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3D reconstruction, CO2 plume flow, reactive transport and reservoir simulations of a potential structure for geological storage of CO2

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A re-interpretation of an available seismic reflection survey dataset has been performed to identify potential structures for CO2 storage.
Seismic reflection data interpretation show that the area is mainly organized in horst and graben structures, bordered by inactive normal faults. Isolated horst structures completely surrounded by caprock units could be considered as structural traps potentially suitable for geological storage of CO2. A thick marly-to-clayey cover succession can be considered as caprock whereas a calcareous fractured succession below (hosting a regional saline aquifer) can be considered as reservoir.
A reliable tri-dimensional model of the reservoir potentially suitable for CO2 injection was built and the calculation of its Gross Reservoir Volume was also done. After this, a physical simulation of the CO2 behaviour in the reservoir during and after injection (for a pilot test site) have been performed, considering the rate of injection, the volume of pores and fractures with respect to reservoir volume, the injected gas composition, the petrophysical properties and P-T conditions of the reservoir.
After this, a 3D numerical simulations of CO2 reactive transport in the reservoir has been performed at the theoretical injection pressure. Reactive transport simulations were conducted under multiphase advection, aqueous diffusion, gas phase participation in multiphase fluid flow and geochemical reaction in non-isothermal conditions. Feedbacks between flow and geochemical processes were taken into account to evaluate changes in porosity and permeability as kinetic reactions were proceeding. Twenty years of CO2 injection were simulated at constant injection rate, whereas water-gas-rock interactions between CO2-rich brines and minerals were simulated over a period of 100 years.