

Chemical and isotopic analyses of sediment pore waters collected off Abashiri, Hokkaido, Japan

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In September 2011, field operations of the TK-11 cruise were conducted in a collaborative effort by scientists from Kitami Institute of Technology and the University of Tokyo to investigate natural gas hydrates (GHs) that have been suggested by a bottom-simulating reflector off Abashiri, Hokkaido.

In the present study, chemical and isotopic analyses of the sediment pore waters were carried out to determine geochemical features relevant to possible GH occurrence in the studied area. The concentrations of sulfate ions in the pore waters were measured to investigate the depth profile down to the depth of the sulfate methane interface (SMI), since the SMI depth is reported to depend on the upwelling methane.

Five sediment cores up to 1 m in length were recovered (TK-11 GC1101 to GC1105). A 5-cm depth interval of the internal portion of the sediment core was drawn into titanium hydraulic Manheim squeezers, and pore waters were collected in plastic syringes attached to the squeezers. The outer part of the sediment, which was in contact with the PVC liner tube, was left in the liner to avoid contamination. In addition to coring, sampling of seawater was conducted from the water column at the coring site using a Van Dorn sampler and from inside the liner tube just over the sediment cores. All water samples were filtrated through a 0.2-um filter and then stored in 50-mL plastic bottles and refrigerated until analyses. The concentrations of anions such as sulfate ions were determined by an ion chromatograph. A flame atomic absorption spectrometer or inductively coupled plasma optical emission spectrometer was used to determine the concentration of metals such as sodium, potassium, etc. Stable isotope ratios of oxygen and hydrogen of the water samples were analyzed by an isotope ratio mass spectrometer.

The fact that the sulfate concentrations decreased linearly with depth from seawater value to under the detection limit (UDL) is consistent with the anaerobic oxidation of methane by a bacterial consortium that uses sulfate as an oxidant in the process of oxidation. In other words, we can estimate that the depth where the sulfate is UDL is the SMI depth. The finding that the SMI depth of all cores is less than 1 m below the seafloor (including extrapolated SMI of TK-11 GC1105) suggests an intense methane flux from below in the studied area. The fact that no ionic anomaly of chloride and sodium ions and no isotopic anomaly of hydrogen and oxygen was observed in the pore waters suggests that GH was not contained in the cores.

Keywords: sediment pore water, ion concentration, stable isotope ratio, Abashiri