temperature (500–720 ˚C), and strain rates of 2.7×10^{-6}–9.7×10^{-6} s^{-1}. Experimental products were observed and analysed with electron backscattered diffraction (EBSD) in scanning electron microscope (SEM). We found two types of LPOs of chlorite depending on the shear strain independent of P-T conditions. Samples with low shear strain ($\gamma \leq 3.1\pm0.3$) showed the [001] axes of chlorite strongly aligned subnormal to the shear plane (Type-1). However, samples with high shear strain ($\gamma \geq 5.0\pm1.5$) showed the [001] axes of chlorite strongly aligned subnormal to the shear direction (Type-2). These two types of chlorite LPOs were previously reported in natural samples without understanding the mechanism of LPO formation. The LPOs of experimentally deformed chlorite produced high seismic anisotropy of P-wave (AVp = 23.6%) and S-wave (max. AVs = 46.9%). It is found that strong seismic anisotropy observed in the mantle wedge and subducting slabs in subduction zones worldwide can be attributed to the LPOs of deformed chlorite.