

Stable carbon isotopic compositions of methane in plumes: Tracers for microbial methane oxidation

Urumu Tsunogai[1]; Fumiko Nakagawa[1]

[1] Earth & Planetary Sci., Hokkaido Univ.

Dissociation of seafloor methane hydrate is one of the major sources of methane infiltrating into deep ocean. Methane gas bubbles liberated through dissociation of seafloor methane hydrate must rise rapidly until dissolution into seawater. They then spread out laterally along constant density surfaces to form lateral methane plumes, entraining large quantities of ambient seawater. Methane anomalies in lateral plumes, however, are mostly large enough to be used as tracers for huge dissociation of seafloor methane hydrate. Two different fates, however, can be expected for methane in plume: rapid microbial consumption around the source area or long-lived stability until emission into atmosphere. Finding key factors to determine relative strength of the two fates must be very important to evaluate the atmospheric impact through seafloor dissociation of methane hydrate in future/past.

One of the useful tracers to evaluate microbial methane-oxidizing activity in plumes is the stable carbon isotopic composition of methane. The content of vent-derived methane declines in seawater due to eddy diffusion (dilution) and to oxidation in seawater. By using an isotopic tracer, we can discriminate between these two effects; the tracer does not vary due to eddy diffusion (dilution), while aerobic methane oxidation consumes ^{12}C preferentially, leaving the residual methane enriched in ^{13}C . It has been shown in both field observations and laboratory microbial culture studies that the kinetic isotope effect (KIE) is around 1.005. By using this kinetic isotope effect, we can determine whether rapid microbial consumption is going on around the source area or not. In this report, we are going to present the way to use this tracer in actual observations of methane plumes in ocean.