Numerical Analysis of Sand Production during Gas Hydrate Dissociation based on Multiphase Mixture Theory

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ABSTRACT

In March 2013, the world's first offshore gas production from marine methane hydrate deposits was conducted in Eastern Nankai Trough off the Pacific coast of Japan. It has been reported that the flow test lasted six days until severe sand production forced to terminate the operation (Yamamoto 2015). Sand production is a simultaneous production of soil particles along with gas and water into a production well, and one of the important technical problem to be solved and controlled during the gas production from hydrate-bearing sediments.

In the present study, a numerical model to predict the chemo-thermo-mechanically coupled behaviour during hydrate dissociation including sand production has been formulated based on the multiphase mixture theory (Akaki 2017). In the proposed model, the sand production is modelled as the internal erosion which is the detachment and migration of soil particles from soil skeleton due to seepage flow. Assuming that the ground is composed of soil skeleton, methane hydrates, water, methane gas, and the fluidized soil particles, the sand production is expressed as mass transition of soil particles from soil skeleton to the fluidized sol particles.

A numerical simulation of offshore gas production test in Nankai Trough was conducted for the seabed sediment at the water depth of 1300 m using axisymmetric model. The simulations with and without considering sand production were conducted and the effect of sand production on the ground behaviour, such as, the gas production behaviour and the ground deformation, was discussed.

REFERENCES

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