Submission date 2013/04/16

Cruise Summary

1. Cruise Information

● Cruise ID: NT13-05

● Name of vessel: R/V Natsushima

● Title of the cruise: NT13-05 Research cruise of biodiversity, symbiosis, and iron/manganese oxide at hydrothermal vent sites in Izu-Bonin Arcs using ROV Hyper-dolphin 3000

● Chief scientist [Affiliation]: Shinji Tsuchida [JAMSTEC]

● Representative of the Science Party [Affiliation]: Shinji Tsuchida [JAMSTEC]

○ Title of proposal: Studies on biodiversity and early life history of vent associated animals in Izu, Bonin and Mariana Arcs.

● Representative of the Science Party [Affiliation]: Koji Inoue [Atmosphere and Ocean Research Institute, The University of Tokyo]

○ Title of proposal: Studies on the role of thiotaurine in symbiosis.

● Representative of the Science Party [Affiliation]: Akira Usui [Dept. Geology, Kochi University]

○ Title of proposal: Processes and Environments of Low-temperature Hydrothermal Iron and Manganese Deposits

● Cruise period: Mar 14-21 2013

● Ports of call: JAMSTEC

● Research area: Izu Islands Area and Sagami Bay

2. Overview of the Observation

● Overview of the observation

This cruise includes above three proposals explored the Sagami Bay for three dives, and Omurodashi for three dives, Myojin, and Bayonnaise Knolls for each one dive. Overviews of each proposals are described respectively.

"Studies on biodiversity and early life history of vent associated animals in Izu, Bonin and Mariana Arcs"

Shinji Tsuchida, Shuichi Shigeno (JAMSTEC), Tomoyuki Komai (Natural History Museum and Institute, Chiba), Hiroshi Miyake (Kitasato University), Kentaro Amemiya (Tokyo Sea Life Park), Jimin Lee (KIOST), and Toshiyuki Yamaguchi (Kanagawa University)

In the previous studies, vent associated communities were known from more than thirteen vent fields in Izu, Bonin to Mariana Arcs ranged from 350 to 1600m depths. In this cruise, a new vent associated community was found from the caldera of Omurodashi in 200m depth. This extended the known geological and vertical distribution of vent community in the Izu, Bonin and Mariana Arcs further 250km in north and the 150m in shallow. The faunal data set would be crucial to understand the biogeological distribution patterns and biodiversity.

In this exploration, three dives of Hyper-Dolphin were carried out along with the track lines of the HD#1408 & 1409, which found the active vent sites in this caldera at the first time. During the dives, we observed simmering and active venting (111°C at the highest) from the aperture on the gravel bottom in the northwest and central area of the caldera (Fig.1). Around the vents, limpets with the black shell and xenograpsid crabs inhabited on the gravel bottom. We, also, collected a small patch of tubeworms, palaemonid shrimp, small lancelets, small mussels, and so on. We will analyze the community structure comparing with other vent fauna in the Izu, Bonin, and Mariana Arcs. Ecological traits such as early life history, growth, reproduction, etc. on the xenograpsid crabs will be studied.

“Studies on the role of thiotaurine in symbiosis”

Koji Inoue, Toshihiro Nagasaki (Atmosphere and Ocean Research Institute, The University of Tokyo), Yuya Makiguchi, Kazuki Tsuzawa, Tomoko Koito (College of Biosciences and Resources, Nihon University), and Suguru Nemoto (Enoshima marine corporation)

It has been suggested that *Bathymodiolin* mussels store sulfides as thiotaurine, a safe substance generated by the reaction of hypotaurine and sulfides. It is also presumed that sulfides released from thiotaurine by the reverse reaction are supplied to symbionts. However, this hypothesis has not been proved experimentally.

In this study, we examine whether thiotaurine can in fact be the source of sulfide for the chemosynthesis of the symbiont by injecting it into the mussels and comparing the amount of symbiotic bacteria with the control group. In addition, we try to identify the hypotaurine synthesis pathway by injecting possible precursors such as cysteine to the mussels. Moreover, we try to test the reaction of the heart movement when the mussels are exposed to sulfide by electrocardiography (ECG).

In this cruise, we sampled the mussel *Bathymodiolus septemdierum* at Myojin Knoll in Izu-Bonin Area. Using the mussels, we tried to establish the method of injection into the mussels, and injected thiotaurine into some mussels during the cruise (Fig. 2). We will repeat the injection several times after the cruise and compare the amount of the symbionts by quantitative real-time PCR. We also collected mussels from three different colonies, where we also measured sulfide level and temperature using sensors. We dissected the mussels immediately after the dive. We will examine the correlation between environmental factors and the expression level of genes involved in hypotaurine accumulation. Moreover, some live mussels will be reared in The University of Tokyo (UT), and Enoshima Aquarium and used for the examination of hypotaurine synthesis pathway in UT, ECG measurement in Nihon University, and some other experiments.

"Processes and Environments of Low-temperature Hydrothermal Iron and Manganese Deposits"

Akira Usui, Kei Okamura (Kochi University), Shota Nitahara (Tokyo University of Pharmacy and Life Science), Hikari Hino (Kochi University)

We dove with the Hyper-Dolphin 3K installed with multi-chemical sensors, continuous water sampler, and on-site thermometer at a small peak of the Myojin Knoll, where possible low-temperature hydrothermal mineralization has been inferred and the two small traps were settled on the sea floor in 2001 for a long-year exposure experiment at a low-temperature hydrothermal vent area. This dive #HPD1494 was a very lucky and memorable moment when we finally found and retrieved the long-lived traps after only one-hour search at the site after 12-year exposure (Fig. 3).

The sampled rocks and manganese oxide deposits suggest a probable modern hydrothermal activity which forms wide-spread deposition of manganese oxides around the area.

We will analyze the recovered rocks, sediments, sea water, and the measured physicochemical parameters during the dive. The Fe-Mn deposits will be mineralogically and geochemically described, the waters be analyzed for chemical components, and one-site physicochemical data will be analyzed in terms of modern hydrothermal activity. The sediments and sea waters will be studied with molecular biology techniques (ex. DNA analysis) and microstructure of microbial activity. We inoculated the samples into media for ammonia oxidizing bacteria and Mn oxidizing bacteria. Our goal is to chracterize the microbial community on hydrothermal and hydrogenetic manganese deposits. We will have to revisit the area with ROV or subs to conclude the possible modern hydrothermal activity.