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Characterization of Rock Properties in Coupled Fluid Flow and Geomechanics Problems

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In the exploration of deep formations, alterations in pore pressure change the mechanical equilibrium of the porous medium leading to stress modifications which alter rock properties such as permeability and porosity and, consequently, the fluid flow pattern (Murad et al., 2013). The coupling of geomechanical effects and fluid flows is widely influenced by the natural rock heterogeneity (Mendes et al., 2012) and the predictability of computational models is limited by the availability of an adequate description of the formation properties, such as hydraulic conductivity, porosity, and poromechanical parameters. Since direct measurements of reservoir properties are only available at a small number of locations, the deterministic description of the hydraulic parameters cannot be accomplished at all relevant locations and alternative conceptualizations suggest that a stochastic methodology is indispensable to treat rock properties. In recent years the increase in field data acquisition (although in limited points) associated with the use of high performing computing have encouraged the use of dynamic data, such as well test data, historical pressure data, fractional flow rate, reservoir compaction and surface subsidence, directly in the simulation of processes in order to reduce uncertainties in rock properties and to improve the predictability of the models. In this work, we use the Markov-chain Monte Carlo (McMC) method to characterize the permeability, porosity and Young's modulus fields in a two-phase flow problem coupled with the geomechanics of the adjacent rocks.

References

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