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Model quantification of the CO_2 storage in the Los Páramos site (Duero basin, NE Spain)

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The Duero basin in NW Spain is one the most promising basin for CO_2 storage in the Iberian Peninsula due to the existence of favourable deep aquifers close to large CO_2 emission point sources. A number of projects are presently active either for scientific research (e.g., the Hontomín site, OXI-CFB300 EPRR project) or commercial purposes (e.g., Sahagún and Los Páramos projects). The project called Los Páramos intends to assess the injection of CO_2 in a group of dome-shaped structures with an estimated total capacity of 200 Mt (ranked 2nd in the Iberian Peninsula, IGME 2010). These domes were studied in the past for hydrocarbon exploration and a large body of information is available from seismic profiles (over 170 km) and 3 deep wells. The Los Páramos site is emplaced in the San Pedro Folded Band (SPFB) that consists mainly of thick-skinned thrusts of Mesozoic rocks (Triassic and Upper Cretaceous) sealed by a thick (1200-1500 m), undeformed cover of Tertiary claystones. Dome-like structures are related to thrusts leading to favourable reservoirs. The target horizon for CO_2 storage is the Utrillas Fm sandstone with high porosity (13-20%) and thickness (225-250 m). In three of the domes, the Utrillas Fm is below -800m, allowing thus the storage of CO_2(sc). This sandstone hosts an aquifer containing saline water, up to 50 g·L-1, according to the data from drill wells. The presence of saline groundwater is explained by water interaction with Triassic evaporite layers just underlying the Utrillas Fm sandstones.

The CO_2 storage at Los Paramos site is planned via injection of supercritical CO_2 (CO_2(sc)) in the Utrillas Fm. In general, the next four trapping mechanisms are expected, which are of increasing importance through time (1) structural, (2) residual saturation, (3) dissolution, and (4) mineral.

The prediction of the mass of CO_2 stored through time in any storage systems is an essential parameter in the pre-injection assessment of a geological storage. For safety reasons, it is relevant to know the mass of CO_2 trapped under the different trapping mechanisms. In this work, storage quantification in the Dome B of Los Páramos site has been performed by using multiphase transport simulations with COMSOL Multiphysics. Model results predict well the amount of CO_2 trapped as residual phase and the onset of the formation of CO_2-rich brine fingers and their extent and evolution.