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Pore- and Nano-scale Imaging of Pore Changes During CO2 Injection in Sandstone

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We employed X-ray Computed Tomography (CT) and Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS), alongside a steady-state flow experiment involving calcite-contained sandstone and pre-equilibrated fluids, to study the changes occurring in the pores of sandstone during CO2 injection. In-situ pore-scale imaging showed a significant increase in average porosity, from 23% to 28%. This increase was due to the formation of new pores and the enlargement of existing ones, which occurred earlier in proximity to the injection inlet. Concurrently, pore shrinkage is also observed, typically after the pore enlargement, affecting regions within small pores. The combined effect increased heterogeneity. SEM-EDS provides nano-scale insights, identifying calcite dissolution as contributing to new pore formation, feldspar fragmentation and clay migration as associated with pore enlargement. Furthermore, the blockages induced by clay or fragmented feldspar migration resulted in pore shrinkage. Thus, it is not only the reactive mineral, calcite, that plays a critical role, but also feldspar and clay exert significant influence. Our study clarifies the changes occurring in the pores during CO2 injection into sandstone and highlights the influence of mineral composition on geological CO2 sequestration.

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Primary authors: CHAI, Rukuan (Imperial College London); Dr GOODARZI, Sepideh (Department of Earth Science and Engineering, Imperial College London)

Co-authors: Dr PATMONOAJI, Anindityo (Department of Earth Science and Engineering, Imperial College London); Prof. BLUNT, Martin J (Department of Earth Science and Engineering, Imperial College London); Dr BIJELJIC, Branko (Department of Earth Science and Engineering, Imperial College London); Dr AL ZARAFI, Anfal (Department of Earth Science and Engineering, Imperial College London)

Presenter: CHAI, Rukuan (Imperial College London)

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