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Malay Basin: The Impact of Tectonics and Basin Architecture on Petroleum Resources and Future Potential

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The regional context of Sundaland is an assortment of continental crusts from eastern Gondwana and southeastern Eurasia. The Sibumasu, West Burma, Indochina–East Malaya tectonic blocks accreted and formed Sundaland in the early Mesozoic, and sutured up the Palaeo-Tethys ocean. The development of Sundaland deformation concepts has its influence on the intracratonic Malay Basin. A new tectono-stratigraphic framework for the Malay Basin was developed from research and analyses of regional tectonic data, stratigraphic and basin scale seismic data. The proposed Malay Basin Ridge and Graben Model identified a total of twelve (12) tectonic sub-provinces, which are flanked by basement escarpments. The polyphased tectonic evolution of the intracratonic Malay Basin initiated from a Mesozoic pre-rift basement, through to Palaeogene syn-rift phase, early to mid-Miocene subsidence, late Miocene pulsed inversion and Plio-Pleistocene sag. This regional Sundaland to Malay Basin deformation hierarchy can be arranged from a 1st order plate scale, 2nd order tectonic block, 3rd order major basin, with 4th order sub-basins, filled with 5th order broad fold lineaments, and smaller 6th order traps. It is these 6th order traps that are being drilled by oil companies.

The refined ridge and graben model is an update on the understanding on regional Malay Basin morphology, and it is able to explain the tectono-stratigraphic distribution of the oil and gas fields better. The basin south-eastern sector has enhanced, high relief E-W strike folds of major oil fields such as Bekok-Seligi-Pulai, Tapis-Tiong-Kepong, and Tabu-Guntong-Palas, which were inverted during middle to late Miocene from Sundaland collision with Indo-Australian plate, and synchronous with early oil generation/migration phase. Whereas, on the basin northwestern sector are moderate relief E-W strike folds of Bintang-Lawit-Jerneh, Noring-Sepat-Laho, which were inverted progressively later during end of late Miocene being farthest from the collision front, thereby mainly capturing late gas generation from deeply buried source beds.

The intra-basin tectonic deformation scale also correlates comparably well to the hydrocarbon trap size. These 6th order trap closures can be: Giant (>500 mmbbl) fields, Major (>100 mmbbl) fields, Medium (>50 mmbbl) fields, Marginal (<30 mmbbl) fields, and Small (<10 mmbbl) fields. The marginal and small sized traps often rank low on the exploration prospect drilling list. However, if several of these 6th order minor traps align on a broader 5th order structural trend, thus amalgamate into a larger continuous closure, then this very large structure could, hypothetically hold a prospective resource volume of a few billion barrels oil equivalent. The role of the petroleum geoscientists is to continuously seek new and different exploration perspective to make future economic-size discovery which will supplement the growing global demand for hydrocarbon resources such as the expensive Tapis-type crude oil from the Malay Basin.

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