Unlocking the Potential: Identification of Early Generating Organofacies in Source Rocks of Assam Shelf

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Abstract

Assam Shelf plays a significant role as a petroleum province, contributing 4.15 MMT of oil and 3.19 BCM of gas. Production comes from various reservoir rocks spanning from Upper Paleocene to Miocene. Predominantly, oil reservoirs are found in Tipam sequences of Mio-Pliocene and Barail of Oligocene age. The prolific source rocks (SR) are Barail and Kopili formations of Oligocene and Eocene age respectively. SRs in the shelf area are generally immature to early mature, with the assumption that mature source rocks are present beneath the Schuppen Belt. It is noteworthy that discovered oils exhibit a range of maturities, varying from early to late stages.

Hence, the present work has been taken up with an aim to characterize early generating source organofacies employing customized kinetics to evaluate the timing and extent of hydrocarbon generation.

Total organic carbon content & Rock Eval analysis was performed on sediment samples in RE-VI instrument. Based on their Rock Eval data, samples are further screened out for custom kinetics and molecular characterization study via GC, GC-MS &GC-MS/MS. Organic petrography was performed on Leica Microscope to determine the thermal maturity (VRo) and maceral composition analysis. The 1D & 2D petroleum system modeling was carried out on PetroMod platform to evaluate the kerogen transformation using custom kinetics. Barail sediments, one of the potential source rocks, exhibit a broad distribution of activation energy, reflecting the structural heterogeneity of kerogen derived from a mixed terrigenous and freshwater algal organic matter as characterized by biomarkers like Bisnorhopane, Oleanane, Oleanoid, unimodal distribution of tricyclic terpanes, C29>C27&C28 regular steranes and absence of C30 24-n-propylcholestanes. Additionally, early hydrocarbon generating kinetics (Emax 44-50kcal/mol and Frequency factor e10-13 s-1) have been determined in wells NRD-e, RD-b, RD-a, RD-c, RD-d, L-h, L-d, L-c, L-b ,L-a, SN-b, G-e, G-d, G-b, D-b, K-a and MN-a for Barail SR. Presence of macerals like liptinite (2.7-17.9%), resinite (3-4.6%), suberinite, exsudatinite and bituminite further reinforces it, as they are considered to play a crucial role in the early generation of oil at lower thermal stress.

For Kopili SR, the kinetics distribution suggests mixed organic matter input (II+III). Well KH-a shows narrow Ea distribution with Emax 51kcal/mol contributing >50% to the total Ea distribution. Similarly, early hydrocarbon generating kinetics are observed in wells L-d & e, G-c, NRD-e for Kopili SR, indicating the generation of early maturity oils.

Petroleum system modeling by applying custom kinetics reveals negligible kerogen transformation in the shelf area, suggesting that the primary expelled hydrocarbons originate from the Schuppen Belt. Although, early generating kinetics (Emax: 50-51kcal/mole, A: e13 s-1), indicates that early oil window (VRo ~0.55%) commenced at the burial depth of ≥4km and attained significant kerogen transformation of Kopili SR; 38% in Nazira & Sonari low in Upper Assam North and 59% in Dimapur low in Upper Assam South. The quantum of hydrocarbons generated from these source rocks may not account for the total accumulated hydrocarbon in reservoirs but they might have contributed significantly towards hydrocarbon charging of adjacent structures viz. Lakwa, Geleki, Demulgaon, Kuargaon, Rudrasagar Sonari, Charali, Panidhing and Khoraghat with early maturity oils (VRc <0.65 %).