



Day: Thursday 27 April
Time: 1:50pm

Session: 7

Central Luconia Carbonate Exploration – An Update: After Three More SK408 Wildcats, has the Story Changed?

James Clark*, Paul Owen, Sean O'Brien and Barry Dawe
SapuraKencana Energy Inc.

Central Luconia, in shallow water Offshore Sarawak is a major gas province that has reached exploration maturity. Since the first exploration well in 1968, more than 110 wildcat wells have been drilled, discovering a total resource in excess of 60 TCF gas in-place. The overwhelming majority of this gas has been discovered within the same play: Late Miocene carbonate build-ups (Fig. 1). SapuraKencana Energy (SKE, formerly Newfield Malaysia) have been active explorers in the Central Luconia Province since 2007, to date drilling 11 operated wells and discovering a total in-place gas resource of almost 9 TCF in nine discoveries.

At SEAPEX 2015 a simple geologic model was presented to explain the successes and failures of historic exploration in Central Luconia. This model had been used to risk prospects for the phase 1 drilling campaign with great success (five discoveries from five wildcat wells). In late 2015, after integrating the results from Phase 1 and updating our geologic understanding, three further wildcat wells were drilled. Two more discoveries were made, including a significant accumulation with interpreted column height potential in excess of 900m.

In mid-2016 acquisition of the Terumbu Luconia 3D – approximately 13,000 sq km of broadband 3D seismic, was completed as part of a joint acquisition with neighbouring PSC's (Fig. 2). Now with a modern, high quality regional 3D seismic dataset, tied to over 100 wells we are in a position to ask the question: with seven discoveries out of eight and having discovered a large gas resource – are we as good as we think....or did we just get lucky?

SKE Exploration in Central Luconia

After drilling five discoveries with the first five exploration wells in the SK408 PSC, the Phase 1 drilling campaign was a tough act to follow. The SK408 JV identified a large carbonate pinnacle on the western side of the block (Fig. 2) that was previously thought to be very high risk for topseal due to the pinnacle crest lying within the often sand-prone upper part of the Cycle V (a Type 3 pinnacle – Fig. 1). Well data across the block suggested a decrease in sand content throughout Cycle V to the west – in particular Well B, only 5km south from the prospect has a 650m gas column indicating a lack of thief beds within the Cycle V stratigraphy at this location. The prospect was drilled in late 2015 and encountered a significant gas column in Well J. A complete logging program was prevented by the occurrence of total losses after 400m of high quality gas bearing carbonate reservoir had been penetrated. However, SKE's strategy of performing an intermediate logging run upon proving gas-bearing carbonate yielded valuable pressure and fluid sample data. Interpretation of the LWD data and the intermediate run wireline pressures are consistent with a vertical gas column in excess of 900m.

Impact of New 3D data

Six out of the first eight wells in SK408 were drilled on 2D data of mixed vintage and quality, including the two largest discoveries in the west of the block (Wells B and J – Fig. 2). The new 3D

broadband seismic processing is currently only at fast-track PSTM, with the final PSDM product available in May 2017. Nonetheless this represents a step change in both quality and quantity of data and for the first time allows all the operators involved to interpret regionally across the entire province rather than being confined to their block. In addition to the clear improvements in imaging of the carbonates themselves (Fig. 2), these data provide a natural laboratory to test the models that SKE invoked for the successful campaigns in previous years. This presentation considers the two critical risk elements – seal and charge and demonstrates how the new 3D seismic has challenged our existing paradigms

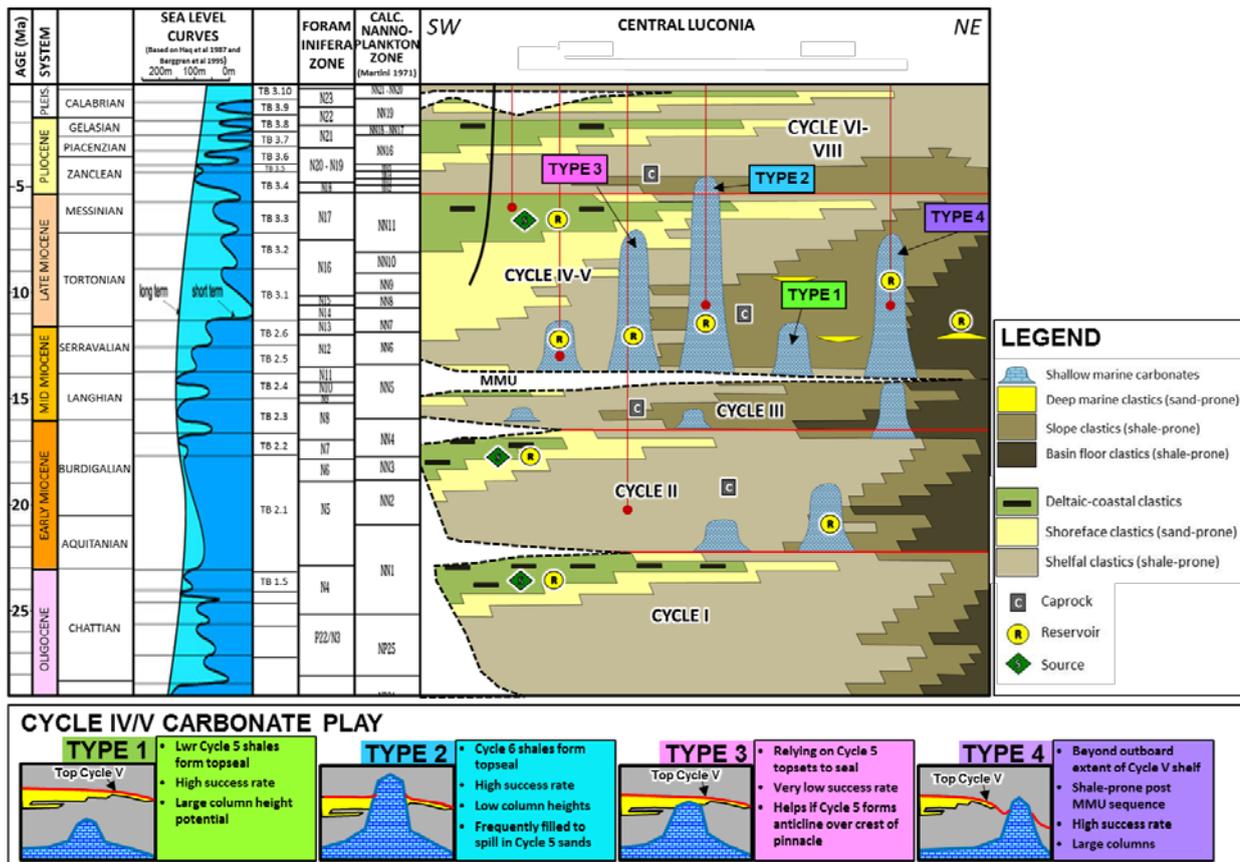


Figure 1: Stratigraphy of Central Luconia and Miocene carbonate play types

Prior to SK408 drilling the existing paradigm was that seal failure was the dominant cause of dry holes across Central Luconia. SKE split the Late Miocene carbonate play up into three types (Figure 1) and demonstrated that for low relief Type 1 pinnacles seal failure was not a significant factor in causing dry holes. Successful results from phase 1 drilling vindicated the low seal risk. However, it was observed that column heights decreased from west to east, commensurate with the decreasing shale content in the Cycle V topseal interval – inviting the interpretation that intra Cycle V sands were acting as thief beds controlling the column heights within under-filled pinnacles in the East. The new 3D seismic allows us to identify and map seismic events that correspond to known gas-water contacts (GWC). As a result SKE concludes that there are no continuous intra Cycle V events that control the GWC across multiple pinnacles. In other words, either we must assume that each under-filled carbonate has its own personal thief bed that only affects it and no other, or that intra-Cycle V thief beds are not as ubiquitous and there is a different mechanism contributing to under-filling of these pinnacles.

Prior to Phase 1 SKE identified charge as the key risk for Type 1 pinnacles. A model of underlying structure providing migration focus was used to rank the charge risk for prospects. Prior to the 3D acquisition the model was necessarily simplistic due to data limitations. The 3D data provides new insights into the pre Carbonate structure and by considering underlying structure at different scales and at various horizons SKE have refined the existing model to capture the additional complexity that was previously hidden. Observations from across the Province suggest that underlying structure still plays a significant role in the success or failure of Late Miocene Carbonates.

Summary

From the eight wells so far drilled in SK408, 7 have been successful, discovering a multi-TCF gas resource. Furthermore, significant prospectivity still remains to be unlocked with the new Broadband 3D dataset. The simple technical concepts that were developed on the legacy 2D seismic in the early stages of the PSC have survived under the scrutiny of a high quality regional 3D dataset and the drilling of eight wildcat exploration wells. These concepts will be used again with only minor modification when planning for three further wells in 2017.

In short, it wasn't all down to luck!

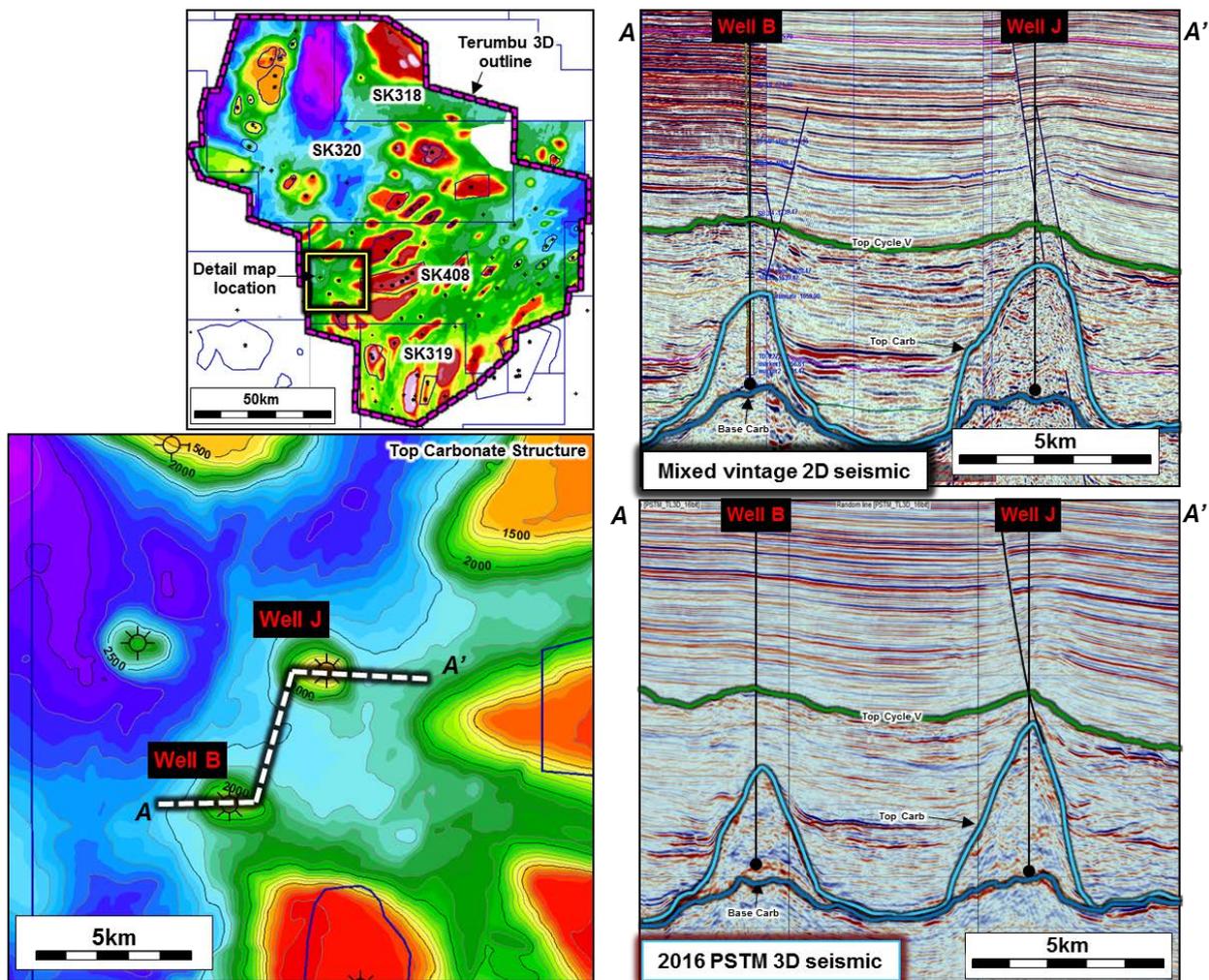


Figure 2: Top Carbonate structure map in western SK408 showing the two discoveries made with Well B and Well J with seismic examples from the discovery 2D dataset and the new broadband 3D fast track data