

Crystal structure of gas hydrates on the Umitaka Spur, eastern margin of the Japan Sea

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A large number of gas chimney structures have been reported just below the seafloor of the Umitaka Spur in the eastern margin of the Japan Sea, which indicates an environment with a large supply of hydrocarbon gas from deep sediments to shallow sediments. Gas hydrate accumulates in the sediments within the gas chimney structures, constituting a huge carbon reservoir in the carbon cycle near the seafloor. The composition of the gases (methane, ethane, propane, etc.) in hydrate phase determines the crystal structure of hydrates (Structure I or Structure II), which may regulate their stability and physical/chemical properties. The differences in the microscopic crystal structures of gas hydrates are, therefore, fundamental information for evaluating the seafloor environment including gas hydrates, and it is necessary to understand the characteristics of their distribution based on the geological background. This study aims to identify the crystal structures of gas hydrate from the Umitaka Spur to examine the distribution of gas hydrate based on the geological structure and chemical environment and to clarify the factors that determine the distribution of gas hydrate with different crystal structures.

In the northeastern part of the Umitaka Spur, Structure I gas hydrate was dominant, and in the central part, Structure I and Structure II gas hydrate coexisted. The ethane, necessary for the formation of Structure II, is generated by the thermogenic degradation of organic matter at depth, and the difference in crystal structure reflects the formation process of hydrocarbon gas and the subsequent migration and accumulation processes. In the central part of the Umitaka Spur, the supply of ethane from the depths is relatively high through the faults that run to just below the seafloor, and it is considered that the gas hydrates of Structure I and II including ethane formed. Concerning the vertical diversity of the crystal structure, it is possible that the gas composition responsible for the hydrate formation has been changed with time, or that gas hydrates have gradually formed during burial where the gas composition differs with depth. Samples used in this investigation were collected by Meiji University's Gas Hydrate Research Laboratory under the commission of AIST from 2013-2015 as part of the methane hydrate research project funded by METI (Ministry of Economy, Trade and Industry).

Keywords: gas hydrate, Crystal structure, Japan Sea