The gas frac scenario in rock salt – implications from laboratory investigations and field studies

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Abstract

Rock salt formations are attributed to be impermeable for gases and fluids gas pressures, which is the prerequisite for high-pressure gas storage in salt formations. The storage capacity is limited by the maximum permissible gas pressure. If the gas pressure may exceed the minimum salt formation pressure fracturing processes in the rock may occur (generally discussed as gas-frac-scenario).

For an assessment of the provable impact of increasing gas pressures on the integrity of rock salt new results from a long-term field test with progressive gas injection in a gas-tight sealed borehole are presented. To detect micro-cracking a highly sensitive micro-seismic network was installed. Remarkably, in the multi-stage injection tests the gas breakthrough was obtained at a gas pressure of 140 bar slightly above the primary stress state inducing a pressure build-up in two neighbored control bore holes. Due to the associated permeability increase of 3 orders of magnitude (up to 10^{-20} m^2) transient pressure decay occurs coevally in the pressurized injection-borehole. Reaching equilibrium at around 100 bar the primary gas integrity is partly restored in the order of 10^{-22} m^2. Most important, no pressure induced micro-seismic activity was observed during the gas breakthrough which clearly contradicts the gas-frac-scenario.

For comparison, additional laboratory investigations had been performed highlighting the impact of increasing pore pressures on permeability whereby the effect of the gas breakthrough could be attributed to pressure induced opening of grain boundaries. In addition, special account is taken to the effect of anhydrite bearing intercalations which may canalize the spatial gas migration in salt.

Finally, consequences of the observed phenomena on long-term gas storage will be discussed.