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The Late Miocene to Late Pliocene depositional sequences and structural developments of the West Baram Delta basin, offshore Sarawak, East Malaysia

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Abstract: The West Baram Delta (WBD) basin is a structurally complex region with an abundance of hydrocarbon that has been produced and yet to be discovered. Within the basin, there is a drastic increase of sedimentary thickness occurred across the growth fault, contributed to major challenges for the sequence framework correlation to be established throughout the basin. Understanding the growth fault development in terms of age-based within the study region is critical for better accuracy in reservoir correlation, reservoir distribution and structural trap analyses. 3D seismic mega-merge of the West Baram Delta was used to interpret the third order Tejas B (TB) stratigraphic sequences. From the structure maps of the maximum flooding surfaces (MFS) and sequence boundary (SB), thickness maps were generated for the system tracts of the corresponding sequence, mainly the highstand and transgressive system tracts. Then, structural restoration using a method of layer back stripping and fault blocks shifting were conducted to study the depositional and structural evolution of the basin. The Late Miocene to Late Pliocene sequence and structural developments of the basin were mainly controlled by growth faulting activities which are divided into seven stages: 1) WBD TB3.1 (~10.6Ma-~8.5Ma), 2) WBD TB3.2 (~8.5Ma- ~6.7Ma), 3) WBD TB3.3 (~6.7Ma–~5.6Ma), 4) WBD TB3.4 (~5.6Ma-~4.2Ma), 5) WBD TB3.5 (~4.2Ma- ~3.8Ma) 6) WBD TB3.6 (~3.8Ma-~3.0Ma) and 7) WBD TB3.7 (~3.0Ma-~1.9Ma) sequences. The high sediment supply rate is believed to provide conducive mechanisms for the gravity-induced syn-depositional growth faults to be initiated, which observed from WBD TB3.1 until WBD TB3.4. The growth faults in the basin were developed stage by stage from the south (landward) to the north (basinward) driven by the progradation of shoreface and delta sedimentation. The Northwest-Southeast wrench- induced compression which happened in Pliocene to Quaternary has caused basin inversion, where the trending of the fold axes is in the Northeast-Southwest orientation. The wrench-induced compression deformation was prominent at the proximal part of the basin, where its deformation extends distally down to the Baram field. The deformation developed the anticlinal features and faulting within this region. The intensity of the wrench-induced deformation decreases basinward, which is the reason why beyond the Baronia field, the deformation is less prominent. The distal part of the basin is mainly controlled by the gravity-induced syn-depositional growth faults tectonic style since the wrenching is not prominent. The six third-order depositional sequences established as WBD TB3.1 to WBD TB3.7 sequences with a complex growth-faulted structure development in the West Baram Delta give a new insight of understanding the depositional and structural evolution through time which may lead to a better stratigraphic correlation and hydrocarbon trap analyses at the field scale.

Keywords: West Baram Delta (WBD) basin, stratigraphic correlation, hydrocarbon trap analyses

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