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Structural Studies of Fault Behaviour and Trap Integrity in the Ahnet and Berkine Basins, Algeria

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Analysis of deformation in different age reservoirs of the Ahnet and Berkine basins reveal contrasting structural controls on hydrocarbon flow. The Palaeozoic reservoirs are primarily influenced by the presence of open fractures, related to the development of Hercynian age fold structures. Selected core from the Bahar Hamra Field indicates poor quality matrix properties for the undeformed reservoir. Quartz cementation and illite growth are the critical factors which impair the quality of the undeformed reservoir. Sandstones with intermediate clay contents (5-15%) appear to have the best permeabilities in the field studied, because cleaner sandstones are prone to preferential quartz cementation, and higher clay content sands are susceptible to enhanced compaction and illitisation. Open fracture porosity is associated with part-cemented deformation features. These are developed during late deformation linked to carbonate cementation. Open fracture apertures are up to a few mm, and in the cores studied the fractures can account for a maximum porosity of 8-11%. However, these fractures are localised within clusters, the location of which appear to be part lithological and part structurally controlled. The average fracture porosity within clusters is likely to be <0.8%. Incomplete cementation of the fractures creates a dog-tooth morphology to the fracture pores which will be resistant to closure under stress. Unreactivated deformation features retarder flow (i.e. act as seals) in the basin. An assessment of stratigraphic variation linked to the evolution of curvature should allow reservoir quality to be predicted field wide.

Outcrop studies of the reservoir successions suggest that in parts of the basin the late fracture / joint array geometry may be related to the late Carboniferous compression. However, the concentration of open pores along steep dipping fractures raises the possibility that the critical fractures have formed during later extensional or strike slip events. Reservoir quality in the basin is related to three factors; a) intermediate clay contents may generate the best finite permeabilities, b) intermediate and uniform open fracture densities may provide the most manageable fracture arrays, and, c) burial to greater than approximately >3.5km may remove the important matrix from a dual matrix fracture porosity system. Reservoirs which experienced only shallow depth of burial may be more prone to the impact of fault sealing.

In contrast, the TAGI reservoir is dominated by normal faulting, some of it synsedimentary, although there was also reactivation when the reservoir was more deeply buried. Faults act to compartmentalize fields and are predicted to be, at least partially, sealing. Variations in throw and TAGI stratigraphy account for changes in the sealing behaviour of these faults with small faults having the greatest risk of leakage. The risk factors associated with fault and fracture control on reservoir quality will be reviewed.