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THE EFFECT OF SEQUENTIAL SOLUTION SCHEMES IN THE NUMERICAL MODELING OF SHEAR STIMULATION IN AN ENGINEERED GEOTHERMAL SYSTEM WELL

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In geothermal energy production, reservoir permeability exhibits various degrees of enhancement or degradation with time. These changes are generally attributed to various multiphysics processes such as chemical alteration (dissolution and precipitation), thermal and poroelastic deformation of fractures or the rock matrix, or inelastic failures such as hydrofracking or hydroshearing. If permeability is dependent upon the deformation state of the solid matrix, then a strong feedback is present in the governing differential equations. Few codes are equipped to handle the fully-coupled Thermal-Hydrological-Mechanical (THM) problems in geothermal reservoir simulation. Therefore, separate codes equipped to handle separate differential equations are often loosely coupled to model THM processes.

While previous efforts have investigated numerical coupling procedures in geochemical transport [2], it is not clear what degree of numerical coupling is required to accurately capture the feedback required for permeability enhancement phenomena. In this work, we compare various levels of coupling for modeling Engineered Geothermal System (EGS) well stimulation. Specifically, we address a flow/stress feedback whereby injection of cold water induces thermal and poroelastic stresses resulting in the hydroshearing of subgridscale fractures and an increase in permeability [1]. The simulations are performed using FEHM [3], a control-volume finite element THM code that allows for various levels of coupling. Coupled THM modeling is gaining momentum in the geothermal energy sector; a robust analysis of the numerical coupling issues discussed here is imperative in understanding the potential and limitations of this growing field.

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