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Determination of crystal orientation fabric from seismic wideangle data

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It is known from ice core analyses that the crystal orientation fabric (COF) of ice sheets is anisotropic and changes over depth. A better understanding of these anisotropies as well as their remote detection is important to optimize flow models for ice. Here we show how seismic wideangle measurements can be used to determine the COF remotely. We demonstrate the principle formalism how observed seismic traveltimes can be related to COF properties by a forward model and then apply the formalism to field data.
The eigenvalues that describe the ice fabric of the ice core EDML (Dronning Maud Land, Antarctca) are set into a relationship with the elasticity tensor. From the elasticity tensor the expected seismic velocities and reflection coefficients are calculated. Additionally we calculate the value eta from the Thomsen-parameters epsilon and delta. The value eta gives a measure of the anisotropy of vertical transverse isotropic (VTI)-media and is an important tool for the NMO-correction of anisotropic data. The approximation of reflection horizons as hyperbolas is not valid anymore in anisotropic media. The calculation of the moveout is therefore performed by a 4th order NMO-correction with the RMS-velocity and the effective eta value as variables.
This approach is applied to data from a wideangle survey shot at Halvarryggen, Dronning Maud Land, Antarctica. From this data we derived RMS-velocities and effective eta values. These values were than recalculated to interval velocities and interval eta values to give a hint on the measure of anisotropy of the different layers. The results give first insight into the anisotropies at Halvfarryggen.