Geophysical Research Abstracts
Vol. 19, EGU2017-6067, 2017
EGU General Assembly 2017

On the level of apparent anisotropy induced by small-scale heterogeneities

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Seismic anisotropy in tomographic models is usually used as a proxy for lattice-preferred orientation of minerals in the Earth's mantle, and provides constraints on the geometry of mantle deformation. In this work we investigate how small-scale seismic heterogeneities (e.g. layering) that cannot be resolved by long-period seismic waves may also produce apparent anisotropy in tomographic models, which is not directly interpretable in terms of mantle flow. We generate geodynamically plausible isotropic mantle models, including a self-similar mixture of basalt and harzburgite. The long-wavelength equivalents to these models are computed using upscaling relations that link properties of an elastic medium to properties of the effective, i.e. apparent, medium as seen by long-period seismic waves. The resulting homogenized media exhibit extrinsic anisotropy and represent what would be observed in tomography. We thus show that a non-negligible part of the observed anisotropy in tomographic models may be the result of unmapped fine layering in the mantle, and that it should not be necessarily interpreted in terms of lattice-preferred orientation of minerals due to mantle deformation.