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The effect of particle-size distribution on methane hydarte formation in sediments

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Natural gas hydrate occurs in sediments, subject to the influence of the properties of sediments. Studies on natural gas hydrate have found that hydrate saturation in sediments are closely related to sediment type: comparatively enriched in sands but poorly saturated in fine sediments. Sorting coefficient is a parameter describing the particle-size distribution of sediments. Based on the results obtained from Nankai Trough sediments Uchida and Tsuji (2004) reported that hydrate saturation also has relation with the sorting coefficient of sediments.

To examine the effect of particle-size distribution, especially the sorting effect of sediment particles, experiments were carried out with artificial sediments. The test specimen was prepared with quartz powder, a representative of silicates and aluminosilicates, kaolinite and Na-montmorillonite, representatives of clay minerals, and calcite, representative of carbonate minerals. The sediments with different sorting coefficient, from well sorted to very poorly sorted, were concocted with quartz of various particle sizes (1 mm to 0.020 mm), clay (<0.002 mm), and carbonate (ca. 0.027 mm) at various ratios. The water saturated artificial sediments were reacted with methane gas at about 100 bar and 3 degree Celsius in a pressure cell. The reaction lasted until no pressure drop was observed for about 1 week, which indicates that the reaction had reached completion. The test specimens were recovered and analyzed for hydrate saturation in sediment.

The initial results obtained imply that hydrate saturation in sediments with various sorting coefficient are mainly controlled by particle size and mineral composition, although sorting effect does play a role in affecting hydrate saturation. Further studies showed that sorting effect is significant only when clay content is high.

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Keywords: methane hydrate, sediment, saturation, sorting, particle size distribution