

Gas hydrate survey at the gas seepage area off Hidaka, the Pacific Ocean

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Existence of gas chimneys have been reported off Hidaka (Hokkaido) in the sub-bottom profiler data of GH06 cruise (AIST 3.5kHz SBP database, https://gbank.gsj.jp/sbp_db/pages/cover.html). To investigate near-surface gas hydrates at the sea floor, we performed K2-2020 cruise using Kaiyo-Maru No. 2 belonging to Kaiyo Engineering Co. Ltd. on September 2020. Our research fields are two areas (sites 1 and 2 locate 60 km east and 60 km southeast from Cape Erimo, respectively). At the site 1, gas plumes were discovered by a multibeam survey. The largest gas plume was about 500 m high and was accompanied by some plumes (200-300 m high). Many mounds with specific heights ranging from several meters to more than ten meters were found. On the contrary, the site 2 had no gas plume but many mounds with specific heights of 10 to 20 meters. In this cruise, we used a hydrostatic corer and gravity corer to take sub-bottom sediment cores. We obtained 16 sediment cores, including some gas-rich cores. Sediment gas samples were obtained by a headspace gas method. Molecular and isotopic compositions of gas samples were measured using a gas chromatograph and an isotope ratio mass spectrometer, respectively.

Sediment gas analysis revealed that concentrations of CH₄ and H₂S at the gas plume site of the site 1 were relatively high (more than 1 mM), and C₁ / (C₂ + C₃) ranged 2,000-5,000 because of high methane concentration. C₁ δ¹³C and δD were about -70‰ and around -185 to -170‰, respectively, suggesting microbial methane produced via CO₂ reduction. C₂ δ¹³C ranged from -59‰ to 43‰ and became smaller with depth, indicating that microbial ethane is also generated in the sediment. CO₂ δ¹³C was also small as well as methane, close to -60‰. Some sediment cores at the plume site had shallow SMI depths of 0.4 to 1.2 m, suggesting an active gas supply and existence of gas hydrates below the sea floor. On the other hand, the concentration of methane was generally in the order of 0.01 mM at the mounds in site 2. Compared to normal sediment cores (methane concentrations ranged from 0.0001 to 0.001 mM), which show no signs of methane migration, the results showed ascending methane in these mounds. However, C₁ / (C₂ + C₃) was less than 1,000, suggesting that these SMI depths were lower than the core bottoms. The values of C₁ δ¹³C and CO₂ δ¹³C were around -80‰ and -20‰, respectively, and their profiles were uniform along with depth.

Keywords: gas hydrate, the Pacific Ocean, gas origin