Integration
geoscience
engineering
partnership
geoConvention 2013

Fracturing and Carbonate Mineralization in Tertiary Carbonate Rocks from United Arab Emirates: Origin and Evolution of Basinal Fluids

Manhal Sirat (1), Ihsan Al-Aasm (2), Sadoon Morad (3), Ala AlDahan (4), and Osama Al-Jallad (5)

(1) ADCO, P.O. Box 270, Abu Dhabi, UAE, (2) University of Windsor, Earth and Environmental Sciences, Windsor, Canada (alaasm@uwindsor.ca), (3) Department of Petroleum Geosciences, the Petroleum Institute, P.O. Box 2533, Abu Dhabi, United Arab Emirates, (4) Department of Earth Sciences, Uppsala University, 752 36 Uppsala, Sweden, (5) Abu Dhabi Drilling Co, Abu Dhabi

Summary

Fracture measurements, field observations, petrographic examination, fracture and geochemical analyses, and fluid-inclusion microthermometry of vein calcite and dolomite helped to unravel the origin of the fracture systems and geochemical evolution of diagenetic fluids, which circulated in Eocene marine carbonates of Jabal Hafit anticline, United Arab Emirates. The vein carbonates consist of coarse-crystalline calcite (mm to 7 cm in diameter) with diverse crystal shapes (equant blocky, bladed and fibrous) and saddle dolomite embedded in limestone and dolostone host rocks.

Two fracture systems have been identified with relatively different time of origin; each of which comprises an extensional set and two conjugate shear sets, wherein the flux of the fluids occurred during tectonic activities of compression and shear related to the Zagros orogeny (Eocene-present).

The $d18O_{V\text{-}PDB}$ values of vein calcite (–20.2h to –2.9h coupled with fluid-inclusion microthermometry (homogenization temperatures 100ºC to 190ºC and salinity of 3-29 wt.% equivalent NaCl) suggest precipitation from hydrothermal fluids of variable salinities and probably origins. In contrast, $d18O_{V\text{-}PDB}$ values of saddle dolomite in fractures and fossil molds (–7.16 to –6.22 h show less depleted values than their calcitic counterparts but their fluid-inclusion microthermometry (homogenization temperatures 91.3 to 97° C and salinity of 20.5 to 22.0 wt. % NaCl) show more saline fluids than the ones precipitated fracture-filling calcite cements. The correlation between the $d18O_{V\text{-}PDB}$ and $d13C_{V\text{-}PDB}$ values in calcite and dolomite reflects two trends; a temperature fractionation dependent trend and a mixing fluid trend. In the latter the possibility of input of dissolved carbon derived from the host carbonate rocks and from meteoric waters may have occurred during tectonic uplift. This could have taken place in association with the folding by the E-W compressional event that has developed Jabal Hafit anticline proper, and the development of the relatively older fracture system. This has been followed by a continuous gradual counterclockwise rotation of the compressive stress to the north, which probably developed the relatively younger fracture system.

Key words: fracture-filling carbonates, fluid flow, Eocene, Tectonic evolution, United Arab Emirates