JOINT INVERSION OF MAGNETOTELLURIC AND SURFACE WAVE DATA IN AN ANISOTROPIC LAYERED EARTH

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All models of the subsurface derived from geophysical data suffer from varying degrees of resolution and non-uniqueness. Joint inversion of different kinds of geophysical datasets has the potential to improve resolution, but has been commonly undertaken with datasets sensitive to the same physical parameter. Our work involves inverting simultaneously for different physical parameters, and is built upon a joint inversion method applied to teleseismic receiver functions and long-period magnetotelluric data for isotropic layered media (Moorkamp et al., 2007). We expand upon the Moorkamp et al., (2007) work to jointly invert surface wave dispersion curves and magnetotelluric data for anisotropic one-dimensional layered media.
Anisotropy is a powerful tool for understanding the formation of a geological environment, and can be related to present and past strain in the lithosphere. At lithospheric and sub-lithospheric depths, seismic anisotropy is often explained in terms of aligned crystals of olivine, the most abundant mineral in the upper mantle. The origin of electrical anisotropy is more controversial, but may also be due to olivine alignment, especially when hydrated.
An approximate agreement between geoelectric strike and seismic fast axis direction in continental lithosphere has been found in various regions, such as the Great Slave Lake shear zone (Eaton et al., 2004), across the Greenville Orogen (Ji et al., 1996), and the Sao Francisco Craton (Padilha et al., 2006). This suggests a common origin is plausible in some situations for both seismic and electrical anisotropy. These observations motivate our attempt to jointly invert seismic and electrical anisotropic parameters.
Assuming that seismic and electrical anisotropy have a common origin, we can thus expect superior resolution of azimuthal anisotropy for lithospheric and sub-lithospheric depths combining these two techniques.
We have examined the capabilities and limitations of this new approach with synthetic datasets and obtained encouraging results. We apply this new joint inversion of anisotropic parameters to real datasets, including northern Germany, but other regions will also be investigated.

magnetotellurics, seismology, inversion.

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