Sedimentation and structural development of the Malibau Basin, Sabah, Malaysia

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This research has revised the stratigraphy and distribution of rock formations in the Malibau Basin. Areas that were previously mapped as the Tanjong Formation is mapped as the Kapilit Formation, and vice versa. The Tanjong Formation and Kapilit Formation are found to be of Early to Middle Miocene and middle Middle Miocene to early Late Miocene respectively. The Tanjong Formation which is more deformed covers the southern and eastern parts of the area and is overlain unconformably by the Kapilit Formation which has an open fold structure and covers the central and western parts of the area.

The Tanjong Formation in this area is estimated to be 6,200 metres in thickness and comprises three stratigraphic units. Unit I, Unit II and Unit III represents the lower, middle and upper units respectively. Unit I is dominated by partly sheared argillaceous lithofacies and characterized by a thick sequence of mudstone interbedded with thin fine sandstone. The thickness of this unit is estimated to be 2,500 metres and was deposited in a neritic to bathyl environments. Unit II is dominated by an arenaceous to rudaceous lithofacies and characterized by a sequence of interbedded thick mudstone and sandstone, and contains coal and carbonaceous mudstone facies. This unit shows the presence of a coarsening upward megasequence, where it comprises interbedded mudstone and sandstone gradually become more dominated by thick to massively bedded sandstones towards the top, and further upwards comprises more arenaceous and conglomeratic beds. The thickness of this unit is estimated to be 2,200 metres and was deposited in a fluvial to deltaic environments. Unit III is dominated by an argillaceous lithofacies and characterized by a thick sequence of mudstone interbedded with thin fine sandstone. The thickness of this unit is estimated to be 1,500 m and was deposited in a neritic to bathyl environments. Facies and sequence associations in the Tanjong Formation show the presence of a coarsening upward megasequence between Unit I and II, and a fining upward megasequence into Unit III. This indicates a change in the depositional process from being regressive to transgressive with the sediment deposition moving towards the east.

The Kapilit Formation in this area is estimated to be 4,500 metres in thickness and comprises two stratigraphic units. Unit I and Unit II represents the lower and upper units respectively. Unit I is characterized by interbedded carbonaceous mudstone and thick sandstone with the occurrence of coal. The lower part of this unit is more arenaceous and towards the top is dominated by an argillaceous sequence. Facies association indicate that the lower part of Unit I was deposited in a deltaic environment which prograded towards the east and southeast whereas the upper part of Unit I was deposited in a transitional environment between the inner neritic to coastal plain. The thickness of this unit is estimated to be 3,300 metres. Unit II is characterized by a dominantly argillaceous lithofacies with rare interbeds of thick sandstone and minor limestone. The thickness of this unit is estimated to be 1,200 metres and was deposited in a middle neritic to bathyl environments. Sequence association between Unit I and Unit II shows the presence of a fining upward megasequence which indicates a transgressive process.

The structural morphology of the study area was the result of four main episodes of tectonic deformation trending northwest-southeast and northeast-southwest. Two earlier episodes (D1 and D2) occurred around

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Middle Miocene whereas the following two episodes (D3 and D4) occurred around Late Miocene. These deformations have produced tight to close, superimposed and plunging fold structures trending northwest-southeast in the Tanjong Formation, and superimposed open fold structures in the Kapilit Formation. The combination of these four tectonic phases have produced a superimposed megastructure and is mainly responsible for the development of subcircular and elliptical structures in the Miocene sediments. The development of these structural morphology was aided by lateral and growth faults trending northwest-southeast and northeast-southwest.

Based on the morphology and structural geometry, it is interpreted that the Tanjong and Kapilit Formations were deposited in a large proto-basin trending northeast-southwest related to the opening of the Sulu Sea and presently occur as separate basins due to deformation, upliftment and erosional process.