Reaction/fixation/migration of methane within the gas chimney on the Umitaka Spur, eastern margin of the Japan Sea

*Hitoshi Tomaru[1], Ryo Matsumoto[2]

1. Department of Earth Sciences, Chiba University, 2. Gas Hydrate Research Laboratory, Meiji University

Pore water geochemistry has reported that methane is oxidized anaerobically by sulfate (anaerobic oxidation of methane: AOM) at the sulfate-methane interface (SMI), and the methane flux has been estimated using the sulfate gradient or SMI depth. The methane flux is therefore an essential factor for assessing the near-seafloor environment of high methane potential area. Gas chimney, characterized by active methane migration, often associates with methane hydrate accumulation just below the seafloor and methane plume in the overlying water column on the Umitaka Spur, eastern margin of the Japan Sea. However, the behavior of these methane cannot be examined by the change of sulfate concentration, direct measurements of the amount of methane in hydrate phase and methane seepage are required. In this research, we estimated the amount of methane that is 1) oxidized at SMI via AOM, 2) fixed in gas hydrate deposit, and 3) released into water column, using independent data sets recently obtained on the Umitaka Spur, respectively, in order to understand more practically the behavior of methane within the gas chimney.
The methane flux oxidized at the SMI was calculated to be >600 mmol/m^2/yr using the SMI depth of <1 mbsf within the gas chimney. Assuming that the methane flux has been constant and all the methane has formed hydrates of 6×10^8 m^3 within 200×250 m gas chimney in <363 ka (data from METI coring), the methane flux directly associated with hydrate was estimated to be >1500 mmol/m^2/yr. The methane flux released into the water column was calculated to be <5 mmol/m^2/yr using the methane concentration in bottom water of <1500 nM and bottom water current of <10 cm/s. These numbers are still tentative because sedimentation rate within gas chimney is rather variable among sites, gaseous methane in sediment must be accounted, a part of methane hydrate has dissolved during massive accumulation of hydrate body, etc. However, recent intensive researches on the shallow gas hydrate system have provided the better understanding of total methane behavior within the gas chimney.
This study was conducted partially under the commission from AIST as a part of the methane hydrate research project funded by METI (the Ministry of Economy, Trade and Industry, Japan).

Keywords: gas hydrate, methane flux, Japan Sea

