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Tidally-Influenced Deposition in the Early Miocene Balingian Province of Sarawak: Sedimentary Characteristics, Geologic Cause and Impact on Earth history

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Tidally-influenced strata are important hydrocarbon source and reservoir rocks in the Early Miocene Cycle II interval of the Balingian Province, north-west Borneo. The Cycle II strata, consists of two c. 100–300 m thick, fining-upwards megasequences containing several higher-order units. The megasequences formed during c. 2-4.5 Myr periods of hinterland denudation and overall eustatic sea-level rise. The age-equivalent, onshore Nyalau Formation consists of several higher-order stratigraphic units that are interpreted as representing high frequency, regressive–transgressive cycles and deposition in a mixed wave- and tide-influenced coastal–deltaic depositional system. Stratigraphic architecture was strongly influenced by high frequency tectonic movement along the West Balingian Line fault zone. The offshore Cycle II strata show greater fluvial dominance, coarser grained sediments, mixed fluvial-tidal coastal systems and a paucity of wave-dominated successions. The higher fluvial influence reflects increased proximity to sediment source areas, including uplifted fault blocks of the West Balingian Line and the Penian High. The increased distance from sediment source areas resulted in decreased fluvial influence during deposition of the Nyalau Formation system, which increased the relative influence of tide and wave processes. Integrated palaeogeographic reconstructions, palaeotidal modelling and facies analysis indicate that Early Miocene tides in the Balingian Province may have had a 5–7 m tidal range and been capable of transporting coarse sand. Strong tides were the result of a regional-scale (100 – 1000 km) increase in tidal inflow and decrease in tidal outflow into the South China Sea, and relatively local-scale (10 – 100 km) funnelling effects in embayed shorelines in the Sarawak Basin. These conditions optimized the development of tide- and mangrove-influenced depositional systems across the South China Sea region, potentially resulting in enhanced lithospheric storage of organic carbon of up to 4,000 Gt (equivalent to 2,000 p.p.m. of atmospheric CO_2).

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