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Balanced Structural Geometry of India's Oldest and Still Producing Digboi Oil Field, North-East India

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Balanced cross section is a technique that allows derivation of geometrically and kinematically valid subsurface structural geometry. Jeypore anticline is thought to be ramp anticline of the Naga Thrust, which is the frontal-most thrust in the Assam-Arakan Fold-Thrust Belt (AA-FTB), NE India. The AA-FTB is formed as a consequence of Tertiary collision between Indian plate and West Burma plate. In NE India, most of the oil fields have been discovered in the foreland, i.e. in the footwall of Naga Thrust. In the hangingwall very few discoveries have been made – Digboi and Kusijan are the better known oil fields. India's oldest and still producing Digboi oil field, discovered in 1889, occurs in the north-eastern part of Jeypore anticline (locally called Digboi anticline) whereas the Kusijan oil field occurs further towards southwest. In this contribution, we report eight balanced cross sections across Jeypore anticline in both Digboi oil field and adjacent Kusijan oil field areas.
Constant bed length/area has been assumed for all the sections for each of the Formations. The cross sections show co-relatable ramp anticlines above the Naga Thrust. The ramp-anticlines are modelled as fault-propagation fold. They undergo high-angle breakthrough in the Digboi oil field area but in the Kusijan oil field area and in remaining Jeypore anticline, the breakthroughs are very close to synclinal axial planes giving rise to snake-head anticlines. In the Digboi region, forelimb thinning is applied during slip along the breakthrough to match with the surface data; however, sections across Kusijan field maintained constant stratigraphic thicknesses during thrust-related deformation.
In the Kusijan area, hanging wall imbrication of Naga Thrust is observed in the cross sections, leading to anticline-syncline-anticline folds. This imbrication is blind and rejoining splay on the Naga Thrust. All the eight cross sections have detachment at the same stratigraphic level (within Tikak Parbat Fm.) but the depth to detachment varies from 4.2 km in the Kusijan field to 5.2 km in the Digboi field. A comparison among the eight cross sections shows variations in shortening, displacement along the detachment and dimensions of fault ramp. The shortening amount in SW end of Jeypore anticline up to Kusijan field is 31% to 36% while in the NE end of Jeypore anticline i.e. in Digboi field it is 25% to 27%. This differential shortening may be responsible for the "Assam Railroad Tear Fault" separating the two areas. The slip along the detachment varies from 5.8 km to 6.4 km in Digboi field; while 7.6 km to 9.4 km in the remaining Jeypore anticline. This slip brings late Oligocene Tikak Parbat Formation up to the present day surface topography. Towards the hinterland of AA-FTB much older Formations are exposed indicating deeper detachment and/or higher slip along the detachment surfaces. We are in the process of extending section balancing from the Naga Thrust to hinterland in order to understand the structural evolution of this collision belt as well as the hydrocarbon prospectivity in the hinterland of the Naga Thrust.