ARMA Future Leader Webinar Series

Every Two Weeks on Fridays 9-10 AM MT (11 AM -12 PM ET)

Hydro-Mechanical Couplings Across Scales to Decarbonize the Energy Matrix

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Friday, May 10, 2024, 9-10 AM MT (11 AM -12 PM ET)

https://westernuniversity.zoom.us/j/99355457319

Abstract

Geo-energy activities in subsurface reservoirs (geothermal energy, carbon capture, and hydrogen storage) have the potential to decarbonize our economy. All these applications require good characterization of injection/extraction flowrates and controlled surface deformation & induced seismicity. Fluid transport and geo-mechanical deformation in rocks and fractures are closely coupled through a number of different mechanisms that control their characteristic time-and-length scales. It is today a major challenge to i) upscale laboratory-observed mechanisms to field scales, and i) to constrain field-scale observations using microscopic physics. In this talk, I will present case studies that allow bridging spatial and temporal scales of the hydro-mechanical coupling in rocks and faults. I will show experimental evidence of how contact mechanics can be a powerful tool to upscale the (1) the fluid transport properties of faults and (2) the microphysics of fault slip from micrometer to multi-decimeter scale. Then, I will show (3) how we can use multi-kilometer scale geophysical observations of fluid flow and geomechanical deformation in subsurface reservoirs to constrain laboratory derived earthquake nucleation laws. I will show how these studies can benefit geothermal energy development, CO2 sequestration, and hydrogen storage in the subsurface.

Biography

Mateo's research focuses on understanding the coupling between mechanical deformation and fluid flow in the subsurface, with the goal of mitigating natural hazards and developing clean energy activities. He uses a variety of techniques, including experimental methods, theoretical and numerical modeling, and natural observations, to study how fluids flow through rocks and how this flow can affect the mechanical deformation of Earth's crust. Mateo holds a Doctorate of Science in mechanics from the Swiss Federal Institute of Technology (EPFL) and an M.Sc. in engineering from Grenoble Institute of Technology. He has worked at Caltech since 2020 first as a postdoctoral scholar and now as a research scientist. In addition to his research, Acosta serves as working leader of the Ecuadorian Geothermal Association.