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Lithospheric structures and geometries in northeastern Botswana revealed through SAMTEX magnetotelluric profiling

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Knowledge of geological terranes and lithospheric structure and geometries in northeastern Botswana is very limited due to the thick Phanerozoic cover rocks. The postulated terrane outlines are based on only a few locations of outcrop and regional-scale magnetic and gravity studies. No lithospheric probing geophysics has ever been conducted in that area, therefore the thickness, internal structure and geometry of the lithosphere of the Zimbabwe craton and the surrounding mobile belts (Magondi Mobile Belt, Ghanzi-Chobe Belt, Limpopo Belt) are totally unconstrained.

Since late-2003 the resistivity of the subsurface structures in southern Africa have been investigated by the deep probing, electromagnetic technique magnetotellurics. The Southern African MagnetoTelluric Experiment (SAMTEX) acquired data at over 700 MT stations across the subcontinent in an area in excess of one million square kilometres.
A data subset of 108 sites located in northeastern Botswana covers the area of the projected western extent of the Zimbabwe craton in Botswana. We have processed the data to response functions, undertaken geoelectric strike analyses to derive regional responses, and initiated 2D inversion of the north-south orientated profile crossing the Zimbabwe craton (called the ZIM line).
Although the strike direction varies along the profile and with depth, acceptable strike directions were found that match the strike of major geological structures, e.g., the orientation of the Okavango dyke swarm and the direction of the Magondi Mobile Belt.

In this paper 2D isotropic inversion models of the whole ZIM profile and a focused inversion of the crustal northern part of the profile will be shown and interpreted geologically. Also the anisotropic effects of the Okavango dyke swarm on the resistivity structure beneath,when a isotropic inversion scheme is used, will be discussed.

The MT data results provide new information about the unconstrained terrane boundaries in northeastern Botswana. Based on our results we suggest relocating the boundary between the Ghanzi-Chobe and Magondi belts northwards. We also found indications that the Zimbabwe craton might extend further west than previously assumed based on the magnetic data. Two-dimensional models of the other profiles and a 3D inversion of this area are desirable to gain a superior overall image of the lithospheric structure and to confirm the suggested modification of the Zimbabwe craton's western boundary.