

Airborne FTG & Magnetic Data Revealing Hydrocarbon Potential of Under-Explored Sanchor Basin, South of Rajasthan, India

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Abstract

Air-borne Full Tensor Gradiometry (FTG) survey was carried out across north Cambay, Sanchor and south Barmer basins by BellGeospace for Cairn Oil & Gas, during year 2021. Both the gravity & magnetic data was acquired. These data immensely helped to delineate basin configuration specially area with poor seismic or no seismic coverage. Sanchor basin is relatively underexplored rift basin and sandwiched between northern Barmer & southern Cambay basin. Processed gravity-magnetic data, specially “2D gravity profile modeling” integrated with available limited 2D seismic data helped to identify several structural closures potential for hydrocarbon exploration. To explore the basin, a few wells has been drilled by ONGC during 1970s. But these wells are drilled in basin margin highs. No well has been drilled in central part (with currently visible prominent horst structure and easy to hydrocarbon charge access) of Sanchor basin. Recently around 10 wells have been drilled to access the coal bed methane (CBM) potential of the basin. But these wells are drilled only upto shallow Akli coal layers.

Under current circumstances, FTG data integrated with available 2D seismic helped immensely to identify several structural closures in deeper stratigraphic level present in central part of the basin, with significant HC potential. A bold decision to drill these structures would establish this Sanchor basin in global map and open up a new basin in Indian context.

Introduction

Sanchor basin is predominantly intra-cratonic rift basin sandwiched between Barmer basin in North and Cambay basin in South (Fig: 1). This North East-South West trending sub-basin is predominantly formed due to India-East Africa rifting during

Mesozoic time. Imprint of younger North-South trending Tertiary rifting and Miocene age inversion structures because of Himalayan collision can be clearly observed in the area.

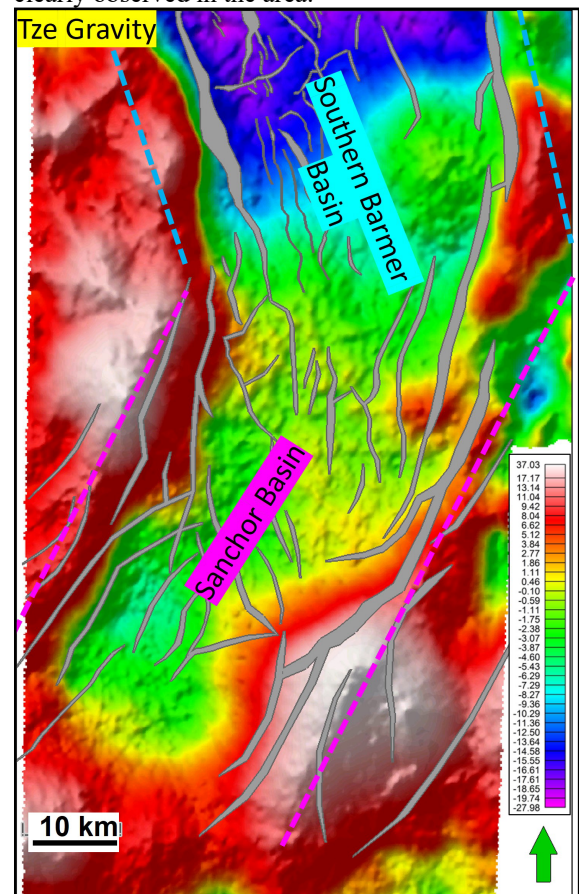


Figure 1: Tze Gravity clearly showing Sanchor basin extent compared to southern Barmer Basin

Till date Sanchor basin is underexplored and heavily challenged by sparse vintage seismic data and limited seismic imaging of deeper rift sequence due to energy absorption by shallow thick coal layer and ambient cultural noise. Recently acquired airborne



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FTG and magnetic data has come out as helpful solution to fill the data gap. Model guided structural imaging based on 2D gravity-seismic profile modelling has helped in imaging deeper rift architecture.

Full Tensor Gradiometry (FTG) is a multicomponent gravity surveying technology that measures different components of the Gravity Gradient Tensor. FTG measures the rate of change of gravity in all directions of the field, caused by subsurface geology. It helps to map contact information generated by density contrasts resulting from stratigraphic and structural changes. Several structural closures are identified specially with band pass gravity processed data (Fig: 2)

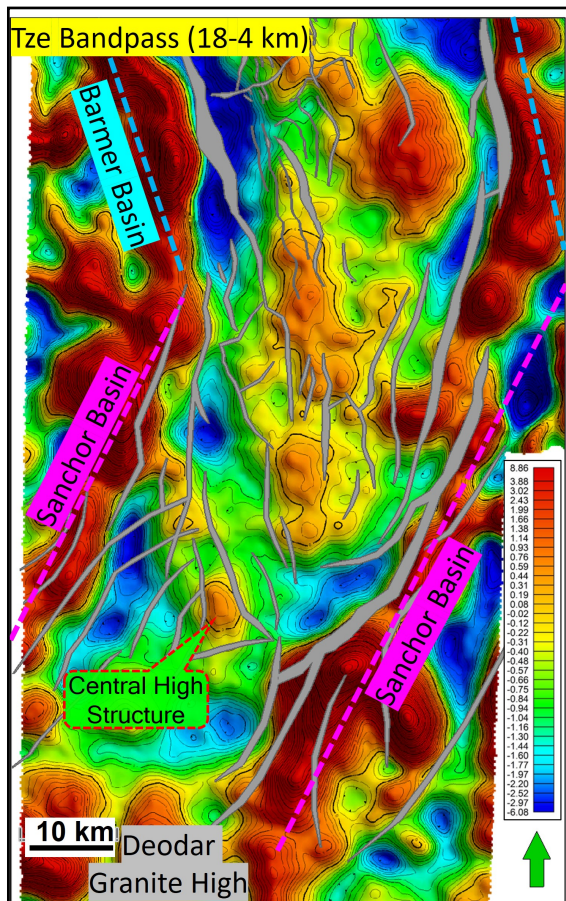


Figure 2: Tze Band Pass (17km - 4 km) showing several structural closures. Central high structure being one of the key target to be explored further

Database and Methodology

Approximately 15000 lkm of airborne FTG and magnetic data was acquired by BellGeospace in North Cambay and Sanchor basin covering 3 OALP blocks with areal extent of ~ 5600 sq. km.

FTG and magnetic data was processed and integrated with drilled wells information, outcrop geology and sketchy seismic to identify basin configuration, rift structures and subsurface closures for potential of hydrocarbon exploration (Fig: 3). Special FTG processing along with its tensor components, Spectral analysis & Wavelength filtering, Contact lineament processing and detailed 2D profile modelling helped further to increase confidence on deeper fault closure, fault position and throws. Integrated FTG-Seismic-well modelling helped to generate “depth to basement” surface which was key to establish potential sedimentary sequence essential for petroleum system modelling.

Results

Detailed 2D profile modelling was key to finetune subsurface structural interpretation and trap geometry for hydrocarbon perspectivity analysis. As a next step 3D structural model was constructed integrating 2D profile models. Drilled well information were used as blind test to validate the model. Constructed “depth to basement surface” across Barmer, Sanchor & north Cambay basins suggest the Sanchor basin as possible continuation of southern Barmer basin. Deepest interpreted basement depth of 7km is sufficient for maturation of early synrift OCS source unit. (Fig 4 & 5) Presence of Cretaceous pre-Deccan sediment is also well evident in Sanchor basin based on gravity modelling and supported by few drilled well results. In addition, well based fluid inclusion study (FIS) proves the presence of petroleum system in this underexplored basin.

Identified traps are predominantly fault closures and around 5-8 closures are identified with areal extent of 4-15 sq. km. from hydrocarbon entrapment point of view. Together these fault closures are having potential resource of ~300 MMBOE. Central high structure being the most prominent and lucrative one presence in central part of the Sanchor basin (Fig: 6)



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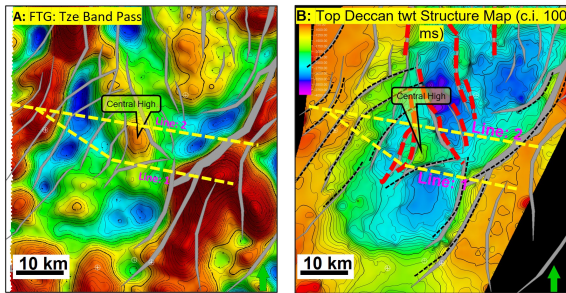


Figure 3: Figure A & B show comparison of Tze band pass gravity map and interpreted top Deccan twt structure map based on 2D seismic data. Yellow dotted lines are position of "2D gravity profile modeling lines" used to confirm presence of structure based on gravity profile modeling. In map B, black dotted lines are older Mesozoic trend and red dotted lines are younger Tertiary fault trend

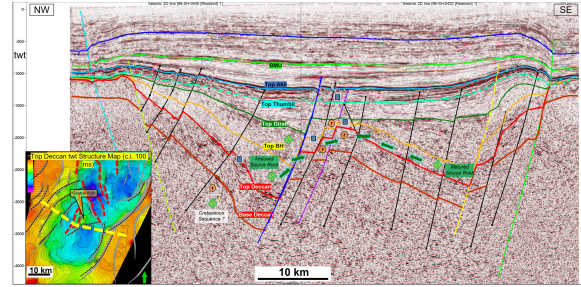


Figure 6: Geo-Seismic cross section with petroleum elements of Central High Structure

Conclusions

FTG emerges as an effective technology to study vast area with low turn-around time for subsurface imaging point of view specially for rift setup. This grav-mag-seismic integrated study clearly indicates vast untapped hidden exploration potential and working petroleum system of Sanchor basin, specially for rift sequence.

References

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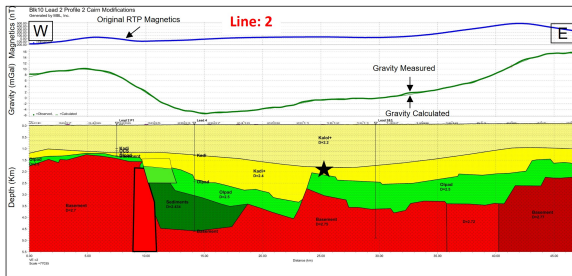


Figure 4: 2D profile modeling of northern line across the central high structure. Black star shows the position central high structure on the section

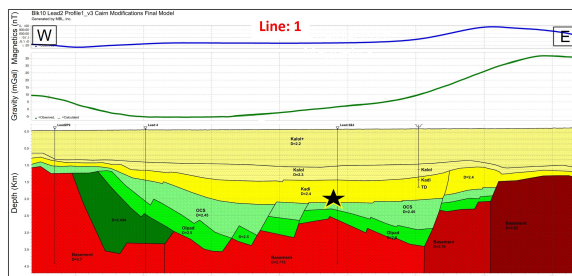


Figure 5: 2D profile modeling of southern line in E-W direction