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Multi-dimensional resistivity modelling of the lithospheric structure of the Baoulé-Mossi domain in West Africa

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In this study we present results from the magnetotelluric (MT) experiment carried out in West Africa in 2013 as part of the WAXI program. The survey comprised a single 500-km-long East-West profile crossing northern Ghana and southern Burkina Faso and aiming for a better understanding of the lithospheric structure of the Baoulé-Mossi domain. The area covered by the WAXI MT data is defined by a very old and complex geological setting and therefore multi-dimensional MT modelling was considered, including joint interpretation with gravity and magnetic data. A 2D resistivity model of southern Burkina Faso was compared with magnetic as well as ground gravity data acquired along the MT profile revealing a detailed crustal structure of the area. MT responses at high and low latitudes are affected by localized currents in the ionosphere, which introduces distortions. The Equatorial Electrojet (EEJ) in West Africa is located right above the area of interest, and the effects on the WAXI MT data associated with the EEJ are mainly observed from 1,000s and higher, i.e., deep lithospheric mantle. Therefore the broadband (BBMT) were considered unaffected and only the long period (LMT stations) were reprocessed prior to 3D modelling. The 3D resistivity models show very interesting correlations with the main surficial geological structures. Some of the shear zones and sutures associated with the Banfora, Houndé, Boromo and Lawra belts can be clearly seen on the models. Those large-scale crustal structures (shear zones and belts) penetrate deep into the lithosphere. This implies that the locations of the structures are controlled by prior lithospheric zones of weakness that focussed stress and facilitated mantle fluid fluxing. Compared to the 2D results, the 3D model highlights stronger conductive anomaly along the major sutures defining the granite-greenstone assemblages. However, despite the apparent extension with depth of some of the relatively more conductive shear zones or sutures, the overall resistivity of the western part of the profile is very high (>10^4 Ω.m). Furthermore, in north-eastern Ghana, the Bole-Nangondi belt marks a transition in the overall mantle resistivity along the profile with resistivity decreasing from west to east. The Bole-Nangondi belt can also be associated with the western limit of a strong conductive anomaly observed in the upper SCLM/lower crust area of the eastern end of the profile. This particular feature as well as the other observed conductive anomalies are likely related

to the presence of graphite films, stable in cratonic areas up to depths of ~100 km, but could also reveal the presence of sulphides issued from past metasomatism events.