

Efficacy of the gravity and magnetic methods in mapping the subsurface features in the NE part of Madhya Pradesh (India)

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ABSTRACT

This study brings out the efficacy of the gravity and magnetic methods in delineating the subsurface features, such as fault/ tectonic contact and basin boundaries in parts of Singrauli and Sidhi districts of Madhya Pradesh (India). The Bouguer gravity and magnetic anomaly map, which was subjected to several filtering and processing techniques, clearly reflected the inferred structural features, which in turn correlate well with the geological features trending in E-W and NE-SW direction. Magnetic anomaly of higher amplitudes in the northwestern part, coincides with the presence of metabasalt, biotite schist and BIF, whereas in the northeastern part, it is due to the concentration of the magnetite grains in biotite schist and phyllite. The regional gravity low observed in central, northeastern and southwestern parts of the area is ascribed to sedimentary rocks belonging Gondwana formation. The residual gravity map shows several local gravity anomalies with amplitude and direction. Similarly, the residual magnetic anomalies reveal various shapes with the direction of extensions and orientations. The inferred boundary/ contact zone (F1-F1' and F3-F3') and faults like Amsi-Jiawan (F5-F5') and Jamui-Markundi (F6-F6'), are clearly brought out in the Total Horizontal Derivative (THDR) and Tilt derivative (TDR) maps of gravity data. The THDR of the magnetic data shows magnetic maxima over the Mahakoshal formation and also at various scattered locations in the northeastern and central parts of the map. The TDR of the magnetic data depicts anomalies close to zero magnetic values that coincide with edges or boundaries of the inferred faults like Amsi-Jiawan (F5-F5') and Jamui-Markundi (F6-F6'). The majority of Euler solutions fall at the contact between two litho-units faults/ contacts, with varying depth of 0.5 to 2.5km.

Keywords: Amsi-Jiawan fault, Jamui-Markundi fault, Singrauli, Gravity and magnetic studies, Total Horizontal Derivative (THDR), Tilt derivative (TDR).

INTRODUCTION

The integrated geophysical methods play a key role in the delineation of the subsurface features (inferred fault/ tectonic contact, cavity detection, regional and global tectonics and basin boundaries), which in turn, provide clues for the exploration of bulk mineral deposits. The study area located in parts of Singrauli and Sidhi districts of Madhya Pradesh, is bounded by the latitude 24° 00'N to 24° 30'N and longitude 81° 45'E to 82° 45'E (Figure 1). The objective of the study is to map the subsurface structures, (inferred fault/ tectonic contact and basin boundaries) from integrated gravity and magnetic studies. Two main faults, Amsi-Jiawan and Jamui-Markundi, has also been delineated from the study area.

GEOLOGY

Geologically, the area is represented by Vindhyan Supergroup, Sidhi gneiss group, Chotanagapur gneissic complex group, Mahakoshal Group, Gondwana Supergroup and Deccan Traps (Figure 2). The Vindhyan Supergroup is represented by Semri and Kaimur group of rocks. The Semri Group lies unconformably over the older granite gneiss and Mahakoshal Group of rocks. The Mahakoshal Group of rock are affected by the tectonic disturbances forming the weaker planes, which are later occupied by quartz veins. The granites belonging to Barambaba granite formation of Palaeoproterozoic age, occur as isolated outcrops and found dominantly exposed in northwestern part of the study area. Similarly, the