

## **Laboratory experiments and numerical modelling of CO<sub>2</sub>-rich brine injection through sandstone samples: Role of flow rate, brine composition, mixing and spreading effects.**

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The Heletz structure has been selected as a test site for a prospective CO<sub>2</sub> reservoir in Israel.

To evaluate the chemical processes occurring in the Heletz site, we performed four flow-through experiments at in situ storage conditions using Heletz rock (T = 60°C, P = 15 MPa, PCO<sub>2</sub> = 1.8 MPa). The flow rates injection were 0.05 and 0.30 mL.min<sup>-1</sup>. Two different brine solutions were used, both representative of the Heletz reservoir native water. The first one was a synthetic brine of the Heletz reservoir (closed to seawater). The second one was the first one equilibrated with gypsum. The results show an increase in permeability for all the percolation experiment whatever the flow rate and the brine solution. This is explained by the dissolution of ankerite, dolomite and feldspar. Precipitation of secondary phases is characterized such as gypsum during equilibrated-gypsum brine injection. Secondary clay minerals precipitation is also observed near feldspar and carbonate dissolution.

Modeling these experiments is a non-trivial task, as some chemical processes are local in space. We have used a water mixing approach which uses the mass mixing fraction between mobile and/or immobile zones. The approach allows decoupling chemistry calculation from solute transport modelling. The results indicate the important role of the mineral distribution and the local transport conditions on chemical reactions. We demonstrate that clay precipitation occurs always close to carbonate dissolution or at least where pH is buffered to high value.