Turbidite Stratigraphic Play in Deep Water Makassar Strait Indonesia

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ABSTRACT

The majority of hydrocarbon production and discoveries made today in the turbidite play, offshore Makassar Strait relies on a structural trapping mechanism. Typically, hydrocarbons fill anticlinal closures that conform with the structures. Additionally, some gas fields have been found under fault dependent traps that feature anticlinal closures. This paper will discuss the potential of stratigraphic traps in the offshore Makassar Straits, Kutai Basin, Indonesia. The stratigraphic traps are mainly seen within Miocene and Pliocene levels and hence, they are amplitude related.

The turbidite slope and basin floor fans provide a perfect stratigraphic trap component. However, the presence of structural trap in addition to the stratigraphic trapping mechanisms such as faults or anticlines helps the trap efficiency towards the updip direction. Laterally enclosed or isolated slope or basin floor fan complex, capped by an efficient top seal creates a perfect stratigraphic trapping mechanism.

The Upper Miocene to Pliocene sediments in the Northern part of Makassar Strait were deposited under a middle to lower slope setting. The slope fans were deposited in the intervening synclines between some anticlines as the structures were syn-deposition and hence, the sands were deposited at the flanks of the structures and lows. The slope fan lobe complex is relatively elongated and consists of amalgamated channels, levees and overbanks or crevasse splay. Down to the basin, in the lower slope to the proximal part of the basin floor environment the turbidite fan lobe complex is more un-confined, building mounded geometry and convexing downward features that are seen as bi-directional downlapping features on seismic. Further, in a more distal position in the basin floor environment, the turbidite lobe complex is lower relief but has widespread distribution laterally.. There is uncertainty in the petroleum system in relation to stratigraphic traps, which include source and migration, reservoir quality, trap definition and containment. Basin modeling suggests that the top oil and gas maturity windows lie at 2800m and 4000m below mudline respectively. None of the hydrocarbon bearing reservoirs penetrated by the deep water wells in the Makassar Straits has reached sufficient maturity for both oil and gas generation, which is also the case for time equivalent synclinal areas. As a consequence, the stratigraphic traps of Middle Miocene to Pliocene age have to rely on a vertical migration of oil and thermogenic gas. Hence this will mean a deeper and older stratigraphic trap would have a better chance of being charged because the migration will be of a shorter distance. The presence of faults, especially extensional faults, will act as a conduit to deliver any expeled hydrocarbons from the underlying mature source rocks.

Scout data suggests that a recent deep water discovery in the Southern portion of the Makassar Strait was made on the lower slope fan complex that contains mainly biogenic, which opens the concept of biogenic gas charge. Hence, in the areas where the overburden thickness for the Miocene and Pliocene stratigraphic traps are low, biogenic gas is envisaged rather than thermogenic gas. Moreover, some shallow gas

discoveries from early Pliocene reservoirs also consists of mixed biogenic and thermogenic gas components as suggested from the isotopic data.

The hydrocarbon migration and seepages in the offshore Makassar Straits can be explained by the following mechanisms: a strong vertical component and hydrocarbons that consist mainly of methane to butane. The vertical migration mechanism could be driven by diffusion and movement via an extensive system of small faults or even fractures. The seepages could possibly migrate in a single phase flow of oil and gas.