Paper 15

Petroleum potential of the Tembeling Group

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Mesozoic sequences occur extensively in the central belt of Peninsular Malaysia (E.H. Yin, 1988). Except for two small Mesozoic conglomerate occurrences at Pulau Kapas in Terengganu and Mersing in Johor, no other occurrences of the Mesozoic sequences in the offshore area have previously been reported. Extensive exploration for hydrocarbons by oil companies has provided new information on the possible extension to the offshore region, of the Mesozoic sequences. In the Malay basin, pre-Tertiary (?) sequences have been observed, and a few wells have been drilled into these sections. One well, Tok Bidan-1, situated east of Pulau Redang, north Terengganu, was claimed to have TDed in the Jurassic-Cretaceous section. Could these pre-Tertiary sections observed outside Tok Bidan area are also the lateral equivalent of the Jurassic-Cretaceous sections mapped in the central belt and the extreme east coastal regions of Peninsular Malaysia? The fieldtrip to the Sungai Tekai area where Jurassic-Cretaceous Tembeling Group is well-exposed, attempted to understand:

i) broad geological settings of the Tembeling Group and how these relate to the observed structural features in the Malay basin,

ii) age of the group, and

iii) hydrocarbon source and reservoir potentials of the Termus Shales and Mangking Sandstones respectively.

The Tembeling Group consists of three lithologically distinct formations: Lanis Conglomerates, Mangking Sandstones, and Termus Shales in stratigraphically ascending order (H.P. Khoo, 1983). The Lanis Conglomerates are polymictic, consisting of quartz, granite and meta-sediment clasts of pebble to cobble size, embedded in fine to coarse grained matrix which is generally red in colour.

The Mangking Sandstones exhibit the most spectacular outcrops along Sungai Tekai. The sandstones are generally fine-to-medium grained, whitish to light pinkish grey, and are "inter-bedded" usually with thin light grey shales. Small to very large scale cross bedding is common within the sandstones. True fossils (burrows and trails) have been observed. Under the microscope, quartz constitutes 75% of the framework grains, with 10% chert, 10% feldspar and 5% rock fragments. Illite is the dominant clay mineral. Porosity is generally poor, with less than 10%, and porosity destruction appears to have been caused primarily by quartz overgrowth.

The Termus Shales are generally reddish, and occasionally pinkish colouration and contain sporadically thin fine grained sandstones. These sandstones in places exhibit sharp erosional boundaries. Mineral composition analysis of the sandstones indicates a high content of framework feldspar (40%), which are generally highly altered, quartz (40%), and rock fragment (15%), and 5% of biotite, muscovite and iron oxide.

Tectonically, based on field evidence, it appears that the Tembeling Group was folded once, resulting in tight folds (in shale sequences) to open folds (in sandstone sequences). The direction of regional compression is established by the pattern of left and right-stepping arrays of quartz veins in the sandstones. This compression within the NE-ENE sector (of probable post-Neocomian-Palaeocene age) also developed slaty cleavage, reverse faulting, and moderate-sized wrench faults. The presence of pencil cleavage in the Termus Shales may be a manifestation of mid-Miocene(?) compressive deformation, which in the Malay basin had caused significant folding, wrench faulting and local reverse faulting.

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It is difficult to determine the age of the Lanis Conglomerates, but the presence of *Classopollis*, *Exesipollenites*, *Ephedrapites*, and *Cicatricosisporites* in the Termus Shales and Mangking Sandstones indicates an Early Cretaceous age, and probable a pre-Barremian age for the two formations, based on the absence of angiosperm miospores. No dinoflagellate cysts or microforaminifera were observed.

Surface shale samples of the Mangking Sandstones and Termus Shales, which have been subjected to weathering effects, indicate generally poor residual total organic carbon content and poor hydrocarbon generating potential. Hydrogen Index values are also very low, indicating Type IV inertinitic kerogen with no hydrocarbon potential. However, Thermal Alteration Index suggests that the samples are matured in the Termus Shales to highly matured in the Mangking Sandstones.