RESEARCH NOTES

HYDROCARBONS IN BARMER AND JALOR DISTRICTS, RAJASTHAN?

Although geological estimates place the thickness of Post-Lower Palaeozoic sediments in Barmer basin at a meagre 500 m, the gravity picture of the Barmer basin, which is probably better called the Shiv basin, exhibits a record low of 50 mgals, suggesting possibly a thick pile of low density sediments. This note presents the results of 3–D modelling of this gravity low which yields a maximum thickness of 5000 m for the sediments, for an assumed density contrast of -0.3 gm/cc for the sediments with respect to the basement. Thus there appears to be a basic need for at least a better gravity coverage and some preliminary seismic work in the Shiv 'low' and the adjoining Sanchor (Gurha) 'low' to assess their possible potential for hydrocarbons.

It is common knowledge that for the occurrence of hydrocarbons, the prime requisite is a thick column of 'oil sediments' which mostly correspond to Jurassic to Eocene ages. In Barmer graben, apart from Proterozoic-Lower Palaeozoic equivalents, over 500 m thick sequence of Cretaceous-Eocene continental, marine sediments are known (Dhar and Mehta, 1974; Pareek, 1976). According to Siddique (1963), the total thickness of the sediments in the Barmer basin is only of the order of 1500 feet (i.e., 450 m). This is considerably less than the 4000 to 6000 m of sediments present in the Jaisalmer basin where a lot of exploration is going on in the search for hydrocarbons. This is perhaps one of the main reasons why the hydrocarbon prospects of the Barmer basin are considered marginal to speculative.

The Bouguer gravity map of this region (Fig. 1) shows some very prominent lows of several tens of milligals. The entire region northwest of Jaisalmer is marked by a low of over 40 mgals which is actually divided into two lows by the NW-SE trending Mari-Jaisalmer high. The other two major lows are: a 50 mgal low located near Shiv and another 40 mgal low near Gurha, north of Sanchor. These two lows actually correspond to the so called Barmer basin and Sanchor basin. The divide between the Jaisalmer basin and the Barmer basin is the gravity high corresponding to the Devikot ridge. Drilling conducted for groundwater over this high on Jaisalmer-Barmer road encountered granite basement at a shallow depth of only 130 m.

Reverting to the remarkable Shiv low of over 50 mgals (which is more than that of Jaisalmer low), spread over 10,000 sq. km. the question arises as to what this may be due to? Basically there appears to be a deep tectonic disturbance in the area. As far as the thickness of sediments is concerned, the Barmer basin (i.e., the Shiv low) appears capable of holding as much thickness of sediments as the Jaisalmer basin, according to gravity data. The stratigraphic sequence mapped in Barmer basin shows similarity to that of Jaisalmer basin (Dasgupta, 1974; Dhar, 1982). Other favourable conditions that are present in Jaisalmer basin are also broadly applicable to Barmer basin except that the latter is steep and somewhat

BOUGUER GRAVITY MAP OF WESTERN RAJASTAN
(EXTRACT FROM NGRI, 1975)

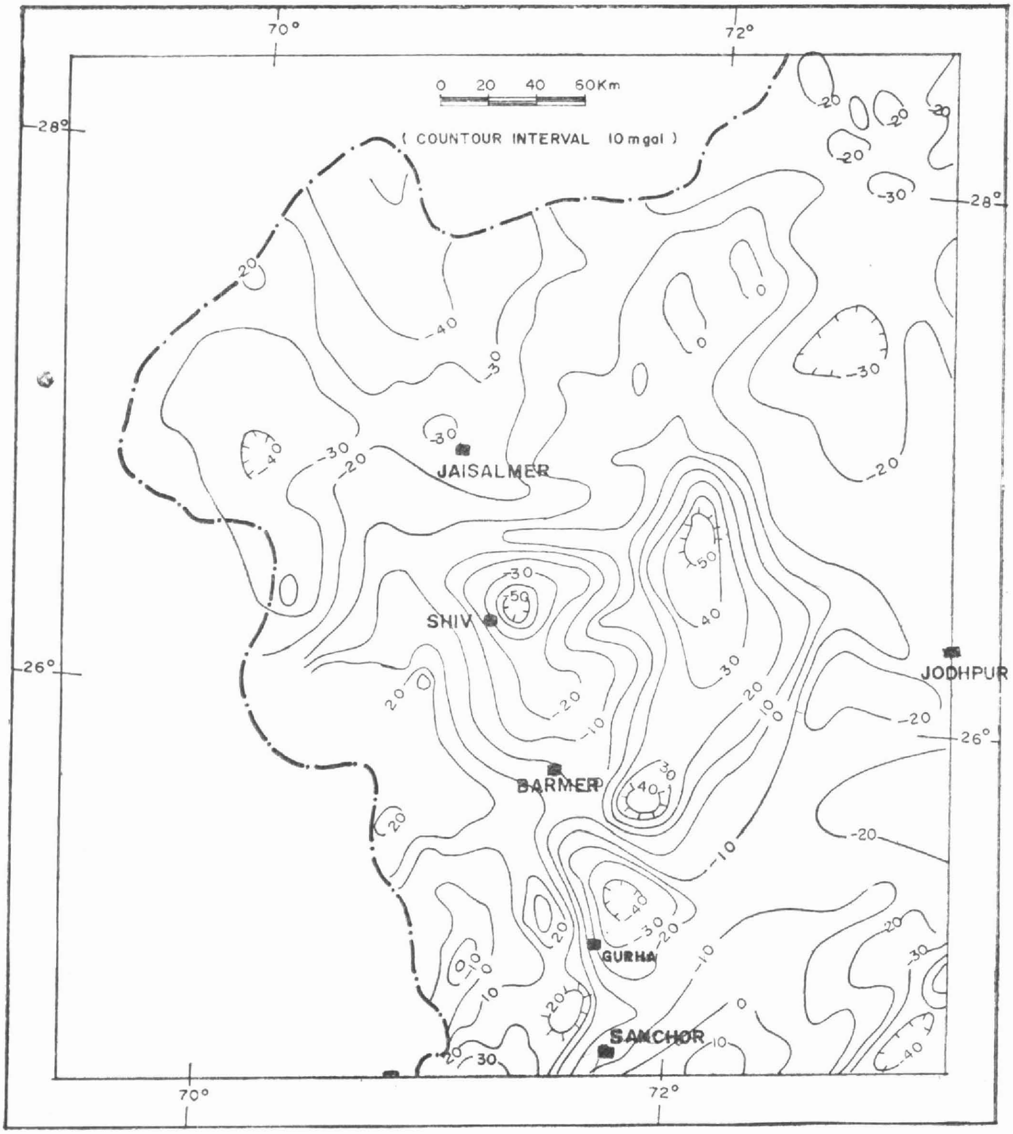

Figure 1.

closed in nature. Furthermore, considering the steep flanks of the Shiv low, the presence of major and concomitant faults appear to be likely in the area which may provide possible traps for oil and gas.

Being a major low of regional proportion, it is quite likely that a part of the Shiv low is attributable to deeper causes like a warp in the Conrad (Ramakrishna, 1988) or Moho. But once the regional is removed, one may be justified in seeking the source in the basement undulations and the formations above. Though the

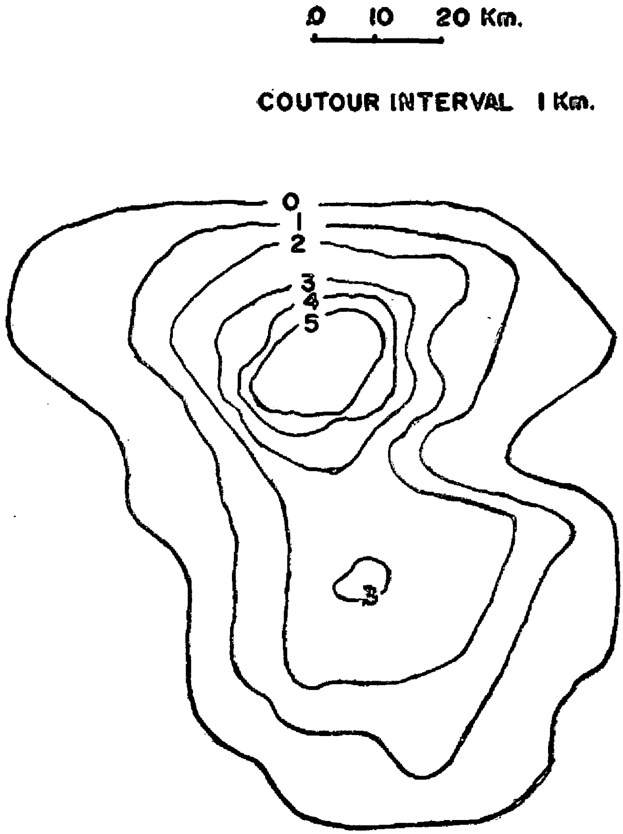

Figure 2.
Three Dimensional model of Shiv basin inferred from gravity.

oldest rocks exposed in the area are post-Delhi Malani intrusives, within this low, there may be deposition of Proterozoics followed by Marwar Supergroup (called the trans-Aravalli Vindhyans). However, if both are present in the basin, the gravity effect due to them is likely to get neutralised because the former are supposed to be denser than the gneisses and the latter lighter. Though there is no way of separating the contribution from various levels to the observed gravity (in the absence of any seismic data), it is worth calculating the thickness of lighter sediments, assuming an effective negative density contrast for the same.

For quantitative interpretation of the Shiv low, it is clear that 3-D modelling is preferable in view of the closed nature of the anomaly. For this purpose the NGRI Bouguer gravity map of India was made use of wherefrom eleven profiles covering the low were extracted with a square grid of 10 km spacing. The regional gravity was removed from these profiles by graphical means, which is preferable when the residuals are interpreted quantitatively. The results of 3-D modelling by a method due to Radhakrishnamurthy (1989) which is based on Bott's (1960) iterative technique are presented in the form of a contour map depicting the inferred thickness of sediments in the basin (Fig. 2). The model assumes an outcropping basin with a negative density contrast of 0.3 gm/cc. It can be seen from the figure that the thickness of sediments arrived at is in excess of 5000 m. Though not modelled separately, by comparison, the Sanchor basin (i.e., Gurha low) also may be expected to have a large sediment thickness of 4000 m.

Irrespective of the exactitude of the geometry of the model, the large inferred thickness of sediments in the Barmer (Shiv) and Sanchor (Gurha) basins, the location of them along an axis passing through the Pakistani oil fields and the high rated Jaisalmer basin in the north and Cambay basin down south, which is producing oil, make it reasonable to think that the Shiv and Gurha lows deserve a better gravity magnetic coverage and preliminary seismic work to assess the correct thickness of the sediments and the associated structures, etc., to confirm whether the hydrocarbon potential of these basins is really marginal and speculative or these are better prospects.

Acknowledgements: The author is thankful to Prof. I. V. Radhakrishna Murthy, Andhra University, Visakhapatnam for help in 3-D modelling of gravity anomaly and to the Director General, Geological Survey of India for permission to publish this paper.

1250B, Road 62, Jubilee Hills
Hyderabad-500 004

T. S. RAMAKRISHNA

References

BOTT, M. H. P. (1960) The use of rapid digital computing methods for direct gravity interpretation of sedimentary basins. Geoph. Jour. Roy. Astro. Soc. v. 3, pp. 63-67.

DASGUPTA, S. C. (1974) The stratigraphy of the west Rajasthan shelf. Proc. 4th Collq. India, Micropalaentol. Strat., pp. 219-233.

DHAR, C. L. and MEHTA, V. K. (1974) Report on the geology of western Rajasthan shelf. ONGC unpub. rep.

DHAR, C. L. (1982) Report on the geology and hydrocarbon prospects of Barmer and Bikaner-Nagaur basins, Rajasthan. ONGC Unpub. Rep.

NGRI (1975) Gravity Map Series of India (1 : 5,000,000).

PAREEK, H. S. (1976) Basin configuration and sedimentary stratigraphy of western Rajasthan. Jour. Geol. Soc. India, v. 22, pp. 517-528.

RADHAKRISHNA MURTHY, I. V. (1989) Three dimensional modelling of gravity anomalies. Jour. Assn. Expln. Geophy. v. X no. 1 pp. 1-9.

RAMAKRISHNA, T. S. (1988) The effect of Conrad on regional gravity interpretations. Jour. Geol. Soc. India, v. 32, no. 5, pp. 411-415.

SIDDIQUE, H. N. (1963) The Jodhpur-Malani divide separating Barmer and Jaisalmer basins. Jour. Geol. Soc. India, v. 4, pp. 97-107.