

Dissolved gas in pore water at the hydrate-bound field off Sakhalin Island

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We summarize characteristics of dissolved gas in pore water in sub-bottom sediments off Sakhalin Island, where gas hydrates were retrieved. Gas hydrates have been discovered at the northeastern, southeastern and southwestern Sakhalin Island in the cruises of LV31 (2003), LV32 (2003), LV36 (2005), and LV39 (2006) in the framework of hydro-Carbon Hydrate Accumulations in Okhotsk Sea (CHAOS) project, and those of LV47 (2009), LV50 (2010), LV56 (2011), LV59 (2012), LV62 (2013), and LV67 (2014) in the framework of Sakhalin Slope Gas Hydrate (SSGH) project. We retrieved sediment cores (184 cores in total) including gas hydrates (29 cores) in these cruises (R/V Akademik M. A. Lavrentyev).

The dissolved gases in the pore water were extracted according to a headspace gas method. Basically, 10 mL of sediment and 10 mL of saturated aqueous solution of NaCl with a small amount of benzalkonium chloride (preservative) were introduced into a 25 mL vial to create a 5 mL headspace. The headspaces were flushed with nitrogen or helium as an inert gas. The vials were then shaken thoroughly and stored overturned. Molecular and stable isotope compositions of these samples were measured in our laboratory (Kitami Institute of Technology).

The depths of sulfate-methane interface (SMI) distributed mainly 1-3 mbsf, and those of hydrate-bound core were shallower (30 cm to 1 m). The dissolved gases in pore water below the SMI depth were primarily methane (more than approximately 99% of the total hydrate-bound gas), although ethane, propane, CO₂, and hydrogen sulfide were also detected. The molecular and isotopic compositions of dissolved gas in the pore water indicated that the sediment cores including gas hydrates contain ¹³C-rich methane and relatively high concentrations of ¹³C-rich ethane compared to other gas-rich sediment cores. The gas-rich sediment cores without gas hydrates are characterized by high C₁/(C₂+C₃) ratios and ¹³C-depleted methane and ethane. We suggested the idea that small amount of thermogenic gas controlled occurrence of gas hydrate in the subsurface sediment off Sakhalin Island.

Keywords: gas hydrate, pore water, stable isotope, Sea of Okhotsk, Sakhalin Island