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Lattice preferred orientation and seismic anisotropy of chloritoid in subduction zone

Jungjin Lee[1], Mainak Mookherjee[2], Taehwan Kim[3], Haemyeong Jung[1], and Reiner Klemd[4]
[1]Seoul National University, School of Earth and Environmental Sciences, Seoul, Republic of Korea (ljj2718@snu.ac.kr)
[2]Earth, Ocean and Atmospheric Sciences, Florida State University, Tallahassee, Florida, USA
[3]Division of Polar Earth-System Sciences, Korea Polar Research Institute, Incheon, Republic of Korea
[4]Geo–Centre of Northern Bavaria, Friedrich–Alexander University of Erlangen– Nürnberg, Erlangen, Germany

Subduction zones are often characterized by the presence of strong trench-parallel seismic anisotropy and large delay times. Hydrous minerals, owing to their large elastic anisotropy and strong lattice preferred orientations (LPOs) are often invoked to explain these observations. However, the elasticity and LPO of chloritoid, which is one such hydrous phases relevant in subduction zone settings, is poorly understood. In this study, we measured the LPO of polycrystalline chloritoid in natural rock samples and obtained the LPO-induced seismic anisotropy and evaluated the thermodynamic stability field of chloritoid in subduction zones. The LPO of chloritoid aggregates displayed a strong alignment of the [001] axes subnormal to the rock foliation, with a girdle distribution of the [100] axes and the (010) poles subparallel to the foliation. New elasticity data of single-crystal chloritoid showed a strong elastic anisotropy of chloritoid with 47% for S-waves (V_S) and 22% for P-waves (V_P), respectively. The combination of the LPO and the elastic anisotropy of the chloritoid aggregates produced a strong S-wave anisotropy of AV_S = 18% and a P-wave anisotropy of AV_P = 10%. Our results indicate that the strong LPO of chloritoid along the hydrated slab-mantle interface and in subducting slabs can influence trench-parallel seismic anisotropy in subduction zones with “cold” geotherms.