Three-Dimensional Subsurface Characterization of Banded Iron Formation Mineralization using Gravity and Magnetic data in parts of Bharatpur, Dausa and Karauli districts of Rajasthan

Abstract

Three-dimensional modeling and inversion of gravity and magnetic data are carried out for characterization of 3D subsurface structures associated with Banded Iron Formation Mineralization in Rajasthan, India. Geographically, the study area is located in the Bharatpur, Dausa and Karauli districts of the Rajasthan province, and, bounded by latitudes 26°30′00″ N to 27°15′00″ N and longitudes 76°30′00″E to 77°15′00″E. Regional mapping using gravity survey in the study area has unleashed responses from the area's geological formations and structures. Post-processed gravity data has revealed that the Bouguer gravity anomaly varies from -30 mGal (in the eastern part) to –79 mGal (in the south-western part) with a total variation of 49 mGal, which shows the full effect of lithology and crustal structures on the gravity map. The area surveyed is characterized by high gravity anomaly in the eastern part and medium to low gravity anomaly in the central, south-eastern, and western parts of the Bouguer anomaly contour map. The Radially averaged power spectrum has brought out three density discontinuities at a depth of 3.20 km, 1.55 km, and 0.85 km in the study area. The interface lying at depth 3.20 km for gravity data may be interpreted as an interface between Bhilwara and Delhi Supergroup. It is clear from the Euler-3D solution is that most depth solutions for the causative sources lie in the range of 1.0-2.5 km depth. The magnetic anomaly map reveals a total variation of 7753 nT in the study area. The analysis of the magnetic anomaly map leads to separate the entire area into five bipolar magnetic domains trending in NE-SW direction of the area. The samples collected near the bipolar anomaly are identified as Banded Iron Formation and the susceptibility value is 26354 × 10-6 cgs unit. The general trends of the contours are in NE-SW directions which are following the general trend of the exposed geology in the study area. The radially averaged power spectrum of magnetic data mainly highlights one susceptibility discontinuity at depth of about 1.45 km which may be interpreted as the interface between Bhilwara Supergroup and Vindhyan Supergroup. Three-dimensional inversion of gravity and magnetic data reveal the lateral as well and vertical extent of causative bodies which can be used for exploitation in future.

Keywords: Gravity survey; Delhi Supergroup; Bhilwara-Vindhyan Supergroup contact; Banded Iron Formation (BIF); Mineralization; 3D modelling and inversion; Euler 3D deconvolution.