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Integrated interpretation of marine GM data of West Coast (GSDWN-2002/01 NELP Block)

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Summary

Interpretation of Gravity & Magnetic data along with seismic of Saurashtra offshore NELP block, GSDWN-2002/01 has been carried out to understand the major tectonic elements & estimation of the sedimentary thickness. The area is located on the continental slope/rise of Saurashtra offshore. Some of the seismic sections show 'rift graben' like signature which are associated with negative gravity anomaly. Gravity modeling shows that deepest co-relatable seismic marker may not correspond to base of sediments, which lies few hundred meters below this marker. Very clear signature of shallowing of Moho towards west is seen from gravity data and estimated to vary from about 30 km towards eastern part of the area to about 20 km towards west.

Sediment fills interpreted in the graben may be interesting for exploration of hydrocarbon in this area.

Introduction

The study has been taken up for integrated interpretation of GM data of GSDWN-2002/01 of NELP block.

The block is located in the Gujrat-Saurashtra deep offshore basin (Fig.1).

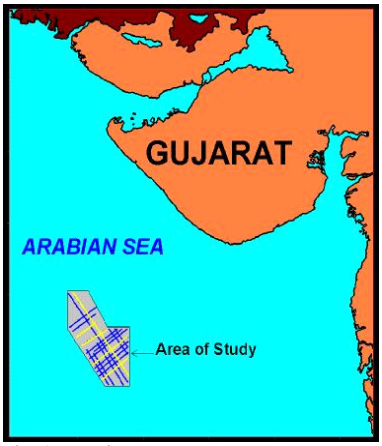

Fig. 1 Location Map

The bathymetry within this block varies from about 2500 to 3500 meters from east to west (Fig.2).

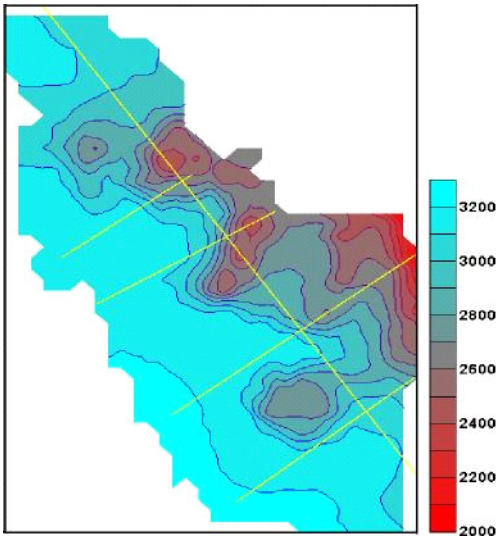

Fig 2 Bathymetry Map

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Fugro LCT Inc. acquired about 1200 lkm. of gravity and 1000 lkm of magnetic data during Jan.- Feb. 2006. KDMIPE processed the GM data. Free Air anomaly and Magnetic anomaly maps (Fig.4 & 5) have been prepared. Integrated interpretation of GM data has been carried out.

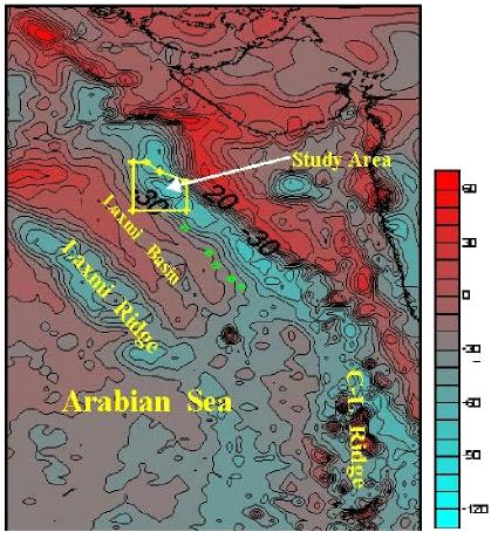

Fig. 3 Free Air Anomaly Map (Satellite)

Description of Gravity & Magnetic Anomaly Maps

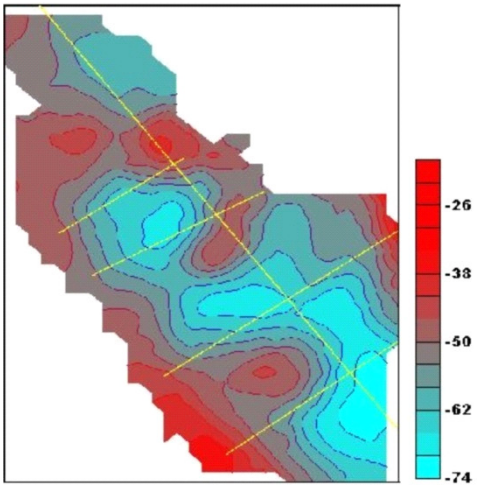

Fig. 4 Free Air anomaly Map

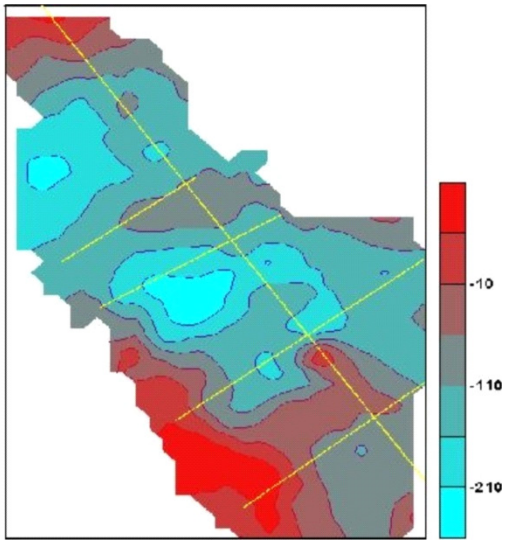

Fig. 5 Magnetic Anomaly Map

The free air anomaly map derived from satellite altimeter data (Fig.3) shows a prominent NNW-SSE trending regional gravity low lies north east of Laxmi basin. Earlier it is interpreted (G.C.Bhattacharya et al, 1994 & S.Rangarajan, 2006) that Laxmi basin is underlain by oceanic crust. Therefore this area may be close to continental-oceanic crust boundary of this region. The continental shelf of the area is characterized by strong signature of well known **shelf edge gravity high**, due to sea ward thinning/attenuation of continental crust. (B.R.Naini & M.Talwani et al, 1982 & S. Sawai et al, 2006)

In the North, Saurashtra arch appears to cross this trend in northeast - southwest direction. Towards south, magnitude of this low diminishes significantly below 15 deg north latitude i.e. roughly at the head of the Chagos - Lacdive ridge. The present study area lies within this low.

Free air gravity anomaly map has been generated with contour interval of 2 mgal (Fig 4). Gravity anomaly in the area varies from around -40 mgal to -68 mgal.General trend of contours is NW-SE associated with three prominent highs namely GH1, GH2 and GH3. These highs are associated with strong relief on bathymetry. One interesting feature of the area is general rise of gravity (GH4) towards south west i.e towards Laxmi basin, though available seismic data shows significant increase in

thickness of sediments towards southwest. **This rise of gravity may be the signature of Continent – Oceanic boundary in this area, however data coverage is scanty for further study.**

Magnetic anomaly map has been generated with 25 gamma contour interval (Fig.5). The anomaly values range between –235 gamma and 40 gamma. Some of the important feature of magnetic anomaly map are (i) magnetic high MH1 at the intersection of line no. L- 09 & L-17 falls in the area of low gravity (ii) magnetic low ML1 is located about 6.5 km southwest of gravity high GH2 (iii) the area of east west trending gravity high GH1 is also associated with mild magnetic low ML2. Therefore except gravity high GH3 other two gravity highs GH1 & GH2 are associated with magnetic low, which suggest possibility of reversed magnetization (remnant magnetization?). Since the magnetic anomaly is controlled both by induced as well as remnant magnetization (?) for which no prior information is available hence no quantitative interpretation of magnetic data is attempted.

However general rise of gravity GH4 towards south west i.e. Laxmi basin is also **characterized by corresponding increase in magnetic anomaly, which supports the possibility of COB in this area.**

2-D Gravity Modeling

Seismic, gravity and magnetic data of the area were analyzed. Five seismic lines were selected for 2-D gravity modeling. The lines Nos. 03, 04, 08, 12(E-W) and 17(N-S) were modeled using GM-SYS package. Depth sections were prepared with sea bottom, Mid Eocene and the deepest

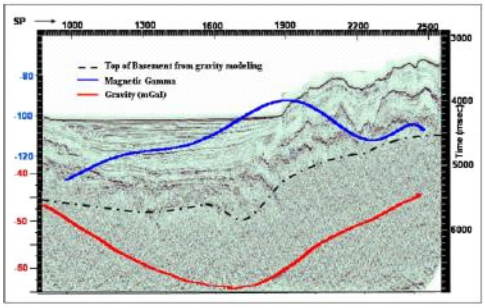

Fig. 6 Seismic-03 along Gravity &Magnetic

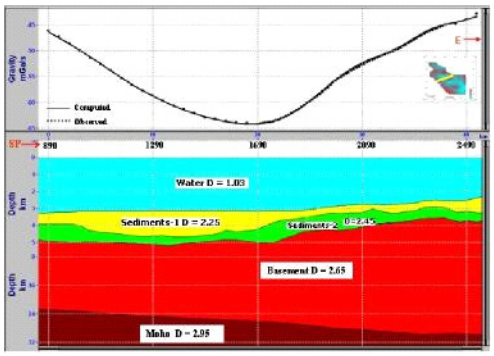

Fig. 7 Gravity Modeling along Line No. 3

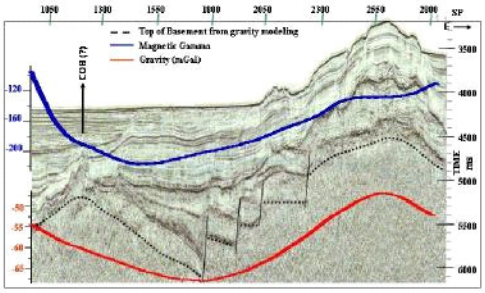

Fig. 8 Seismic-04 along Gravity & Magnetic

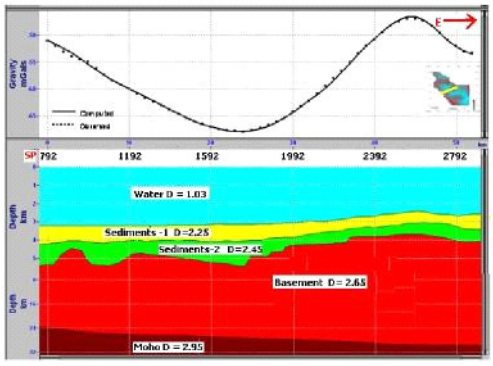

Fig. 9 Gravity modeling along Line No. 04

mapable marker, which was considered as basement/ trap top. Modeling has been done with density of 2.65 gm/cc for basement, 2.4 gm/cc and 2.2 gm/cc for the sedimentary

layers from bottom to top. Density of sea water has been taken as 1.03 gm/cc. To check the effects of the density used in modeling, gravity response was simulated with a suite of density values for basement and sediments. It was found that density values could be changed only marginally (0.02gm/cc) than the values mentioned above for realistic basement configuration. In the modeling the computed gravity field is compared with the observed gravity field (Depth model) . The most important feature, brought out by modeling is that on almost on all lines deepest continuous & correlatable marker does not appear to be the base of sediments, the basement is much deeper than the deepest marker seen on seismic data.

The seismic sections superimposed with GM data (Fig. 6 & 8) and modeling results are shown in Fig. 7 & 9.

As mentioned earlier (i) Laxmi basin, south west of the working area, is interpreted as underlain by oceanic crust & (ii) possible presence of COB in the south western part of the area, therefore gravity data is expected to show (a) the signature of seaward thinning of crust towards south west, which will result in sea ward shallowing of Moho and (b) break up related sedimentary basins. The prominent gravity low on line L-3 & L-4 associated with the steeply dipping events below angular unconformity surface appears to be rift basin related sediments, which has been brought out clearly in gravity modeling.
Average depth to top of Moho for these lines varies from 20 – 30 Km. from West to East.The modeling on profile GSDWN-L-4 shows wedge shaped pack of events between shot points 1300 – 2000 are sediments. Similar feature is observed on the results of modeling on GSDWN-L-3. In all the other lines modeling requires sediments below the deepest marker on seismic.

Depth to the basement varies from 4.5 to 5.5 km. in the area.

Conclusions

- Gravity modeling has given a good estimate of sedimentary thickness and it ranges from 3 to 5.5 km.
- Gravity modeling shows that the basement is much deeper than the deepest marker seen on seismic data.
- Depth to Moho varies from about 20 to 30 km with considerable crustal thinning in the western part of the block.

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