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Stratigraphy and Depositional History of the Marib-Jawf Basin, Yemen

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The sedimentary fill of the Marib-Jawf Basin is Jurassic and Lower Cretaceous. Initial marine transgression occurred in the Middle Jurassic, with the Kohlan Formation unconformably overlying Paleozoic sedimentary rocks and Proterozoic basement. These basal fluvial to nearshore-marine sandstones and shales are conformably overlain by intertidal to shallow-marine carbonates of the Saba Formation of Callovian–Oxfordian to Kimmeridgian age.

Extensional faulting formed grabens that deepened during the Kimmeridgian and Tithonian. Up to 6,000 feet (2,000 meters) of deep-marine sediments unconformably overlie and lap onto high margins of the basin. At the base are outer-shelf / slope argillaceous carbonates and shales of the Arwa Formation. These pass upwards into slope and basinal shales with minor limestones and sandstones of the Meem Formation, which in turn are overlain by shales with interbedded sandstones and limestones of the Lam Formation. The sandstones were deposited by turbidity currents from the margins of the basin, where submarine fan deposits are present. Shales of the Meem and Lam formations are organic rich and are the source rocks for most of the oil and gas in the basin.

A drop in relative sea level occurred in the middle to late Tithonian with restriction of the basin from the open ocean. Three progradational sequences (Yah, Sean and Alif members of the Alif Formation, from base to top) of fluvial-alluvial to deltaic-marine siliciclastic sediments were deposited down the axis of the basin, passing into offshore-marine shales and basinal evaporites to the east. The sandstones are the main reservoirs for oil and gas in the basin.

A transgressive shale at the top of the Alif Formation records marine flooding of the basin, followed by deposition of five sequences of basin-filling evaporites of the Safer Formation. Thick halite beds were deposited subaqueously when the basin was filled with hypersaline water and have thin anhydrite beds at top and base. These evaporites are separated by lowstand fluvial to shallow-marine siliciclastics, including thin, organic-rich shales that are minor source rocks for oil. The evaporites are the primary seal for the reservoirs of the Alif Formation.

Berriasian–Valanginian shelfal-marine shales and limestones of the Azal Formation unconformably overlie the Safer evaporites. The lower part of the Azal Formation is dominantly limestone and shale, the middle is shale with few thin limestones, and the upper unit has limestone, shale and minor sandstone. These are overlain by the Tawilah Group, possibly as old as Valanginian–Early Hauterivian and at least as young as Aptian in parts of the basin, equivalent to the Qishn Formation to the east. The Tawilah Group is dominated by non-marine to shallow-marine sandstones and shales with minor thin dolomite and skeletal-limestone beds. Regional erosion truncates the sedimentary fill of the basin, progressively cutting out more strata toward the west and in places exposing Middle Jurassic rocks at the surface.