Fault-Controlled Dolomitization of Upper Cretaceous Reservoirs, Zagros Basin, Kurdistan Region of Iraq: Implications for Hydrocarbon Migration and Degradation

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Abstract

The close association between oil seepages with fault- and fracture-bounded dolomitized limestones as well as vug/gash-lining saddle dolomite and/or calcite is widespread in Cretaceous carbonate successions of the Kurdistan Region of Iraq. This integrated field, petrographic, chemical, stable C, O and Sr isotopes, and fluid inclusion investigations aims to link these diagenetic alterations to the origin and geochemical evolution of fluids and oil migration in the Upper Cretaceous Bekhme carbonates. Flux of hydrothermal fluids, which is suggested to have occurred during the Zagros Orogeny, resulted in dolomitization and cementation of vugs by saddle dolomite, coarse-crystalline equant calcite and anhydrite. The saddle dolomite and host dolostones have similar stable isotopic composition and formed prior to oil migration from hot (81-115˚C) basinal NaCl-MgCl2-H2O brines with salinities of 18-22 wt.% NaCl eq. The equant calcite, which surrounds saddle dolomite, has precipitated during oil migration from cooler (60-110˚C) NaCl-CaCl2-H2O brines (14-18 wt.% NaCl eq). The yellowish fluorescence color of oil inclusions in the equant calcite indicates that the oil had API gravity of 15-25˚ composition, which is lighter than present-day oil in the reservoirs (API of 10-17˚). This difference in oil composition is attributed to oil degradation by the flux of meteoric water, which is evidenced by the low δ13C values (-8.5‰ to -3.9‰) as well as by nil salinity and low temperature in fluid inclusions of late columnar calcite cement.

This study demonstrates that linking fluid flux history and related diagenesis to the tectonic evolution of the basin provides important clues to the timing of oil migration, degradation and reservoir evolution.