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Electrical structure beneath the Hangai Dome, Mongolia, from magnetotelluric data

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The Hangai Dome in west-central Mongolia is an unusual high-elevation intra-continental plateau located far from tectonic plate boundaries and characterized by dispersed, low-volume, basaltic volcanism. This region is an ideal natural laboratory for studying intra-continental orogenic and magmatic processes resulting from crust-mantle interactions. The processes responsible for developing the Hangai Dome remain unexplained, due in part to a lack of high resolution geophysical data over the area.

Here we present newly acquired broadband (0.008 – 3,000 s) magnetotelluric (MT) data from a large-scale (∼200 x ∼450 km) and high resolution (site spacing > 5 km) survey across the Hangai Dome. A total of 125 sites were collected and include full MT sites and telluric-only sites where inter-station transfer functions were computed. The MT data are used to generate an electrical resistivity model of the crust and upper mantle below the Hangai Dome.

The model shows that the lower crust (∼30 – 50 km; below the brittle-ductile transition zone) beneath the Hangai Dome contains anomalous discrete pockets of low-resistivity (∼30 ohm-m) material that indicate the presence of local accumulations of fluids and/or low-percent partial melts. These anomalous regions appear to be spatially associated with the surface expressions of past volcanism, hydrothermal activity, and an increase in heat flow. They also correlate with observed crustal low-density and low-velocity anomalies. However they are in contrast to some geochemical and petrological studies which show long-lived crustal melt storage is impossible below the Hangai due to limited crustal assimilation and crustal contamination, arguing for a single parent-source at mantle depths.

The upper mantle (< 70 km) contains an anomalous low-resistivity zone directly below the Hangai Dome that represents a shallow asthenosphere, and possibly a zone of melt generation. The MT data require the presence of a small amount of partial melts (> ∼6%) at this location. The results are consistent with modern geochemical and geophysical data, which show a thin lithosphere below the Hangai region. Furthermore the results agree with geodynamic models that require a low-heat flux asthenospheric upwelling that thermally modifies the lithospheric mantle to explain both dome-like uplift and sporadic volcanism in the Hangai region.