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Sequence Stratigraphy Analysis, Depositional Regime and Hydrocarbon Prospectivity of Tura Formation, North Assam Shelf, A & AA Basin

Abstract:

The present study is a part of integrated analysis of seismic and well data of North Assam Shelf, utilizing Sequence Stratigraphy to understand the techno sedimentation pattern prevailed during Paleocene to Early Eocene and to identify new areas for hydrocarbon potential in Tura formation.

The onset of sedimentation in the Northern Shelf part of the basin started during Paleocene to Early Eocene time in which Tura formation was deposited and directly overlies the Precambrian Basement. This Formation consists of silisiclastics sediments and was deposited in a shallow marine setting.

Sequence stratigraphic analysis of electrologs, supported by lab data brought out two, third order sequences. The lower sequence has been deposited in a regressive regime and upper sequence deposited in a transgressive regime. Both the sequences thicken towards SE along the paleoslope direction. Sequence stratigraphic analysis supported by conventional core data suggests deposition of Tura formation took place in a tidal deltaic environment. The study brought out areas with good reservoir development which appear to be good hydrocarbon exploration targets to explore Tura Formation.

Introduction:

The study area lies in the North Assam Shelf of A & AA Basin. The exploration in North Assam Shelf is mostly confined to the shallow occurring plays like Barails and Tipams. As these two plays almost entered a matured phase of exploration it warranted a relook into the hydrocarbon prospectivity into deeper and stratigraphically older plays like Tura. A number of wells have been drilled through Tura in North Assam Shelf. But, commercial hydrocarbon has been established from Tura Formation in Disangmukh, Panidihing and Lakwa fields only. Therefore study is mainly focused to develop a better understanding of the depositional environment of Tura and its reservoir facies distribution in the entire North Assam Shelf and brought out locales for Tura exploration.

Geological Setting:

Assam Basin is a polyhistory basin and a shelf-slope-basinal system. The evolution of the basin is influenced by breakup of Gondwana and movement of Indian plate towards Eurasian and Burmese plate during Early Cretaceous. As the northward movement of the Indian plate continued, block faulting and southeasterly dipping shelf developed. The Assam & Assam –Arakan Basin is bounded by the Eastern Himalayan fold belt in the North , Mishmi hills in the northeast and Patkai-Arakan fold belt in the east. Towards the west, the basin is bounded by the Shillong plateau-Mikir hill massif. Major tectonic elements are; i) The Assam Shelf, ii) Naga Shuppen belt and iii) The Assam Arakan fold belt. Major fault trending NE-SW and some E-W and NW-SE trending faults creating a number of fault blocks. Assam basin faced three tectonic phases; the earliest development of block faulting and Southeasterly dipping shelf, upliftment and erosion during Oligocene and deposition of extensive fluvial sediments during Miocene period. Deep-seated Basement related faults get activated during upliftment and erosion during Oligocene time. Sedimentary thickness increases from NW to SE along the basin slope direction.

Stratigraphy:

Deposition of Paleozoic sediments started during Paleocene and directly overlies the Basement. In the North Assam Shelf, Tura formation consisting of alteration of sandstone and shale was deposited in passive margin setting and unconformably overlies over the Granitic Basement. The Tura formation is followed by

carbonate dominated Sylhet Formation and marine pro-delta shale-sandstone sequences of Kopili formation in a widespread transgression regime. Delta front sandstone of Demulgaon Formation (BMS) conformably overlies The Kopili formation, which is again succeeded by delta plain interbedded shale and sandstone with thin layers of coal of Rudrasagar Formation (BCS). These delta plain BCS deposits are unconformably overlained by a thick sequence of high energy (braided) fluvial sandstone of Tipam Group. The Tipam Group is divided into four formations, viz. Geleki Sandstone (Lower) successively overlained by Lakwa Sandstone, Girujan Clay and Nazira Sandstone. The Tipam Group is unconformably overlain by Namsang Formation of Plio-Pleistocene age. The stratigraphy of Upper Assam exhibits typical epi-continental basin overlying the Precambrian granitic basement.

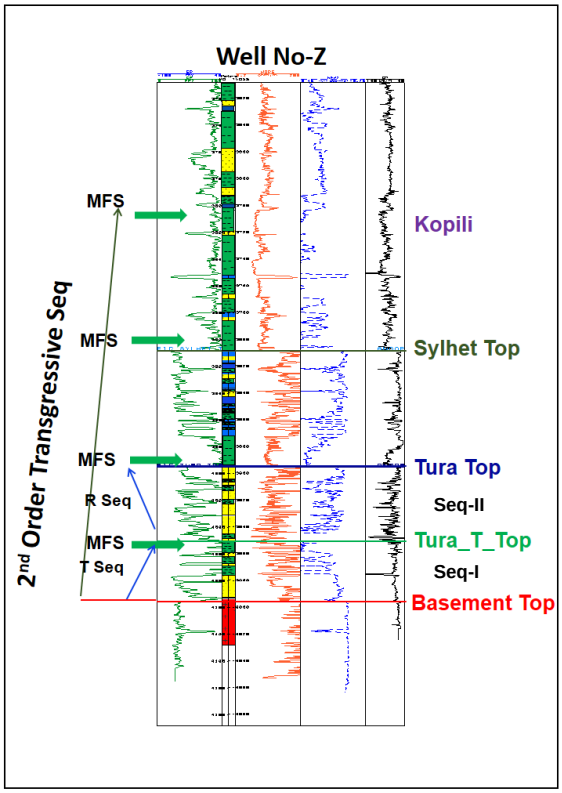


Fig 1: Sequence Stratigraphic Analysis in Well No. Z

Present Study:

Sequence stratigraphic analysis was carried out for Tura using mainly electrolog data and was supported by lab studies wherever available. Two broad third order sequences have been identified (fig.1), the lower sequence deposited in a transgressive system, overlained by a relatively Regressive sequence, the top of which coincides with Tura top. These two sequences are separated by a Maximum flooding Surface (MFS) which is prominent in the electro logs (fig.1). A number of flooding surfaces of lower order are present within each cycle. Both the sequences consist of sand/ shale alternations with occasional thin volcanoclastic sediments. The log correlation profiles, one dip (fig.2) and one along strike (fig.3) depict the facies variation of these sequences across the North Assam Shelf Block. Though individual sands cannot be correlated, as packs good correlability is observed.

Three horizon close to top of Tura along with Sylhet and Basement have been correlated in the entire study area. The reflector close to top of Tura is good in continuity and mappable in the Disangmukh- Panidihing area compare to Geleki area (Fig 6b).

Depositional Model and Hydrocarbon Prospectivity:

Depositional environment of Tura formation has been established based on sequence stratigraphic analysis and core studies of Tura formation. Sequence stratigraphic analysis was carried out mainly on electrolog supported by core data. Isopach and Sand Isolith map of Sequence-I and Sequence-II of Tura were prepared (fig. 5a, b). The Sedimentological and paleontological studies of some cores of the wells drilled in Rudrasagar and Disangmukh area indicate a tidal delta. Most of the cores of the wells in this area show flaser (fig.4a) and lenticular bedding and are highly bioturbated (fig. 4b) indicating a very shallow, quiet environment of deposition. Isopach and Isolith maps of Sequence-I and Sequence-II suggests that around five distributaries were active in the area of study, with the input direction being from NW to SE. Only a minor shift in the channel axis is observed from lower to upper Sequence. Analysis suggested that Tura Formation represents an incipient delta forming for the first time in the North Assam shelf.

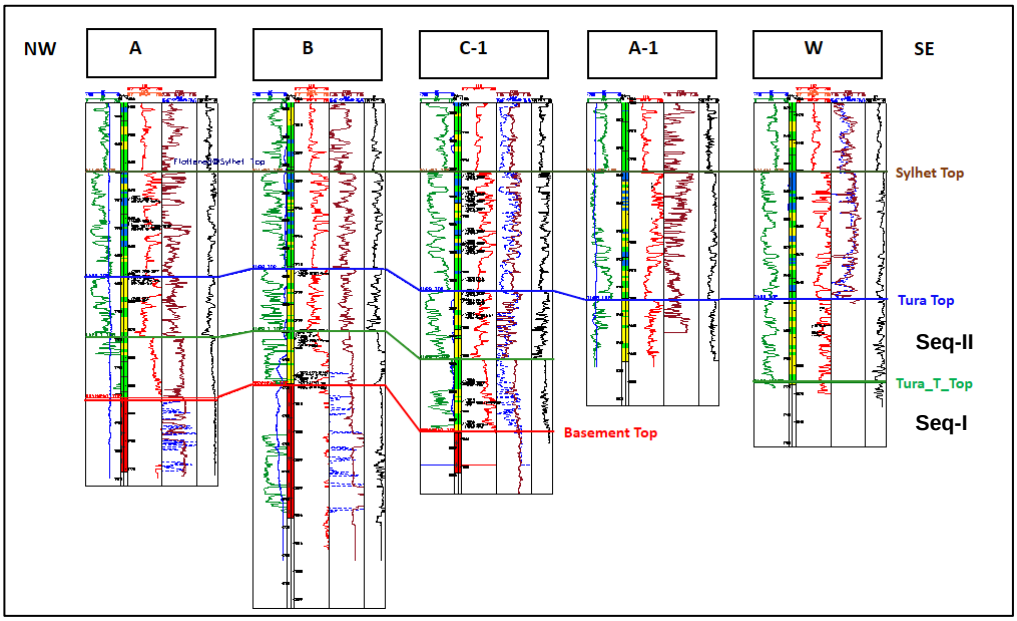


Fig 2: Stratigraphic electrolog correlation along the dip.

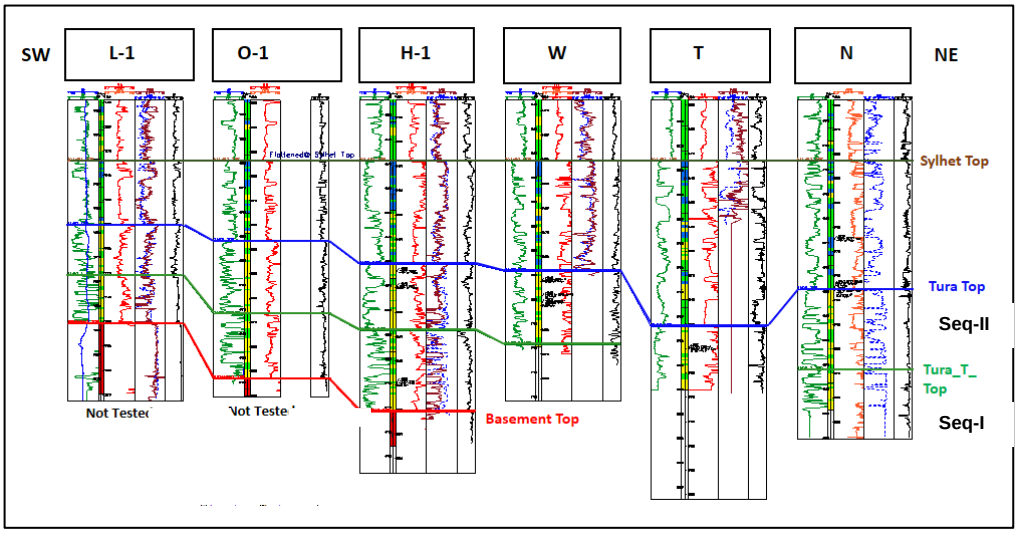
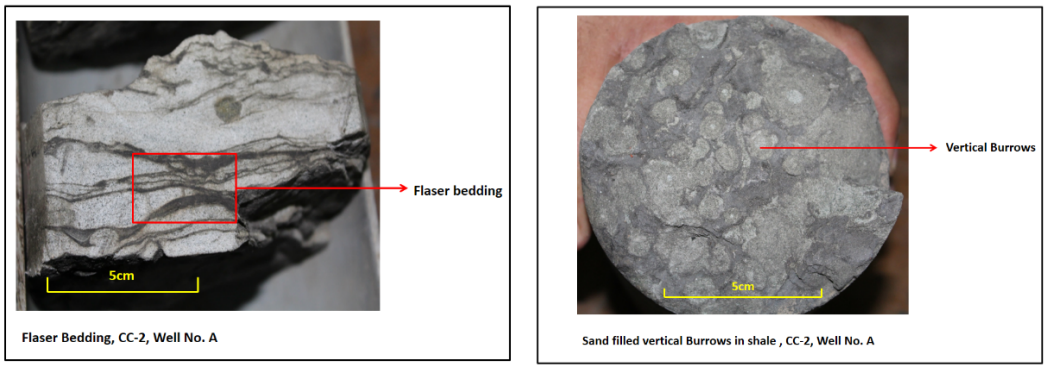


Fig 3: Stratigraphic electrolog correlation along the strike.

The isopach and isolith maps of the both the units thicken towards SE suggesting the depositional slope prevailing during that time.

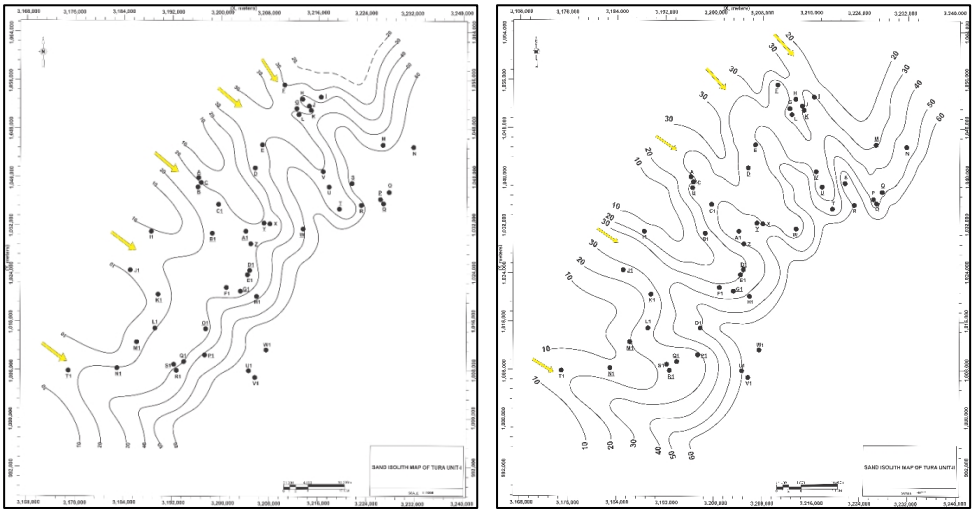
Two major types of fault system are prominent in Tura formation. The initial fault system fault system was generated in an extensional regime in NE-SW direction, whereas fault trending in WNW-ENE developed in later stage due to Himalayan orogeny. Hydrocarbon migration and entrapment in Tura formation is governed by the multiple sets of NE-SW and WNW-ENE trending faults (Fig. 6a).

Hence the area with thicker reservoir facies especially falling within the channel axis and structurally advantageous position are future exploration targets for Tura Formation like Panidihing, Disangmukh, Lakwa, Demulgaon and Geleki.



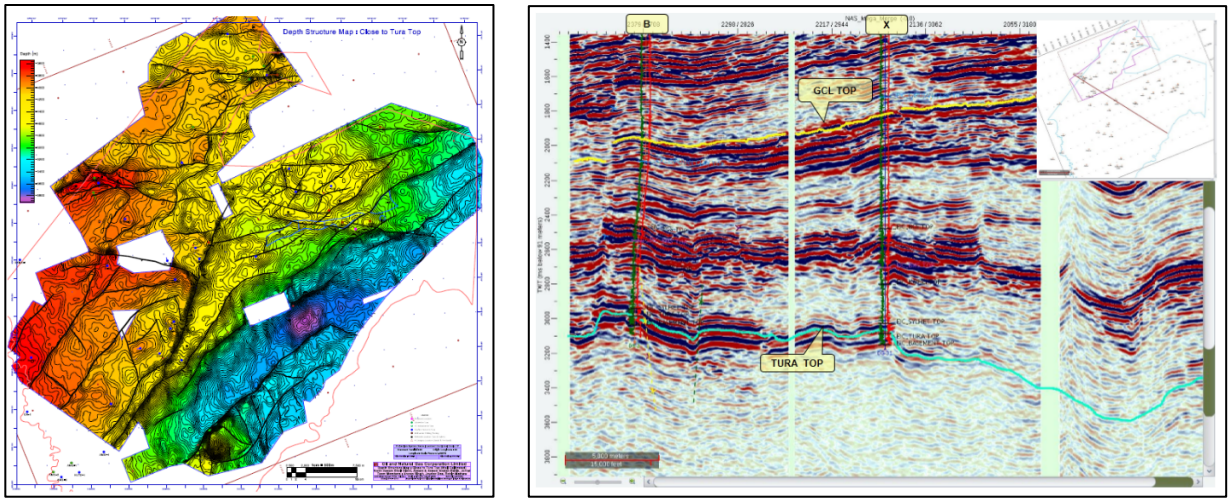
(a) (b)

Fig 4: a) Flaser bedding and b) Bioturbation in CC-2, Well No.A



(a) (b)

Fig 5: a) Sand isolith map of Tura Sequence-I, b) Sand isolith map of Tura Sequence-II



(a) (b)

Fig 6: a) Depth map on top of Tura top, b) Regional seismic section passing through Disangmukh to Bihubar

Conclusion:

- Deposition of Paleozoic sediments started during Paleocene and directly overlies over the Basement in North Assam Shelf and analysis suggests that Tura Formation represents an incipient delta forming for the first time in the North Assam shelf.
- Two third order transgressive/ regressive sequences were identified in Tura Formation. The lower sequence-I is deposited in a transgressive regime and upper sequence -II deposited in a regressive regime.
- Isopach and Isolith map of both the sequences of Tura suggests that around five distributaries are active with input direction from NW and paleoslope towards SE.
- Sedimentological studies of cores in Tura indicates a shallow, quiet environment of deposition in a tidal regime.
- Major fault system is NW-SE and some cross trend developed in WNW-ENE of Tura formation.
- Hydrocarbon migration and entrapment in Tura formation is governed by the multiple sets of NE-SW and WNW-ENE trending faults.
- The areas with thicker reservoir facies especially falling within the channel axis are future exploration targets for Tura Formation like Panidihing, Disangmukh, Lakwa, Demulgaon and Geleki.

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Views expressed in this paper are those of the authors only and may not necessarily be those of ONGC.

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