Regional magnetotellurics across Mongolia: Constraining lithospheric properties and architecture

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SUMMARY

Mongolia is a region of major scientific relevancy because it is a prime example of continental intraplate surface deformation, which is poorly studied and not well understood. There are open questions regarding the tectonic evolution of the region, including the closure of the Mongol-Okhotsk Ocean and subsequent re-arrangement, the development of the Central Asian Orogenic Belt, and the genesis of the Khangai Dome and Mongolian Plateau.

Previous magnetotelluric (MT) field campaigns (2016-2018: 328 MT sites) across the Khangai Dome (Central Mongolia) imaged a localized asthenospheric upwelling with a corresponding thin lithosphere and fluid-rich domains within the lower crust. In this study, we report on new MT data consisting of 378 MT sites installed across Mongolia, west and east of Central Mongolia, from 2020 to 2023. This extended survey area now includes approximately 700 magnetotelluric measurements collected over a total area of approximately 1000 km by more than 1150 km, similar in scope to other national survey programs.

We use MT responses (impedances) estimated from both the previous and new measurements to generate a new, regional-scale, 3-D electrical conductivity model of more than half of Mongolia, using an open-access forward and inverse solver (GEMMIE), based on an integral equation approach. The new data were processed by employing, in particular, a multi-taper approach to improve the estimated MT responses at long periods.

The new 3-D model reveals lithospheric high-conductivity anomalies consistent with the main geological and tectonic features of Mongolia and indicates that the lithospheric anomalies previously imaged below Central Mongolia extend further westward but are bounded to the east by the Mogod fault system. It also reveals significant lithospheric-scale boundaries separating the northern and southern regions within Eastern and Western Mongolia. Furthermore, it establishes links between high-conductivity anomalies in the lower lithosphere with features of scientific and economic interest, such as fault or suture systems, important mineral zones, and intraplate volcanism.

Keywords: Magnetotellurics; Electrical Conductivity; Inversion; Lithosphere; Tectonics