The distribution of atmospheric CH_4 concentration and gas plume location in the sea around Japanese islands.

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In previous studies, methane emissions from the seabed have been reported worldwide. The reports that methane reached the atmosphere are limited to some sea areas with shallow water depths in the Arctic Ocean. Most of the researches reported that methane does not reach the atmosphere in many other sea areas and is decomposed in the water column. However, a methane hydrate shell is formed on the surface of methane bubbles released from the seabed in the gas hydrate stability zone. The methane hydrate shell delays the dissolution of methane in the water column. Therefore, a system efficiently transports methane to a shallow location in the ocean. It is difficult to clarify the amount of methane carried by this transport system and it is pointed out that some methane may release into the atmosphere. As methane is one of the greenhouse gases like carbon dioxide, release to the atmosphere leads to an increase in atmospheric concentrations and can be a cause of climate change. On the other hand, if an increase in atmospheric concentration occurs, there is a possibility that it can help in searching the methane hydrate-bearing area from the observation with the artificial satellite. Our objectives were to investigate the influence of gas seep from the sea floor on atmospheric methane concentration. In this study, we performed continuous measurement of atmospheric methane concentration, observed gas plume and measured water temperature profile by CTD. The survey area is the Japan Sea (7 K 14 and 7 K 15 cruises) where the gas plumes were reported and the Pacific Ocean (MR 15 - 3, KH 16 - 3, KH 17 - 3 cruise) as the control area. The upper limit of the stable region of methane hydrate was estimated from the water temperature profile by CTD and the phase equilibrium curve of methane hydrate in seawater for each sea area. Atmospheric methane concentration observed in the Pacific Ocean at 1.9 ppm slightly higher than the average concentration of the whole earth. Atmospheric methane concentration observed around the Japanese islands was also the mode of 1.9 ppm, which was the highest in methane concentration (> 2.1 ppm) compared with other sea areas only in the Mogami trough and off Abashiri. As gas plume was observed in these two regions, it seems that capture the influence of the gas plume on the atmosphere. However, since the methane concentration observed in other gas plume sites (off Tokachi and off Hidaka) was almost unchanged from those in which no gas plume was observed, all gas plumes did not always influence atmospheric concentrations. A high methane concentration was observed only the surrounding of the gas plume at Mogami trough and off Abashiri. However, high concentrations are not always observed when passing through the same gas plume point, but different concentrations are observed depending on time. This is considered to be caused by the methane discharged from the sea floor is flowed by ocean currents and offshore winds, and the amount of methane discharged has changed. The upper limit of the gas hydrate stability estimated from the water temperature profile was slightly shallow in off Abashiri and Mogami trough. Heeschen et al. (2003) reported that the height of the gas plume coincided with the water depth at the upper limit of the gas hydrate stability, but the gas plume observed shallower than a depth of the upper limit off Abashiri. This results suggested that methane emitted from the seafloor reaches the atmosphere at not only the gas plume with shallow water depth but the gas plume with a shallow upper limit of the gas hydrate stability. This study was conducted under the commission from AIST as a part of the methane hydrate research project funded by METI (the Ministry of Economy, Trade, and Industry, Japan). We appreciate the support of the crew during 7K14, 7K15,

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