Df-015 Room: C309 Time: June 8 14:45-15:00

Carbon isotopic distribution of methane in deep-sea hydrothermal plume, Myojin knoll caldera, Izu-Bonin arc

Urumu Tsunogai [1], Naohiro Yoshida [2], Junichiro Ishibashi [3], Toshitaka Gamo [4]

[1] Environ. Sci. & Tech., IGSSE, Tokyo Institute of Technology, [2] IGSSE, Tokyo Institute of Technology, [3] Dept. Earth and Planet. Sci., Kyushu Univ., [4] ORI, Univ. Tokyo

http://www.depe.titech.ac.jp/index.html

Concentration and stable carbon isotopic composition of methane have been measured for both seafloor hydrothermal fluids and effluent plume waters supplied from the vents at Myojin knoll caldera. Pure hydrothermal end-member show almost homogeneous concentration and carbon isotopic composition among vents, while those in the effluent plume exhibit vertically large variation. Assuming steady state emission from the vents, kinetic isotope effect due to the microbial oxidation (k12/k13), methane flux from the vents (F), heat flux from the vents (Q) and average turnover time of hydrothermal methane (T) are estimated to be k12/k13 = 1.005, F = 90 - 340 (mol/day), Q = 30 - 110 (MW) and T = 60 - 240 (days), respectively.

Concentration and stable carbon isotopic composition of methane have been measured for both seafloor hydrothermal venting fluids and effluent plume waters supplied from the vents at Myojin Knoll Caldera, Izu-Bonin arc, western north Pacific. Pure hydrothermal end-member show almost homogeneous concentration and stable carbon isotopic composition of methane among vents : 41.2 (umol/kg) and -16.3 (permil PDB), respectively, while those in the effluent plume stratified in the caldera and exhibit vertically large variation: 2.1 - 11 (nmol/kg) and -11.3 - -29.0 (permil PDB), respectively. Comparison of concentration and stable carbon isotopic composition data of both vent fluids and plume waters suggest that the methane is not conservative but microbially oxidized within the plume. Gradual decrease of diffusive methane flux in proportion to distance from the vent fields also suggests significant microbial oxidation within the plume. Assuming steady state emission of methane from the vents, (1) kinetic isotope effect due to the microbial oxidation (k12/k13), (2) methane flux from the vents (F), (3) heat flux from the vents (Q) and (4) average turnover time of hydrothermal methane (T) are estimated to be k12/k13 = 1.005, F = 90 - 340 (mol/day), Q = 30 - 110 (MW) and T = 60 - 240 (days), respectively. The distribution of turnover times, however, are heterogeneous within the plume. The turnover time of methane around the vents are one of the shortest value in pelagic ocean (less than 50 days), while those at the distant points are almost corresponds to that at usual deep ocean water.

The methane analyses were supported by the CREST project, Japan Sciecne and Technology Corporation.

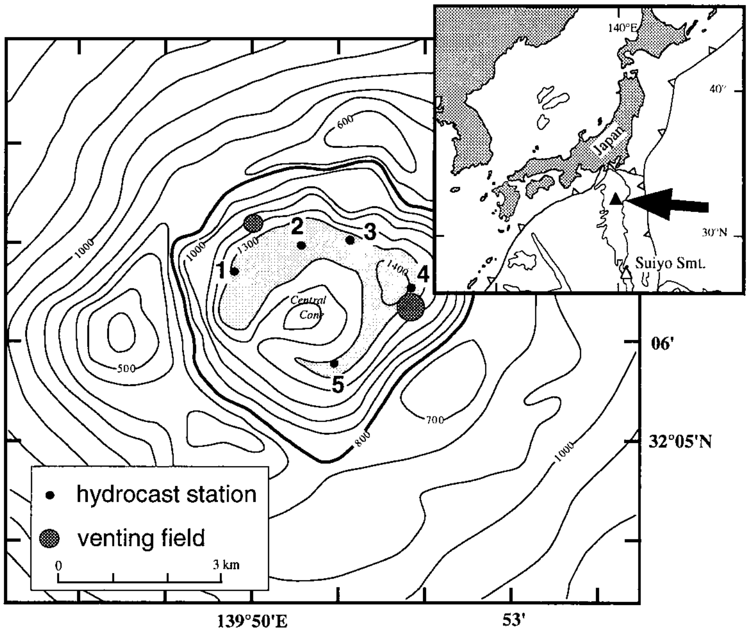

Fig. 1 Location and bottom topography of Myojin Knoll Caldera, together with the sampling stations of hydrocasts and the locations of hydrothermal venting fields within the caldera. Bold line in the topography indicate inner 800 m depth contour, which almost corresponds to the deepest rim of the caldera.

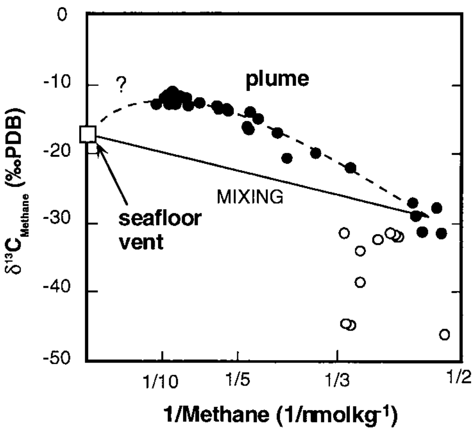

Fig. 2 δ^{13}C vs. 1/CH_4 plot for the effluent plume water samples (● for depth > 800 m and O for depth < 800 m). That of the estimated pure hydrothermal fluid is shown in □. The solid line indicates a hypothetical mixing line between the pure hydrothermal fluid end-member and background sea water around the depth of 800 m.

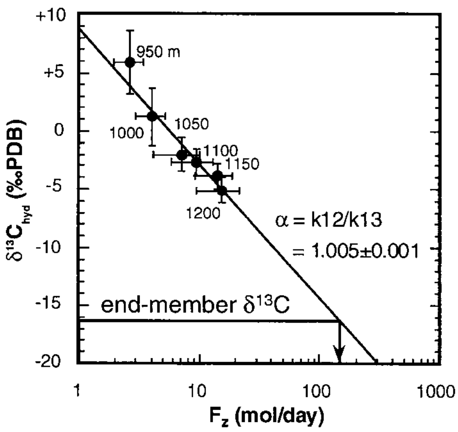

Fig. 3 Changes in diffusive methane flux (F_z) and stable carbon isotopic composition of vent-derived methane ($\delta^{13}C_{hyd}$) at each depth in the caldera.