Hydro-Mechanical Model Developments and Insights into Injection-Induced Seismicity

Abstract

Several industries all require the injection of large volumes of fluid into the subsurface. This naturally alters the subsurface conditions near the injection well, which may increase the likelihood of seismic events in that particular area. When seismicity does occur in response to fluid injection, we refer to it as injection-induced seismicity (IIS). Here, we develop two hydro-mechanical models for studying problems of IIS (and potentially other subsurface processes): a generalized, fully coupled poroelastic model and a partially coupled fluid flow model capable of simulating three-dimensional, field-scale domains of fractured rock. Using these models, we study a suite of problems related to IIS. First, we study the influence of mechanical coupling on the stability of a fault within the basement formation, during wastewater fluid injection. Next, the research focuses on the influence of heterogeneity (specifically discrete fracture networks) and nonlinear pressure diffusion on the spatiotemporal patterns of IIS.

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