EGU21-9894
https://doi.org/10.5194/egusphere-egu21-9894
EGU General Assembly 2021

Geochemistry of Geological Hydrogen Storage in Sandstone Reservoirs

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To enable a fast transition of the global energy sector towards operation with 100% renewable and clean energy technology, the geological storage of hydrogen in depleted gas fields or salt caverns has been considered as a strong candidate for the future energy storage required for limiting global warming to well below 2 °C, as agreed under the Paris Agreement. As such, understanding the impact of injected hydrogen on the geochemical equilibrium in these storage reservoirs is critical. Here, using our bespoke high pressure/temperature batch reaction vessels we investigate the potential effects of hydrogen injection into 3 different sandstones reservoirs. These experiments were conducted at reservoir temperature and at different injection pressures from 1 to 20 MPa with salinities from 0 to 10 weight% over different time periods from 1 to 8 weeks. Our experiments reveal that there is no hydrogen-associated geochemical reaction for the selected sandstones. Although changing reservoir pressure slightly affected the mineral dissolution equilibria at ppm level for hydrogen injection scenarios, the fluctuations of mineral dissolution in water associated with pressure change have a negligible influence on the efficiency of geological hydrogen storage. Therefore, based on the analysis of water chemistry before and after the mentioned experiments, we demonstrate that from geochemical point of view geological storage of hydrogen in these sandstone reservoirs is safe and we don't expect any hydrogen loss due to geochemical reactions.