

## **Cruise Summery**

### **1. Cruise information**

- Cruise Number: YK10-10
- Ship name: Yokosuka
- Title of cruise: Shinkai6500 Exploration and OBS/OBEM deployment cruise in the Southern Mariana Trough
- Chief Scientist: Junichi Miyazaki (SUGAR project, Japan agency for marine-earth science and technology (JAMSTEC))
- Title of proposal 1: Are there HyperSLiME in the subseafloor on basaltic hydrothermal field? Direct verification of subseafloor microbial ecosystem utilizing high temperature torelance biosampler.
- Title of proposal 2: Southern Mariana Trough back-arc spreading system with three different hydrothermal activities
- Science Party: Junichi Miyazaki, Tomoo Watsuji, Hiroko Makita (SUGAR project, JAMSTEC), Kentaro Nakamura (PEL, JAMSTEC), Tomohiro Toki, Miki Tawata (University of Ryukyus), Shingo Kato (Tokyo University of Pharmacy and Life Science), Nobukazu Seama, Maho Kimura, Yuki Shibata (Kobe University), Toshinori Sato, Mariko Mizuno (Chiba University), Takehi Isse (The University of Tokyo), Satoshi Okada (Nippon Marine Enterprises)
- Cruise period: 17 August, 2010 ~ 31 August, 2010
- Port call: JAMSTEC (17 August, 2010) ~ Guam (31 August, 2010)
- Research Area: Mariana trough

### **2. Overview of observation (Title of proposal 1)**

- Purposes: The primary scientific objective of this research project is to clarify whether there is HyperSLiME (Hyperthermophilic Subsurface Lithoautotrophic Microbial Ecosystem) in the subseafloor at Archaean site which is the basaltic hydrothermal field on Southern Mariana Trough. To obtain the direct evidence of the question, we tried to deploy the high temperature tolerated in situ colonization system into the vent.
- Backgrounds: In the DSV Shinkai 6500 dive #903 in YK05-09 Leg2, about 7-m height chimney structure was found around the 6k Marker #12. From the top of the chimney, black smoker (343°C) was erupted. On the other hand, from the foot of this chimney, clear smoker (117°C) was shimmered. Previous study shows that methane concentration of the clear smoker was 8 times higher than that of black smoker and the carbon isotopic ratio of methane of the clear smoker vent fluid in Archaean site

was much lighter than that of the black smoker fluid. And also hydrogen concentration of clear smoker was slightly higher than that of Black smoker. Moreover carbon dioxide concentration of the clear smoker was slightly lower than that of black smoker. The vent distance between two smokers was almost 2 m. These results suggested that there is the subvent biosphere supported by methanogen (HyperSLiME) around the clear smoker stream. However, mother-rock of the Archaean hydrothermal fields is basalt. It is generally that these basaltic hydrothermal activities do not generate the enough amount of hydrogen to maintain methanogenic activity. To investigate subvent biosphere in Archaean site, BMS (Boring machine system) cruise was conducted at in this June. We had a chance to directly investigate subvent biosphere, because in YK10-10 cruise, we deployed the pressure-tightly *in situ* colonization (Miyazaki's Bio Sampler) in the borehole. It is expected that binding core study and post-drilling study would have gratefully led us to understand subvent biosphere. However, boring at Archaean site was failed, so we cannot conduct this plan. To accomplish the primary objective, we deployed the Miyazaki's Bio Sampler directly in the vents. Miyazaki's short Bio Sampler is a product of Kandata project which is a post-drilling project and which has been supported by JAMSTEC AWARDS for "Obsebing system research and technological development". The goal of this project is an innovation of tools for post-drilling. The project has two rules. One is that this Kandata system must be conducted only by ROV, although many of post drilling research required a large drilling ship to access bore hole. Another feature is that this Kandata system required a tight system to prevent contaminations from seawater. Because these contaminations cause the error for detecting lower microbial population in subvent biosphere. Now in this project, we developed the tools with high-temperature tolerance. In this YK10-10 cruise, we will test the high-temperature tolerance of Bio sampler to capture microbes in the subvent biosphere under the clear smoker vents.

- Methods & Instruments: WHATS (Water and Hydrothermal-fluid Atsuryoku Tight Sampler), Bag Sampler, Niskin Sampler, Succsion sampler, high-temperature torrelance *in situ* colonization system, Hooking *in situ* colonization system), M-type sampler
- Research results: We conducted 6 Shinkai 6500 dives and we successfully deployed 4 *in situ* colonization systems (ISCS) into the vent or casing-inserted borehole to detect subsurface microbial ecosystem. These ISCSs will be recovered in YK10-13 Leg1 cruise at this October. And also we obtained very valuable samples to analyze microbial ecosystem, fluid chemistry, and rock composition. Finally, we discovered new hydrothermal field at north of Pika site. This discovery was predicted by AUV Urashima's data obtained from YK09-08 cruise. And also this discovery showed that survey by Urashima could become the efficient method for discovering hydrothermal fields. We propose the name of the newly discovered hydrothermal field as Urashima site.

### **3. Overview of observation (Title of proposal 2)**

We successfully deployed 11 OBEMs and 15 OBSs across the Southern Mariana Trough back-arc spreading system. We started our observation; the measurement of magnetic and electric field variations by OBEMs and seismic observation by OBSs at the ocean bottom. The observation continues up to the recovery of OBEM and OBS during another Yokosuka cruise in this November. Further, we conducted surface geophysical survey to collect multi-narrow beam bathymetry, magnetic field, and gravity field data mainly during night time, which cover total 1040 miles in the survey area. These observed data will be used to provide geophysical constraint on geodynamics of the Southern Mariana Trough back-arc spreading system with three different hydrothermal activities. The observed data will be analyzed to derive upper mantle structure, crustal structure, hypocenter distribution, and tectonic history, which will provide important constraint on geodynamics of the Southern Mariana Trough back-arc spreading system with three different hydrothermal activities.