Multi-scale conductivity model of the contiguous US from inversion of the MT USArray

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SUMMARY

The MT component of the USArray consists of a high quality data set of magnetotelluric measurements that addresses both of these problems. Covering ~70% of the contiguous United States on a quasi-regular 70 km spaced grid, this unique publicly available data led to the development of several regional 3-D electrical conductivity models. However, an inversion of the entire data set demands novel multi-scale imaging approaches that can handle and take advantage of a large range of spatial scales contained in the data. We here present a 3-D electrical conductivity model of the contiguous United States derived from the inversion of the 1100 highest quality USArray magnetotelluric stations. The use of state-of-the-art modeling techniques based on high-order finite-element methods allows us to take into account complex coastline and reconstruct Earth's conductivity across many scales. The retrieved electrical conductivity variations are consistent with well-known continental structures such as the active tectonic processes within the western United States (e.g., Yellowstone hotspot, Basin and Range extension, and subduction of the Juan de Fuca slab) as well as the presence of deep roots (~250 km) beneath cratons. Furthermore, we interpret the conductivity variations in terms of upper mantle water content by coupling electrical conductivity with constrains on mantle thermochemical structure derived from the analysis of seismic data. Our results suggest the existence of a relatively upper mantle beneath the United States, with slight lateral variations. In particular, we find an increase in upper mantle water content from west to east, with largest values underneath the Midcontinent Rift System and the Appalachians.

Keywords: global induction, mantle conductivity, inversion, water content