An integrated approach for basement exploration in Dhansiri Valley, South Assam Shelf, A&AA Basin

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Summary:

Dhansiri Valley lies towards the South of the Assam Shelf, a part of the Assam &Assam Arakan basin(A&AA basin), situated in the South-Western part of the Brahmaputra Valley (Fig.1). It is bounded by the Naga Hills to the east and the Mikir Hills to the west. Its northern limit is marked by the Jorhat Fault and the southern limit by the Dauki fault.In Dhansiri valley, basement oil was first discovered in Borholla field in 1970's from fractured granitic basement. In the Khoraghat and Nambar fields situated in South-Eastern part of the Dhansiri Valley, oil occurs mainly in the Bokabil Formation. Basement was never a primary objective of exploration in this part of South Assam Shelf. Recently, considerable amount of oil has been surfaced from fractured basement, during barefoot testing done in some wells in the western part of the Khoraghat field. The leads obtained in these wells warrants a focused Basement exploration in Dhansiri valley. Characterization of the basement fractures in this area is required to understand the behavior of basement reservoir. Seismic attributes based on discontinuity principle provide useful tools to characterize faults and fractures. Petrel's Ant tracking tool was used in our study for identifying the fracture networks & in understanding the fracture intensity in the Basement. Formation Micro Imager (FMI) logs were also used in our study.

Keywords:

South Assam Shelf, Basement, Fractures, Ant tracking.

Introduction

The Assam-Arakan Basin is a poly-history basin controlled by the occurrence of more than one phase of sedimentation and tectonics which includes the northward collision of the Indian plate with the Tibetan plate and eastward movement of Indian plate towards the Burmese plate. Assam Shelf came into existence in the late Cretaceous by a south easterly dipping block-faulting.

Geophysical studies indicate presence of a broad arch at basement level whose crest is situated very close to the present course of Brahmaputra River. The major deformational trend in the upper Assam shelf is in the form of NE-SW & ENE-WSW trending longitudinal faults which lie sub parallel to the Naga-Schuppen belt. Another relatively younger lineament exists in the form of cross faults trending in NW-SE direction which dissect the basement arch. A major wrench fault system, called Jorhat fault separates Dhansiri valley from Upper Assam. The basin was evolved from an easterly dipping passive-margin setting in Paleogene to present day foreland basin during Neogene and onwards.

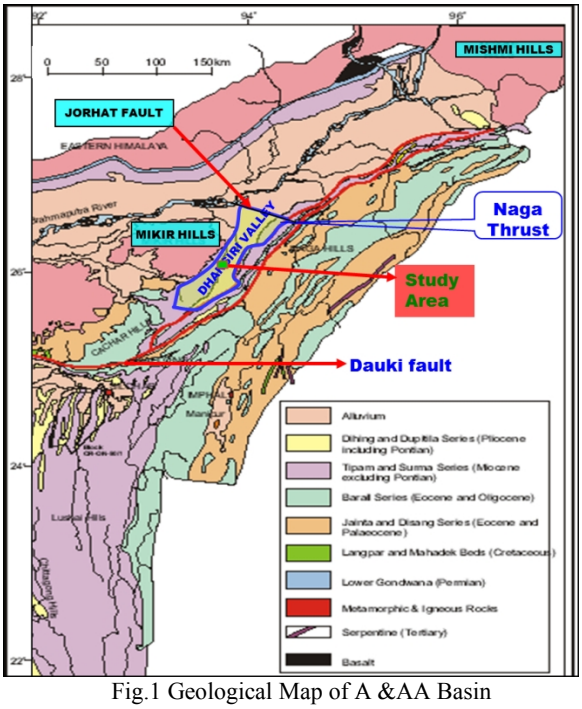

Fig.1 Geological Map of A &AA Basin

Two petroleum systems have been identified in Assam shelf, one is Paleocene to Middle Eocene (Tura and Sylhet) another Late Eocene to Oligocene (Kopili and Barail). Source rocks mainly in Barail, Kopili and Sylhet/Tura formations of the Schuppen belt have charged reservoirs in upper Assam shelf since Late Miocene. It has been proved thatfractured basement reservoirs juxtaposed to Barail/ Kopili/Sylhet are charged with oil&gas in Borholla & Khoraghat.

Recently in the West Khoraghat area, a very significant exploration lead has been obtained from well-A where about 32 m^3 of oil surfaced from basement on barefoot testing. The well needs artificial lift for further production. Another well-B in the same block has been tested in Basement and on initial barefoot testing around 5 m^3 of oil along-with water surfaced.In the light of these exploration leads from fractured basement in the west Khoraghat area (after 40 years from the first Basement discovery of Borholla field), whole South Assam shelf area from Borholla in the north to Nambar field in the south is opened up for fractured Basement exploration.

Level close to Basement top is mapped in 3D Seismic PSTM volume& a time structure map is prepared (Fig.2). Using data of drilled wells in Basement (in the West Khoraghat block) a depth map has been prepared. Both the time and depth maps in this block show an eastern fault closure against the main west Khoraghat fault. The SW-NE high trend of this fault closure is nosing towards NE in the Basement level. In this fault block, the wells A&B (oil and water bearing in basement) lie in the northeastern nosing part of the high trend and in main fault closure in the eastern part respectively. Due to the intense faulting on either side of this prospective block, basement has developed different sets of fractures which are oil bearing.

Special Studies:

3D Seismic PSTM volume and other G&G data were loaded in Petrel. Structural smoothening was carried out for conditioning the data. Relative Acoustic Impedance (RAI), Chaos and Maximum Positive Curvature were generated on conditioned data to get fault / fracture image. Variance cube was generated using Relative Acoustic Impedance (RAI) as input. Ant tracking and 'ant on ant' was run, to fine tune the fracture image. FMI log data of the nearby wells wereanalyzed and integrated with the seismic data and Intensity logs were generated.

Fig.2 Time Structure map close to Basement top

The analysis of RAI, Variance and 'ant on ant' track volume has brought out a dominant set of fault/fracture pattern trending NNE-SSW in the whole area. Another set comprising of relatively less number of fractures, trending roughly ENE-WSW is also noticed in this area. This ENE-WSW trending fracture intensity is prominent in the vicinity of well-A, where presence of oil in basement is established and 32m^3 of oil along-with water is surfaced. The well-A has better permeability than well-B. Hence the fractures trending ENE-WSW are supposed to be open in nature. Development of good fracture network & good fracture intensity is also observed near to the West Khoraghat fault.

Two time slices at 1858ms (at Basement top), 1864 ms (6ms below basement top)from the ant track volume are provided here to show the fracture pattern (Fig.3&4).Fault correlation from seismic data

interpretation was overlaid on the attribute maps.FMI log in Well-B (Fig.5) shows the presence of sub-vertical fractures in basement, with a maximum fracture aperture of 0.02 cm. The mean fracture magnitude is depicted as 44.7°, striking NNE-SSW.

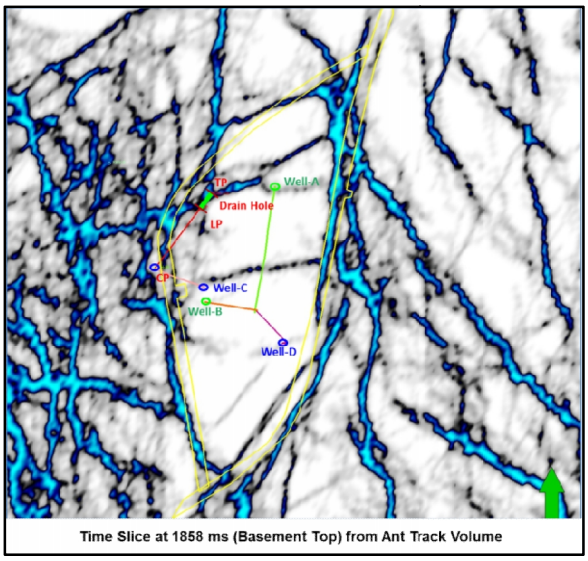

Fig.3Time Slice at 1858ms (from Ant track volume)

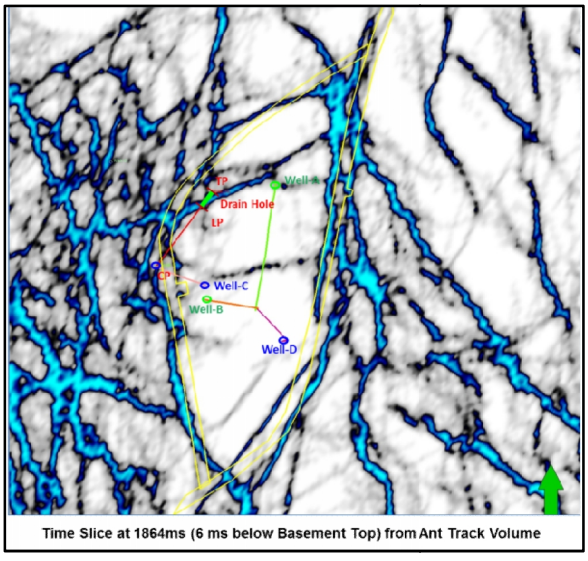

Fig.4Time Slice at 1864ms (from Ant track volume)

After analyzing the results of Ant-Tracking& FMI log data, it is proposed to place an exploratory horizontal well(NL) with a drain hole section of 150m within basement, at a suitable position within the fault block of well-A, where fracture intensity is more as per the ant tracking studies.

Further, this will also enable the well section to encounter more fracture zones. The Inline section passing through the exploratory well (NL) is shown in Fig.6. A schematic cross section along the drain hole of NL is shown in Fig.7.

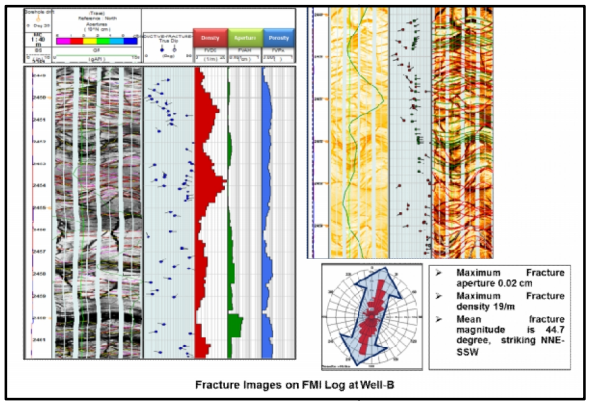

Fig. 5FMI log of Well-B

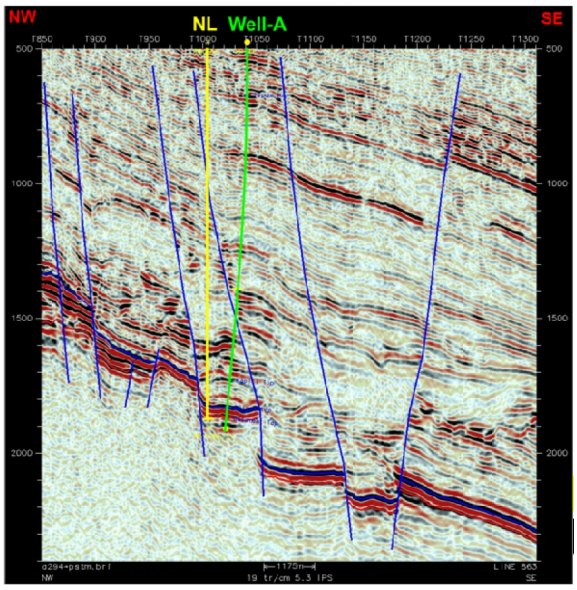

Fig.6 Inline through the proposed exploratory well

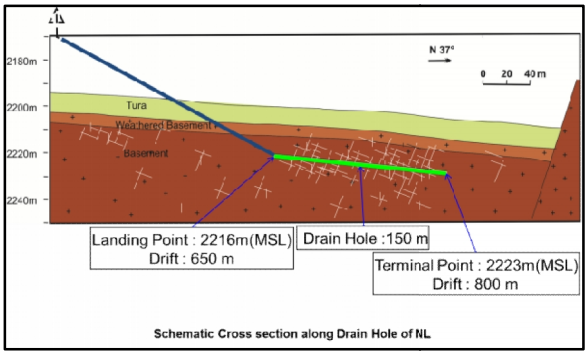

Fig.7Schematic cross section along drain hole of NL

Conclusions

This study showed that ant-tracking can be helpful in identifying fractured areas in basement. Well log data viz FMI, DSI along with attribute studies based on 3D seismic data, helped in identifying the fracture orientation & fracture density.

Ant track volumes were generated to understand Basement fracture pattern in the Khoraghat -Nambar area of South Assam Shelf in Assam & Assam Arakan Basin.Based upon this, some other areas were identified for further Basement exploration.

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