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Carlos Rossi[1], Otto Kälin[2], Antonio Alaminos[3], Robert H. Goldstein[4], José Salvadores[3], Chris Carr[3] (1) Dpt. Petrología y Geoquímica, Instituto de Geología Económica (CSIC-UCM), Universidad Complutense, Madrid, Spain (2) Dpt. Paleontología, Instituto de Geología Económica (CSIC-UCM), Universidad Complutense, Madrid, Spain (3) Cepsa E & P, Dpt. Geology & Geophysics, Madrid, Spain (4) University of Kansas, Dpt. of Geology, Lawrence, KS

Quartz Cementation Concomitant to Oil Charging Causes Major Reservoir Quality Variation in the Giant Ourhoud Field (Berkine Basin, Eastern Algeria)

In the Ourhoud Field, Algeria, the reservoir quality of the Triassic fluvial TAGI reservoir sandstones declines markedly from the structural crest towards the flanks: porosity decreases by ~5% and permeability decreases, more than an order of magnitude, downward across an oil column of ~300 m. Both parameters decrease abruptly at ~60 m above the present-day oil-water contact. The observed poroperm versus depth trend is independent of depofacies, composition, and texture. Over the same depth interval, mean quartz cement volume increases downward by ~6%, pointing to quartz cementation as the main cause for reservoir-quality deterioration with depth.

The distribution of quartz cement can be explained if cementation and oil emplacement overlapped in time. In samples from a mid-flank well, authigenic quartz contains primary petroleum inclusions, demonstrating that quartz precipitated during or after oil charge. Petroleum inclusions are observed only in the oil-leg, where their abundance increases upward. No petroleum inclusions are observed in the lower part of the oil-leg, but bitumen postdates quartz overgrowth. These observations suggest that the most recent oil charge postdates most quartz cementation.

Homogenization temperatures of fluid inclusion assemblages of primary aqueous inclusions yield consistent temperatures, evidence against thermal reequilibration of inclusions. If they are assumed to approach trapping temperatures, quartz in the oil leg precipitated at 88-106°C (present-day: 111°C) and quartz in the water leg precipitated at 91-115°C (present-day: 112°C). These temperatures are consistent with a Late Cretaceous-Early Tertiary timing for quartz cementation, and thus, a similar age for charging some of the reservoir with oil.