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Geophysical investigation for lead and zinc and associated minerals around Phophonga Hill, Goalpara District, Assam

Ashish Kumar*[1, 3], Om Prakash[2] and Uma Shankar[3]
[1]Geological Survey of India, Northern Region, Lucknow-226024
[2] Ex, Geological Survey of India, Northern Region, Lucknow-226024
[3]Department of Geophysics, Institute of Science, Banaras Hindu University, Varanasi-221005
*Corresponding author: akumar282@gmail.com

ABSTRACT

The detailed geophysical survey comprising self-potential (SP), induced polarization (IP) time domain (TD) and magnetic vertical field (VF) has been carried out in and around Phophonga hill, Goalpara district (Assam) in an area of 1.9 sq. km in order to delineate the subsurface extension of the anomalous body. The area is mainly occupied by Assam-Meghalaya Gneissic Complex rocks. These rocks of Archaean to Proterozoic age are deeply weathered. They are comprised of banded biotite hornblende gneiss and quartzo-feldspathic gneiss with pegmatite and schist. The geophysical data were processed and interpreted for the identification of lithological contacts, as well as a favourable zone for mineralization. Magnetic and apparent resistivity maps reveal a wide range of variation in magnetic and resistivity values over the exposed formation. The smooth variation in magnetic and resistivity values is recorded in the central part, occupied by soil/cultivated land. The contacts of exposed formation on either side of the study area and soil/cultivated land in the central part, have been demarcated by magnetic and resistivity methods. Some important anomalies have been delineated by the geophysical investigations (W200/N240, 0/N190, E200/N190, E400/N120, and W2600/N200) from Phophonga hill area to Satbaini area for possible lead, zinc, and iron sulphide mineralization. These anomalous zones have been recommended for the verification of the causative sources.

Keywords: Self potential; Induced polarization; Magnetic vertical field; Resistivity; Self-Potential anomalous zone; Mineralized body; Assam-Meghalaya Gneissic Complex

INTRODUCTION

Lead (Pb) and zinc (Zn) are the minerals that mainly occur in sulphide mineralization like galena (PbS) and sphalerite (ZnS). It is found in association with iron sulphide and also occur in its oxides. Iron sulfides are conducting in nature and can be helpful to detect Pb-Zn deposits (Evrard et al., 2018). The western Indian craton of Rajasthan remains the main attraction of base metal exploration (Imam et al., 2014; Bhadra et al., 2021). The lead and zinc are first reported by the Geological Survey of India (GSI) in the Rajpura-Dariba-Bethumni and Pur-Banera belt of western Indian craton of Rajasthan (Gupta, 1934; Imam et al., 2014). Geochemical mapping (Bora and Baruah, 2011) by GSI in Assam has reported higher concentrations of REE, Be, Ti, V, Rb, Sr, and Y in the inselbergs and isolated hillocks in and around the study area. Based on the anomalous values obtained during the geochemical mapping, a preliminary investigation for REE in the southern part of Agia around Sujukona Hill and Tukureswari Hill, was taken up during field session 2013-14 of GSI. The detailed mapping has delineated a shear zone controlled mineralization in the area (Bora et al., 2014). Given the presence of sulphide mineralization in the weak planes with quartz veins and fracture planes, as well as the high values of Zn and Pb in the samples taken along the shear zone, the detailed geophysical surveys (SP, IP, and magnetic) have been carried out along the shear zone to delineate the sub-surface extension and the sub-surface depth continuity of the anomalous body in and around Phophonga hill area (Figure 1). A total area of 1.9 sq. km has been covered with 10 line km from traverses E800 to W3000. Twenty (20) traverses were laid with a 200 m traverse interval with each traverse having length of 500 m with a station interval of 10 m.

GEOLOGY

The area is mainly covered by Assam-Meghalaya Gneissic complex rocks of Archaean to Proterozoic age, surrounded by Quaternary sediments of Late Pleistocene to Late Holocene age. The survey area is the northern extension of the Shillong/Meghalaya plateau, occupied by isolated hills and small hillocks (Baruah and Hazarika, 2008; Kumar et al., 2022). The inselbergs are isolated hills and ridges of Precambrians of the gneissic complex i.e. granite gneiss, hornblende biotite gneiss and migmatites. The gneissic complex has structural relation with the Shillong massif and basement (Bhagabaty et al., 2017). They form the oldest components of the basin and the rocks are deeply weathered, which include high-grade metamorphic rock granitoid gneisses, banded biotite hornblende gneisses with pink granitic injections and pegmatite and quartz veins. The meta-sediments and banded magnetite quartzite of the Shillong group are intruded by grey granite and pink porphyritic granite, pegmatite, quartz veins, basic intrusive and overlain by the Quaternary sediments of the Brahmaputra valley (Bora and Barua, 2011). The depositional landscape of the valley took its present shape during Quaternary era. Its origin and development are