

Stratigraphic Trap Styles of the Triassic to Early Jurassic of North Oman

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ABSTRACT

Shallow marine carbonates of Early to Middle Triassic age, Sudair and Jilh Formations of Oman were deposited in a passive margin ramp environment. These sediments prograded North-Northeast as a result of a regressing shoreline, following the gradual opening of the Neo-Tethys. Subsequently, continued continental breakup created the Indian Ocean to the East of Oman with the rifting to form East Gondwana by Late Triassic to Early Jurassic times. The break-up unconformity associated with these events is represented in the rock records of North Oman as the Late Triassic to Early Jurassic regional unconformity.

This major unconformity caused by the Northwest-Southeast tilting of the rift shoulder gradually exposed the underlying stratigraphy, from the directly underlying Triassic carbonates to Pre-Cambrian granitic basement along the Southeast margin of Oman. Concurrently accommodation space was created to the Northwest of Oman. This regional tilt created multiple truncation wedge geometries beneath the unconformity and the exposed Triassic carbonates (Khuff, Sudair and Jilh Formations) underwent development dissolution to create enhanced secondary reservoir properties. The presence of karsts in these Triassic carbonates is proven by observations in outcrops and subsurface well results. These sequential series of truncation wedges and associated karsts are clearly visible on seismic data and presented attractive stratigraphic traps exploration opportunities. There are indications of a working petroleum system within these formations with multiple hydrocarbon shows encountered within the Triassic sequence by wells that were drilling through on the way to deeper targets.

Above the unconformity, the previously dominated carbonate succession was progressively exposed and a clastic dominated sequence was deposited, with sediment sourced from the exposed basement high to the Southeast, whilst the open marine environment conditions receded further to the Northwest. This clastic sequence, is the Early to Middle Jurassic Mafraq formation, and comprises coarse clastic sediments deposited in a lowstand environment at the base, grading into finer clastics and overlain by open marine carbonates as a global sea level rise ensued and flooded the basement high to the Southeast, turning off the clastic sediment input. The depositional slope associated with the basin tilt also created multiple onlap geometries overlying the break-up unconformity with Mafraq clastics and Middle to Late Jurassic carbonates of the Dhurma and Tuwaiq formations sequentially deposited in a Southeast younging direction as the transgressive system progressively migrated the shoreline Southeasterly over the Lower Jurassic sediments. These depositional thinning and onlap features are also evidently clear from subsurface wells and seismic. Similar to the Triassic carbonates, these could be stratigraphic trap exploration opportunities with already indications of a working petroleum system from numerous well penetrations.

The critical element to de-risk in maturing these stratigraphic traps as with any other stratigraphic traps would be the de-risking of the top and lateral seal occurrences and effectiveness. Full integration of surface and subsurface data to understand and predict the lateral distribution of reservoir and seal in relation to the hydrocarbon migration and trapping timing hold the key to unlock these exciting plays.