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Results from SAMTEX: The Southern African lithospheric mantle – electrical structures and geometries and comparison with seismological information

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The Southern African Magnetotelluric Experiment (SAMTEX) is imaging the electrical structures and geometries of the continental lithosphere below Botswana, Namibia and South Africa to depths of 200+ km. Primary geometrical information can readily be obtained from lithospheric-scale MT experiments about the three-dimensional variation in conductivity, and this information can be related to formation and deformation processes. In particular, one important piece of geometrical information easily and relatively precisely (to within 10%) obtained from MT data is the depth to the lithosphere-asthenosphere boundary (LAB), due to the sensitivity of conductivity to small fractions (<1%) of partial melt and/or increased water content.

Over four phases of acquisition SAMTEX measurements have been made at a total of more than 700 MT sites in an area of greater than a million square kilometers, making it by far the largest-ever MT project undertaken. In particular, during Phase IV very challenging MT measurements were made in the highly-remote Central Kalahari Game Reserve, completing the coverage of Botswana. One of the most significant results from SAMTEX is the mapping of the LAB beneath the Archean cratons and bounding mobile belts of Southern Africa, particularly beneath Namibia and Botswana for which no prior lithospheric information exists. As would be expected, the electrically-defined LAB is generally shallow (150 km) beneath the mobile belts, deep (250 km) in the centres of the cratons, and transitional at the edges of cratons. Kimberlites are useful in also inferring lithospheric thickness, and diamondiferous kimberlites are located primarily where the electrical lithosphere is transitional in thickness, or where there is a change in its electrical anisotropy properties, both of which are craton edge effects.

The electrical properties of the continental mantle derived from SAMTEX data can be compared with seismic ones derived from data from the South African Seismic Experiment (SASE) of the Kaapvaal Project and from regional/continental-scale investigations. Generally there is very good predictive linear agreement between seismic velocity and log(conductivity), indicative of both being influenced by the same bulk property factors, such as temperature, Mg# and composition.