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Depth profile of formaldehyde concentration in pore water from eastern margin of the Sea of Japan

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Natural gas hydrate is a clathrate compound. Gas molecules are encaged by hydrogen-bonded water molecules. Gas hydrate is found together with deep-sea sediments that contain natural radioisotopes like uranium-series, thorium-series, and ^{40}K. Natural radiation from those radioisotopes will break bonds of water and guest gas molecules, and form radical species. Although the radical species are unstable in the pressure and temperature of natural gas hydrate occurrence on the Earth, radical reactions may occur in the hydrates. The reaction products will be accumulated in gas hydrates (Tani et al., 2006). For example, ethane, methanol, and formaldehyde are mainly formed in gamma-irradiated methane hydrate (Ishikawa et al., 2007, Tani et al., 2011). Methanol and formaldehyde may be closely related to microbial activities in the seafloor sediments. Therefore, we are interested in depth profiles of these compounds in the deep-sea sediments.

We investigated methanol concentration in pore water of the deep-sea sediments obtained during MD179 cruise in 2010. The methanol concentration in pore water beneath the seafloor was less than 2 microM, which is the detection limit. The concentration increased with depth, and reached to 10-20 microM around 30 m below the seafloor (Yamamoto et al., 2011). In this study, we have investigated the depth profiles of formaldehyde concentration in pore water of the same sediments.

Pore water was obtained by squeezing sediments recovered from Umitaka Spur and Joetsu Knoll, in Joetsu Basin. Each sample was taken into a glass vial (3-5 ml), sealed, and kept in a freezer. These procedures are performed on the ship. The vials were warmed at room temperature before the following analysis. Headspace gas in each vial was analyzed by gas chromatography-mass spectrometry (GC-MS). Because Henry's constant of formaldehyde is large (Sander, 1999), o-(2,3,4,5,6-pentafluorobenzyl)-hydroxylamine (PFBOA) was used as a derivative reagent for aldehyde (Kobayashi et al., 1980).

The results show that formaldehyde concentration in pore water is 0.3-0.8 microM beneath the seafloor, increased with depth, and 1-2 microM around 30 m below the seafloor. Formaldehyde concentration is well correlated with methanol one. These results indicate that formaldehyde and methanol in pore water may have similar production, consumption, and diffusion processes.

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Keywords: pore water, gas hydrate, Joetsu Basin, formaldehyde