

Long-term temperature monitoring in cold seep site of a mud volcano, Kumano Basin

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Introduction

Mud volcano is a seafloor expression of a mud diapir derived from deep depth. In Kumano Basin, east of Kii Peninsula, there are several mud volcanoes. Some of these have been investigated using submersible and ROV and chemosynthetic biological communities, one of indicators of cold seepage activity, have been discovered. In May 2006, Shinkai 6500 dove to a small knoll, 1 km in diameter and 40 m in height from the seafloor, in the Kumano Basin and confirmed that this knoll is mud volcano. This mud volcano, named Kumano Knoll No.8, is the smallest one of the mud volcanoes that has been discovered in the Kumano Basin so far. The summit and the eastern part of the knoll were covered by mud and no chemosynthetic creature was visually observed there. On the other hand, carbonate rocks exposed on the western part of the knoll, where several chemosynthetic creatures were observed. Large chemosynthetic biological communities were discovered on the southwestern and northern margins of the knoll, suggesting the active cold seepages at the present time were concentrated there.

In order to investigate thermal and hydrological natures of the Kumano Knoll No.8, a long-term temperature monitoring system (LTMS) was deployed on the northern biological community area in May 2006 using Shinkai 6500. This system was recovered in August 2007 using HyperDolphin. During the dive of HyperDolphin, seven heat flow measurements were carried out on and around the knoll with a stand-alone heat flow meter (SAHF). In this presentation, we will report preliminary results of the long-term temperature monitoring and heat flow measurements.

Long-term temperature monitoring system (LTMS) and stand-alone heat flow meter (SAHF)

LTMS is composed of a data-logger (titanium pressure case including a circuit and a battery), two geothermal probes (Probe-1 and Probe-2) connected to the data-logger with cables, and a stainless frame to put it on the seafloor. Each probe is 76 cm in length and contains six thermistors at an interval of 10 cm. In this monitoring, Probe-2 was inserted into a bacterial mat. For reference, Probe-1 was penetrated into sediment with no signature of cold seepage.

SAHF is designed to manipulate heat flow measurements using submersible and ROV. In the pressure case, an electric circuit and a battery are contained and five thermistors situated within the probe at 11 cm intervals. In this study, five heat flow measurements were carried out in the margin, slope and summit areas. We also conducted heat flow measurements within and outside a bacterial mat in the northern part of the knoll.

Preliminary results

Previous studies of long-term temperature monitoring in the Kumano Basin observed temporal changes of subbottom temperatures associated with temporal variation of bottom-water temperatures. Subbottom temperatures measured in this study also show temporal variations associated with bottom-water temperature variation. To resolve a temperature signal associated with cold seepage, therefore, the effects of bottom-water temperature variation have to be removed. The preliminary results of the analyses indicated that subbottom temperature variations measured with Probe-1 (outside of bacterial mat) could be explained by a model assuming that the effects of bottom-water temperature variation propagated by conduction only. However, subbottom temperatures measured inside the bacterial mat (Probe-2) could not be explained by a heat conduction model, suggesting that cold seepage in the bacterial mat affected the subbottom temperatures.