

Dynamics of the Faults in the Colorado Plateau in Utah. Impact of Tectonic Heritage and Reservoir Architecture on the Fault Sealing Efficiency

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What are the dominant parameters which governed the fluid/gas migration along the main faults on the Colorado plateau, where fluids could be purely HC and/or CO₂ and H₂S enriched ones? Several sites have been investigated in Utah and Idaho: the Colorado Plateau, the frontal thrusts of the Sevier fold-and-thrust belt, as well as the Basin & Ranges in the Sevier basin and Idaho.

Three distinct structural provinces have been analyzed depending on their seal/reservoir characteristics regarding confinement properties: 1) the Green River leaking area where large WNW-ESE faults show several water, oil and gas seepages; 2) the Basin & Range province where low-angle normal faults are seismically active (leaking locally); 3) the Canyonlands zone adjacent to the Moab fault, where the Permo-Triassic system is confined.

The migration pathways used by composite hydrocarbon and locally CO₂-rich fluids along Jurassic reservoirs are easily traceable, due to mineralogical changes. These diagenetic processes are locally marked by "bleached bands" in some of the reservoirs and faults pathways. The architecture of the paleo and active fluid migration network can thus be mapped. Natural gas have also been sampled either from oil/gas producing wells in the Moab and Ferron Valley areas, or from natural seepages (along leaking fault sections or from artificial geysers along the Green-River fault system). The results, based on noble gas isotope analyses, show that three distinct provinces can be defined, marking different depth of hydrocarbons and CO₂ sources.

To explain the existence of these provinces, we analyzed the reservoir properties and fault mineralization in order to evaluate the fault and fractures permeability evolution through time. In the strongly eroded Moab area, the occurrence of a thick salt pillow acting as an efficient seal, has driven the tectonic style and has imposed different migration pathways than in the Green River fault zone. There, the sealing efficiency is composed by the regional Lower Cretaceous Mancos shale Fm, which maintain pressure at depth along fault planes

The possible strong link between the seismicity and the volcanic activity, corresponding to periods of large CO₂-rich gas expel, have been also investigated. These parameters have been analysed for the three investigated areas, allowing to propose an integrated model of the local circulation and/or storage of the composite fluids HC, locally CO₂-enriched, for each zone.