Biogenic methane and methanogens in the Holocene marine mud under the Nakagawa and Tokyo Lowlands, central Japan

Hideyoshi Yoshioka[1]; Mio Takeuchi[2]; Susumu Tanabe[3]; Mieko Uchiyama[4]; Hideyuki Tamaki[5]; Shunichiro Igari[2]; Susumu Sakata[6]

[1] GSJ,AIST; [2] AIST; [3] GSJ, AIST; [4] GSJ/AIST; [5] Advanced Industrial Science and Technology (AIST); [6] GREEN/AIST

Biogenic methane is widely found in the Earth's subsurface environment. Many natural gas deposits and methane hydrates contain biogenic methane and some studies estimated roughly 20% of the worldwide natural gas reservoirs are from microbial sources (Rice, 1992; Whiticar, 1994). So far, geochemical data, such as stable carbon isotopic compositions of methane and volume ratio of methane to ethane and propane, have been used to judge whether methane is biogenic or thermogenic. In spite of frequent occurrence of biogenic methane, methanogen or its methane production in subsurface environments remains unclear.

In the 1990's, researches by ODP (Ocean Drilling Programs) and IODP (Integrated Ocean Drilling Programs) have been focused on the biosphere in marine sediments and unearthed widespread biosphere in the deep environments (Parkes et al., 1994; Whitman et al., 1998). Some studies have successfully reported DNA of methanogen. But those are quite rare opportunities and their activities of methane production were very low. Few studies have successfully observed methanogen as active microbes in the sediments.

We examined a low-density layer in Holocene marine mud under the Nakagawa and Tokyo Lowlands, northeast of Tokyo, and discovered that biogenic methane and active methanogen in the layer. We analyzed sediment cores from two points, Souka city in Saitama Prefecture and Adachi ward in Tokyo. Core from Souka city includes 30-m Holocene marine sediment, which was accumulated in dissected valley in the Nakagawa Lowland. The core from the last point includes 20-m Holocene marine sediment, which was accumulate in terrene in the Tokyo Lowland. The two cores included the low-density layer, in which water content was over 30-40 wt%, and accumulated biogenic methane in the pore water. The low-density layer in the cores contained microbes in orders of 10^6 to 10^8 cells per gram of dry sediment and methanogen in orders of 10^4 to 10^5 cells per gram. Culture experiments indicated that the methanogen was active and produced methane gas. Depositional environments of the Holocene marine mud and type of organic matter in the sediments and hydrological environments would be essential factors to understand the distribution of methanogen and methanogensis in the sediments.