Thermogenic hydrocarbon gasses in Mud Volcanoes at Kumano Basin

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1. Introduction

Recently, several mud volcanoes have been found in Kumano Basin (Kuramoto et al., 1998). Besides, on the summits of the mud volcanoes, cold seep biological communities have been found by the dives of SHINKAI 6500 in 1999 and 2000. They suggest the supply of methane gas or hydrogen sulfide from deep sediment. Mud volcanoes are surface expression of mud diapirs, which intruded through sedimentary column by high pressure in deep sediments. Many mud volcanoes have been reported at the subduction zones in the world. The Kumano Basin is also located in the northern part of the Middle Nankai Trough. It is important to know the origin of materials in the mud volcanoes for understanding the process to supply deeply buried materials at subduction zones. Here, we report the result of chemical analyses of pore water, mainly the concentration of methane and ethane and those stable carbon isotope ratios, in the mud volcano sediments that retrieved on three mud volcanoes by R/V Hakuho and R/V Kaiyo in 2000 and 2001.

2.Materials and methods

Two piston cores and four heat flow piston cores, taken by R/V Hakuho and R/V Kaiyo, respectively were used for chemical analyses of pore water; KMP-1 (33;40.60'N, 136;34.02'E), KMP-2 (33;36.54'N, 136;32.60'E), PH-2 (33;41.01'N, 136;33.42'E), PH-3 (33;43.98'N, 136;33.97'E) and PH-4 (33;41.08'N, 136;33.59'E). The core KMP-2 was retrieved at a distance of several miles from mud volcanoes as for reference core representing general sediments, and other cores retrieved on the summits of three mud volcanoes in the Kumano Basin. The retrieved cores on the summits were very short (1-2.5 m) and the lower part of the core were composed of low porosity sediments, because the deep consolidated sediments intruded just below the sea floor. The core KMP-1 and PH-2 contained several mud stone clasts larger than 1 cm in diameter. This suggests that these cores covered successfully the erupted sediments. The pore water was extracted on boards, R/V Hakuho and R/V Kaiyo. About 400-600 cm3 of sediments were taken at 10-50 cm interval from the cores, and pore water aliquots were squeezed from these sediments by oil hydraulic press. The concentration and stable carbon isotopic compositions of hydrocarbons were measured by using continuous flow isotope ratio monitoring-GC/MS.

3.Results and discussions

The concentration and carbon isotope ratio of methane at the shallow depth (shallower than 2 mbsf) in the reference core KMP-2 was 0.2-1 umol/kg and -60--70permil vs PDB, respectively. Those of ethane were under detection limit (under 0.01 umol/kg). The isotopic compositions and ethane concentration indicate that the methane in KMP-2 originated from usual bacteriogenic mediation processes in marginal marine sediments. On the other hand, both the concentration and carbon isotope ratio of methane in the sediment taken on the mud volcanoes were generally higher than those of the reference site, 0.2-22 umol/kg with d13C of -60--38permil. The concentration of ethane at the deeper part of these core was also high (0.01-4.1 umol/kg), and the ratio of methane to ethane (C1/C2) was smaller than 100. These results suggest that the thermogenic-originated hydrocarbons mixed in the bacteriogenic hydrocarbons. The existence of thermogenic hydrocarbons just under sea floor is an important evidence for the supplement of gasses from deep sedimentary column where the temperature is high (over 50 degree). Especially the carbon isotope ratios and C1/C2 in the core KMP-1 and PH-2 that penetrated into erupted sediment indicated very closed value of thermogenic hydrocarbons (-53--50permil, 16-23 and -46--38permil, 2-7). Based on these results, hydrocarbons of the thermal origin must be supplied on the summits of the mud volcanoes. The mud volcanism in the Kumano Basin may be a pathway into sea floor for deeply buried materials.