Mix3-HydResSim-GM: A fully coupled THCM simulator for gas hydrate reservoir

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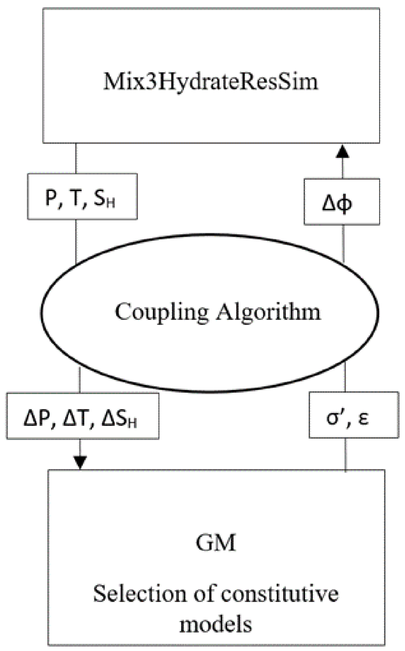
Introduction

Gas hydrate has been recognized as possible future energy resources and it also closely related with many engineering and environment problems. Gas production from gas hydrate bearing sediments is accompanied with coupled Thermo-Hydro-Chemo-Mechanical (THCM) processes that involve endothermic gas hydrate dissociation, multiphase flow and heat fluxes in porous media, and mechanical deformation of the sediments.

This study presents a THCM coupled code-Mix3HRS-GM- developed by National Energy Technology Laboratory's group. The developed code can be applied to deal with a wide range of problems encountered for hydrate bearing sediment research, from 1D to 2D axisymmetric, from laboratory scale to reservoir scale production test, from pure flow analysis to THCM fully coupled analysis. Some case study were shown to demonstrate the capabilities of the developed code.

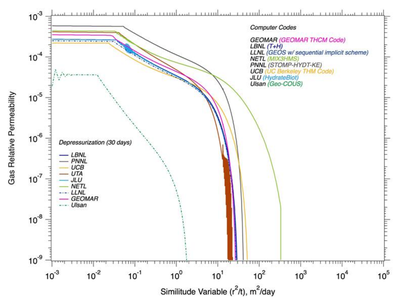
Mix3-HydResSim-GM

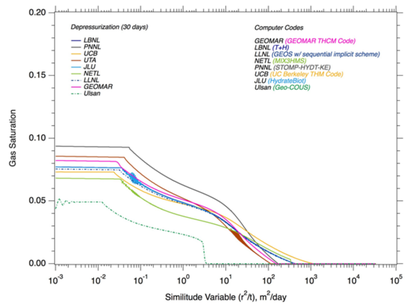


- ✓Independent flow component based on Finite Volume Theory
- ✓Independent geomechanical components based on Finite Element Theory
- ✓Efficient sequential coupling technique to ensure the coupling accuracy between the flow and geomechanical components.
- ✓Multiple convenient functions such as time dependent boundary condition , mesh generator, stress redistribution terms.

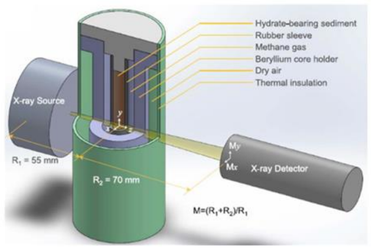
Case Study

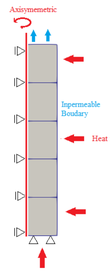
Benchmark Problems from 2nd International Code Comparison study (IGHCCS2).



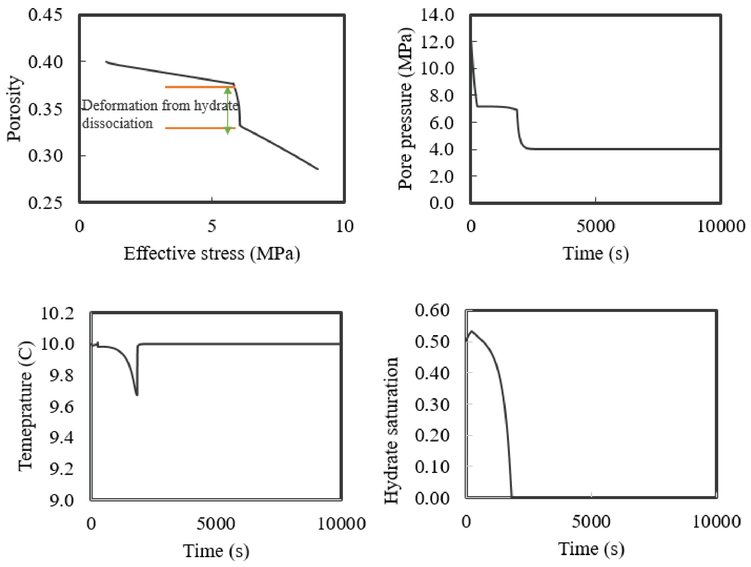


Laboratory Test Simulation



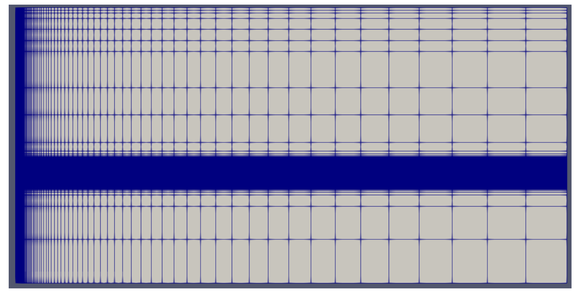


Isotropic consolidation and thermal stimulations modeling for pressure and temperature responses under hydrate dissociation

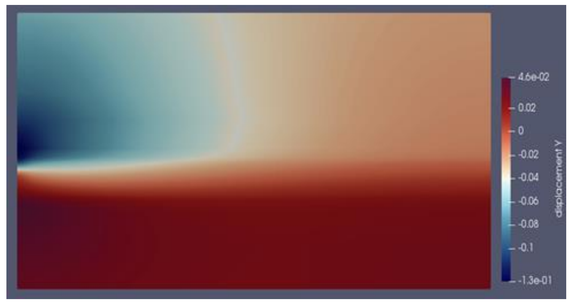


THCM Fully Coupled Hydrate Reservoir Production Simulation

Depressurization

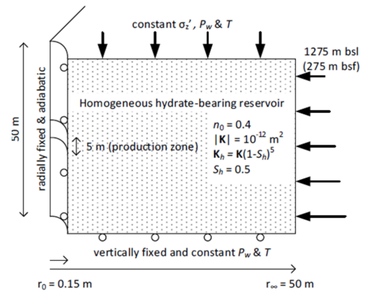


Gas production from hydrate reservoir using depressurization



Vertical Displacement

Sand Production Analysis



Sand Migration in Homogenous Hydrate Reservoir