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Geophysical Analysis of the Paleoproterozoic Bui Greenstone Belt, Western Ghana; the Constraints of Conductivity on the Belt using an EM Inversion Technique

Ayikwei, A.E.[1], Armah, T.E.K.[1] , Jessell, M. [2,3], and Ley-Cooper, A.Y.[4]

[1]Department of Earth Science, University of Ghana, Legon, Ghana. aayikwei@ug,edu,gh
[2]Centre for Exploration Targeting, University of Western Australia, Perth, Australia
[3]IRD, Laboratoire, GET, 14 av E Belin, Toulouse, 31400, France
[4]CSIRO, Bentley WA 6102, Australia

The Bui Greenstone Belt of Ghana forms part of the 2.4 – 2.0 Ga Proterozoic Birimian domain of the West African Craton. It is situated between the Maluwe and Sunyani basins to the northwest and southeast respectively and is a 10 – 25 kilometre wide and 150 kilometre long prospective terrain for gold exploration (Zitzmann et al., 1997 [1]) in Ghana. The integration of geophysics with field relations to determine the structural nature of the belt as well as its depth to basement (i.e. base of regolith) is essential as a result of the limitations that arise from the use of field data as a stand-alone parameter for defining the belt. Some of these limitations include the acquisition of little or no geological and structural information as a result of variable exposure of outcrops. The use of airborne electromagnetics (AEM) in mapping the electrical properties of the ground, locating conductors and mapping overburden and bedrock geology and structures (Suppala et al., 2005 [2]) is an important constraint on our interpretations. It supplements results obtained from aeromagnetics and allows for weakly magnetized but conductive formations to be traced effectively in areas of poor outcrop exposure (Peltoniemi, 1982 [3]).

The AEM data processed using EMFlow produced conductivity depth images (CDIs), which over apparent resistivities such as those defined by frequency domain data, provide depth information (Ley-Cooper et al., 2010 [4]). From the CDIs evaluated, it was identified that the general conductivity depth to the basement was on average about 300m deep increasing or otherwise in some areas. This shows that the causative bodies creating these very high conductivities are at deeper depths and detectable by the AEM survey at lower frequency.

Evidence from the electromagnetic analysis shows that the Bui Greenstone Belt has generally been affected by two episodes of folding. The first, which is responsible for the general form of the syncline produced an asymmetric kind of fan shaped fold gentler on the westward side than the east as a result of the northwest–southeast (NW-SE) compressional forces acting on the belt. A second folding at the central eastern portion of the syncline suggests a possible shearing proposed to be dextral, culminating from its shape. The highly deformed nature of the conglomerates sampled within this zone exhibiting phyllitic kind of signatures and the presence of lineations provide evidence of possible shearing.

Dip values estimated from structural measurements from the field were used to correlate the various layer conductivities with their lithologic types. Since these extracted sections created are perpendicular to the strike of the rocks, we can assume that these variations in structures in relation to their dips will correlate with their conductivity trends. The result compared with magnetic data, downward continued to about 50, 100, and 150m respectively, showed that the amplitude of these conductivities correlated magnetically and were actually resultants of deep seated features.

References:

[1] Zitmann et al (1997) Geological, Geophysical and Geochemical Investigation of the Bui Belt in Ghana 7-112

[2] Suppala et al (2005) Geological Survey of Finland Special Paper 39: 103-118

[3] Peltoniemi M (1982) Geological Survey of Finland Bulletin 321: 222

[4] Ley-Cooper et al (2010) Geophysics 75: WA179-WA188