Model coupling methodology for thermo-hydro-mechanical-chemical numerical simulations in integrated assessment of long-term site behaviour

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The integrated assessment of long-term site behaviour taking into account a high spatial resolution at reservoir scale requires a sophisticated methodology to represent coupled thermal, hydraulic, mechanical and chemical processes of relevance. Our coupling methodology considers the time-dependent occurrence and significance of multi-phase flow processes, mechanical effects and geochemical reactions (Kempka et al., 2014). Hereby, a simplified hydro-chemical coupling procedure was developed (Klein et al., 2013) and validated against fully coupled hydro-chemical simulations (De Lucia et al., 2015).

The numerical simulation results elaborated for the pilot site Ketzin demonstrate that mechanical reservoir, caprock and fault integrity are maintained during the time of operation and that after 10,000 years CO_2 dissolution is the dominating trapping mechanism and mineralization occurs on the order of 10 % to 25 % with negligible changes to porosity and permeability.

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