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Seismic anisotropy in the lower crust: The link between rock composition, microstructure, texture and seismic properties.

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Seismic anisotropy observed in Earth's interior is caused by the presence of aligned anisotropic minerals (crystallographic and shape preferred orientation; CPO and SPO respectively), and fluid and/or melt inclusions related to deformation. Therefore, the variations in seismic anisotropy carry valuable information about the structure of the mantle and crust. For example, anisotropy observed in the upper mantle is mainly attributed to the CPO of olivine, and provides strong evidence for the flow within the upper mantle.
Seismic anisotropy in the crust is still poorly constrained, mostly due to the much larger heterogeneity of the crustal rocks in comparison with the more homogenous mantle. Anisotropy in the crust will be affected by the variations in rock composition, microstructure, texture (presence or lack of CPO), brittle structures (e.g. fracture systems) and chemical composition of the minerals. However, once the relationships between those variables and seismic properties of the crustal rocks are established, seismic anisotropy can be used to derive characteristics of rocks otherwise out of reach.
Our study focuses on two sets of samples of middle to lower crustal rocks collected in Fiordland (New Zealand) and in Sweden. Samples from Fiordland represent a root of a thick (ca. 80 km) magmatic arc and comprise igneous rocks, which crystallized at high P and T conditions and were subsequently metamorphosed and deformed. Samples from Sweden are derived from a metasedimentary nappe in the Caledonian orogenic belt, which is mostly composed of gneisses, amphibolites and calc-silicates that have experienced different amounts of strain.
We use large area EBSD mapping to measure the CPO of the constituent phases and record the geometric relationships of the rock microstructure. Data is then used to calculate the elastic properties of the rock from single-crystal stiffnesses. Here, we utilize the EBSD GUI software (Cook et al., 2013), which offers varied homogenization techniques, including Voigt, Reuss, Hill, geometric mean and self-consistent and Asymptotic Expansion Homogenization (AEH) methods.
To test the advantages and disadvantages of the method, results are compared to measured geophysical properties of equivalent rocks. Such comparison, allows refinement of seismic data interpretation for mid to lower crustal rocks.

References:
Cook, A., Vel., S., Johnson, S.E., Gerbi, C., Song, W.J., 2013. Elastic and Seismic Properties (ESP) Toolbox (beta version); http://umaine.edu/mecheng/faculty-and-staff/senthil-vel/software/ESP$_{T}oolbox/$