Thermogenic Methane Hydrates Formation due to Fault Activation in Marine Environment

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Methane hydrates have long been regarded as a future energy resource. Significant efforts have been made in the exploration and research of methane hydrates and production of methane gas from these resources. A major part of the research is identifying and characterizing possible reserves. Seismic imaging, well logging, core sampling are some of the methods that have been used to characterize methane hydrates in the subsurface. This study is based on the numerical simulation and characterization of hydrate reserves by modeling the formation of hydrates due to fault activation and gas migration through the fault.

Thermogenic methane are formed at a high pressure and high temperature, typically at a depth greater than 1 km below sea floor. The migration of such methane gas through faults into gas hydrate stability zone forms methane hydrates. The hydrate stability is a function of pressure and temperature in the reservoir and as the gas reaches the stability zone, it starts to nucleate into hydrates.

Numerical simulations, however, show that the methane hydrate formation is not merely a function of pressure and temperature, but also the fluid regime, reservoir properties and geological structure and stratigraphy. The numerical simulation was done in TOUGH+HYDRATE, which uses an integrated finite difference method to solve coupled heat and mass balance equation. Basecase model representative of Gulf of Mexico subsurface was considered and sensitivity analyses were performed to quantify the impacts of various reservoir and fluid properties.

Significant variations in the methane hydrates saturation and distribution indicate that fluid flow and reservoir parameters must be taken into consideration. Quantitative characterization of methane hydrate reserves by numerical simulation serves as an important tool that can be employed for reserve estimation and production planning from methane hydrates.