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Geophysical mapping east of Closepet Granite in Eastern Dharwar Craton for inferring geology and structure

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ABSTRACT

An integrated gravity and magnetic survey was carried out over the eastern margin of the Closepet Granite in the Eastern Dharwar Craton (EDC), southern India, to delineate concealed structural trends and crustal configuration. Ground gravity measurements were acquired using a Scintrex CG-5 gravimeter with DGPS elevation control, and magnetic total field data were collected using a proton precession magnetometer. Bouguer gravity anomalies were computed using standard free-air and Bouguer corrections ($\rho = 2.67$ g/cm^3), while the magnetic data were corrected for diurnal variations and the IGRF (epoch 2015). The datasets were processed using minimum curvature gridding and Fourier domain filters including analytical signal, tilt derivative, and Reduction to Equator (RTE). Spectral analysis, Euler deconvolution, and joint gravity–magnetic modelling were carried out to constrain source geometry and depth. The Bouguer gravity anomaly map exhibits a total relief of ~33 mGal (–95 to –62 mGal) and reveals a prominent N–S trending gravity high in the central part of the study area. This feature is characterized by steep gradients along its eastern margin and comparatively gentle gradients to the west, suggesting asymmetric geometry. Spectral analysis of gravity data identifies three principal depth levels at approximately 6 km, 3 km, and 1.5 km, indicating a layered upper crustal structure. Euler depth solutions corroborate these estimates and suggest deeper-seated sources in the northern part, compared to the south. The gravity high is interpreted as a laterally extensive three-dimensional crustal body and is considered to represent the probable subsurface extension of the Ramagiri Schist Belt. Associated gravity lows are attributed to lower-density granitic intrusions and structural depressions. Magnetic data, after RTE transformation, reveal dominant E–W to NW–SE trending features, superimposed on the N–S structural fabric. Spectral depths from magnetic data (4.5 km, 3 km, and 1.5 km) indicate that the deepest gravity source lacks significant magnetic susceptibility contrast, suggesting a weakly magnetic basement. Analytical signal and tilt derivative maps clearly delineate structural boundaries and dyke-like intrusions. Euler solutions further constrain shallow magnetic sources aligned along E–W and NW–SE trends. Further, the Joint gravity–magnetic modelling along a 76 km AA′ (N–S) profile, constrained by spectral depths, Euler solutions, geological information, and measured density and susceptibility values, confirms presence of a deep N–S trending density-controlled body and relatively shallow magnetically controlled intrusions. Spatial correlation between structural intersection zones and known corundum occurrences suggests additional prospective targets.

Keywords. Eastern Dharwar Craton, Closepet granite, gravity-magnetic, Indian shield

INTRODUCTION

The Dharwar Craton of Peninsular India, comprises Archean greenstone belts ranging in age from 3.4 to 2.7 Ga, intruded by extensive granitic bodies during later tectono-magmatic events. The craton is broadly divided into the Western Dharwar Craton (WDC) and Eastern Dharwar Craton (EDC) by ~2518 Ma Closepet Granite (Naqvi and Rogers, 1987; Jayananda et al., 2000; Ramakrishnan and Vaidyanadhan, 2008). Compared to WDC, EDC contains smaller and discontinuous greenstone belts. Subsequent Proterozoic dyke intrusions modified the crustal architecture after granitic emplacement, resulting in present-day surface exposures dominated largely by the Peninsular Gneissic Complex (PGC) and granitic terrains.

Extensive gravity and magnetic surveys have been conducted in the region to delineate subsurface geological structures and lithological variations. The Geological Survey of India (GSI) carried out geophysical investigations in multiple phases (Kailasam et al., 1974; Khare and Nagabhushanam, 1984; Chayanulu et al., 1989; Kesavamani et al., 1994), primarily focusing on localized areas of 1–2 km extent. The present survey covers a large area with higher data density using advanced geophysical instruments. Bouguer gravity anomalies and magnetic total field anomalies were computed from the acquired data. To enhance structural interpretation, derivative maps such as the first vertical derivative and horizontal gradient maps were generated. These derivative maps amplify short-wavelength anomalies and sharpen anomaly gradients, thereby enhancing the shallow subsurface features. The first vertical derivative, highlights near-surface sources by suppressing deeper regional effects, while horizontal gradient maps delineate lateral density and susceptibility contrasts by emphasizing maxima along structural boundaries. Consequently, faults, dyke intrusions, lithological contacts and structural discontinuities, can be identified more clearly from these enhanced gradients. The processed gravity and magnetic data sets were integrated to examine spatial correlations between density and magnetic susceptibility contrasts. Joint gravity–magnetic modeling was then performed to constrain the geometry of subsurface bodies and propose a plausible geological configuration for the study area.

GEOLOGY SETTING

Geochronologically, Archean Sargur group and Peninsular Gneissic Complex (PGC) forms bottom followed by Dharwar Supergroup (Archean-Lower Proterozoic) and then Closepet granite and dykes of Proterozoic age (Geology Map Degree sheet 57G by Cartography Division, GSI, Hyderabad