New Reserves Discovery: Deep Oligocene Syn-rift Reservoirs, Arthit Field

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ABSTRACT

Gas in Oligocene, Formation 0 (FM0) new reserves in Arthit Field were established after the successful of Platform A. The main objective of this platform is to develop gas reservoirs in Formation 2 (FM 2): Fluvial-Deltaic, Formation 1 (FM 1): Fluvial and Upper Formation 0: Lacustrine delta. Based on the depositional system, encountered reservoirs of FM0 could be deviated into 2 main units which are 1) Upper FM0 (H90-H100) and 2) Lower FM0 (BelowH100). “A new discovered reserve of FM0 is identified at hydrocarbon accumulation below H100”.

A complete of syn-rift petroleum system leads to the success of FM0 new hydrocarbon discovery. A source rock is identified as Oligocene lacustrine shale deposited in Arthit Lake. Interbedded sand-shale layers of a lacustrine deltaic created a perfect pair of reservoir-seal package and self-sourced system which directly charged/migrated to sand reservoirs. A series of structural closures and ramp structures created by syn-rift fault system introduce an appropriate hydrocarbon accumulation trap. The uppermost section of the new pay interval is identified at a high velocity shale package of FM0 (H100), deposited boardly over the northern part of Arthit Field. The seismic signature of this event could be explained as a good continuous seismic reflectors, high seismic amplitude value and contain high seismic frequency content. At the main reservoir unit below H100, log character and petrophysical study illustrates the first sequence of cylindrical shape which indicates the deposited bar sands interfingering with lacustrine shale during aggradational sequence. This sequence was later overlaid by the funnel-like shape log character of FM0 (H90-H100). It indicates bar sands deposited in lacustrine deltas during the progradational and retrogradational sequences. In general, top FM0 was encountered at a depth near 3000mTVD-MSL, bottom hole static temperature is over 190 °C and a formation pressure is at 1.0-1.2 SG EMW (slightly abnormal pressure). Wonderfully, FM0 sands reservoirs are showing a very promising well results with net pay ranging from 3-26 mTVD and containing a moderate to good reservoir property with 10-21 % porosity. However, to quantify or evaluate the FM0 reservoir potential, the production performance is one of the significant information.

KEY WORDS: Oligocene / Gas production / Petroleum

1. INTRODUCTION

Arthit field is located in the Gulf of Thailand which is 700 kms south of Bangkok and 230 kms north east of Songkhla. The production area covers 3,682 sq km in concession blocks B14A, B15A and B16A.

Arthit field is initially developed gas from Miocene reservoirs which distributed throughout the concessions with various production behaviors and high complexity of hydrocarbon accumulations.

In 2011, the success of discovery of deep Oligocene syn-rift Lacustrine reservoirs open new opportunity to develop into deeper play where successes were previously limited. Excellent well result of FM0 (Oligocene) indicates remaining porosity and permeability at depth not tested before. Depositional packages of interfingerring lacustrine sand and shale create a pair of reservoir-source. Net-to-gross is relatively low (shale-rich) in section between H90-H100 effecting less requirement for a large fault displacement to create effective trap. Thick shale packages below H100 correlate to possible effective source and seal for petroleum system.
2. OLIGOCENE PETROLEUM SYSTEMS

Generally, source rock is identified as lacustrine shale deposited broadly in the Arthit Field during Oligocene syn-rift period. Deposition of relatively thick source-lacustrine shale is expected in Lake West Arthit and in Lake Arthit.

The deep gas pays in FM0 (H90-H100 and below H100) contains interbedded sand-shale layers of a lacustrine deltaic unifying self-sourced system of FM0 which charged/migrated directly into sand reservoirs that the uppermost lacustrine shale interval is considered to be the effective vertical seals capacity of FM0 sands.

Complex syn-rift faults controlled the series of west and east dipping fault forming several fault blocks. It creates a proper prospect consists of a combination structural - stratigraphic trap.

The FM0 was investigated by several exploration wells and development wells. Nevertheless, AWP-17 is fully appraised FM0 section with approximately 250 m below H100. The well results illustrate encountering section of lacustrine fan delta deposits. The FM0 reservoirs exhibit moderate to good porosities and low CO2 contents.

3. HYDROCARBON OCCURRENCE

The uppermost section of the new pay interval is indentified at a high velocity shale package of FM0 (H100), deposited boardly over the northern part of Arthit Field. The seismic signature of this event could be explained as a good continuous seismic reflectors, high seismic amplitude value and contain high seismic frequency content.

At the main reservoir unit below H100, log character and petrophysical study illustrates the first sequence of cylindrical shape which indicates the deposited bar sands interfinger with lacustrine shale during aggradational sequence. This sequence was later overlied by the funnel-like shape log character of FM0 (H90-H100). It indicates bar sands deposited in lacustrine deltas during the progradational and retrogradational sequences.

In addition, heavy component of hydrocarbon (C3-C5) can be observed from drilling gas data starts appearing at the top FM0 all the way and peaks are encountered in the shale section at the bottom part of H90 interval.

The amount of net pay is ranging between 3-26 mTV. This succession in this interval proved a complete petroleum elements and processes. Filling ratio ranges from 0.3 to 0.9.

4. RESULT AND BENEFIT

The knowledge of this Oligocene deep play and the success in Platform A open new opportunity to develop into deeper play where successes were previously limited.

The impact of these newly discovered Oligocene reservoirs to the appraisal program is significant to Arthit Field. Many areas were revisited to relocate potential appraisal targets in the syn-rift section. Similar concept can be applied to other parts of the basin and also to other basins in the Gulf of Thailand.

At the production of the FM0 was commenced on April 2012. There are 2 wells initially produced from upper unit; H90-H100 and 8 wells produced from the lower unit; Below H100 in order to optimize among reservoir management, potential requirement, and
data gathering in the new pay zone. Actual production information shows various initial gas flow rate range from 3 to 13 MMscfd. The gas quality from Formation 0 has moderate CO₂ content ranging from 24 to 42% with low condensate-gas ratio and gas heating value.

5. CONCLUSIONS
Recent discovery of new reserve from Oligocene does not only bring more production potential to the Arthit field but an additional detailed subsurface evaluation is also conducted in order to explore more potential. Moreover, it also encourages moving forward exploring this new potential in other area of the field.

Furthermore, the production from these syn-rift lacustrine reservoirs can be applied to the future nearby development wells in term of production-to-log calibration, well completion design and production technologies for improving recovery of these new pay zones.

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