Structural Features and it’s brief study in and around Margherita-Ledo Area, Upper Assam Basin

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Summary

The Upper Assam basin is the feather edge of extensional basin system. Tertiary non-marine sediments dominate the stratigraphy mainly in Assam shelf and frontal thrust belt area. Structurally the basin is ornamented by complex thrust and strike slip fault in the frontier areas which reflects the complex models for hydrocarbon plays.

The Naga thrust is the major structural feature of this area, has mostly steep dip which has been hypothesized as reactivated of normal fault. An integrated study based on surface and subsurface data was undertaken to provide a re-appraisal of the structural features and its relationship to the region’s structural history. The total 2D seismic data of 1920 GLKM (113 lines) was acquired in the study area around Margherita and Ledo of Upper Assam Basin and so far number of wells have been drilled in the neighboring area viz. Duarmara, South Digboi, Kherem and Kumchai (Figure 1). Structural interpretation reveals that various play types exist at Upper Assam Thrust Belt areas. Among those hanging wall anticline, anticlinal closures at foot wall of Naga Thrust, inversion structures and inverted fault blocks are the major play types for hydrocarbon exploration.

Introduction:

Structural Interpretation

Margherita-Ledo area can be divided into two separate structural units; one to the north of the Naga Thrust and Kumchai inversion structures to the south. The northern unit, the sub-thrust unit, has a relatively normal deformation history in the foreland area beyond the deformation front, dominated by a set of normal faults. The supra-thrust units to the south of these structures have been highly deformed and dominated by contractional deformation suggested the Margherita and Naga Thrusts.

Theory and Methodology:

The segmentation of normal faults

Seismic data from Margherita-Ledo area indicates significant segmentations of normal and reverse faults both in map view and cross-section (Figure 2 & 3). A similar example of such model is shown in figure 4.
A characteristic feature of faults is that they are composed of stepping and linked segments over a wide range of scales. Steps and bends along normal faults are commonly visible on seismic sections and in cliff exposures. Pull-aparts (extensional bends) typically develop in brittle layers where there are a high proportion of less brittle layers in the rock sequence.

**The dips of thrust faults**

Thrust faults are usually low dipping (< 30°) reverse fault, which may be steepened by the development of underlying thrusts or if they are folded, but such steepened thrusts commonly maintain ~ 30° angle between the thrust and bedding. A common interpretation of steep thrust faults is that they are reverse-reactivated normal faults (e.g. Allmendinger et al., 1987; Jackson, 1987; McClay 1989; Williams et al., 1989). The relatively steep dip of the Naga Thrust in the west and east of the Margherita-Ledo area (Figure 5) suggests that this fault involves the reverse-reactivation of normal faults. It is hypothesized that the Naga Thrust buttresses against south-dipping normal faults along parts of its length, creating the Naga Anticline and reactivating the normal faults.

**Fault reactivation and inversion**

The Naga Thrust appears to involve the reverse-reactivation (positive inversion) of one or more normal faults (Figure 6 & 7).
A fault is *reactivated* if it undergoes renewed displacement after a prolonged period of inactivity; the fault has therefore been affected by at least two distinct tectonic events (e.g. Shephard-Thorn *et al.*, 1972; Sibson, 1985). Fault reactivation is a key factor in modifying fault displacement geometries and in controlling the pattern of deformation in covered sequences above previously deformed basement (e.g. Allmendinger *et al.*, 1987; Jackson, 1987; McClay 1989; Williams *et al.*, 1989). Kinematic reconstructions of tectonic domains usually invoke major fault zones to accommodate several deformation episodes, with reactivation being a function of the stress regime, and the orientation, frictional strength and location of the pre-existing faults (e.g. Sassi *et al.*, 1993). The reactivation of a population of faults will not reactivate in all orientations or scales of faults equally. Kelly *et al.* (1999) show that common features of a fault system during a reactivation episode include:

i) The largest faults alter their geometry to accommodate the change in the imposed stress.

ii) Reactivation will commonly be concentrated on the largest faults in the population. The smallest faults, which were the product of an earlier deformation episode, remain largely unaffected.

iii) A new set of faults may be formed to accommodate the new stress state and the reactivation of the largest faults.

**Conclusions:**

Structural interpretation of the area at various prospect levels reveal number of play types for hydrocarbon exploration. Play types have been delineated by recognizing closure on the structure contour maps. On this basis different areas of interest have been identified for hydrocarbon exploration. These are:

i) Hanging-wall anticlinal features with 3 ways dip closure: Anticlinal features associated with Naga Thrust are very prominent at Barail, Tipam and Girujan levels. Digboi oilfield appears to extent along the whole length of the Naga Thrust as hanging wall anticline structure at Tipam and Barail levels.

ii) Anticlinal feature at footwall of Naga Thrust: Anticinal features formed due to hidden thrust of Naga splays. Such structures are generally observed at Barail level.

iii) Inversion structure: Inversion structures were delineated between two segments of Naga Thrust at Girujan and Tipam levels. The structural style is mostly elongated domal style.

iv) Inverted fault block: Kumchai structure is one of the examples of such style. The structure observed at both Tipam and Girujan levels. Structural style is that of an inversion anticline with majority of closure dependent on cross-fault sealing against the boundary fault.

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**References**


