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Electrical conductivity structure of the mantle derived from inversion of geomagnetic observatory data: implications for lateral variations in temperature, composition and water content.

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As most of Earth's interior remains geochemically unsampled, geophysical techniques based on seismology, geodesy, gravimetry, and electromagnetic studies play prominent roles because of their ability to sense structure at depth. Although seismic tomography maps show a variety of structures, separating thermal and compositional contributions from seismic velocities alone still remains a challenging task. Alternatively, as electrical conductivity is sensitive to temperature, chemical composition, oxygen fugacity, water content, and the presence of melt, it can serve for determining chemistry, mineralogy, and physical structure of the deep mantle. In this work we estimate and invert local C-responses (period range 3-100 days) for a number of worldwide geomagnetic observatories to map lateral variations of electrical conductivity in Earth's mantle (400-1600 km depth). The obtained conductivity profiles are interpreted in terms of basalt fraction in a basalt-harzburgite mixture, temperature structure, and water content variations. Interpretation is based on a self-consistent thermodynamic calculation of mineral phase equilibria, electrical conductivity databases, and probabilistic inverse methods.