

Gas Hydrate Petroleum System Analysis in Marine and Arctic Permafrost Environments

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Abstract

The study of gas hydrates in nature has been ongoing for over 40 years. Significant strides have been made in our understanding of the occurrence, distribution, and characteristics of marine and permafrost associated gas hydrates. Numerous field studies have shown that the potential amount of gas stored as gas hydrates in the world greatly exceeds the volume of known conventional gas resources. Gas hydrate research in recent years has focused on: (1) documenting the geologic parameters that control the occurrence and stability of gas hydrates in nature, (2) assessing the volume of natural gas stored within various gas hydrate accumulations, (3) analyzing the production response and related characteristics of gas hydrates, (4) identifying and predicting natural and induced environmental and climate impacts of natural gas hydrates, and (5) analyzing the effects of gas hydrate on drilling safety.

With an increasing number of highly successful gas hydrate laboratory and field studies, significant progress has been made in addressing some of the key issues on the formation, occurrence, and stability of gas hydrates in nature. The concept of a gas hydrate petroleum system, as a subcomponent of a conventional oil and gas petroleum system is now commonly used to describe and assess the geologic nature of newly discovered gas hydrate accumulations. In a gas hydrate petroleum system, the individual factors contributing to the formation of gas hydrate accumulations, such as (1) gas hydrate pressure-temperature stability conditions, (2) gas source, (3) gas migration, and (4) the growth of the gas hydrate in suitable host sediment can be identified and quantified.

The primary goal of this lecture is to bring together the knowledge from both marine- and permafrost-related gas hydrate studies in order to document the critical components of various example gas hydrate petroleum systems. This lecture reviews the results of field, laboratory, and modeling studies to better document and assesses the geologic controls on the formation and occurrence of gas hydrates in nature and their resource potential.