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GROWING EVIDENCE OF ACTIVE DEFORMATION IN THE MALAY BASIN REGION

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Very young crustal movements in the Malay basin region point to the possibility of reactivation of regional faults in the basin that may compromise their sealing integrity. In addition, active or reactivated faults that are rooted in the pre-Tertiary basement and reach up close to the base of Quaternary seabed sediments of the basin pose obvious hazards to offshore installations.

The Malay basin originated in the Late Cretaceous as a major aulacogen on the Malay Dome and developed structurally through modifications by differential extrusion of Indosinian crustal slabs. Initially the extrusion imparted sinistral transtensional wrenching on the axial basement fault along the basin length. In post Mid-Miocene, wrench reversal produced transpression, accompanied by general structural inversion. From the Pliocene onward most of basin area has been considered tectonically quiet on the basis of horizontal stratification, absence of volcanic centres, absence of earthquake epicenters, and low relief. However, basement-rooted regional fault zones may reach as high as 150 metres below the shallow seabed and into the Pliocene-Pleistocene strata (Fig. 1) implying structural reactivation in the Quaternary. Onshore Peninsular Malaysia, small Early Tertiary basins hosts lacustrine and fluvial-dominated deposits. These basins appear associated with regional fault zones suggesting structural activity up to that time. Neogene deposits are apparently missing while the blanket of Quaternary sediments only indicates local disturbances associated with base collapse and gravity sliding. On the other hand, an Early Quaternary pillow-basalt flow near Kuantan on the eastern shore of the Peninsula is traversed by long fractures orientated parallel to faults in the pre-Tertiary basement. The fractures in the basalt are vertical to subvertical and are evident manifestations of reactivation of the older faults (Fig. 2). In Southeast Johor at the edge of the Penyu Basin, crustal uplift of 0.5-0.8 m in the past 5000 years is suggested by an abrasion platform that is that much higher compared to the secular Holocene sea-level curve of the Peninsula established from almost one hundred radiometrically determined bio-shoreline indicators. On the shores of Langkawi, in the northwest of the Peninsula, a 2500-year old abrasion platform is cut by long fault zone with associated secondary structures suggesting dextral displacement (Fig. 3). The 26 December 2004 mega-thrust Indian Ocean earthquake is recorded by GPS measurements to have displaced the entire Peninsula laterally in WSW direction by several centimetres. Among relevant findings of ongoing research in the Langkawi islands are geologically very recent crustal uplift of 40-50 cm that manifests as sea-level notches at elevated positions above present mean sea level (Fig.4).

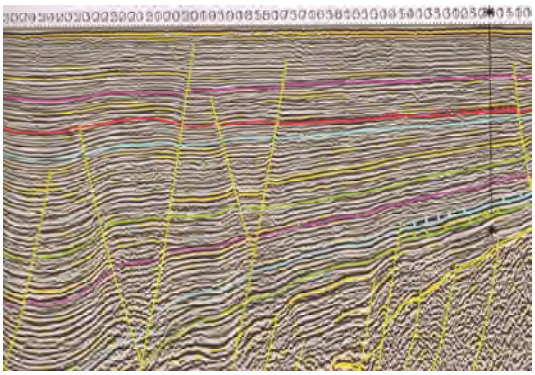

Figure 1: Fragment of a regional seismic line across the Malay basin. Some of the deeply rooted regional faults reach up very close to the sea bed.

Figure 4: The notch corresponds with a mean sea-level now about 0.5 m above the high tide level that is approximately represented by the current water level. Sungai Kilim in the Langkawi Geoforest Park (March 2007). trends N60°E. Pulau Ular, Langkawi.

Figure 2: Flow of Early Quaternary pillow basalt at Pantai Batu Hitam near Kuantan Pahang. Compass points North. The long fractures are parallel to regional faults in the pre-Tertiary of Peninsular Malaysia.

Figure 3: The raised abrasion platform is over a metre above present high tide. This elevation corresponds with 2500 years on the Quaternary sea-level curve of Peninsular Malaysia and Thailand. The young fault across the platform trends N60oE. Pulau Ular, Langkawi.

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