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Comparison of Depositional Environments and Reservoir Characterization of "O-sands" in Pailin and "Thick stacked sands" in Benchamas Fields, Pattani Basin, Gulf of Thailand

Pimlada Veerapongwattana

Petroleum Geoscience Program, Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand

*Corresponding author email: zimsygirl_mai_@hotmail.com

Abstract

Conventional cores from the "Massive O-sands" in Pailin-07 and the "thick stacked sands" of Benchamas Field in BE-01, BE-03 and B-08 were observed to study the depositional environment and reservoir characteristics. The Benchamas cores are fining-upward channel-fill sandstones and floodplain/overbank mudstones deposited on an alluvial plain by a meandering river. All the sands in the Pailin-07 core are single-storey channel sands that fine upward but they have highly variable thicknesses over short stratigraphic intervals and tidal sediments form the transition to overlying mudstones, indicating increasing marine influence upward. The Pailin sands are interpreted as lowstand fluvial channels that were back-filled during a subsequent relative sea level rise. Despite the different depositional environments, wireline log signatures through the cored intervals in the two areas are virtually identical, with sands in both areas generating blocky to bell-shaped gamma ray curves. This suggests that log signatures are not always reliable indicators of depositional environment, which has important implications for prediction of sand body geometry and reservoir properties. In the Gulf of Thailand post-rift, there are many other areas and stratigraphic intervals that may have back-filled channels. It is possible in any area near a paleoshoreline or stratigraphically near the transition to or from a marine stratigraphic unit.

Keywords: back-filled channels, single-storey sands, thick stacked sands

1. Introduction

The general similarity of wireline signatures can be seen in many areas in Pattani Basin (Jardine, 1997) such as Pailin Field, which is in the southern part of Pattani Basin and Benchamas Field, which is situated in the northwestern edge of Pattani Basin. Although these two fields are far away from each other, they appear to have the similar sandstone reservoirs based on wireline signatures. Massive "O-sands" in Pailin Field look a lot like the "thick stacked sands" that are the crucial sandstone reservoirs in Benchamas Field. Therefore, it is interesting to study the depositional environment of the two areas by using cores integrated with wireline data in order to understand the similarities and differences in their geology.

2. Methods

The main objective of this study was to characterize the depositional environments of the "O-sands" in the Pailin-07 well and the "thick stacked sands" in the Benchamas-01,

Benchamas-03, and Benchamas-08 wells by using a combination of conventional core and wireline log data. The results were compared to each other to see how similar or dissimilar the paleoenvironments are in these two study areas.

3. Results

3.1. Pailin Field (Pailin-07 well)

The sands in the Pailin-07 core have been previously interpreted as meandering fluvial channels (Hinthong, 2003). However, this would require several rivers of vastly different size to have crossed the Pailin-07 area within a very short period of time as all the channel sands are single-storey and have highly variable bed thicknesses. Also, each of the sands is transitional upward into tidal sediments, indicating increasing marine influence with time whereas progradational fluvial systems should record decreasing marine influence with time.

An alternative interpretation is back-filling of a lowstand fluvial channel during subsequent marine transgression. Tidal fluctuations cause current speeds to decrease, and coarse sediment to be deposited, near the upstream limit of tidal influence, which can be 10s of km from the coast in a river on a low-gradient coastal plain like the late Tertiary Gulf of Thailand. The progressively increasing tidal influence seaward results in progressively finer sediment being deposited toward the coast. As sea level rises, tidal influence shifts continually landward, causing the channel to fill aggradationally with progressively finer sediment, thereby generating a fining-upward succession. When the coastline is near, the sediments reflect direct tidal influence with abundant flaser bedding, mud drapes and burrows.

This interpretation allows the Pailin-07 sands to have been deposited by a single river and still have the observed highly variable bed thicknesses because, with aggradational back-filling, thickness is independent of channel width and is controlled exclusively by the rate of sediment supply versus the rate of relative sea level rise.

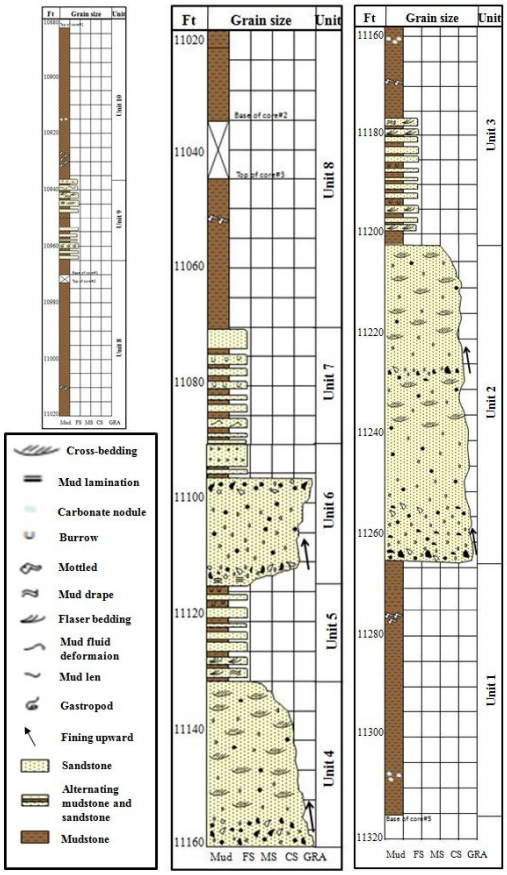

Figure 1. Conventional cores from Pailin-07 well can be divided into ten units from the bottom to top. The core stratigraphy is approximately 418.4 ft (127.5m) from depth 10883 ft (3316.9m) to 11315.6 ft MD (3448.8m).

3.2. Benchamas Field (BE-01, BE-03, and BE-08 wells)

Core observations from three wells in the Benchamas Field (BE-01, BE-03, and BE-08) indicate fluvial environments related to a meandering river. Thick mudstone beds with some very fine sandstone units in Benchamas-01 are interpreted as floodplain deposits. Fine sandstone with common mud lamination in Benchamas-03 is interpreted as levee deposits whereas the medium to coarse sandstones are interpreted as part of a meandering channel. The underlying mottled mudstone with rootlets is interpreted as floodplain/overbank deposits. In Benchamas-08 cores, there are five sandstones with variable bed thicknesses and gradational contacts with mudstones. The sandstones are interpreted as point bar deposits that are capped by mottled mudstone with rootlets which is interpreted as floodplain sediments. The entire succession is interpreted as meandering channel deposits.

4. Discussion

Based on core observations from the Pailin-07 and three Benchamas wells (BE-01, BE-03, and BE-08), there are significant differences in their depositional environments and reservoir characteristics although the wireline log signatures through the cored intervals in the two areas are virtually identical. The reason why they look the same is that they both fine upward over about the same distance, which is controlled by channel depth, and the tidal deposits have the same general lithology as crevasse splay deposits. However, this suggests that wireline signatures are not always reliable indicators of depositional environment, which has important implications for prediction of sand body geometry and reservoir properties

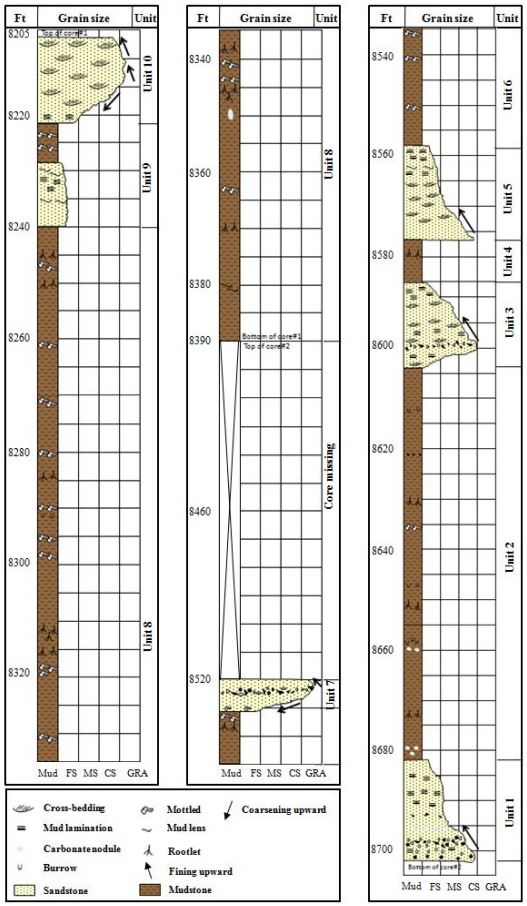

Figure 2. Core observations from Benchamas-08 comprise ten units from bottom to top. The core stratigraphy is approximately 365 ft (111.25m).

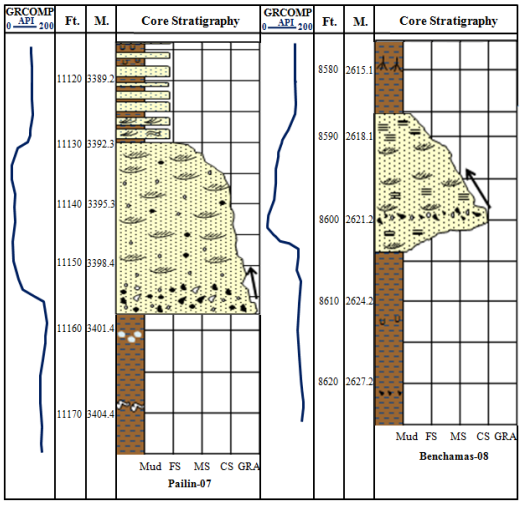

Figure 3. Gamma ray log through the cored intervals versus the core stratigraphy in the two fields are virtually identical. The sandstone generates blocky to bell-shaped gamma ray curves and both fine upward over about the same distance.

5. Conclusions

The depositional environment in these two fields is significantly different. The Pailin-07 core observations indicate back-filling of a lowstand fluvial channel during a subsequent marine transgression whereas core observations in Benchamas Field (BE-01, BE-03, and BE-08) indicate fluvial deposition related to a meandering river. Similar wireline log signatures from different depositional environments suggest that log signatures are not always reliable indicators of depositional environment.

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