

# Porosity types in the prolific carbonate reservoirs of northern Iraq

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Northern Iraq is dominated by the Zagros and Taurus mountain ranges and their respective foothills domains. The region is highly prospective for hydrocarbons and highly underexplored; there are over 100 four-way dip closure anticlines yet to be drilled and concepts such as stratigraphic trap are rarely considered at this nascent stage of exploration. The Kirkuk oil field alone sums 25 billion barrels of proven and probable recoverable oil (Verma et al., 2004). Recoverable reserves ( $P_{50}$  case) from discoveries in just the Kurdish controlled region total 11 billion barrels and 40 TCF to date (KRG 2011). The oil and gas industry is now focusing much attention upon northern Iraq, especially as large hydrocarbon pools and plays are being discovered with monthly frequency, and some of the world's largest energy companies are now acquiring vast tracts of exploration acreage.

The area is also a textbook natural laboratory for carbonate and structural geology study. The Mesozoic-Cenozoic stratigraphy of the NE Arabian Plate margin is dominated by carbonate lithologies: carbonate reservoir rocks, carbonate source rocks and even carbonate cap rock units. A range of depositional facies can be discerned: lagoons, reefs, ramps and carbonate slopes. Porosity-permeability systems span a range from cavernous through to fracture types.

The principal aim of this presentation is to display, and stimulate discussion about, the reservoir characteristics of several prolific carbonate units in northern Iraq. Emphasis is placed upon discerning the spatial and temporal relationships between porosity and reservoir lithology, loading history, folding, faulting and fracture types, because modeling of all are required to better understand and model reservoir oil volumes and potential flow rates. Innovative fracture characterisation techniques are demonstrated. Spectacular outcrops, such as those liberating cascades of oil, are displayed (Figure 1). Examples of fracture porosity (Figure 2) are shown that may elucidate how low matrix porosity ("Tight") reservoirs produce thousands of barrels of oil per day.

Studying and modeling matrix and fracture porosities in conjunction with reservoir lithology, loading-unloading history and fracture types, as one repeatedly deformed system, permits better understanding of a carbonate reservoir.

### References

KRG, 2011, Kurdistan Regional Government: Preliminary Reserve and Resource Survey Results.

Verma et al., 2004, Referenced in World Energy Outlook 2005: Middle East and North Africa Insights: International Energy Agency.

Figure 1: A bitumen cascade from the Qamchuqa Formation, northern Iraq



Figure 2: Fault porosity in the Kometan Formation, northern Iraq

