Laboratory CO_2 injection in Utrillas Sandstone (Cretaceous): Analysis of changes in porous media using Hg porosimetry

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CO_2sc trapping and injection in non-exploitable saline aquifer pore spaces appears to be the most feasible method for reducing the emission of this greenhouse gas into the atmosphere. CO_2sc trapping will be performed using four potential trapping mechanisms, as follows: (1) solubility trapping, (2) capillary trapping, (3) structural trapping, and (4) mineral trapping. The rock microstructure will play a key role in all the four mechanisms.

This study has been conducted within the framework of the PmaCO2 project (Porosity and CO_2 Trapping Mechanisms [1]). The goal of this study is to determine variations in pore space microstructure caused by the injection of CO_2 in supercritical state in two samples of sandstone of almost identical chemical composition and different texture. We want to remark the key role of the initial rock texture in determining variations in the pore space and trapping mechanisms. These variations in pore space significantly affect the storage capacity of the rock and can modify the flow or percolation pattern of the fluid (or gas) through the rock.

We analyzed rock response to the injection of CO_2sc in two samples which chemical composition was analyzed in terms of major, minor and trace elements, and X-ray diffraction. Texture was analyzed using SEM imaging.

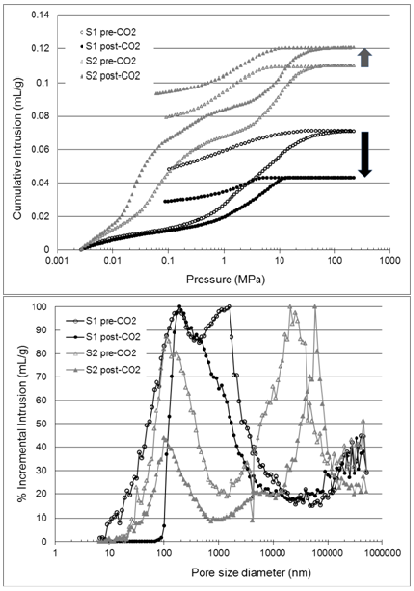

Figure 1 - Intrusion - extrusion Hg mean curves and pore diameter distribution obtained from MIP in samples pre and post CO_2sc injection.

Once the sample was saturated with brine, the injection cell was connected to supercritical carbon dioxide generator with the injection and evacuation or production valves opened. This way, displacement of the brine due to the injection of CO_2 was simulated. Once the sample with CO_2sc was saturated, the cell remained closed for two months with pressure (8Mpa) and temperature conditions (32ºC) controlled daily. The resulting variations in porosity and pore distribution and size were analyzed and verified by Hg porosimetry. Following the test, significant changes in the pore space were found, which in turn produced variations in the storage capacity and CO_2 flow pattern through the rock. The reduction in porosity affected a large volume of pore space, but in a selective way, mainly to mesopores in fine grained sandstone. A moderate increase of porosity, along with a reduction in the size of the smallest pores was observed in the thick grained sandstone sample. These results were confirmed by N2 adsorption. A decrease in the BET and micropore area was observed in the two samples of sandstone before and after the CO_2 injection. The most plausible cause for the mesoporosity loss is mineral precipitation in the pores of smaller size. The reduction of porosity and subsequent reduction of their effective storage capacity after CO_2 injection should be taken into account when assessing the potential formations for geological CO_2 storage.

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References: [1] R. Campos; I. Barrios; J.Lillo, *Energy Reports* **1**, (2015) 71-79.