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Structural and Stratigraphic Interpretation of Geophysical Data of the Semutang Structure, Bengal Basin, Bangladesh

Tahera Afrin[1*], Delwar Hossain[2], and Md. Hasan Imam[2]

[1]Geological Survey of Bangladesh, Segunbagicha, Dhaka, Bangladesh
[2]Department of Geological Sciences, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

(*Corresponding E-mail: tahera.afrin87@gmail.com)

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Abstract: The Semutang structure is an elongated, exposed anticline situated in the Eastern Chittagong Fold Belt of the Bengal Basin. The main objectives of the study are to analyses of available geophysical data and identify the subsurface structures. To define geologic features in the subsurface, geophysical data are used. Low pass filtering and polynomial fitting methods are applied to bouguer anomaly field data to separate features from different subsurface levels. On the residual gravity anomaly map, the approximately NNW – SSE trending gravity high axis delineates the Semutang anticline crest line, with peak value of 2 mGal. To characterize in detail, the structural settings of the study area, 2-D seismic data are interpreted. The most dominant structure in the area is a 'pop-up' anticline and elongated feature with an NNW-SSE orientation, flanked in the west and east by major reverse faults. The seismic interpretation has allowed the generation of a depth contour map on upper gas sand horizon with well data. From the analysis it is concluded that in the subsurface the fold is not as simple as it is on the surface. Further investigation using 3D seismic survey can give valuable information about real subsurface structure, potential geohazards associated with tectonic deformation and hydrocarbon occurrence in this area.

Keywords: *Anticline, Semutang, Gravity anomaly, 2D seismic, Structural geology.*

Introduction

The Eastern Chittagong Fold Belt (ECFB) in the Bengal Basin is a tectonically active zone with significant compressional deformation and notable fold structures. Among them, the Semutang anticline is one of the most prominent structural highs. It is bounded by the Sitakund Anticline in the southwest and the Changutang Anticline in the east, which is nearly 25 km long and 5 km wide (Afrin, 2013). It covers the latitude from 22°45' to 22°57'E and longitude from 91°42' to 91°49'E. The surface exposure is covered by low-lying terrain of small hills and hillocks at various elevations ranging from 100 to 250 feet. The oldest exposed rock in this structure is DupiTila Formation (BAPEX, 2005). The intensity of the folding is greater towards the east, causing higher topographic elevation in the eastern Chittagong Hill Tracts. As the intensity of folds decreases towards the west, the fold belts unit merges with the Foredeep unit, which is characterized by only mild or no folding. Comprehending the subsurface condition of these structures is essential for assessing geohazard in tectonically active regions as well as for hydrocarbon exploration. The objective of the present study is to interpret subsurface complexities using mainly integrated gravity and seismic data. In combination they constitute a powerful method to provide insights into the stratigraphy and structural evolution of fold-thrust belts and relate the structures to potential hydrocarbon systems.

Methodology

The gravity data used in this study has been extracted from Bouguer gravity map of Bangladesh (Rahman et al., 1990). The data were processed, interpreted and analyzed by low pass filtering and polynomial fitting using Montaj MAGMAP filtering package of Oasis Montaj (2007), allowing the regional and residual components to be separated.

Integrated 2-D seismic data and well logs interpretation has been undertaken, with the data being collected from Bangladesh Petroleum Exploration and Production Company Limited (BAPEX). Eleven 2-D seismic lines of study area have been analyzed, two being strike lines and the rest dip lines. Seismic data are used in interpreting horizons, fault identification and horizon correlation. Lithologs of different wells were analyzed and correlated among the wells.

Results and discussion

Qualitative interpretation of the Bouguer anomaly data (Figure 1) reveals heterogeneity in the subsurface density distribution. This field includes effects from both small-scale, shallow sources as well as large-scale, deeper sources. The gravity variation indicates that, apart from local sources more or less highlighted, there is a general trend consisting of a decrease in values from NNE to SSE, implying mainly thickening of the sedimentary cover and basin formation complexities. The gravity field in the Semutang structure and surrounding area varies within a range of -8 to -30mGal. Steep gravity gradients trending N-S to NNE-SSW outline major faults or fold limbs with contrasting densities.

The residual gravity map of the study area shows both positive and negative anomalies: positive anomalies likely represent anticlinal fold and uplifted zone, while negative anomalies synclinal fold or sedimentary sub-basins (Figure 2).

Eleven seismic sections of the study area have been used to construct structure maps on seismic horizons and interpret subsurface structures. Five seismic horizons were interpreted on section CEB-96-211 (Figure 3).

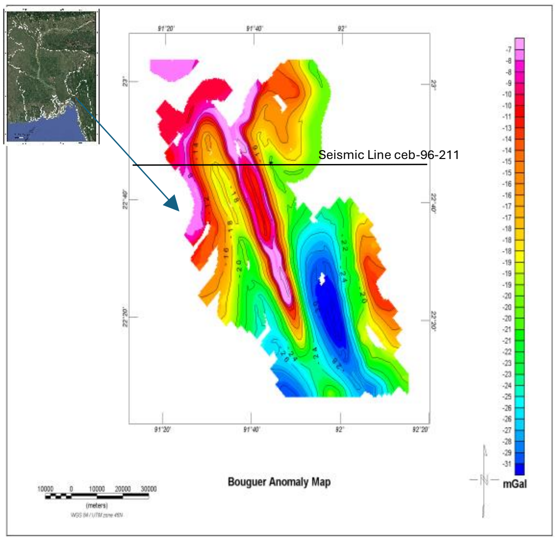

Figure 1, Bouguer anomaly map of Semutang and adjoining areas.

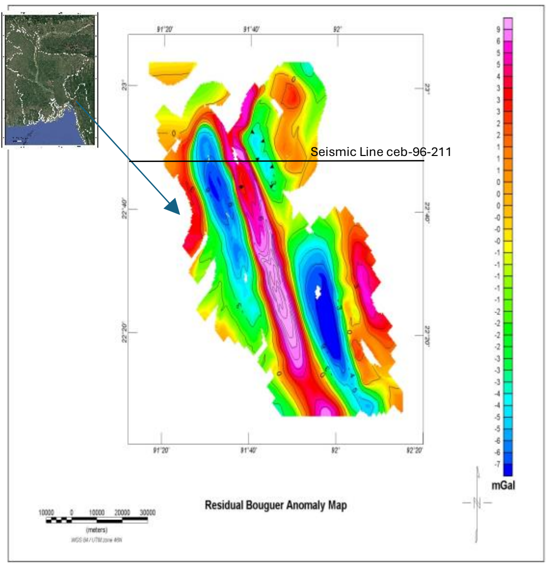

Figure 2, Residual bouguer anomaly map of Semutang and adjoining areas.

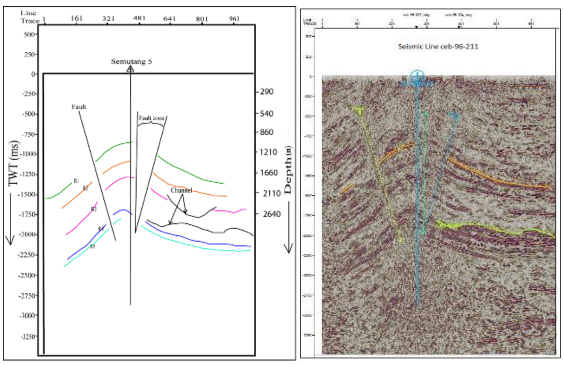

Figure 3, Interpretation of seismic section along line CEB-96-211.

In the seismic section, structures from major geological events are recognized with better resolution than other geophysical methods. The Semutang field is an elongate, asymmetrical anticline with a simple four-way dip closure and structural trend approximately NS; the western flank is steeper than the eastern one.

Conclusion

The Semutang anticline is a classic "pop-up" flower structure influenced by active compressional tectonics. The subsurface structures derived from the gravity data have been better understood by means of the integration of seismic data. The results not only contribute to understanding the potential hydrocarbons but also have implications for engineering geology, since the identified fault zones and structural discontinuities may influence ground stability and could be susceptible to reactivation under stress, potentially generating seismic hazards.

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