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Evidence and scale of mass transfer associated with a Quaternary thrust fault: examples from the Wheeler Ridge oilfiled, southern San Joaquin Basin, California

Diagenetic patterns associated with a subsurface thrust fault indicate that cements and porosity within the fault zone is a function of depth and temperature. At depths shallower than 2500m, the porosity increases due to microfractures followed by plagioclase dissolution, while at depths greater than 2500m, the fault zone is characterized by calcite cementation. Calcite cemented veins associated with the deformation have a $\delta^{13}C_{PDB}$ range from -7.19‰ to -26.6‰ suggesting a mixed marine-thermogenic source. Based on a time-temperature burial reconstruction of the area and $\delta^{18}O$ analysis of reservoir waters and calcite veins we find two vein groups: 1) veins cemented by intraformational (lateral) aqueous flow to the fault, 2) veins cemented by warmer waters ascending from sources at least 75 to 760m deeper than their present depth. Oil migration is the last event related to faulting. Based on a structural reconstruction and oil generation kinetic modeling of the area, we interpret that hydrocarbons migrated laterally from sources 5 to 8 km away from their present location. While hydrocarbons present in shallow reservoirs migrated laterally across the fault, hydrocarbons present in deep reservoirs migrated vertically ~200m and were trapped against the cemented intervals of the fault. A constant whole-oil $\delta^{13}C_{PBD}$ (-23.4±0.2‰) and an absence of correlation between toluene/n-C_7 and n-C_7/methylcyclohexane suggest little fractionation associated with vertical hydrocarbon flow through the fault. In conclusion, the porosity distribution along the fault zone is a function of depth, and fluid movement through the thrust fault is limited to distances less than a kilometer long.