

Understanding Rock Multiphysics – Key Needs in Symbiotic Pursuit of Mining Critical Minerals and Transitioning Energy

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Extended Abstract

Both mining critical minerals and transitioning energy towards carbon neutrality draw heavily on fluids in the subsurface. For mining critical minerals, this involves the injection of specially designed fluids into and the recovery of pregnant fluids from ore deposits. For transitioning energy, this includes sequestering CO₂, fuel switching to lower-carbon sources, such as from abundant gas shales and coal gas reservoirs, recovering deep geothermal energy via EGS (Enhanced Geothermal System), and diurnal and inter-seasonal storage of heat, H₂ and energized fluids (CAES: Compressed Air Energy Storage). In all these endeavours, either maintaining the low permeability and integrity of caprocks or in controlling the growth of permeability in initially very-low-permeability shales/coals or geothermal reservoirs represent key desires. Injected volumes are necessarily enormous and anticipated processes complex. We assess these desires through advancing our understanding on fluid injection/extraction induced multiphysics in rocks/reservoirs. In rock multiphysics, all essential processes are coupled through the links between fluid injectivity/extractability and rock permeability. This lecture will cover rock multiphysics principles and how they can help in mining critical minerals and transitioning energy.