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変形岩の弾性的異方性
Elastic anisotropy of deformed rocks

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The seismic anisotropy will provide us the information about deformation in the Earth's interior. In order to interpret observed anisotropy, we must understand the relationship between deformed textures and elastic properties. Plastic deformation gives rise to the lattice preferred orientation (LPO) of mineral grains, which leads to elastic anisotropy in deformed rocks. The development of SEM-EBSD has enabled us to measure the orientation of individual mineral grains in a deformed rock. Using the measured orientations and elastic constants of single crystals, we can calculate elastic properties of the deformed rock using Voigt or Reuss averaging schemes. No information about the shape or arrangement of grains is used in these averaging schemes. The Voigt average gives an upper bound, and the Reuss average a lower bound to elastic stiffness. The stiffness of the rock sample should be found within these bounds. When component minerals have similar elastic properties and weak anisotropy, Voigt and Reuss averages are nearly equal. These values can provide a good prediction of elastic properties. However, when component minerals have strong anisotropy, Voigt and Reuss values are far apart (Mainprice and Humbert, 1994). Additional information like the shape and arrangement of grains should be taken into account for a better prediction of elastic properties.

As the arrangement of grains, we focus on a layered structure seen in deformed rocks. For simplicity, we consider an alternation of two compositionally different layers. The two layers are composed of different mineral grains, which are well aligned in each layer. Two layers have different effective elastic constants. The elastic properties are assumed to have the symmetry of orthorhombic systems in both layers. Two layers are assumed to have the same principal axes of elastic tensors. The calculated effective elastic constants show Reuss values in relation to deformation perpendicular to the layers. The calculation gives Voigt values in association in relation to deformation parallel to the layers. In this presentation, we will also compare calculated and measured velocities for serpentinite mylonites.

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