Geophysical Research Abstracts
Vol. 20, EGU2018-17139, 2018
EGU General Assembly 2018

Employing Finite Element Method using COMSOL multiphysics to predict seismic velocity and anisotropy: Application to lower crust and upper mantle rocks

Mohsen Bazargan (1), Bjarne Almqvist (1), Christoph Hieronymus (1), and Sandra Piazolo (2)

(1) Uppsala University, GeoCentrum, Geophysics, Sweden (mohsen.bazargan@geo.uu.se), (2) School of Earth and Environment, University of Leeds (s.piazolo@leeds.ac.uk)

Crystallographic preferred orientation (CPO) is one of the principal parameters in causing seismic anisotropy in the lower continental crust and upper mantle. A very common method of calculating seismic anisotropy takes into consideration the bulk properties of the rock, based on the average value of CPO measurements using, for example, Scanning Electron Microscopy (SEM) - Electron backscatter diffraction (EBSD). This technique mainly uses Voigt-Reuss-Hill (VRH) estimates to calculate the bulk elastic tensor. Single crystal elastic constants and the volume and CPO for each mineral phase are combined to calculate the bulk elastic stiffness tensor for the rock. However, this does not provide any information on the role of other microstructures in the rock. In this study, we demonstrate a new method to predict seismic anisotropy. A new numerical modelling tool is introduced, which is based on the finite element method and uses the COMSOL multiphysics software. This program is used to simulate elastic wave propagation through heterogeneous and anisotropic medium and generate a model of seismic anisotropy, based on microstructural and CPO data from the EBSD microscopy images. The method allows for investigation of contributions of CPO as well as shape preferred orientation (SPO), as well as other microstructural features. We present calculated seismic anisotropy based on microstructural data from one Finero peridotite from Ivrea Verbano in Italy and two Caledonian amphibolites from central Sweden. The COMSOL program allows us to evaluate quantitatively the significance of different microstructural parameters, including CPO and SPO for these upper mantle and lower crust rocks. In the future steps we plan to develop the tool to be able to incorporate the effects of fractures, pores and presence of fluids into the model.