

Short Communication

## Delineation of structural lineaments from marine magnetic anomalies off Jonnalakonda, east coast of India

K V L N S Sarma, T C S Rao\* & D Gopala Rao  
National Institute of Oceanography, Dona Paula, Goa, 403 004, India

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Bathymetric and total magnetic intensity data off Jonnalakonda, south of Visakhapatnam have been collected. Magnetic anomaly contour map reveals that (1) the well developed magnetic anomaly occurring seaward side of Jonnalakonda is due to charnockitic bodies occurring at shallow depth around 0.37 to 0.4 km and (2) the high frequency and amplitude anomalies near to the coast are trending north west-south east direction. The well developed magnetic anomaly is interpreted following automated Werner deconvolution method and is verified with 2 dimensional model studies.

Geophysical survey was carried out over the continental shelf off Visakhapatnam and nearby areas on the east coast of India to detect anomalous zones that could aid in identifying structural features and mineral rich zones. From bathymetric and magnetic surveys Rao and Murty<sup>1</sup> identified 2 such anomalous zones off Bhimuniapatnam and Lawsons

Bay. Subsequently, detailed geological and geophysical surveys were carried out in Jonnalakonda and adjacent areas. This article describes results of detailed model studies deciphered from Werner deconvolution results for the magnetic data off Jonnalakonda.

Jonnalakonda (Fig. 1) is located at about 10 km

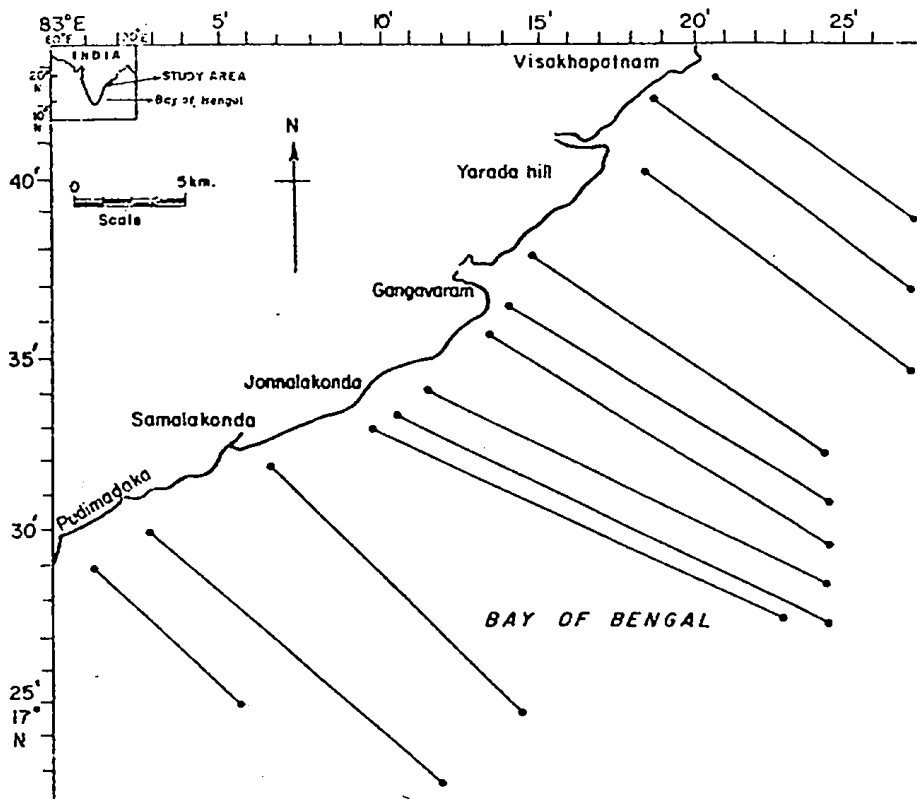


Fig. 1—Profile location map of the study area

\*National Institute of Oceanography, Regional Centre, Visakhapatnam 530 023, India

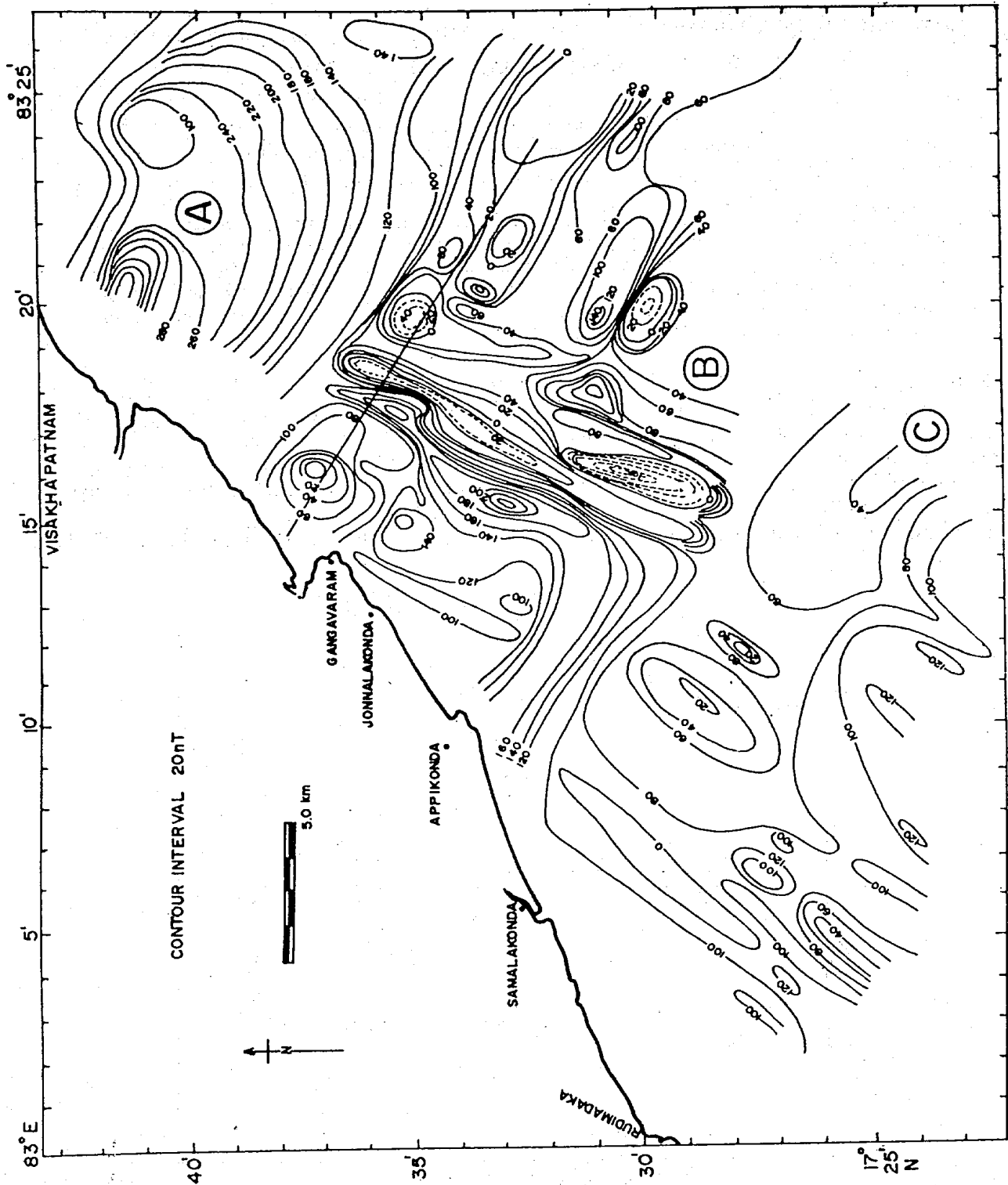


Fig. 2—Magnetic anomaly contour map

south of Visakhapatnam. Magnetic and bathymetric surveys along 12 east-west profiles were carried out covering the area within 5 to 15 m water depths between Visakhapatnam to Pudimadaka coasts.

Barringer proton precision magnetometer was used to record total magnetic intensities at 30 sec polarization interval. The bathymetric data were recorded by a Simrad echosounder. Positioning was obtained using sextant and reference to known shore objects. Total magnetic intensity anomalies were obtained by subtracting earth's dipole magnetic field following IGRF coefficients suggested by IAGA working group (DGRF)<sup>6</sup> and magnetic anomaly contour map presented (Fig. 2).

The total intensity magnetic anomaly contour map reveals 3 anomalous trends A, B, and C. The anomalous trends A and C are extending NW-SE direction whereas anomaly B is extending

approximately N-S direction. The anomaly A represents a broad and high amplitude positive anomaly of the order of 300 nanotesla (nT) extending from the coast to the eastern end of the survey area. The anomalous zone B of 100 to 300 nT amplitude trends in N-S direction. The anomaly B is located off Jonnalakonda whereas anomaly C is located off Pudimadaka.

The anomaly profiles are interpreted by Werner method, modified by Ku and Sharp<sup>2</sup>, with 2 digitizing intervals corresponding to the data length (NX) 24 points and appropriate decimation operator (DOPR). The method is applied to both the total field anomaly and horizontal derivative. Here the solutions from the horizontal derivatives are marked as crosses in Fig. 3. The depth from the Werner solutions is shown by thick line. The DOPR used for each case is varied from 1 to 6. The Werner solution

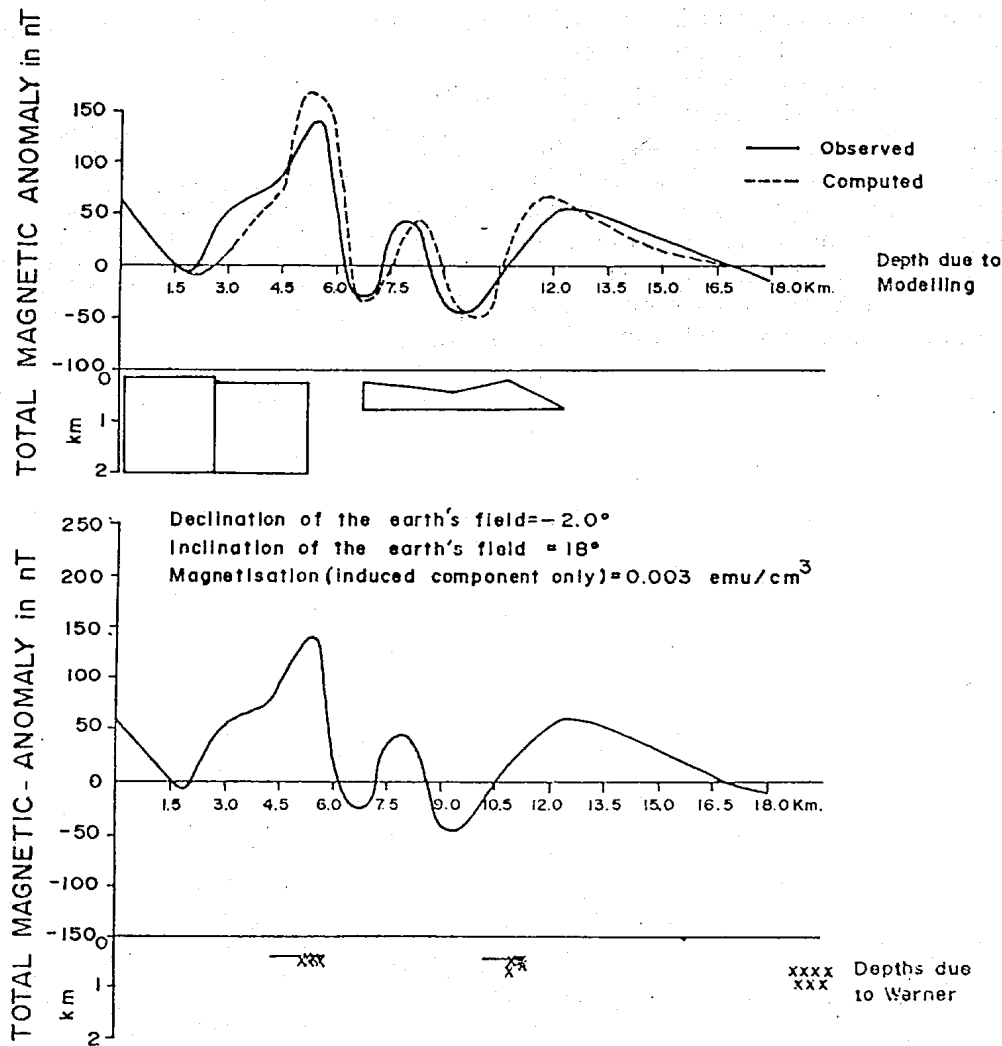


Fig. 3—Depths due to Werner and 2—dimensional model studies

from horizontal derivatives for the anomaly (with  $NX=24$ , increment = 0.75 km and  $DOPR=1$ ) appears to be the body situated at the corresponding depths as the causative source. The depth (0.4 km) and location of the top edges, susceptibility ( $0.003 \text{ emu.cm}^{-3}$ ) and other parameters are obtained.

The magnetic anomalies of B selected from the contour map off Jonnalakonda are modelled making use of the induced magnetisation following 2 dimensional model studies<sup>3</sup>. Results of the model studies along with some parameters such as the induced magnetization and magnetic inclination assumed in these computations are shown in Fig. 3. The depth about 375 m to the top of the causative source of the anomalies in water depth of 10 m was estimated.

The depths interpreted from the analysis of the present marine magnetic anomalies are correlated with the geological features adjacent to study area comprising charnockites and khondalites overlying granitic/gneissic rocks<sup>4</sup>. The basement features due to folding in the granitic/gneissic basement resulted from intense tectonic activity associated with the Eastern Ghats of this region<sup>4,5</sup>. Considering the shallow depth to top of the intrusive bodies and the magnetisation parameters the sources of the anomalies appear to be charnockites akin to adjacent onshore area. Occurrence of charnockites as intrusives into the khondalites is well reported in this area. Charnockites of both basic and acidic origin

have been reported and are being excavated from some parts of Visakhapatnam area. So charnockite sources at shallow depth appear to cause the anomalies. Occurrence of magnetite, ilmenite black sands on the nearshore beaches of Visakhapatnam coasts are reported<sup>5</sup>. High frequency anomalies of 10 to 180 nT amplitude off Pudimadaka and Jonnalakonda up to 15 m water depths are distinct from the well resolved anomalies in the seaward side. Causative sources of the anomalies are quite different and they may perhaps be due to occurrence of magnetic rich minerals at further shallow depths. Further detailed investigations of the areas are suggested to outline them and identify the minerals from the seabed and establish likely offshore extension of the nearshore black sands causing the anomalies.

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