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## **The 3D Modeling of a Fractured Carbonate Reservoir, Ghaba North Field, Oman**

The Ghaba North oil field, situated in the Ghaba North Salt Basin, Central Oman, was discovered in 1972. Tested by 30 wells and estimated to contain 118 MM m<sup>3</sup> STOIIIP in the Cretaceous (Aptian) Shuaiba formation, the low relief domal structure had a rapid production decline caused by water break-through via a connected fracture system. In order to support an increase in recovery by gas-oil-gravity drainage (GOGD) or thermal GOGD the reservoir and its fracture system were modeled in 3D. The model frame is provided by a layer-cake architecture of the Shuaiba Fm with 2 higher order sequences of transgressive and regressive cycles identified in cores and logs (the lower transgressive hemi-cycle is the Hawar Mbr of the Kharai Fm.). The late highstand deposits are lower porosity, more brittle and believed to be fracture prone. A hierarchical fracture model has been built. Major and minor faults are mapped from seismic and assumed to define fractured damage zones cutting the vertical extent of the reservoir. Smaller fracture swarms are derived from FMI data, are bed-bound and thus related to the stratigraphic frame. Mapped fault damage zones and data from fracture orientation and frequency can be used to build combined deterministic/probabilistic fracture models. These models can be reconciled or contrasted with fracture models derived from regional strain analysis or automated seismic visualization techniques. The models are used for visualization and as input to dynamic flow simulation and history matching. Ultimately the modeling process consists of iterative update loops between the static and dynamic models to optimize future development.