Mechanics of Induced Microseismicity in Fractured Reservoirs

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Abstract:

Injection and production of fluids in fractured formations will significantly increase in the next decades to achieve carbon neutrality through enhanced geothermal systems, geologic carbon storage, and subsurface energy storage. These activities induce pressure, temperature, and stress changes that affect fractures stability and, thus, may induce microseismicity. Understanding how geomechanical and fluid flow coupled processes control induced microseismicity is crucial for the success of low-carbon geo-energy projects. We perform coupled thermo-hydro-mechanical simulations of fluid injection and production into a fractured rock containing two perpendicular fracture sets. Cold water is injected into the fractured network, which is four orders of magnitude more permeable than the rock matrix. Pore pressure and heat diffusion preferentially advance through fractures, yielding a distribution different from the one obtained with an equivalent porous media. Additionally, the stress changes induced by pore pressure and temperature changes also differ from the ones occurring in an equivalent porous media. These pore pressure, temperature, and stress changes affect fracture stability, especially within the cooled region, where a higher rate of microseismicity is expected.