10th International Conference on Gas Hydrates (ICGH10), June 21-26, 2020, Singapore

Fully Thermal-Hydro-Chemo-Mechanical (THCM) Coupled Numerical Simulations of Gas Production from Gas Hydrate Reservoirs at Alaska North Slope

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Abstract

Gas hydrate-bearing sediments (GHBS) are natural sediments that formed in permafrost and marine settings where the temperature and pressure conditions maintain the stability of gas hydrate. A THCM coupled numerical simulation of gas production from on a gas hydrate reservoir on Alaska North Slope is conducted. The reservoir model utilizes interpreted well-log data and core sample measurements acquired during the well drilling. The simulations are performed using the recently developed fully THCM coupled simulator (Mix3HRS-GM). Depressurization used as a means of gas hydrate destabilization, induces the effective stress increase during gas production that, in turn, causes sediment deformation. As gas hydrate dissociates the increased effective stress carried by gas hydrate lattice is transferred to sediment matrix, which produces additional deformation due to loss of sediment stiffness. The geomechnical model implemented in the simulator considers this aspect and the impact of geomechanical behavior of gas hydrate-bearing sediments on productivity is investigated connecting pore space compaction with absolute permeability change. The sensitivity analysis is conducted to assess the effects of other factors on reservoir performance. The results of the numerical simulation can be used to support field gas production test design and extend the knowledge of gas production from gas hydrate reservoirs in permafrost area.

Keywords: numerical simulation, THCM, Alaska North Slope