

Application of Aerogeomagnetic and Ground Magnetic Surveys for Deep-Seated Kimberlite Pipes in Central India

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Abstract : The Central India Diamond Province (CIDP) is known for the occurrences of primary and secondary sources for diamonds from the Vindhyan platformal sediments, which host several kimberlites, with one operating mine. The known kimberlites are Neo-Proterozoic in age and intrude into the Kaimur Group of rocks. Based on the interpretation of aerogeomagnetic data, three potential zones were demarcated in parts of Chitrakoot and Banda districts, Uttar Pradesh, and Satna district, Madhya Pradesh, India. To validate the aero-geomagnetic interpretation, ground magnetic coupled with a gravity survey was conducted to validate the anomaly and explore the possibility of some pipes concealed beneath the Vindhyan sedimentary cover. Geologically the area exposes the milky white to buff-colored arkosic and arenitic sandstone belonging to the Dhandraul Formation of the Kaimur Group, which are undeformed and unmetamorphosed providing almost transparent media for geophysical exploration. There is neither surface nor any geophysical indication of intersections of linear structures, but the joint patterns depict three principal joints along NNE-SSW, ENE-WSW, and NW-SE directions with vertical to sub-vertical dips. Aeromagnetic data interpretation brings out three promising zones with the bi-polar magnetic anomaly (69-602nT) that represent potential kimberlite intrusive concealed below at an approximate depth of 150-170m. The ground magnetic survey has brought out the above-mentioned anomalies in zone-I, which is congruent with the available aerogeophysical data. The magnetic anomaly map shows a total variation of 741 nT over the area. Two very high magnetic zones (H1 and H2) have been observed with around 500 nT and 400 nT magnitudes, respectively. Anomaly zone H1 is located in the west-central part of the area, south of Madulihai village, while anomaly zone H2 is located 2km apart in the north-eastern direction. The Euler 3D solution map indicates the possible existence of the ultramafic body in both the magnetic highs (H1 and H2). The H2 high shows the shallow depth, and H1 shows a deeper depth solution. In the reduced-to-pole (RTP) method, the bipolar anomaly disappears and indicates the existence of one causative source for both anomalies, which is, in all probabilities, an ultramafic suite of rock. The H1 magnetic high represents the main body, which persists up to depths of ~500m, as depicted through the upward continuation derivative map. Radially Averaged Power Spectrum (RAPS) shows the thickness of loose sediments up to 25m with a cumulative depth of 154m for sandstone overlying the ultramafic body. The average depth range of the shallower body (H2) is 60.5-86 meters, as estimated through the Peters half slope method. Magnetic (TF) anomaly with BA contour also shows high BA value around the high zones of magnetic anomaly (H1 and H2), which suggests that the causative body is with higher density and susceptibility for the surrounding host rock. The ground magnetic survey coupled with the gravity confirms a potential target for further exploration as the findings are co-relatable with the presence of the known diamondiferous kimberlites in this region, which post-date the rocks of the Kaimur Group.

Keywords : Kaimur, kimberlite, Euler 3D solution, magnetic

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