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TECTONIC EVOLUTION, SEDIMENTATION AND CHRONOSTRATIGRAPHIC CHART OF SABAH, MALAYSIA

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A stratigraphic chart incorporating all the Tertiary tectonic evolution and sedimentation phases of the Sabah Basins (North Borneo) was constructed based on onshore and offshore exploration data. This chart reflects the most recent interpretations of Sabah stratigraphy and correlations of onshore and offshore areas of Sabah. It includes major lithostratigraphic units and biostratigraphic markers.

The diverse structural trend and depositional framework of Sabah (North Borneo) were contributed by several regional tectonic events occurred since the early Tertiary. At least three major episodes were linked to NW-SE compressions coinciding with the ongoing subduction of the proto-South Chine Sea during the Late Eocene (Sarawak Orogeny), middle Early Miocene (22-20Ma, Sabah Orogeny-BMU) and early Middle Miocene (15.5Ma, MMU/DRU).

The Late Eocene tectonic deformation is characterized by folding and thrusting of basement rock and older paleogene sediments i.e. Rajang-older Crocker fold-thrust belts. The Paleogene regional tectonic setting of Sabah seems to be very complex with southeasterly subduction in the NW Borneo, and extension in the SE in the Celebes Sea and Makassar Strait (Hall 1996, 1997). The Paleogene appears to be a period of continued deposition of deep marine turbidites. The probable Late Eocene regional uplift was suggested by Hutchison (1996) as the Sarawak Orogeny which is related to the collision of the Luconia Continental Block. The palaeontologically dated Upper Eocene unconformity is found only in the onshore Sarawak area (Tatau Horst) between the Tatau and Belaga Formations (Wolfenden 1960, Haile and Ho 1991, Hutchison 1996).

The Early Miocene (BMU, 22-20Ma) deformation is interpreted to mark a major tectonic event, causing formation of the mélanges, major uplift and erosion which produced the Base Miocene Unconformity (BMU). This was followed by a change in depositional environment from deep-water to a shallow deltaic setting (Balaguru 2001, Balaguru et al. 2003, Van Hattam 2005). Patches of limestone (Burdigalian age) formed during this uplift. This tectonic event is related to subduction and collision of the Dangerous Ground Continental Block to the NW Borneo and referred as the 'Sabah Orogeny' (Hutchison 1996). This uplift has particular significance since it provided a nearby and abundant sediment source from the Middle Miocene onwards which explains the tremendous thickness of rapidly deposited Middle to Upper Miocene sediments found in the surrounding basins. This unconformity which should be the real deep regional unconformity is here been referred as pre-DRU (Deep Regional Unconformity) to avoid any confusion.

The Late Early Miocene (~19-20Ma) marked the NW-SE direction of rifting of the Sulu Sea interpreted to have rejuvenated the Central Sabah Basin with regional extension and subsidence, and initiated rift basins as part of the formation of the Sulu Sea in a back arc setting (Balaguru et al. 2003 and 2004, Nichols et al. 1990). The rift basin with coeval onshore extension became

depocentre for the Stage III deltaic-shallow marine deposition of the Tanjong Formation in the east and Meligan/Setap Shale Formation in the west of Sabah.

Middle Miocene collision of another arc-continent collision in the northern Borneo between the Cagayan Arc and Palawan micro continental block (Rangin 1991) caused another Middle Miocene Unconformity (MMU, 15.5Ma) has been referred to mark the Deep Regional Unconformity (DRU) in Sabah. This deformation caused inversion of the early Middle Miocene sediments.

The early Late Miocene Kinabalu emplacement plausibly marks the Intermediate Regional Unconformity (IRU, 10.6Ma) in Sabah.

The Late Miocene (SRU, 8.6Ma) tectonic event marks another major folding and uplift which can be correlated as the Shallow Regional Unconformity (SRU) of this region (Bol and Van Hoorn 1980, Levell 1987). This latest phase of major tectonic event most probably caused by NW-SE trending strike-slip faulting and transpressional fault movement in this region (Balaguru et al. 2003). Continuous transpressional movement resulted in major structural inversion and uplift most of the southern and eastern parts of Sabah where the Miocene strata now are exposed onland with a highest point at 1500 m (Gunung Lotung) above the sea level. This event is here termed the Meliau Orogeny (Balaguru 2001).

The transpressional movement along the major strike-slip faults in this region would better explain the structural development in these areas. It probably continued during the Late Pliocene and another unconformity can be picked at 5.5Ma, and is possibly related to propagation of deformation from Sulawesi towards NW Sabah. The Late Pliocene strike-slip deformation is regionally significant and occurred at similar time as important deformation in NE Kalimantan, Sulawesi and NW Sabah. This transpressional movement is interpreted to be the cause of the major orogenic deformation, uplift and final structural development in Sabah region and possibly continued to the present day.

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