Three-Dimensional Forward Modeling of Magnetotelluric Data Over Cratonic Lithosphere and Attendent Geological Structures: Case Study of the Zimbabwe Craton

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The Southern African MagnetoTelluric Experiment (SAMTEX) is covering a huge area - containing parts of South Africa, Namibia and nearly the whole of Botswana - with acquisition of magnetotelluric (MT) data. The project's aim is to gain more information on the lithospheric geometries of the geological structures of this region which contains some of the oldest lithospheric pieces on Earth – the cratons (e.g. Kaapvaal and Zimbabwe cratons).

Since the standard modeling of MT data is only in two-dimensions and the recently developed three-dimensional inversion programs require a lot of computation time and high speed computers with large memories, 3D forward modeling is a good compromise on the way to full 3D interpretation of MT data. Forward modeling of subsurface structures similar to the cratonic areas of study will give some indication of how the MT responses should look like and if they change significantly when the cratons have a different shape or extent or resistivity. The determined synthetic data then can be compared with the real data collected in the SAMTEX project.

The area for the case study is the western edge of the Zimbabwe craton in eastern Botswana. The craton is surrounded by the Damara Mobile Belt and the Magondi Mobile Belt to the north and west and the Limpopo belt to the south. The giant northern Botswana dyke swarm is cross cutting the craton in about WNW to ESE direction. Based on this geological information, a 3D model was created to calculate synthetic MT responses using the forward modeling routine implemented in the 3D inversion program MT3Dinv (developed by the Geophysical Inversion Facility, University of British Columbia).

We will show the results of this modeling exercise and compare them with the observations.