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A Numerical Study on Gas Production from Hydrate Deposit through Depressurization and Thermal Stimulation

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Gas hydrate, which has vast reserves and one of the most potential clean energy of 21 century, attracted growing interests on natural gas production. Depressurization, thermal stimulation and inhibitor injection are considered as possible approaches to produce natural gas from the hydrate deposit. Based on the characters and geological conditions of the hydrate deposit observed in Shenhu SH2 drilling site, we conducted a numerical study on the gas production by means of the combined utilization of depressurization and thermal

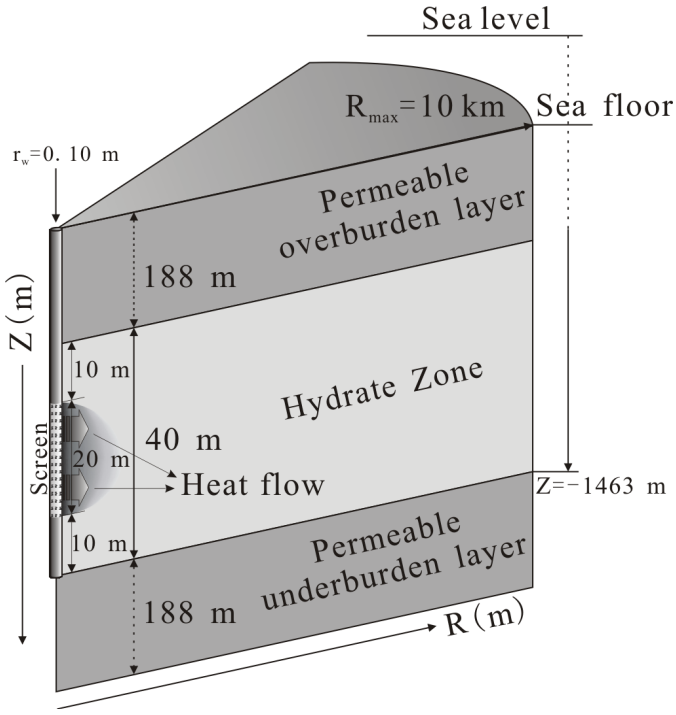

Fig.1 Schematic description of gas production from SH2 hydrate deposit of shenhu through the combined utilization of depressurization and thermal stimulation

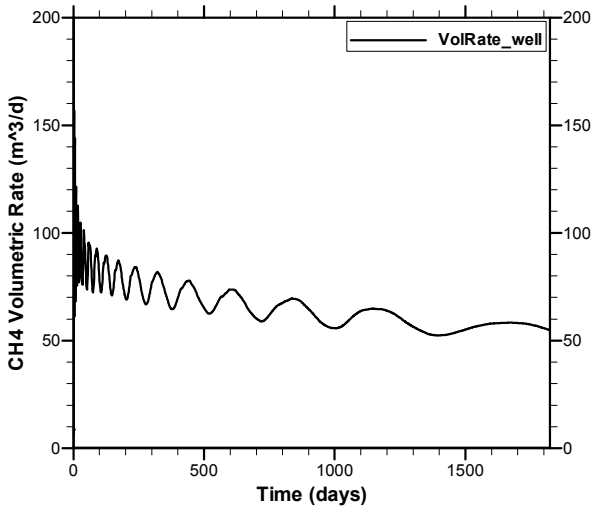

Fig.2 Evolution of CH_4 Volumetric Rate produced at well

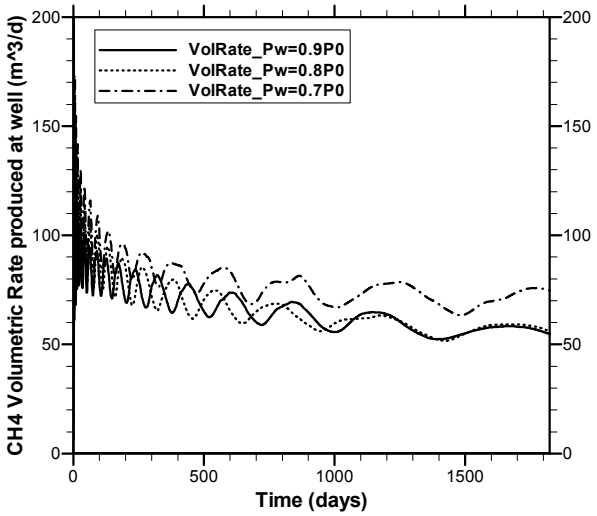

Fig.3 Evolution of CH4 Volumetric Rate produced at well under different bottom-hole pressure

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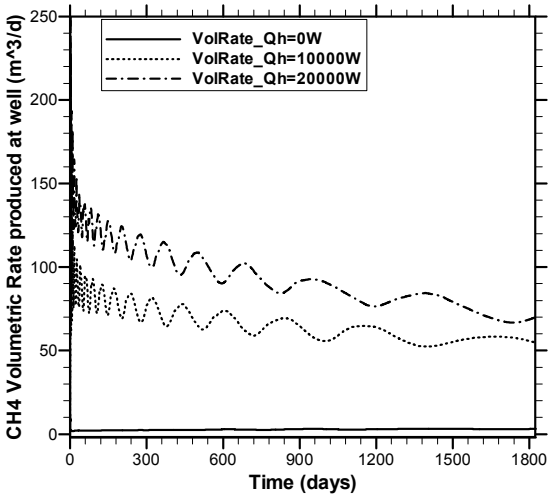

Fig.4 Evolution of CH4 Volumetric Rate produced at well under different thermal stimulation intensity

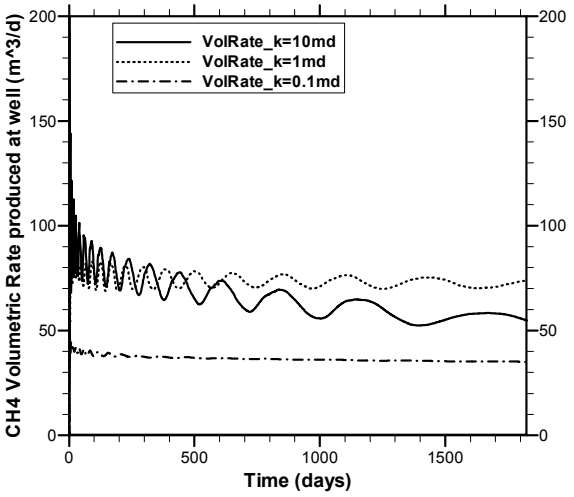

Fig.6 Evolution of CH4 Volumetric Rate produced at well under different permeability

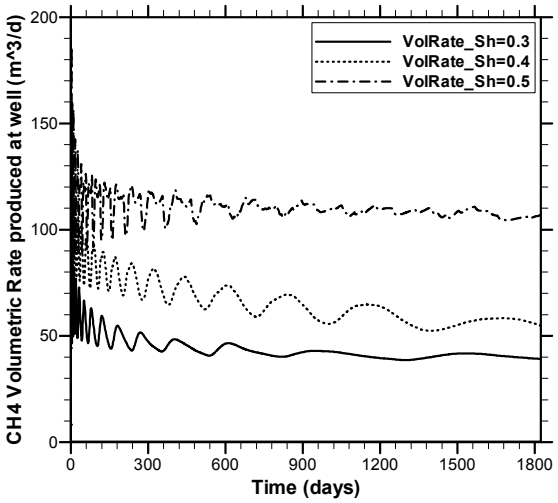

Fig.5 Evolution of CH4 Volumetric Rate produced at well under different initial hydrate saturation

stimulation through a vertical well. To minimize gas losses through the permeable strata overlaid the hydrate deposit and excessive water production from the permeable strata, the screen interval of well is limited to the middle section of the well. Heat was evenly applied to the screen interval at a constant rate of heat flow rather than hot water injection. Numerical simulations show that hydrate zone near the permeable strata is waterproof and trap methane gas at early stage, and may become the leakage path for methane gas at late stage. Most of methane gas released from hydrate reservoir remains captured. Sensitive analyses to the parameters, i.e. bottom-hole pressure, thermal stimulation intensity, initial hydrate saturation, reservoir permeability, indicate that stronger thermal intensity or higher initial hydrate saturation result in higher gas production rate but with larger water production. When the permeability of hydrate deposit decreases, the gas production rate increase first and then decrease. This is caused by the combined action of fluid transport and heat conduction. The numerical method presented here may be useful for future design and optimization of methane gas production from a hydrate deposit.

Acknowledgment

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Key words: Gas Hydrate, Depressurization, Thermal Stimulation, Numerical Simulation, Shenhu Area