2015 年 6 月 2 日受付，2015 年 6 月 2 日採録

Abstract

The governments and the industry are developing major programs to produce gases economically for commercial use. The safety record of the industry, in general, is remarkable with respect to deepwater exploration. Nevertheless, as the production increases the risks also increase. Recognizing this, the development of tools for contingency and emergency planning and impact assessment have become an integral part of the exploration programs. In the United States, some of the oil and gas platforms are in the hurricane zone. When the exploration and production reaches the full scale, some of the rigs in Japan may be in the areas vulnerable to typhoons. These factors further heighten the need for contingency and emergency planning. A computer model that can predict the fate and transport of gasses and hydrates accidentally released is needed for dealing with emergencies, contingency planning, and impact assessment. The water depths to many of these gas resources easily exceed 1,000 m. At these depths, the high pressure and cold temperatures combine to convert the gases (if they are already in gas form) to hydrates, which are mixture of gas and water with a consistency like frazil ice. The conversion to hydrates is a physical process that is totally reversible. The gas hydrates are lighter than water and hence move upward. When they reach areas that are of lower pressure in regions nearer to the water surface they dissociate and get converted to gas. Hydrates and gases dissolve in water. When gas is released, initially, the dynamics become important and the behavior is like a jet or plume. As they get dispersed the dynamics of the plume becomes unimportant, but gases and hydrates are still subjected to advection and dispersion. This report presents a model MEGADEEP that is complete with the above mentioned dynamic and non-dynamic behavior of the plume. The model considers the complete thermodynamics and the hydrodynamics of the plume. It also includes the hydrate formation and dissociation kinetics and dissolution. The model can simulate the conversion of gas to hydrate and vice versa as the gases travel through the water column. MEGADEEP is a new model that is developed to predict the behavior of gas and gas hydrates released in deepwater. It has many processes that previously have never been modeled such as bubble break up and coalescence in gas plumes in the deep water and multiple size gas bubbles in the plume phase. Previous models were developed for oil and gas blowouts with emphasis on oil fate. The present model MEGADEEP focuses on gas fate and transport and makes comprehensive simulations from the point of release in the deep until all gas and hydrate are dissolved in water or until they reach the surface. This report contains the model formulation and the simulation of several possible scenarios.