

Structural style, Tertiary stratigraphy and basin evolution of southern Sabah: implications to the tectonic evolution and sedimentation of Sabah, Malaysia

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The Southern Sabah Basin is located in the south-central part of Sabah, Malaysia, and includes the enigmatic 'circular basins' of Sabah. The Oligocene-Neogene sedimentary rocks in this basin were studied by surface mapping and SAR image interpretation. A new geological map covers an area of approximately 10,000 km² of the region has been produced, with a new Neogene stratigraphy and structural interpretation. A new Cenozoic tectono-stratigraphic evolutionary model for this region is proposed as a result of the study.

Mesozoic ophiolitic basement rocks are unconformably overlain by Upper Cretaceous to Middle Eocene deep marine turbidites of the Sapulut Formation. These are succeeded by the Labang and Kuamut Formations (Kinabatangan Group) which are deep water turbidites deposited between the Late Eocene to Early Miocene. The Labang Formation shows evidence of several deformation events. There are abundant syn-depositional and syn-diagenetic extensional faults, but also evidence of several phases of folding. The Kuamut Formation includes deep-water sedimentary rocks which are chaotically deformed mud-rich blocky melanges and mudstone-dominated brittle faulted rocks. The two formations are interpreted to include subduction-related tectonic melanges, olistostromes and mud-rich diapirs representing different structural positions in an accretionary wedge. Much of the deformation of the Labang and Kuamut Formations is interpreted to have occurred in a forearc region.

There is an important unconformity between the Labang/Kuamut Formations and younger rocks which represents a period of deformation, major uplift and erosion, followed by subsidence and sedimentation of the Serudong Group. The deformation event corresponds to the Sabah Orogeny of Hutchison (1996) and is Early Miocene (NN2-NN3). The unconformity is well dated by nannofossils and foraminifera and is older than previously suggested; it is interpreted to correlate with the deep regional unconformity (DRU) of offshore NW Sabah.

The Serudong Group includes local Burdigalian marine carbonates, and the Tanjong, Kalabakan, Kapilit and Simengaris Formations which were deposited in a large fluvio-deltaic system prograding towards the ENE. The Tanjong and Kalabakan Formations were deposited in the Late Early to Middle Miocene and are succeeded by the Middle to Upper Miocene Kapilit Formation. The Tanjong and Kapilit Formations each contain two upwardly coarsening megasequences, which comprise a lower mudstone and siltstone dominated sequence (Unit I), overlain by a sandstone and mudstone dominated sequence with some coal beds (Unit II). The Kalabakan Formation is dominated by shallow marine to shelf mudstones and is the distal equivalent of the Tanjong Formation. The Kapilit Formation was deposited above the Tanjong Formation after a major transgressive event; an important deeply incised erosional surface marks the boundary between them. This is correlated with the Intermediate Regional Unconformity (IRU) of offshore Sabah. The Simengaris Formation is unconformable upon the older formations and was deposited during the latest Miocene to early Pliocene, and this unconformity is correlated with the Shallow Regional Unconformity (SRU) of offshore Sabah.

Syn depositional structures in the Miocene sediments indicate subsidence and regional extension in a NW-SE direction. The Tanjong and Kapilit Formations are deformed by broad NW-SE-trending synclines separated by narrow anticlines. The anticlines are sub-parallel to major faults and associated with high angle reverse faults, and positive flower structures. Secondary fold-faults formed oblique to the major faults. The structural style suggests that the NW-SE trending faults acted as major left-lateral transpressional zones. The faults may in part be reactivated basement structures.

The Early Miocene unconformity is interpreted to be the result of deformation and uplift following underthrusting of continental crust of the South China Sea which terminated Paleogene subduction beneath North

Borneo. Renewed subsidence is related here to rifting in the Sulu Sea which led to the development of a major Miocene depocentre above the older forearc accretionary complex. The major transpressional deformation, probably occurred during the Late Pliocene, and is possibly related to propagation of deformation from Sulawesi towards NW Sabah. This strike-slip deformation which uplifted the area is termed here the Meliau Orogeny. Renewed extension during the Quaternary has caused some sequence repetition. The 'circular basins' of the Meliau, Malibau and Tidung areas, are interpreted as remnants of a single large basin, deformed in the NW-SE trending transpressional fault zones.