Geochemistry of cold seepage in the Eastern margin of the Japan Sea

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The eastern margin of the Japan Sea is a convergent plate boundary with many active faults and frequent large earthquakes, supporting chemical synthesis communities and deep-sea cold seepages. In 1999 and 2001, a mega-bacteria mat (about 800,000 m2, roughly square) with patchy distribution (like the spots of a leopard) was found together with traces of bottom disturbances indicative of landslide and seafloor disruptions off Motsuta-misaki by submersible investigations (#485, #624 and #631 dives). To investigate the chemical characteristics of the deep-sea cold seepages and to clarify the generation mechanisms of the bacteria mat, chemical concentrations (minor ions and nutrients) and isotopic compositions (d18OH2O, dD, d 34SSO4) of pore water in sediment under the bacteria mat were analyzed.

The SO42- reduction (DSO42- (D: the concentration changes between sea bottom water and pore water in the sea floor)= 7.7 mM/cm at the bacteria mat site but 0.1mM/cm at a non-bacteria mat site) and d34SSO4 increase (up to +28.3, +20.5 per mil in the bottom sea water) in pore water suggest the sulfate-reduction of the bacteria mat, and because the ratio of DSO4 and DCa+DMg is 1:1, this indicates that CH4, not the common organic substance in the sediment (with a ratio of 1:2), is the reactant of the sulfate. Depending on the sulfate reduction by bacteria in the sediment, the emission of methane and its flux were calculated as 2.8 micro mol/cm2/day (#631)which was similar with those from the Calyptogena community region off Hatsushima. Together with the Cl- reduction (DCl- =92 mM/cm) and d18OH2O increase (+0.8, bottom water +0.1 per mil) in the pore water, as the possible origin of methane, the ooze of methane hydrate and/or other hydrocarbon deposit feeds the mega-bacteria mat.

Furthermore, the temperature in the sediment beneath the bacteria mat site increased from the sea floor toward to the deep sediment by 0.186C. over 40cm bsf, clearly higher than the 0.046C. over 40cm bsf measured at a nearby non-bacteria mat site, which is consistent with the sulfate being supplied from the seawater and the CH4 released from the deep source by tectonic activity. The geochemistry of the pore water is expected to contribute to the elucidation of the source of methane hydrate, upon which the bacteria mat feeds, and understanding the connection between life in this extreme environment and its connection with the tectonic activity.