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Stratigraphy, Sedimentology and Reservoir Quality of Permian Siliciclastic Reservoirs (Unayzah and Basal Khuff), Ghawar Field, Eastern Saudi Arabia

Non-associated sweet gas in southern Ghawar Field, occurs in the quartzose sandstones of the upper Unayzah ''A'' and overlying basal Khuff clastics reservoirs. Core and log-based studies identify a base ''A'' reservoir Sequence Boundary representing the onset of a major sub-regional desiccation event, evident as a widespread, eolian sand sheet. This is overlain by an extensive sheet of interstratified sandstones comprising flat-laminated fine to medium-grained sands; irregularly laminated and locally highly disrupted, silty very fine-grained sandstones; and thin carbonaceous siltstones. Cyclic facies relations suggest fluctuating water-table conditions in a playa salt-flat environment, interpreted as a Transgressive Systems Tract in a terrestrial setting. Overlying deposits are fine to medium-grained sandstones comprising well rounded and frosted grains, displaying high-angle, grain size-segregated cross-stratification that is consistently oriented to the east. They occur in thick sharp-based bedsets that are variably separated by fine-grained, rippled to structureless sandstones; thin very fine-grained silty sandstones; and rare carbonaceous siltstones. These rocks represent eolian transverse dunes and interdune sabkha sands that were deposited under metasaturated wind conditions, and constitute a Highstand Systems Tract. These HST eolian deposits are incised, and the resulting irregular surface represents the Base Khuff Unconformity. This Sequence Boundary is overlain by fining-upwards packages of carbonaceous, rooted sandstones that pass upwards into a series of earthy, carbonaceous and dolomitic mudstones. These basal Khuff clastics represent a coastal Transgressive Systems Tract overlying the Base Khuff Unconformity. Reservoir quality is demonstrably facies controlled; intra-reservoir connectivity and potential compartmentalization are also strongly dependent on sedimentary facies distribution through the reservoir.