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Molecular and isotopic signatures of dissolved gas in sub-bottom sediments retrieved off Abashiri, the Sea of Okhotsk

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We measured molecular and isotopic compositions of dissolved gas in sub-bottom sediments retrieved off Abashiri, the Sea of Okhotsk, where sub-bottom profiler revealed the existece of gas chimneys ascending from the deep sediment layer. In the cruise of TK11 (September 2011), we obtained sea-bottom sediment cores by using a gravity corer (1.5m length) and sampled (1) dissolved gas in pore water, (2) dissolved inorganic carbon (DIC), and (3) dissolved gas in the sea-bottom water. Methane concentration in the four sediment cores increased rapidly at aroud 40-70cmbsf, that indicates shallow SMI (sulfate-methane interface) and high methane flux. Compared to the gas data obtained off Sakhalin Island, these high concentration of methane and shallow SMI imply that gas hydrate layers could exist below 1mbsf. Because the length of the corer was only 1.5m, the length of core recovery was less than 1m and we could not get gas hydrate samples. At the SMI depths, delta ^{13}C profiles of methane showed their minimum value (less than -85 permil VPDB), suggested ongoing biogeochemical process: anaerobic oxidation of methane (AOM) produces ^{13}C-depleted CO_2, and ^{13}C-depleted methane also is generated via CO_2 reduction (Borowski et al., 1997). In this process, hydrogen sulfide (H_2S) is still produced by sulfate reduction at the depth of SMI, however, we could not detect H_2S in the headspace samples due to the simplified process of sampling procedure. delta ^{13}C and dD of dissolved methane ranged from -87 to -75 permil VPDB and from -210 to -203 permil VSMOW, respectively. Molecular ratio of hydrocarbons (mehtane/ethane) below the SMI depth ranged 5000-40000. Therefore, we conclude that these gases are microbial origin produced by CO_2 reduction. In the upper SMI layer, the concentration of methane was depleted and its delta ^{13}C increased because methane oxidation was dominant. The profiles of DIC delta ^{13}C agrees with that of methane delta ^{13}C and showed minimum delta ^{13}C at the SMI depth.

Keywords: gas hydrate, stable isotope, Sea of Okhotsk, off Abashiiri