**Numerical Model Development for Gas Extraction from the Hydrate Reservoir**

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The phenomenon of gas extraction from a hydrate reservoir is modelled by considering the associated multiphysical processes. Gas extraction via depressurization affects the distribution of pore pressure, which, in turn, leads to the dissociation of hydrates, resulting in the change of phases and the stiffness of the hydrate sediment. In this study, a THMC (Thermo-Hydro-Mechanical-Chemical) solver is developed, incorporating non-linear critical state geomechanical models for hydrate sediment, hydrate phase change kinetics, non-isothermal multiphase flow in porous media, and alterations in permeability. The governing mass and energy balance equations are discretized using the node-centered finite volume method (FVM), while the force equilibrium equation is discretized using the finite element method (FEM). The developed solver is validated against the existing experimental results and other benchmark problems to assess its accuracy and reliability. This comprehensive approach allows for the coupled analysis of complex interactions between temperature, pressure, fluid flow, mechanical behavior, and chemical reactions within the hydrate reservoir during gas extraction, providing valuable insights into the behavior of such systems, especially under different boundary conditions.

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