8th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2010"

P-130

Possible Extension of Hydrocarbon Bearing Jabera-Damoh Vindhyan Basin, Central India and its Geotectonic Evolution: Inferences from Detailed Gravity Studies

Nimisha Vedanti*, Ravi Prakash Srivastava and V.P.Dimri
National Geophysical Research Institute, Council of Scientific and Industrial Research, Hyderabad

Summary

Jabera-Damoh area of the southern Vindhyan basin is known to contain favorable conditions for hydrocarbon entrapment. To study the prospective Jabera basin and its lateral extent, a detailed gravity survey network comprising 40 gravity bases and 1500 data points in an area of about 110 x 100 km^2 was planned in and around Jabera-Damoh region. Fractal based optimum gridding technique was used to generate the accurate free air and Bouguer gravity anomaly maps Analysis of Bouguer and free air gravity anomaly maps, prepared using fractal based gridding method, indicates presence of two sedimentary basins (Jabera and Damoh) faulted on either sides. Another interesting finding is the well-known Jabera domal structure,which appears to be a shallow feature only. Further, it is evident from the free air and Bouguer anomaly maps that the Jabera basin extends further south. The areal extent of the Jabera basin is much more than hitherto known.

Introduction: about the study area

The Jabera-Damoh region is located in the western part of the Vindhyan basin. This area is largely disturbed, associated with folds, wrenches, boundary faults and domal structure. Jabera dome is one such prominent structure, which is located about 40 km NW of Jabalpur. This dome is an oval shaped feature extending in ENE-WSW direction and developed during the early stages of upper Vindhyans due to structuring of great Vindhyan Syncline (Jokhan Ram et al., 1996). It occupies an area of about 320 km^2. Axially, it is about 20 km in length and 16 km in width. In this domal structure, lower horizons of the upper Vindhyans are exposed, surrounded by upper horizons with rocks dipping in all directions. In comparison, the Damoh basin, situated in the north of Jabera, however, appears to have evolved much earlier than Jabera region and restricted to lower Vindhyans only. It is bounded by two major faults trending NW-SE, whereas Jabera dome is associated with ENE-WSW trending faults which are in close proximity of SONATA rift. Major rock formations in Jabera Dome are sandstone, shale and limestone with some basaltic intrusive. In connection with hydrocarbon search, this region has been studied extensively by Oil and Natural Gas Corporation Ltd who struck gas at about 2.6 km depth in a borewell drilled near Jabera (Das et al.,1999).

Theory and/ or Method

To study the extent of Jabera-Damoh basin and its evolutionary structure, we designed a gravity survey network with optimum fractal dimension. The data acquisition network (Figure 1) includes 40 gravity base stations and 1500 gravity data points spread in an area of about 110 x 100 sq. km. Before moving to the field, fractal dimension of various networks (grids) was computed to design the appropriate survey network, (Srivastava et al., 2006). Well known box counting method was used to obtain the fractal dimension of the data. Further, the fractal dimension was used to find the optimum gridding interval of the gravity anomaly data to generate spurious anomaly free maps (Srivastava et al., 2007, 2009). Free air and Bouguer gravity anomaly maps over the studied region are prepared using the concept described above.

** Room No 102, MB, National Geophysical Research Institute, Uppal Road, Hyderabad 500606, India, nimisha@ngri.res.in*

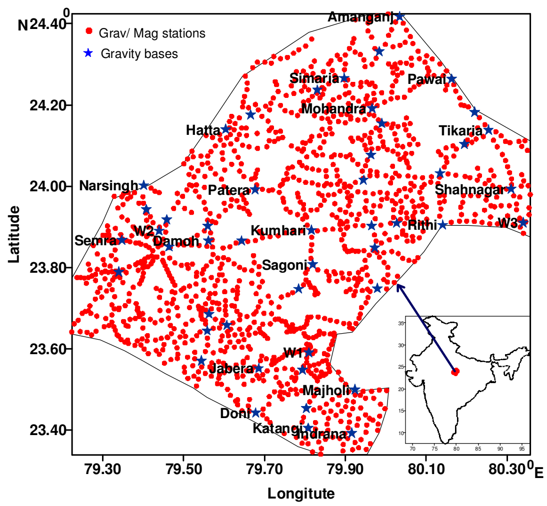

Figure 1: Location of study area. Location of gravity stations is shown in red colour and gravity bases are shown in blue colour

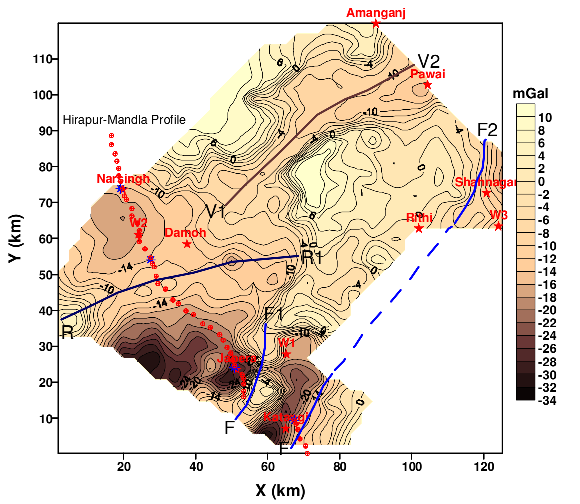

Figure 2: Free air anomaly map of the region. Partially delineated Jabera basin with high negative gravity anomalies is clearly seen.

Results

(i) Free Air Anomaly Map

The free-air gravity anomaly map generated using fractal based gridding method and contoured at 2 mGal interval is shown in Figure(2). This map shows large variations in gravity anomalies from –34 mGal to 10 mGal. Major faults situated near Katangi and Damoh and a small fault dividing Jabera and Katangi regions (FF1) are well reflected in the free air anomaly map.

Further, a possible ridge like structure (marked as RR1, running between Jabera and Damoh basin) and a linear feature (marked as V1V2) trending NE-SW Besides, a basinal structure sloping from ENE to WSW direction appears to exist in south-western part of the study area. The most important aspect of the present study has been the high negative gravity anomalies in the SW part of the region, which reveals that the areal extent of the Jabera basin extends much further south then hitherto known.

(iii) Bouguer Anomaly Map

The overall trend of Bouguer gravity anomaly map is well supported by free air anomaly gravity trends. Bouguer anomaly map with 2 mGal contour interval, generated by using fractal based gridding method is shown in Figure (3). This map reveals a large variation in Bouguer gravity anomalies from –74 mGal to –22 mGal. Lowest anomaly (-74 mGal) contours characterize the Jabera area, which could be attributed to the thick pile of sedimentary column present in the area. A steep gravity gradient can be seen running from Narsinghgarh to Amanganj in an ENE-WSW direction, which could be attributed to varying basement thicknesses. This is also evident from the free air gravity map (Figure 2). It is interesting to note that a prominent boundary like feature as revealed in free air anomaly map (Figure 2), dividing the area into two parts and running from V1V2 to FF1, is altogether missing in Bouguer anomaly map (Figure 3). It is thus, felt that it could be a shallow feature. However, a similar feature marked as XX1 in Figure(3) is quite prominent in free air gravity map also (Figure 2) indicating it to be a deep-seated feature. Lowest gravity anomaly associated with Jabera is still persistent in Bouguer gravity map, probably representing the deep basinal part having thick sedimentary column. Further, Bouguer gravity map also exhibits a small basinal feature near Damoh. Damoh and Jabera basins are bifurcated by a small direction and extending from Damoh to Pawai has also been demarcated. The latter feature is bounded by steep high gradient anomalies on either side. ridge like structure shown as RR1 in Figures (2 & 3) running in northeast-southwest direction. Further, the extent of Jabera basin delineated in the free air anomaly map is similar to that delineated in Bouguer anomaly map.

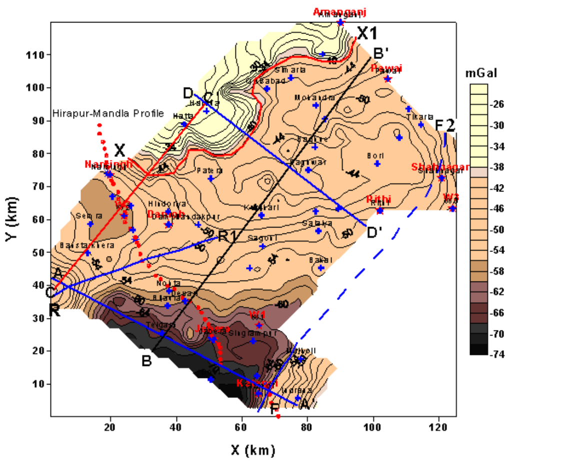

Figure 3: Bouguer anomaly map of the region. These anomalies are well supported by free air anomalies. Partially delineated Jabera basin with high negative Bouguer anomaly is clearly seen.

Conclusions

From Figures (2 & 3), it is clearly seen that only a part of the Jabera rifted basin has been gravimetrically mapped. However, it is quite revealing that the lateral extent of the basin extends much further south than was known earlier. Presence of a large sedimentary thickness column would make it a very suitable source region for hydrocarbon accumulation. Further, a very popular domal structural feature usually known as Jabera dome and associated with -60 to -70 mGal gravity anomaly, appears more to be an erosional feature, rather than a deep domal structure.

References

Das, A.K., Baruah, R.M., Bisht, S.S., Agrawal, B., 1999, An integrated analysis of late Proterozoic lower Vindhyan Sediments for Hydrocarbon exploration in western part of Son Valley, Central India, Jour. Geol. Soc. India, v.53, pp.239-253.

Jokhan Ram, Shukla, S.N., Pramanik, A.G., Varma, B.K., Gyanesh Chandra, Murthy, M.S.N., 1996, Recent investigations in the Vindhyan basin: Implications for the basin tectonics. In: Recent advances in Vindhyan Geology, A. Bhattacharya (Ed.), Mem. Geol. Soc. India, v.36, pp.267-286.

Srivastava, R.P., 2006, Design of potential field network and interpretation technique for fractal sources and its application to Jabera-Damoh area of Vindhyan basin, Central India, PhD thesis, Osmania University, India.

Srivastava, R.P., Vedanti, N., and Dimri, V.P., 2007, Optimum Design of a Gravity Survey Network and its Application to Delineate the Jabera—Damoh Structure in the Vindhyan Basin, Central India, Pure Appl. Geophys, v.164, pp.1–14, doi:10.1007/s00024-007-0252-1.

Srivastava, R.P.,Vedanti, N., Pandey, O.P., and Dimri,V.P., 2009, Detailed gravity studies over Jabera-Damoh region of the Vindhyan basin, central India and crustal evolution, Journal of Geological Society of India, Vol. 73, 715-723.

Acknowledgement

The financial support from Department of Science and Technology, Govt. of India to carryout this work is greatly acknowledged.