

Subtle Traps in Minagish Formation: Targets for Future Exploration in Kuwait

Dhari Al-Aradah, Riyasat Husain, Afrah Al-Ajmi, Lin Ye, Yousuf Al-Azmi, Hamid Sabri, Meshal Al-Wadi

Kuwait Oil Company

Abstract

The Berriasian-Early Valanginian Minagish Formation is a major oil reservoir in the southern and western Kuwait. Regionally, the formation consists of three members: the Lower and Upper hard and dense Minagish members bounding the Middle Minagish reservoir. All of the established production occurs in the Middle Minagish oolitic and grainstone facies having structural entrapment. Exploration potential of this established structural play is limited due to paucity of remaining undrilled structural traps in south and gradual deterioration of reservoir facies in the north. The paper is focused on remaining exploration potential of the formation envisaged mainly within stratigraphic and strati-structural traps in off-structure areas. The formation was deposited in an overall northeastward-prograding carbonate ramp setting. Several sedimentary features are documented within the Minagish Formation. These are the massive and interconnected oolitic shoals and reworked oolite lenses on the margin of the main shoal in the south, peloidal accumulation in the west, and thin grainstone layers (including oolite) in the north. Development of unconformity traps is seen in the south-west where the Middle Minagish peloidal/oolitic grainstones associated with well-preserved and connected large primary interparticle macro-pores and having heavy hydrocarbon stains are capped by overlying clay/organic matter-prone deposits of Upper Minagish across a pronounced angular unconformity. Geometry and extent of these stratigraphic features in lower, middle and upper Minagish is very clearly reflected in the seismic data as mounds, downlaps, onlaps and erosional truncations as well as by distinctive seismic facies. The major seals for these subtle traps are extensive low porosity carbonates in the Upper Minagish as well as vertical and lateral facies changes within the reservoir intervals. The Kimmeridgian Najmah Formation provides major charge to these reservoirs. Minor contribution of the charge occurs from the Tithonian Makhul Formation only in the northern Kuwait. Migration from Najmah to the reservoir happens through major faults cutting through the Gotnia - Hith formations. The concept opens up the Minagish exploration in an area, which is generally devoid of large structural traps with additional leads in upper and lower Minagish. Synergistic workflows involving sequence stratigraphy and forward stratigraphic modeling incorporating drilling data, log data, core data and 3D seismic facies and characterization data are pre-requisite for prediction, mapping and de-risking of these traps.