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Hydrocarbon habitat in offshore Southeast Asia: comparison between the Mekong, South Con Son, Natuna and Malay Basins

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Hydrocarbon exploration in the Tertiary basins of the South China Sea has been conducted since 1968. This has resulted in the discovery of over 3.5 billions barrels of recoverable oil and 20 TCF of gas in some 38 major oil gas fields. About 70% of these

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reserves are located in the Malay Basin, 14% are in the Natuna Basin, 8% are in the Mekong Basin and 8% are in the South Con Son Basin. Some 20% of the total oil reserves have been discovered since 1989, suggesting that despite the long history of exploration in the basins there is still scope to discover further significant reserves.

The tectonic history of the South China Sea can be split into 2 phases: pre-Tertiary and Tertiary. During the Palaeozoic and Mesozoic, rifted fragments of Gondwanaland amalgamated to form South East Asia which collide and sutured to South China. In the Tertiary phase: India collided with Eurasia; Australia moved northwards and collided with the Pacific plate; and the Pacific/Philippines plate moved westwards and subducted below Eurasia. The consequences of these plate interactions are a complex assemblage of strike-slip faults, extension, inversion, subduction and seafloor spreading. The Malay, Natuna, South Con Son and Mekong basins are interpreted as Oligocene rifts formed by extension within a strike-slip regime. Structural development was influenced by pre-Tertiary trends, especially suture zones, and was modified by continued tectonic movement throughout the remainder of the Tertiary. Structural features in the South China Sea basins are generally consistent with a dextral strain ellipsoid.

The Tertiary stratigraphy of the South China Sea can be correlated in broad terms between the basins. Two components are identified: an Oligocene synrift megasequence and a latest Oligocene to Recent postrift megasequence. In the Mekong and South Con Son Basins two synrift sequences are identified. The postrift can be divided into three sequences in all the basins by a top Oligocene/early Miocene transgression and a mid-Miocene unconformity. The trasgression represents a major regional sea-level rise; the unconformity is the result of a structural inversion which reaches a maximum in West Natuna and decreases progressively into the South Con Son, Mekong and Malay basins.

Hydrocarbon plays in the South China Sea basins are comprised of similar components; knowledge of the variations and controls on these components, between and within basins, is key to understanding the hydrocarbon habitat. Lacustrine algal source rocks are developed in the synrift. Postrift sources include oil and gas-prone mudstones and coals deposited in a lakeshore/coastal plain environment and an oil-prone algal source. Source rocks tend to be interdigitated with reservoirs. Synrift reservoirs include fluvial and alluvial sandstones. Reservoirs are also developed in basement wash and fractured basement in the Mekong basin. Postrift reservoirs consist of fluvial, lacustrine deltaic and shallow marine sandstones. Some 80% of the discovered oil is in Early Miocene and latest Oligocene postrift sections. Traps include inversion anticlines, hanging wall and footwall tilted fault blocks, faulted anticlines, hanging wall rollovers and drape structures. Traps typically involve stacked reservoirs with complex fluid contacts.