

Characteristics of natural gas hydrate retrieved off Abashiri, the Sea of Okhotsk

*Akihiro Hachikubo¹, Satoshi Takeya², Masaaki Konishi¹, Hirotohi Sakagami¹, Shintaro Yamasaki¹, Hirotsugu Minami¹, Satoshi Yamashita¹, Nobuo Takahashi¹, Hitoshi Shoji¹

1.Kitami Institute of Technology, 2.National Institute of Advanced Industrial Science and Technology (AIST)

In the area of southwestern margin of the Sea of Okhotsk, an existence of natural gas hydrate has been expected using seismic data. Yamamoto et al. (2002) suggested existence of natural gas hydrate off Shiretoko, the Sea of Okhotsk, by a long piston coring. Recovery of sediment core for gas hydrate started in the cruise of TK11 in 2011 in the framework of joint research between Kitami Institute of Technology and University of Tokyo, and obtained gas-rich sediment cores off Abshiri. Gas hydrate crystals were first retrieved in the cruise of UT12 (T/S Umitaka-Maru) in 2012. New hydrate-bearing sites were also discovered in the cruise of NT13-20 (R/V Natsushima in 2013. We planned operations using T/S Oshoro-Maru, and obtained sediment cores and gas hydrates at this area in the cruise of OS249 (2012), OS263 (2013), and C020 (2015).

Gas hydrate crystals were obtained and stored in liquid nitrogen for Raman spectroscopic analysis and calorimetry. Samples of hydrate-bound gas were obtained onboard and stored in 5-mL vials, and sediment gas were also obtained using a headspace gas method. We measured molecular and stable isotope compositions of these samples. We summarized the results as follows:

- 1) Gas hydrates belong to the cubic structure I, containing methane (more than 99%) and hydrogen sulfide (less than 1%). C1/C2+ ranges from 5,500 to 5,800.
- 2) Hydration number is estimated as 6.03 ± 0.04 , agrees well with 6.04 ± 0.03 for synthetic methane hydrate (Sum et al., 1997).
- 3) Dissociation heat from hydrate to gas and water is estimated as 55.1 ± 0.3 [kJ/mol], agrees well with 54.19 ± 0.28 [kJ/mol] for synthetic methane hydrate (Handa, 1986).
- 4) Hydrate-bound gas is of microbial origin according to C1/C2+ and stable isotopes of hydrocarbons, however, $\delta^{13}\text{C}$ of ethane seems relatively large.
- 5) Gas hydrate in the NT13-20 PC06 core contains trace amount of ethane (several ppm), whereas that in the NT13-20 PC02 core contains about 100ppm of ethane.
- 6) SMI (sulfate-methane interface) depth of the sediment cores are less than 1m, indicating high methane flux off Abashiri.

We appreciate the support of the crew onboard R/V Natsushima during the NT13-20 cruise, and T/S Oshoro-Maru during the cruises of OS249, OS263, and C020. This study was supported by the Grant-in-Aid for Scientific Research (B) 25289142 and 26303021 of the Japan Society for the Promotion of Science (JSPS).

Handa (1986) Compositions, enthalpies of dissociation, and heat capacities in the range 85 to 270 K for clathrate hydrate of methane, ethane, and propane, and enthalpy of dissociation of isobutane hydrate, as determined by a heat-flow calorimeter. J Chem Thermodyn 18: 915-921.

Sum et al. (1997) Measurement of clathrate hydrates via Raman spectroscopy. J Phys Chem B 101: 7371-7377.

Keywords: hydrate, the Sea of Okhotsk, stable isotope