



Uncertainty analysis of mineral precipitation potentials in carbon capture and storage (CCS)

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Storage of carbon dioxide in geological reservoirs is attributed to three different processes, i) filling of pore space within the reservoir by gaseous or supercritical CO₂ (pore trapping), ii) dissolution of the CO₂ into the formation water (solubility trapping) and iii) precipitation of carbonate as mineral phase (mineral trapping), which has probably the most long-term potential of carbon sequestration in the subsurface. Underlying concepts of geochemical equilibria computation are described for the conditions of pressure and temperature in deep reservoirs up to 300°C and 1000 atmospheres. The geochemical codes Phreeqc and MIN3P have recently been upgraded for that purpose and were applied in the study. Models using field data from the Heletz oil field (Israel) sandstone formation are presented, focusing on the shift of saturation index (SI) of carbonates due to injection of CO₂. Alterations of the mineral phase over time become visible and potentials to precipitate were observed for the minerals Ankerite > Dolomite > Siderite ~ Calcite > Magnesite, and for the mineral Dawsonite during early stages when only Na⁺ is present in high ionic concentrations. Uncertainty of mineral saturation depending on variability of water chemistry and the database records are discussed by means of principal component analysis and sensitivity coefficients.