FLOW-THROUGH EXPERIMENTS OF ORGANIC COMPOUNDS IN CLASTIC RESERVOIR ROCKS

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Within the scope of the DFG-financed project (SPP 1135) we investigate the interaction of petroleum compounds with hematite coatings on mineral surfaces in reservoir rocks and their effects on porosity and permeability. We want to evaluate the hypothesis that liquid hydrocarbons in hematitic reservoirs can generate reactive organic acids and/or carbon dioxide during post-emplacement thermal evolution. The expected outcome could allow a better understanding of mechanisms of reductive bleaching in red sandstones by the presence of liquid hydrocarbons and late stage (syn- and post-oil-charge) porosity enhancement in deep basinal settings with methane source/reservoir potential (tight gas plays).

Flow-through experiments were carried out with red bed sandstones from the Upper Rotliegend and Middle Triassic Bunter under elevated temperature (up to 200°C) and pressure (400 bar) conditions and different reactant fluids. The sandstone samples and the reactant fluids are characterised prior and after experiments. Preliminary short-term experiments started with acidic deionised water (ph 5.7). Mineral reactions are monitored by analysis of the ionic species in the post experimental fluids by Inductively Coupled Plasma-Mass Spectrometry/-Optical Emission Spectrometry (ICP-MS/-OES) and titration methods. They showed a significant concentration of Silica, Calcium, Potassium, Aluminium, and carbonate species. Comparative petrographic-mineralogic investigations of the Rotliegend sandstone samples indicate leaching of carbonate cements and detrial feldspar grains. Pre- and post-experimental permeability measurements showed enhanced permeabilities after the leaching experiment. Further short-term and long-term (10 days) experiments were carried out with organic fluids consisting of a mixture of four n-alkanes (n-Hexane, n-Octane, iso-Octane and n-Decane) in equal volumes. Long-term experiments are planned with carbon dioxide, complex organic fluids or petroleum in interaction with the inorganic framework of water saturated sandstone samples. In the advanced stage of the investigations we will focus on the change of the mineral surfaces caused by reactions with reactants in different scales by Scanning Electron Microscopy (SEM), Vertical Scanning Interferometry (VSI), Atomic Force Microscopy (AFM), and Transmission Electron Microscopy (TEM).