Paper P25

Sedimentological Characterization of Deeper Group M Reservoirs in Malay Basin

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With the proven resources established in the shallower stratigraphic intervals in Malay Basin, the focus has now shifted to the plays in deeper reservoirs. This paper focuses on the sedimentological characteristics of the deeper Group M, the deepest penetrated sedimentary sequence in the study area with hydrocarbon discovery. The early Oligocene Group M top is well demarcated by a regional shale marker (M shale) and has been divided in to subunits from M10 to M110 based on wireline log characteristics in the drilled wells (Fig. 1). The sediments of Group M were laid down in the early rifted continental sequence in alluvial to lacustrine environments.

The sedimentological characteristics were defined using core (conventional and sidewall) and wireline log signatures from three key wells. Based on available conventional core data, wireline logs and limited biostratigraphic control, the depositional setting for the studied interval was characterized by an active braided fluvial system draining in to lake. The recognized key subenvironments within this system include braided fluvial channels and in-channel bars, lacustrine mouthbars, and open lacustrine muds. The stacked and repetitive nature of the environments especially for the deeper M110 indicates an active progradation. The inferred environments and well log correlations show that the sand bodies are laterally extensive with sheet geometry.

Based on petrographic studies, the sandstones are fine to coarse grained, subangular to subrounded, compositionally immature lithic and feldspathic arenites (Fig. 2) and diagenetically altered with presence of silica and carbonate cements, authigenic kaolinite with subordinate illite. The sandstones were derived from metamorphic and igneous basement rocks with a contribution from pre-existing sedimentary rocks. The evolution of depositional system and the sandstone compositions for the Group M sediments were primarily controlled by the interplay between the syn-rift tectonics and available accommodation space and probably influenced by climatic and lake level fluctuations.

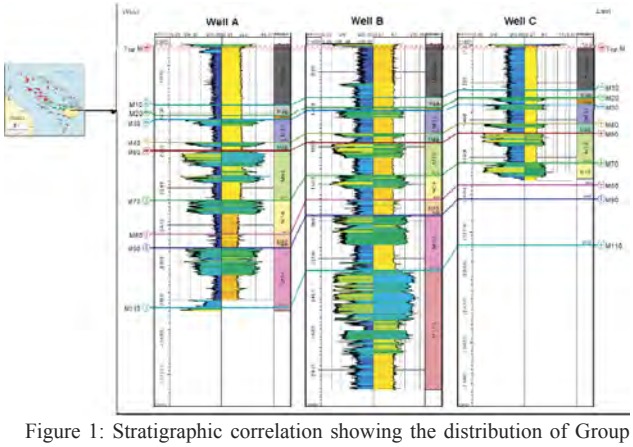

Figure 1: Stratigraphic correlation showing the distribution of Group M in the drilled wells.

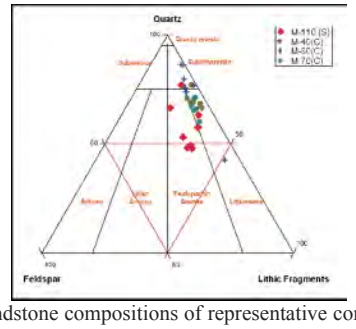

Figure 2: Sandstone compositions of representative core samples from penetrated Group M in the study area.

In general, good reservoir quality is shown by braid plain to channel sandstone, with some proximal mouthbar to lacustrine shoreface sediments also showing good reservoir quality (Fig. 3). For the deeper M110 unit, limited sidewall cores are available for evaluation; the general porosity values are moderate to poor whereas the permeability values are low (Fig. 4). The primary controlling factors for reservoir quality in the deeper Group M sandstones are depositional facies, grain size variations and diagenesis. The study has helped in understanding the controls on reservoir characteristics and to evaluate the use of appropriate technology like hydraulic fracturing for possibly enhancing the production in the discovery wells.

References

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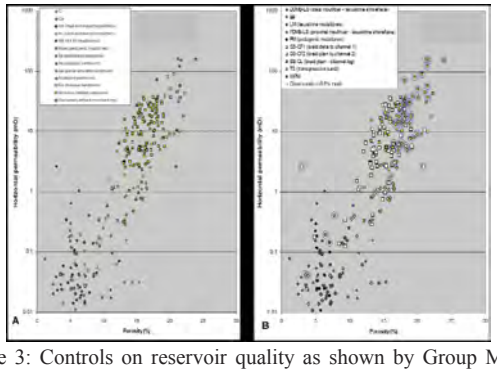

Figure 3: Controls on reservoir quality as shown by Group M40-70 in Well C showing (A) Distinct grain size and facies association, and (B) Better reservoir quality samples are associated with braid plain to channel sandstone, with some proximal mouthbar to lacustrine shoreface sediments also having good reservoir quality.

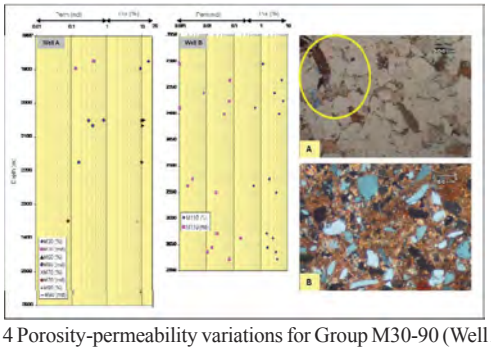

Figure 4 Porosity-permeability variations for Group M30-90 (Well A) and M110 (Well B) units. The variations are controlled by facies and grain size variations with the coarser sandstones preserving porosity (A) and the sandstones with higher matrix content having lower porosity (B).

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