

Chasing Remaining Thin Oil Column in Mature Gas Injection Reservoir with Active Aquifer

E. Chang, K. Buang, V. Drahaman, S. Hamzah, ExxonMobil E&P Malaysia Inc.

Objective/Scope

The revelation of considerable thicker remaining oil column based on recent contact logging in a reservoir which was assessed to be near depleted has sparked the interest for a more thorough subsurface study. This paper demonstrates successful integration of comprehensive surveillance data acquisition, especially via cased-hole contact-logging to identify and affirm opportunity pursuit of remaining oil column in reservoir X-6 in the mature Field S.

Method, Procedures, Process

Reservoir X-6 was discovered with 39m of original oil column with fieldwide original-gas-oil-contact (OGOC) and original-oil-water-contact (OOWC) observed from well and pressure data. The reservoir X-6 consists of 80m thick stacked subtidal bars with a permeability range of 100-500 millidarcies (md). The approved Reservoir Management Plan calls for an optimum oil recovery via gas cap expansion supplemented by gas injection with Gas-Injection-over-Gas-Production volume-ratio of 85% with presence of active aquifer. The average perforation interval depth for all oil producers was approximately 2/3 down from the OGOC. Through prudent data acquisition programs focusing on contact-logging coupled with frequent well-test throughout development life, both GOC and OWC advancement across the field were observed inharmoniously which led to well work opportunities identification through zonal-isolation of swept-areas and adding perforations targeting remaining-oil columns.

Results, Observations, Conclusions:

In 2003, cased-hole contact-logging conducted in Well-A1 (northern sector) indicated gas cap has expanded 20m deeper than OGOC depth. In 2007, Well-A1 started to experience water breakthroughs with high-gas-oil-ratio (HGOR) and eventually watered-out in 2012. Several offset wells observed the similar trend of high-water-cut (HWCUT) and HGOR, suggesting Reservoir X-6 in the northern area is undergoing good reservoir fluid contacts closures or sandwich-effect where the current GOC and OWC are coming close together. However, southern oil producers continued to exhibit strong oil production performance despite majority of the northern wells were shut-in due to HGOR and HWCUT. This observation triggered a contact-logging acquisition in Well-B14 (southern sector) in 2018 which discovered 9m of remaining-oil columns. Following the favorable results, several additional contact-logging surveys were acquired in the reservoir X-6. Results showed that the reservoir has an uneven current GOC and OWC movements where remaining-oil column in the northern sector is approximately ~4m whereby the southern sectors are ~9m. The integration of surveillance data to understand the fluid contact movement generated behind-casing-opportunities (BCO) in reservoir X-6 with 1-2 kbd build-up beginning 2020 with additional reserves capture expected to be ~1 MMSTB.

Novel/Additive Information

This study demonstrated the value and importance of timely acquisition of dynamic data as part of reservoir surveillance and management plan. The integration of surveillance data helps to maximize asset value in a relatively matured field. The identification and successful execution of BCO opportunities of X-6 reservoir opening similar consideration to other deemed depleted reservoirs.