Appraising a Forgotten Thin Reservoir: Optimizing the Placement of Horizontal Wells Within the Intra Rahab Sand, Field M, South Oman

Shamsa A. Al Batrani[1]

[1] Petroleum Development Oman

Abstract

The Intra Rahab Sand (IRS) is a one and a half meter thick oil reservoir which is present in Field M and extends regionally. The sand unit is interpreted to represent small scale intermittent gravity flow deposition within a lacustrine environment during the deglaciation that occurred in the early Permian. The key reservoir uncertainties of the IRS relate to the lateral continuity of these thin sand units which may be due to either lateral facies changes or fault compartmentalization. Given the thin scale of this reservoir the risk of sub seismic resolution faults may result in the well exiting the target abruptly while drilling. Due to these challenges the reservoir's development has previously been overlooked in favor of more attractive reservoirs within field M. The aim of this study was to test two distinct geosteering assemblies, resistivity and azimuthal gamma ray, to optimally placing two horizontal wells within this challenging reservoir. This study would result in determining the optimal geosteering assembly for improved well placement in the IRS and consequently support its development.

Previous appraisal of IRS focused on confirming the productivity of the reservoir. Prior to drilling the two horizontal wells, the IRS was in 2019 perforated in a vertical well to establish a baseline for productivity of the reservoir. The well produced a sustained low net yet commercial oil rate for over a year. The results triggered the drilling of two horizontal wells in 2021 and 2023 to evaluate productivity and reservoir properties of horizontal wells.

The results from the two wells have shown that the azimuthal gamma ray resulted in a 30 percent increase in net pay when compared to resistivity. This improvement has been attributed to the better contrast of the gamma ray log response between the IRS and surrounding lacustrine shales of the Rahab member. Furthermore, the placement of the gamma ray tool close to the drilling bit resulted in faster reaction times and improved decision making during geosteering operations when compared to the resistivity tool. It was also observed in both wells, that the sands are of similar reservoir properties occurring with approximately 80 percent hydrocarbon saturation, with the only reservoir variable being the length of the sand section. The observed difference in net pay while drilling was subsequently reflected in the well tests which showed enhanced oil production in the well which was geosteered using azimuthal gamma ray.

Despite this result, the two tools were not able to adequately resolve the nature of the sand's limited lateral continuity, be it depositional or structural. Additional appraisal wells in the IRS will build on these learnings and are recommended to acquire bore hole image logs to confirm the facies versus fault controls on reservoir continuity.