

Abstract

Methane hydrate has been considered as a possible energy source for the future, providing that a cost-effective production method can be developed. However, production of methane gas from gas hydrate bearing sediments requires a drilling and production technology specially adopted for gas hydrate bearing sediments. Wellbore design is an important and challenging part of gas production from gas hydrate bearing sediments. As a result, it is necessary to develop a numerical model to predict potential risks associated with drilling and production from gas hydrate bearing sediments.

This study mainly focuses on investigating the wellbore behaviour during the life of well as the presence of methane hydrate brings about new challenges in wellbore design in shallow offshore fields. The mechanical characteristics for methane hydrate bearing soil degrade, either through hydrate dissociation by changing of pressure or temperature, or by soil softening due to shearing. This changes the stress stage of the formation around the wellbore, which in turn changes the stress state of the cement and casing of the wellbore. These uncertainties may lead to unexpected potential risks associated with construction and production processes, such as soil fracture, sand production, casing damage and cement failure.

The scope of research can be divided into the following four parts. First, a staged finite element approach is developed for evaluating the stress state of a wellbore. Second, a series of analyses are performed to investigate the mechanical behaviour of wellbore during the construction process at the Nankai Trough site. Third, a numerical analysis of the production well for gas production trial at Nankai Trough is conducted. Fourth, a series of simulations are conducted using simple wellbore models to investigate factors influencing the behaviour of the casing during the gas production process.