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Structural Style of the Assam Shelf and Schuppen Belt, A &AA Basin, India

Abstract

The Naga Thrust Belt is a narrow, elongated zone of imbricate thrusts about 20 to 35 km wide, extending for about 200 km in a NE-SW direction. It constitutes the outermost morpho-tectonic unit of the Assam-Arakan fold belt formed as a result of subduction of the Indian Plate beneath the Burmese Plate. The main axis of compression is SE-NW, with the oldest Disang Thrust of Late Eocene-Oligocene age. Thrusting continued up to Late Pliocene; the youngest emergent thrust is the Naga Thrust, which separates the foreland and the imbricate thrust zone. The structural evolution of the Naga Imbricate Thrust Belt is not well understood due to poor seismic imaging, few well data and abrupt variations in the stratigraphy across the foreland and Schuppen Belt and within the imbricate belt itself. To these problems we can add the lack of geological data in the inaccessible terrain to the east of the Disang Thrust upto the Indo-Burman border.Earlier works have brought out models ranging from thin-skinned tectonics with movement along thrust planes merging in a basal thrust propagating westward to pure thick-skinned tectonics. Modelling using MOVE – 2D software of Midland Valley indicated that simple thick or thin skinned models do not adequately explain the structural features observable within the Naga Thrust Belt.

A geological model that considers inversion along pre-existing (pre-Oligocene) extensional faults and development of thrust splays due to continued compression from the SE, however, could explain the present configuration. In this study we present a model involving combination of extensional features, later inversion along older normal faults and thrusting. The construction of a a balanced cross-section in the north-central part of the Naga Thrust Belt (Geleki) gives a fairly representative figure for shortening of about 25%.

The main hydrocarbon producing structures within the foreland are mostly located adjacent to the Naga Thrust. It is anticipated that these reservoirs extend below the Naga Thrust, perhaps upto the Disang Thrust. Extension of existing petroleum system(s) of the Shelf under the Schuppen is then postulated, with the Kopili and Barail source rocks attaining maturity during late Miocene and Pliocene with increased burial. Traps are not expected to be encountered in the overthrust sheets due to lack of a well developed cap rock, poor lithological characteristics and reactivation of faults upto the synorogenic erosion surface resulting in breaching of anticlines. The present work followed by petroleum systems modelling has led to a more realistic prospectivity perception of the area. Modelling by the TECLINK module of PETROMOD software suggests that the subthrust part of the imbricate thrust zone seems to be a prolific source and kitchen from the Kopili shales and the Barails for the generation of hydrocarbons, which then migrated during the Pliocene period through faults, thrusts and permeable pathways into structural and strati-structural traps already present in the foreland.

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Introduction

The Naga Thrust Belt is a narrow, elongated zone of imbricate thrusts about 20 to 35 km wide, extending for about 200 km in a NE-SW direction (Fig A). It constitutes the outermost morpho-tectonic unit of the Assam-Arakan fold belt formed as a result of

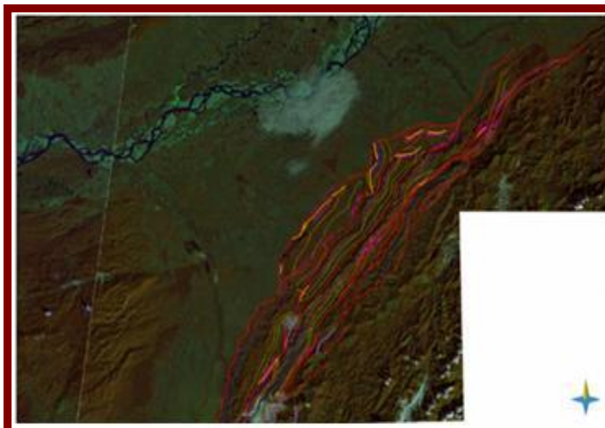

Fig A: Landsat Imagery with Major Thrusts and Formation Boundaries of the Imbricate Thrust Belt Superimposed

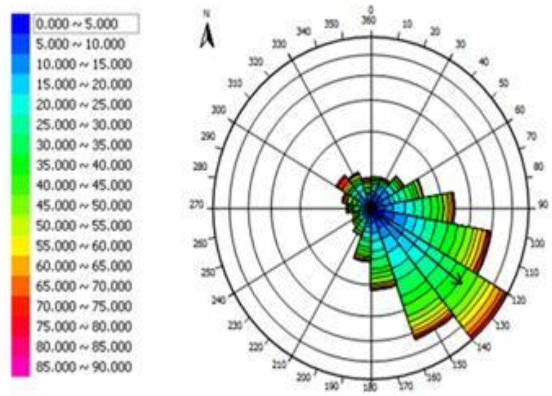

Figure B: Unidirectional Rose Plot showing mean dip direction towards 127 deg.

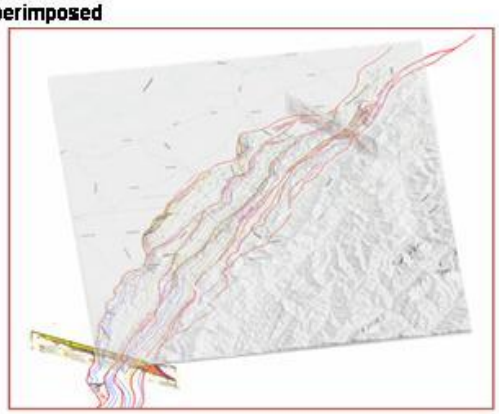

Figure C: Integration of DEM Data With The Geological Map.

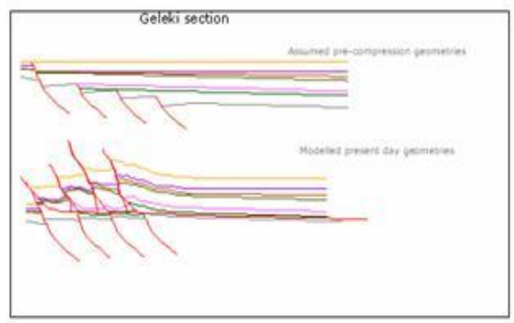

Figure D: Present Day Geometries Derived From A Pre-Compression Scenario Using A Combined Thick-Thin Skinned Model.

subduction of the Indian Plate beneath the Burmese Plate. Regional dips as determined from tangential plots of structural data elements is towardw SE (Fig B). Structural contacts (e.g. faults, formation boundaries etc.) draped over DEM data of the area allows for visualization of the 3D-structural pattern of the area (Fig C).

Stratigraphy :

The stratigraphy of the area is complicated, with different stratigraphic successions in the North Assam Shelf (NAS), South Assam Shelf (SAS) and the Schuppen Belt (SB). Stratigraphic equivalences drawn from published and unpublished literature have been depicted in Table A. An uniform stratigraphic column is required to be constructed in order to do structural balancing and restoration.

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Discussion

Based on existing field observations and inferences, a combined thick /thin skinned model is thought to able to best express the features seen in the area (Figure D). In this model, first inversion and then thrusting is postulated to occur along normal faults which form locales of thrusting. The forward model (figure D) closely depicts the present day scenario.

NAS	SAS	SB
Namsang Fm	Namsang Fm	Namsang Fm
Nazira Sst	Tipam Gp	Tipam Gp
Girujan Clay	-	Girujan Clay
Lakwa Sst	-	Tipam Sst
Geleki Sst (incl. LCM)	Bokabil Fm	Surma Gp
Barail Gp (BCS)	Barail Gp (BCS)	Renji / Tikakparbat Fm
BMS	BMS	Jenam / Baragolai Fm
-	-	Laisong / Naogaon Fm
Kopili Fm	Kopili Fm	Disang Fm
Sylhet Fm	Sylhet Fm	-
-	Moabund Fm	-
Basement	Basement	Basement

Table A: Time Equivalents for Study Area and Construction of a Stratigraphic Database for Restoration.SB = Naga Imbricate Thrust Belt.

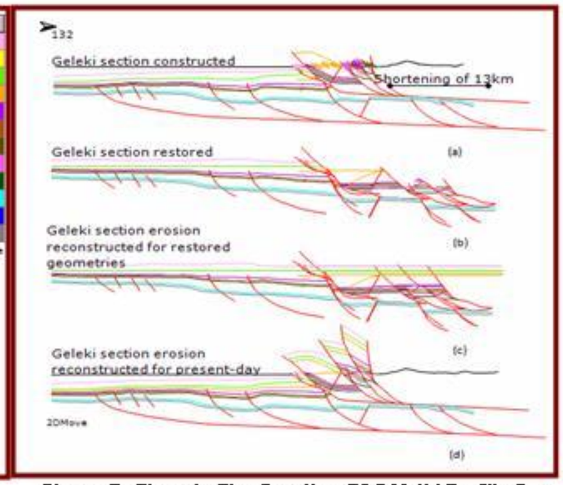

Figure E: Steps In The Creation Of A Valid Profile For The Geleki Section.

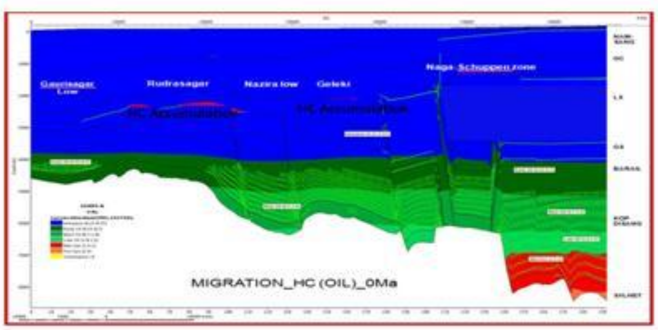

Fig F: Potential Hydrocarbon Generating Zones within The Schuppen – TECLINK Present Day Restored Section.

The forward model was quick-restored using field data and 2D – Move software. Erosion was built up, step by step, for restored geometries and then the present day geometry (Fig E). This validated model was later used for reconstruction of palaeosections through time from the Eocene to the recent for the Geleki-Disangmukh section.

The balanced and restored palaeosections were then analyzed by the TECLINK module of PETROMOD – 2D software using known geochemical parameters for the shelf area and assuming their extension into the Schuppen. Preliminary results suggest main oil generation zone in the subthrust part of the Schuppen, with some early oil generation in the lows of the Assam Shelf (e.g. the Nazira low and the Gaurisagar low. These generated hydrocarbons may have migrated through open faults and permeable pathways to form the prolific fields of the Assam Shelf.

Conclusions

The Naga Imbricate Thrust Belt has evolved as a consequence of compression from the south-east. Balanced and restored sections suggest a combined thick- and thin skinned model for the evolution of the Naga Imbricate thrust zone. A shortening of 25% is indicated. Preliminary studies by the TECLINK module of PETROMOD 2D suggests that the subthrust part of the Schuppen belt could be a prolific source and kitchen within the Kopili and Barail formations for the generation of oil and gas which then migrated updip through permeable pathways to form the prolific oil fields of the Assam Foreland.

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The views expressed in this paper area those of the authors and not necessarily of the organization.

References

Bally, A.W. etal., 1997 : Hydrocarbon potential of the Assam-Arakan basin, unpublished report (collaborative with ONGC).

Deshpande, S.V. et. al., 1993: Lithostratigraphy of Indian petroliferous basins, Assam-Arakan basin, Vol-I, II document X, KDMIPE, ONGC.

Kent, W.N., Hickman, R.G. and Dasgupta U. 2002. Application of a ramp/flat fault model to interpretation of the Naga thrust and possible implications for petroleum exploration along the Naga thrust front. AAPG Bulletin, Vol. 86 (12), pp. 2023–2045.