Paper 9

Reservoir characterization of Cycle I & II clastics, offshore Sarawak — a sedimentological investigation

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The Sarawak Basin extends 300 km off the Northwest coast of Borneo. The basin can be divided into two sub-basins; one to the east and one to the Northwest, separated by a basement high located towards the southwest. The sub-basin high coincides with a pronounced northwest-southeast structural lineament termed the West Balingian Line (WBL). The area investigated was Balai-1, located within Block SK306, southwest

Warta Geologi (Newsletter of the Geological Society of Malaysia), Vol. 26, No. 6, November-December 2000

of the WBL on the basement high. The data set comprised FMS* data, composite logs and 2D seismic, also available were biostratigraphic, mineralogical and petrophysical results.

The basin comprises Tertiary sediments, composed of interbedded sandstones and mudstones with carbonate mounds located on the highs. The interbedded sandstones and mudstones have been divided into seven stratigraphic divisions (T1S-T7S) based predominantly on unconformities or its correlative conformity (Mat-Zin and Tucker, 1999). An older scheme, divides the sediment into cycles I – VII/VIII, based predominantly on the biostratigraphy and lithology (Ho, 1978; Hageman, 1987). The well in question, Balai-1 has been divided according to the scheme adopted by Sarawak Shell (Hageman, 1987) and exhibits the top of Cycle I and most of Cycle II. The division between Cycle I and II is concurrent with the delineation of T1S and T2S.

Structurally, it was evident from the FMS results that Cycle I displayed dips orientated NNW, striking NNE-SSW and this interval was characterized by much faulting, dipping N (strike E-W). In Cycle II the dips were orientated SW/SE (strike NW-SE or NE-SW, respectively), with faulting only associated with the lower part of the succession. The petrographic results (Hill and Soo, 1991) indicate the sandstones were composed predominantly of litharenite, comprising around 44% quartz, 5% feldspars, 12% rock fragments 16% accessories, framework grains. The rock fragments identified include chert and volcanic fragments. The sandstones are commonly composed of fine to medium grained, moderately well sorted grains. No conclusive, palynological results were recorded in Cycle I to indicate palaoenvironment, whereas in Cycle II, the presence of foraminifera suggested a marine, inner neritic depositional environment i.e. lower coastal plain (Hulsbos *et al.*).

The stratigraphy in Cycles I and II was analysed using predominantly FMS data, as no core was recovered. In Cycle I, thick units of stacked sandstones (>10 m), displaying erosive basal surfaces, cross-bedding, variable grain-size distributions and divergent palaeoflow patterns were observed. The palaeoflow direction, was predominantly towards the E quadrant, commonly to the NE, with the dominate channel orientated NE-SW. Cycle II, appears similar in nature with only the upper part of the succession exhibiting a more varied sand body characteristic, interpreted as meandering channels and distributary mouth bars.

The thick sandstone units are thought to represent a more fluvial, upper coastal plain environment dominated by anastomosing sandy braided channels possibly laterally constrained i.e. valley-fill. In contrast, the upper part of Cycle II is interpreted to exhibit a more marine, coastal influence depositing as a tide dominated delta front within a lower coastal plain environment.