Hyper-Dolphin/Natsushima

Cruise Summary

NT 10-13 Leg.2

NW Rota, NW Eifuku, Nikko Seamounts

Mariana Fore Arc

July 25, Guam

– August 8, JAMSTEC

Chief Scientist:

Shinji Tsuchida (JAMSTEC)

&

Proponent:

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Taro Nakagawa (Hosei University)

“Studies on the life history of hydrothermal vent communities distributed to Izu-Bonin and Mariana Arcs”

Shinji Tsuchida

Deep-sea volcanic chains extend from Mariana Arc (12°N) in south to Izu and Bonin Arcs (32°N) in north. In these areas, hydrothermal vent fields and vent-associated communities were found at several deep-sea volcanoes around 400-1600m depths (Fig. 1). Dominant species and biomass of these sites are different each other, but some species are common in each site like as bythograeid crab, alvinocaridid shrimps, limpets, bathymodiolid mussels, and so on. However hydrothermal venting is known from E Diamante and NW Rota-1 in South Mariana Arc, still species composition and faunas in those sites are poorly understood. Also faunas in Mariana Back-Arc Basin as Alice Spring Fields are known to be quite different from those in North Mariana Fore Arc in spite of close geological distance. It is considered that the distributions of vent-associated animals would be correlated to the environmental factors like as current, temperature, chemical components, and so on, rather than those geological distances. Our knowledge for the larval stages of those animals is quite limited because of its difficult sampling from the fields. Here, we examined to reveal the detailed distributions of vent-associated animals. And, I will try to keep the matured adults such as bythograeid crabs and alvinocaridid shrimps, which are relatively easy to rear under the laboratory atmospheric conditions for breeding the larvae. I will seek the suitable conditions as salinity and temperature for growth of these larvae. Finally, I will estimate the larval dispersals between hydrothermal vent fields in Izu-Bonin and Mariana Arcs.

Methods

Two dives for this proposal were carried out at the NW Rota-1 and East Nikko Seamounts respectively. HDTV and CCD cameras recorded the movies of distributions and habitats of animals. Digital camera was used to take high quality still photos of animals and habitats. Specimens were collected using by suction sampler loaded on the *Hyper-Dolphin*. Plumes were sampled by Niskin and RI vacuum sampler. Hydrothermal vent fluids were sampled by WHATS and bag sampler. Environment conditions were measured using by pH sensor, turbidity meter, D-port (hydrogen sulfide meter), DO meter, and CTD/DO profiler.

Preliminary results

NW Rota-1 is known as one of most eruptive deep-sea volcano by the previous geological surveys. Around the top of the seamount was covered by sand and gravel with dense patch of the alvinocaridid shrimp, *Opaepele loihi*. And also, scale worms and limpets were found. Only one bythograeid crab *Gandalfus yunohana* was collected.

East Nikko Seamount is a different peak located at seven kirometer in north-east from the main peak of Nikko Seamount. Previous NOAA survey detected a week signal of plume suggesting the active hydrothermalism in this peak. In this survey, we found no active hydrothermal venting, but just faint simmering on the bottom. While, we collected some rare non-vent species such as Polychelid lobster, deep-sea stomatopod, leucosiid, majid and progeryonid crabs which are new records for seamount faunas.

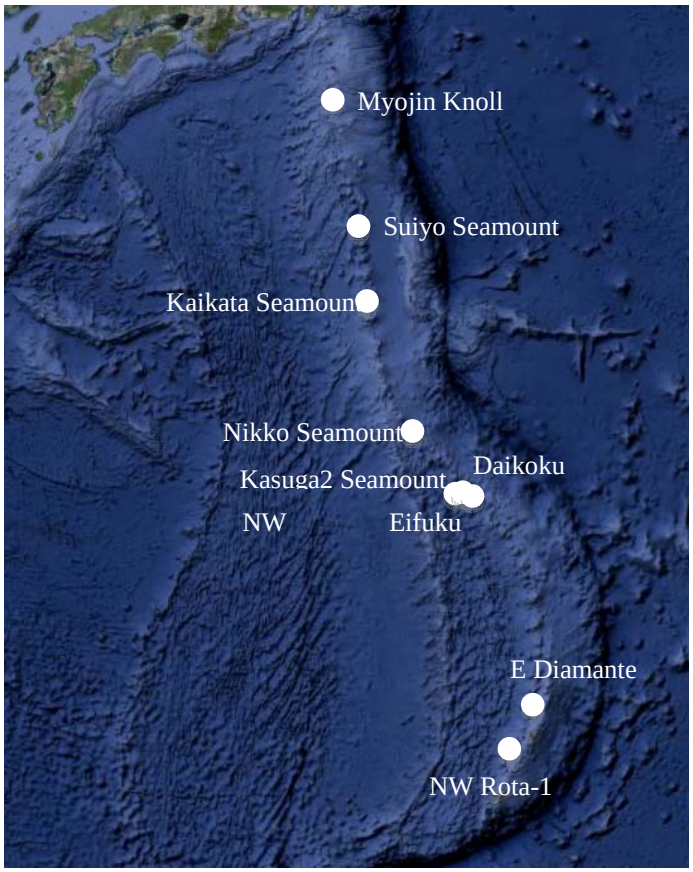

Fig. 1 Distribution map of hydrothermal vents in Izu-Bonin, and Mariana Arcs.

“Research for microbial interaction with iron provided from subseafloor hydrothermal aquifer in the NW Eifuku Seamount of the northern Mariana Arc: Microbial ecosystem sustained by weathering of iron-containing fluids and rocks and biogeochemical interaction with abundant magmatic volatiles.”

by Hiroko Makita

Purpose and Background:

Our objective is to research microbial interactions with iron provided from subseafloor hydrothermal aquifer in the northern Mariana Arc. Two dives are planned to visit at NW Eifuku seamount and to obtain rocks, iron mat and fluid samples to examine the associations between endlithic microorganisms and rock alteration processes at deep-sea hydrothermal fields. During the Ring of Fire cruise 2004 by using *ROV ROPOS*, massive yellow-orange mats were observed at the summit and western ridge of the NW Eifuku Seamount (Embley, *et al*., 2004). The iron mat samples were soft and fluffy texture, and were probably composed of amorphous silica and iron hydroxides (Embley, *et al*., 2004, Nakamura, *et al*., 2005). There is no doubt that the mat consists of iron-utilizing biosphere. In recent years, culture –depend and –independent microbiological characterization has demonstrated that the zeta-proteobacteria “*Mariprofundus ferrooxidans*” (Emerson D., *et al*., 2007), which utilizing ferrous iron choemolithoautotrophic microorganism, commonly observed in some deep-sea low-temperature hydrothermal fields; rocks alteration regions and iron mat site (Davis and Moyer, 2008, Kato *et al*., 2009). This kind of iron utilizing chemolithoautotroph microorganisms has the most significant ecological roles, such as iron and carbon cycling, in microbial communities occurring in deep-sea low-temperature hydrothermal field (Bach *et al*., 2003). However, little is known about these iron-utilizing chemolithomicroorganisms, how many types existing, what is dominant species in each site, what exactly do they role in natural habitats, and how do they interact with other microorganisms and rocks. Objectives of our microbiological studies include, 1) the evaluation of microbial diversity and distribution, 2) the measurement of microbial activity by using cultivation-, enzymatic-, DNA and RNA approaches, and metabolic product analysis. Results of the analyses will provide insights into contribution of microorganisms to alteration of oceanic rocks, and iron utilizing microorganism’s diversity. In addition, during each dive the transmissivity of water had been measured and pH sensor and electrochemical analyzing system (D-Pote2) were tested.

References

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・ Davis R.E. and Moyer C.L. (2008) Extreme spatial and temporal variability of hydrothermal microbial mat communities along the Mariana Island Arc and southern

Mariana back-arc system. *Journal of Geophysical Research*. 113, Bo8S15, doi:10.1029/2007JB005413
- Embley R.W. Chief Scientist, Cruise Report of Submarine Ring of Fire 2004: Mariana Arc Expedition. R/V *Thomas G. Thompson* Cruise TN167, ROPOS dives R782-R795. March 30 - April 15, 2004
- Emerson D., *et al*., (2007) A novel lineage of proteobacteria involved in formation of marine fe-oxidizing microbial mat communities. *PLoS One*, 1: e667
- Kato S., *et al*., (2009) Microbial communities in iron-silica-rich microbial mats at deep-sea hydrothermal fields of the Southern Mariana Trough. *Environmental Microbiology*, Epub ahead of print.
- Nakamura K. Chief Scientist, NT05-18 Cruise Report of research for northern Mariana arc volcanoes. R/V *Natsushima and* ROV Hyper-Dolphin. October 22 - November 08, 2005

Methods and Instruments:

For accomplish the purpose, we sampled seawater (Niskin bottle, bag pump sampler, RI bottle sampler and WHATS with temperature probe), sediments (M-type, SUDO-type and Ekman-Birge type sediment sampler), rocks and organisms (bivalve, shrimp, etc. with suction sampler). In addition, during each dive the transmissivity of water had been measured and pH and D-POTE2 sensors were tested.

Research results:

We have collected iron mat, rocks, fluid samples and some chemical data during NT10-13 Leg2. Samples were onboard prepared for future studies. Results of the analyses will provide insights into contribution of microorganisms to alteration of oceanic rocks, and iron utilizing microorganism’s activity and diversity.

Objectives of our microbiological studies include, 1) the evaluation of microbial diversity and distribution by using DNA and RNA approaches (e.g. 16S rRNA gene analysis), Fluorescence in situ hybridization (FISH), quantitative polymerase chain reaction (Q-PCR) and T-RFLP analysis, 2) the measurement of microbial activity by using cultivation-, enzymatic-, DNA and RNA approaches, and metabolic product analysis.

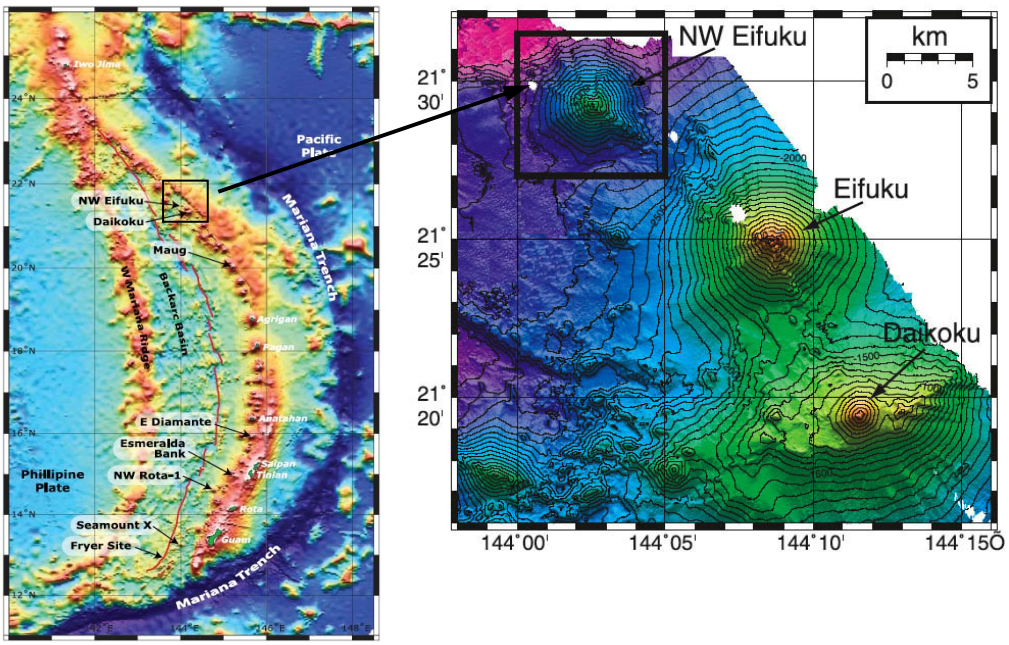


Fig.1 Research area

Study on the relationship between structure and function of the extracellular giant hemoglobins of *Lamellibrachia satsuma* (vestimentifera, annelid)

by Taro Nakagawa

Overview of the observation

1) Background and Purpose

Nikko seamount located in between the south Izu-Bonin arc and the north Mariana fore-arc, is the circular conic submarine volcano at the relative elevation of about 2900 m. There are many hydrothermal vents with low or medium temperature in the caldera on the mountaintop. This area formed into the large greatest hydrothermal-vent community in the world, which lived in the vent specific animals of the tubeworm, crab, shrimp, tongue fish, and mussel, etc. It has been reported that these hydrothermal vent animals could generally possess the toxic resistances of hydrogen sulfide and heavy metals, and could utilize the symbiotic bacterium for acquisition of organic substance, but it is still unclear to understand them biologically. So, we tried to research the vent-specific animals and plankton living in the hydrothermal vent and plume by observation and collection, the measurements of environmental factors (water, med, rock, soil, temperature, DO, pH and H_2S) , and placing (picking up) the sponge agar mediums and beef bones in the Nikko seamount.
Predominately the tubeworm in the spotlight, we performed the research with the views to clarification of the relationship between structure and function of the extracellular giant hemoglobins and lectins in the blood of the tubeworm, and to biological understanding of the adaptive physiology, symbiontic relationship, and life history of the tubeworm by captive breeding.

2) Research themes

・#1163, #1164, #1169: Collection of the vent-specific organisms and environment research in the hydrothermal vent of Nikko seamount.
・#1168: Collection of the planktons in the plume layer and the vent-specific organisms in the hydrothermal vent of Nikko seamount.

3) Date of operations

July. 30 (#1163, #1164), August. 3 (#1168), and August. 4 (#1169)

3) Instruments for collection

・Slurp gun, square canister, rotary canister with or without 6 bottles, plankton net, three gate sampler, Niskin water sampler, Bag-type water sampler, RI pressure-keeping water sampler, M-type bottom sampler, and Sample box

4) Instruments for measurement

・D-Pote, pH sensor, DO sensor, and RMT thermometer

5) Instruments for placing and picking up

・Sponge agar mediums (1163-1, 1163-2, 1163-3, 1163-4, 1163-5, and 1163-6), and Flame boxes containing beef bones (FL-101, FL-102, FL-103, and FL-104)

6) Research results

We succeeded in collection and observation many hydrothermal-vent animals and communities which are tubeworm, crab, shrimp, tongue fish, mussel, hermit crab, starfish, sipunculid, and annelids, near the hydrothermal vents on Nikko seamount through the 4 dives of Hyper-Dolphin in this research. These animals obtained were all classified on board a ship, and soon implemented appropriate measures for captive breeding, sampling, and experimental sample preparation. We also succeeded in obtaining many environmental information from the measurements which are water sampling, mud sampling, temperature, dissolved oxygen concentration, pH, and sulfide concentration, inside or near the tubeworm habitat and hydrothermal vents on Nikko seamount. And we performed the placing and picking up the sponge agar mediums for bacteria cultivation, and setting on the flame boxes containing beef bones for putting down roots of the tubeworm around the their colony. Moreover, we collected the plankton and larva of the hydrothermal-vent animals in the hydrothermal plume with foggy white smokes from 380 m to 450 m depth above the bottom, and performed their observation and breeding on board a ship. We found that the foggy white plume emerged from many hydrothermal vents in Nikko seamount, were mixed and arrived at 380 m depth above the mountaintop, and formed to the large plume layer with white smoke. These results will provide insights into the biological understanding of the adaptive physiology, symbiontic relationship, and life history of the vent-specific animals living in the hydrothermal environment on Nikko seamount.

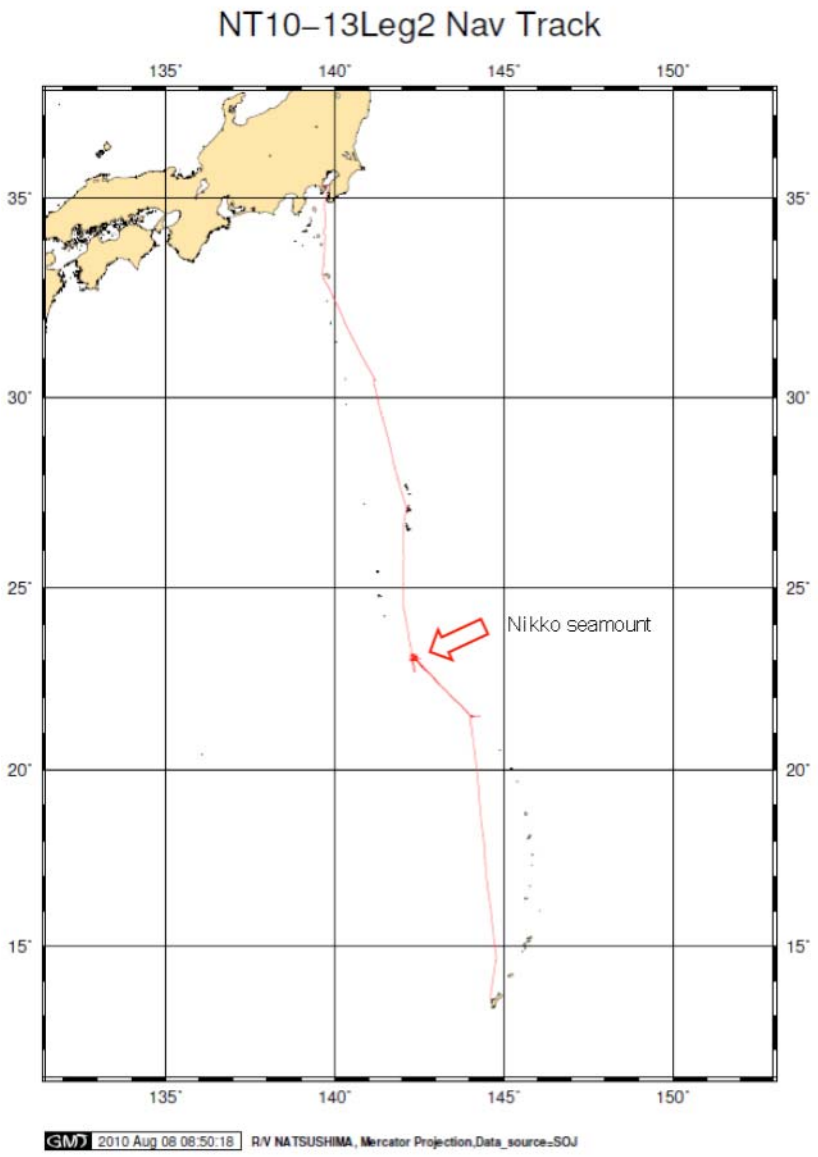
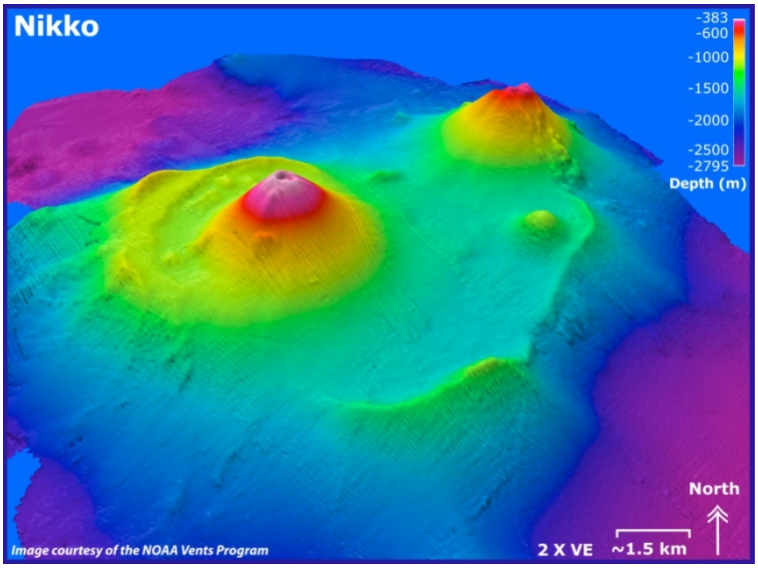

NT10–13Leg2 Nav Track
135°
140°
145°
150°
35°
30°
25°
20°
15°
Nikko seamount
GMT 2010 Aug 08 08:50:18
R/V NATSUSHIMA, Mercator Projection,Data_source=SOJ

Fig.1


Nikko
-383
-600
-1000
-1500
-2000
-2500
-2795
Depth (m)
North
Image courtesy of the NOAA Vents Program
2 X VE
~1.5 km

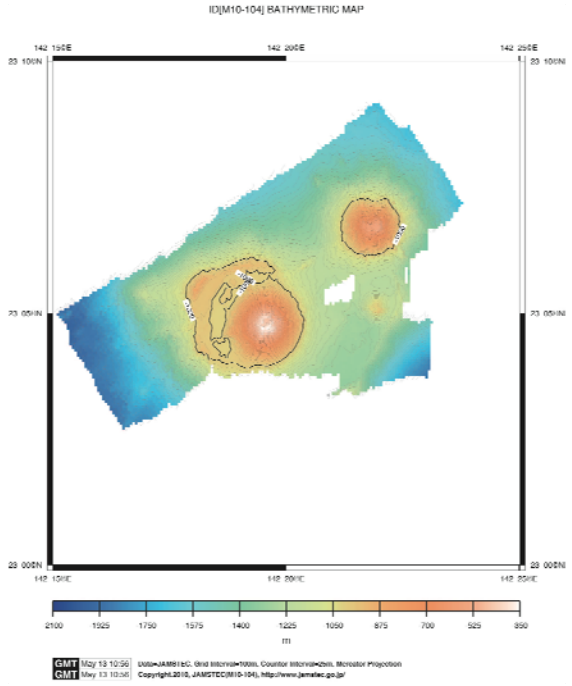

ID[M10-104] BATHYMETRIC MAP
142 15'0E
142 20'0E
142 25'0E
23 10'0N
23 05'0N
23 00'0N
2100
1925
1750
1575
1400
1225
1050
875
700
525
350
m

Fig. 2