

Probing coupled processes in the laboratory from pore scale to whole core scale

Tarolli, P. ; Porporato, A. M. ; Tarolli, P. ; Porporato, A. M. ; Tarolli, P. ; Brown, A. ; Fallu, D. ; Walsh, K. ; Cucchiaro, S. ; Tarolli, P. ; Zhao, P. ; Van Oost, K. ; Snape, L. ; Lang, A. ; Albert, R. M. ; Alsos, I. G. ; Waddington, C. ; Xu, X. ; Wei, W. ; Beach, T. ; ...

Injection of fluids in the Earth's subsurface for energy production or storage involves a number of complex and non-linear coupled processes, because these fluids are usually not in thermal, chemical and/or hydrostatic equilibrium with the host geological medium. These processes can be purposely induced, for example in the case of deposition of minerals in fractured or damaged caprock that would decrease the permeability of the unit, forming thus an effective seal for a carbon geological storage site. They can also be unwanted: for example, this same deposition of minerals around a wellbore would decrease injectivity of an oil field undergoing water flooding, or change the rock stiffness and hence would give erroneous interpretation of the seismic monitoring of a CO₂ plume . Observing and quantifying these coupled processes in the laboratory is a key element for the design of geoengineering activities: (i) experimental studies are performed under controlled conditions of temperature, pressure, fluid flow velocities and fluid chemistry enabling direct analysis of these processes, (ii) they provide insights into key inputs parameters needed for reservoir and field scale modeling, (iii) they also provide data to probe and constrain models and constitutive relationships that describe these coupled processes and their dependency on temperature, pressure and fluid chemistry conditions.

In this talk, I will review some previous laboratory studies where the chemical and physical changes were induced by the injection of CO₂ gas and CO₂-rich brines in carbonate rock cores and monitored by their geophysical (electrical and acoustic) responses. I will then present some recent developments at the pore scale that use nano-indentation tests. This technique measures rock's stiffness at the micrometer scale, allowing us to quantify the effect of changes in the pore space (dissolution, fracturation, cementation, etc.) on the rock's stiffness.

Publication: American Geophysical Union, Fall Meeting 2020, abstract #MR001-0001
Pub Date: December 2020
Bibcode: 2020AGUFMMR0010001T
Keywords: 1822 Geomechanics; HYDROLOGY; 5104 Fracture and flow; PHYSICAL PROPERTIES OF ROCKS; 8020 Mechanics; theory; and modeling; STRUCTURAL GEOLOGY; 8135 Hydrothermal systems; TECTONOPHYSICS

 Feedback/Corrections?