

Khuff-A Reservoir Porosity Creation and Destruction: A Product of Depositional and Diagenetic Processes

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The Upper Permian-Lower Triassic Khuff Formation was deposited upon an extensive carbonate ramp that was at least 1000 km wide. The Khuff is divided, in descending order, into the Khuff-A, Khuff-B, Khuff-C, and Khuff-D carbonates, of which the Khuff-A and upper part of the Khuff-B are of Triassic age. The Khuff Formation reservoir potential varies from excellent to none in the Khuff-A, excellent to good in the Khuff-B, good to low in the Khuff-C, and low in the Khuff-D.

The highly variable reservoir potential of the Khuff-A is a product of (1) depositional processes, (2) fabric-preserving diagenetic processes, and (3) fabric-destructive diagenetic processes. The Khuff-A depositional environment commenced with transgressive backstepping salina evaporites of the "Black Anhydrite" separating the Khuff-A carbonates from the underlying Khuff-B carbonates. Highstand deposition consisted of ramp-crest shoal, grain-rich carbonates that contained good to excellent reservoir potential, with a mixture of interparticle, moldic, and intercrystal porosity. In addition, environments included inner ramp lagoon salina evaporites, and intertidal mud-rich carbonates that contain low to no reservoir potential. Fabric-preserving diagenesis was created by penecontemporaneous dolomitization by magnesium enriched brine derived from evaporation of sea water during deposition of the uppermost Khuff-A evaporites. Fabric-destructive diagenesis occurred when the Khuff-A was subaerially exposed and karstified during a brief lowstand. This event partially dissolved the uppermost evaporites and formed a brine enriched in calcium and sulphate that descended and became supersaturated leading to precipitation of anhydrite cement that, in some areas, completely occluded primary Khuff-A porosity.

In a regional perspective, depositional and diagenetic processes responsible for anhydrite cementation of the Khuff-A porosity developed where uppermost Khuff-A evaporites were deposited and experienced subaerial exposure and karstification. This process was retained within the Khuff-A strata by the "Black Anhydrite," which acted as a basal seal.