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Visualization of Gas Hydrate Dissociation Using Micromodel under Permafrost conditions

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Abstract

Understanding of Gas Hydrate dissociation and stability in permafrost sediments are essential for modelling these systems both with respect to global warming and in schemes of CH_4 recovery and/or CO_2 storage. It is known that CH_4 hydrate is thermodynamically less stable than CO_2 hydrate due to the lower activation energy of the decomposition. However, recent studies show that the presence of ice with hydrate in permafrost sediments have a different impact on the dissociation rate of CH_4 and CO_2 hydrate due to different self-preservation mechanism.

In this work, pore-scale visualization of CH_4 hydrate, CO_2 hydrate dissociation in sedimentary rock in permafrost temperature is carried out using the micromodel and image analysis. The primary purpose of the research work is to evaluate CH_4, and CO_2 hydrate dissociation kinetics containing different ice quantity at moderate pressure and temperature below the ice melting point and further compare the self-preservation characteristics. Pore level visualization is carried out in transparent, etched, micromodel of sedimentary pores of a 2D thin section of the actual sandstone rock. We have studied the effect of ice content, pressure, and temperature change on the dissociation rate below the ice melting point.

Micromodel experiments show that the presence of Ice develops different dissociation rates for CH_4 and CO_2. Effect of ice content on methane hydrate dissociation rate is stronger in comparison to CO_2 hydrate. We experimentally evaluate the effect of initial hydrate saturation on CH_4 and CO_2 hydrate dissociation using high-pressure micromodel, and we report the variation in the dissociation pattern as the function of pressure and temperature change.

Keywords: Micromodel, Methane Hydrate, CO_2 hydrate, Self Preservation, Hydrate dissociation