

The effect of particle size on the Formation of Methane Hydrate in powdered silica particles

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Based on the investigations in the past years, it has been recognized that methane hydrates in the Eastern Nankai Trough primarily occur in turbidite sediments^{1,2,3}. Turbidite is composed of a set of sediments, generally becoming finer upward in particle size, from coarse sand to clay⁴. In natural environment, the formation of gas hydrate will be inevitably subject to the influence of sedimentary characteristics, so the modes of gas hydrate formation and occurrence might be different in the sediments with various particle sizes and mineral compositions. The elucidation of this issue, how sediments affect the formation of gas hydrate and occurrence, will help in efficient gas hydrate exploration, accurate estimation of gas hydrate reserve and the design of gas hydrate production method.

In this research, we especially studied the effect of particle size on the water conversion degree to methane hydrate using a set of powdered silica particles with the size from medium silt (0.02mm) to medium sand (0.25-0.5mm). The test specimens saturated with 3.5% NaCl solution, simulating the interstitial water of marine sediments, reacted with methane gas at the pressure of 10 MPa and temperature of 3 C. The water conversion degree to methane hydrate in a test specimen was estimated with the amount of gas that was clathrated in methane hydrate.

The obtained results indicate a clear relationship between water conversion degree to methane hydrate and particle size: only 3.2 % for particle size 0.02mm is increasing dramatically from 5.7% to 82.8 % for particle size from 0.03mm (coarse silt) to 0.2mm (fine sand), and almost stable at 80% for particle size 0.25mm (medium sand). Because the test materials are all silica, the difference in water conversion degree to methane hydrate could be resulted from physical properties of silica particle, specific surface area and/or the property confined by silica particle, pore size.

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