

Volume proportion of gas hydrate evaluated from oxygen isotope of water in locus sub-samples

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Gas hydrate distributed offshore around the Japanese Island is actively studied for evaluating its resource. However, the evaluation is not always easy because gas hydrate rapidly decomposes in a low-pressure onboard condition. We contrive a new method using oxygen isotope ratio of locus sub-samples of muddy sediment and hydrate. Together with the isotope ratio of the bulk pore-water, we can calculate volume proportion of gas hydrate.

This study was conducted as a part of the shallow methane hydrate exploration project of METI. During the expedition with the research vessel Poseidon in August-October 2015, we analyzed mixed sediment of hydrate and mud from 26 core sections drilled from Oki trough and Joetsu Basin. From each core section, we quickly encapsulated locus sub-samples of mud and hydrate (3-5 sub-samples for each) in 4.5-ml vials. Air in the vial was later substituted in laboratory by He for the mud sub-sample, by He-CO₂ for the hydrate and bulk pore-water sub-samples. After leaving more than 2 days in a constant temperature (at 23 degrees), we measured the isotopic ratio by Finnigan DeltaPlus with GasBench II (2SD = 0.15%).

Mud sub-samples generally recorded larger deviation in oxygen isotopic ratio than hydrate sub-samples. This is because of difficulty in avoiding contamination of hydrate-molten water. After excluding the contaminated sub-samples, we found that oxygen isotopic ratio was always higher in hydrate than in mud, likely reflecting isotopic fractionation during hydrate formation. Difference between the hydrate value and the mud value was site-specific ranging from 1 to 4 permil, and tended to decrease with increasing the volume proportion of hydrate. The oxygen isotope ratios of water in locus sub-samples successfully provided the hydrate volume proportion from 28 core sections, which appear consistent with images observed onboard.

Keywords: Oxygen isotope, Gas hydrate