

**FACIES AND STRATIGRAPHIC SUCCESSIONS OF MARGINAL MARINE TO
SHALLOW MARINE DEPOSITS OF THE (UPPER OLIGOCENE-MIDDLE
MIOCENE) NYALAU FORMATION, SOUTH BINTULU, SARAWAK,
MALAYSIA**

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ABSTRACT

The upper Oligocene-Middle Miocene Nyalau Formation is well exposed in the south Bintulu, Sarawak. Integrated facies analysis and biofacies studies were carried out on four well-exposed outcrops in this area to characterize the facies, facies associations and biofacies and interpret the depositional environment of the successions. Fourteen sedimentary facies were recorded and grouped into five facies associations (Figure 1) and these are; tabular-planar cross bedded sandstone, amalgamated trough cross bedded sandstone, trough cross bedded sandstone, flaser-wavy rippled sandstone, bioturbated flaser to-wavy-rippled sandstone heterolithic, bioturbated heterolithic mudstone, well-bioturbated mudstone, interbedded sandstone and well bioturbated mudstone, hummocky cross stratified sandstone, interbedded hummocky cross stratified sandstone and bioturbated mudstone, laminated mudstone, carbonaceous mudstone, coal and paleosol. The facies associations are; lower to middle shoreface, tidal fluvial channel, tidal flat, mangrove (lagoonal) and coastal peat swamp. The biofacies study has revealed that each facies association consists of different biofacies characteristics based on palynomorphs and foraminifera assemblages. The lower to middle shoreface characterized by winnowed and reworked palynological assemblages with relatively barren foraminifera. The tidal channel and tidal flat facies associations consist of largely mangrove and back mangrove

pollen with low abundance and bad preservation of arenaceous agglutinated foraminifera. Mangrove (lagoonal) facies association is overwhelmed by mangrove pollen notably *Zonocostites ramonae* and *Florschuetzia trilobata* including high percentage of typical marginal marine and mangals foraminifera such as *Ammobaculites* sp., *Arenoparella Mexicana*, *Miliammina fusca* and *Trochammina macrescens*. The coastal peat swamp facies association is dominated by common peat swamp pollen such as *Palaquium*, *Blumeodendron*, *Stemonurus*, *Metroxylon*, *Pandanus* and *Camptosperma* including high proportion of typical climbing fern spores such as *Stenochlaena palustris*. The overwhelming of mangrove palynomorphs may reflect the occurrence of a former mangrove belt within coastal area, which related to the event of relative rise in sea level (e.g., Poumot 1989) and bounded by peat swamp vegetation in landward direction. The richness of mangrove along with common peat and fresh swamp pollen are also characteristics of tropical vegetation and linked to everwet and seasonal climatic condition (Germeraad *et al.*, 1968). Based on the integration studies, the studied sedimentary successions were deposited within mixed tide- and wave- influenced coastal environment ranging from estuarine system to wave and storm-dominated shallow marine setting with varying degree of fresh water and salinity influx. The interpretation of shallow to open marine wave-dominated system is based on Walker and Plint (1992). While the terminology and environmental subdivision within estuarine and tidal setting is according to Dalrymple *et al.*, (1992).

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