A Listric Model of the Naga Thrust and Fold Belt, Assam, India

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Abstract

The thrust and fold belt of the Assam Shelf in India is a prolific onshore hydrocarbon province. Exploration of the foreland and the supra-thrust regions of the Naga Thrust, the youngest thrust in the shelf continues to find new oil but these discoveries, although laudable, have been rather marginal. The sub-thrust, which can contain bigger plays, remains underexplored because its imaging using conventional seismic processing is difficult. Consequently, structural concepts have remained untested. Here, we have applied a state-of-the-art inversion-based processing to a 20 km long 2D profile crossing the thrust close to the type-locate of the prevalent thrust model (the Digboi oilfield). We intended to address a key structural puzzle in the region - does the Naga Thrust and Fold Belt contain inversion structures? At the outset, we used a combination of traveltime tomography and pre-stack depth migraton to image the profile as a whole. Then, we imaged the fine-scale supra-thrust structure using full-waveform inversion. Finally, we interpreted the migrated image with the help of the waveform velocity model, available well tops and cross-sectional structural balancing. Structural restoration of our profile differs from the previously proposed fault-propagation fold model of the Naga Thrust. Our restoration shows the Naga Thrust to be a listric thrust resulting from the inversion of a pre-existing extensional growth structure. Our results, although new, do not challenge the existing thrust model. Instead, we propose that there is a change in fault kinematics along the strike of the thrust belt likely across a tear fault that separates our profile from the Digboi oilfield. In our model, the Naga thrust system has two decollements - a deeper decollement in the upper Eocene Jaintia Group, which ramps up into a shallower decollement in the Oligocene Barail Group. The footwall has duplex structures resulting from under-thrusting and triangle zone formation, and the hanging wall

has extensive second-order deformation from an antithetic thrust, which accommodates over 50% of the total shorting. In our case, the cross-section-balancing not only provided a way to weave non-intuitive bed geometries into an admissible geological model but also isolated the key components to provide insight into the timing of formation of various structural elements. Numerous prospects emerge from our listric thrust model and may provide a new direction to sub-thrust exploration in the Assam Shelf.

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