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Fracture Systems of the Zagros Mountain Front (Iran): An Analogue of Hydrocarbon Migration Pathways vs. Reservoir Leakage

Oil-seeps along the Zagros Mountain Front have traditionally been interpreted as the recent leakage of hydrocarbons from different reservoirs. However, high-resolution petrography, isotopic composition ($\delta^{13}\text{C}$, $\delta^{18}\text{O}$) and fluid inclusion microthermometry of calcite cements filling veins and fractures enables the interpretation of the role of fracture systems as hydrocarbon migration pathways. The evolution through time of the fracture-system is constrained from fracture cross-cutting relationships. Oil-migration related calcite cements precipitated at 120 to 130°C from saline fluids (6.5 wt% NaCl equiv.) with $\delta^{18}\text{O}$ between +2 and +5 ‰ SMOW. Supply of organically-derived CO_2 is recorded in the progressive decrease of $\delta^{13}\text{C}$ from the walls to the centre of fracture-fills. Parental fluids correspond to formation waters at reservoir temperatures more than to meteoric waters related to recent oil-seepage. Under this scenario, the study of the fracture systems from the Zagros Mountain Front becomes a major issue for exploration as an analogue for the role of fractures during hydrocarbon migration in the whole region.