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The electrical lithosphere in Archean cratons

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The southern African tectonic fabric is made up of a number Archean cratons flanked by Proterozoic and younger mobile belts, all with distinctly different but related geological evolutions. The cratonic margins and some intra-cratonic domain boundaries have played major roles in the tectonics of Africa by focusing ascending magmas and localising cycles of extension and rifting. Of these cratons the southern extent of the Congo craton is one of the least-constrained tectonic boundaries in the African tectonic architecture and knowledge of its geometry and in particular the LAB beneath is crucial for understanding geological process of formation and deformation prevailing in the Archean and later. In this work, which forms a component of the hugely successful Southern African MagnetoTelluric Experiment (SAMTEX), we present the lithospheric electrical resistivity image of the southern boundary of the enigmatic Congo craton and the Neoproterozoic Damara-Ghanzi-Chobe (DGC) orogenic belt on its flanks.

Magnetotelluric data were collected along profiles crossing all three of these tectonic blocks. The two-dimensional resistivity models resulting from inverting the distortion-corrected responses along the profiles all indicate significant lateral variations in the crust and upper mantle structure along and across strike from the younger DGC orogen to the older adjacent craton. The are significant lithospheric thickness variations from each terrane. The The Moho depth in the DGC is mapped at 40 km by active seismic methods, and is also well constrained by S-wave receiver function models. The Damara belt lithosphere, although generally more conductive and significantly thinner (approximately 150 km) than the adjacent Congo and Kalahari cratons, exhibits upper crustal resistive features interpreted to be caused by igneous intrusions emplaced during the Gondwanan Pan-African magmatic event. The thinned lithosphere is consistent with a 50 mW.m-2 steady-state conductive lithospheric geotherm. Preferential alignment of graphite and/or interstitial sulphides along grain boundaries facilitated by deep shear movement during crustal extension and thinning could account for the high conductive region within the DGC. The Congo and Kalahari cratons are characterised by very thick and resistive lithosphere, approximately 220 km and 160 km respectively and both their cratonic roots appear to be thrusted underneath the DGC. The Archean-Proterozoic basement inliers, which are part of the Congo craton nuclei are geologically mapped within the DGC in northern Namibia, further suggesting that the craton extend far south into the orogenic belt.