On Achieving Adaptive Controls of Subsurface Fracture Networks

Abstract: The Earth's subsurface supplies over 80% of the U.S. energy, 50% of its drinking water, and holds vast potential for the safe storage of CO_2 and nuclear waste. However, effective utilization of these resources faces significant challenges, particularly in predicting, optimizing, and controlling subsurface fracture systems. Although fractures occupy only a small volume of rock, they play a dominant role in solute transport, fluid flow, mechanical behavior, and seismic activity. Achieving adaptive control of subsurface fracture networks has the potential to transform almost all strategies in subsurface resource utilization, imposing far-reaching environmental and economic impacts. In this talk, I will present the latest research progresses conducted at Los Alamos National Laboratory on this topic, including fluid-driven fracturing and cracking induced by thermo-hydro-mechanical-chemical coupling, with applications in oil and gas extraction, geothermal utilization, CO_2 sequestration, and geologic hydrogen stimulation.

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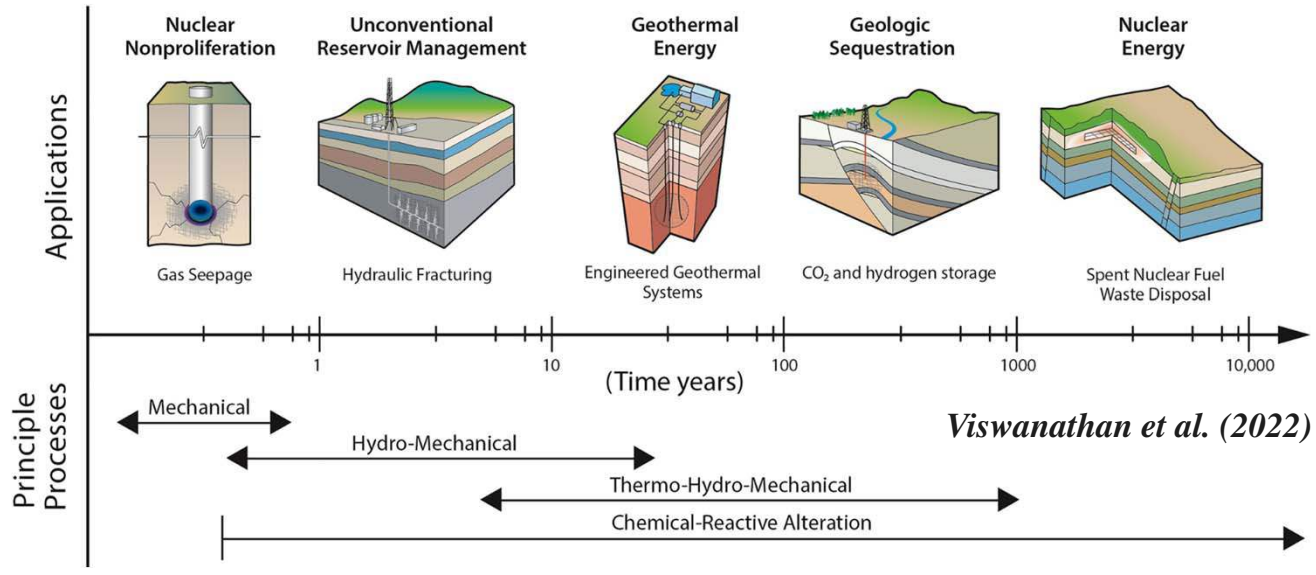

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