Cruise Summary

1. Cruise Information

Cruise ID: NT12-24

Name of vessel: R/V Natsushima

Title of the cruise: Exploration of iron-based microbial ecosystems at hydrothermal vent sites in the Southern Mariana Trough

Chief scientist: Kentaro Nakamura [JAMSTEC]

Representative of the Science Party:

Kentaro Nakamura [JAMSTEC]

Shingo Kato [RIKEN]

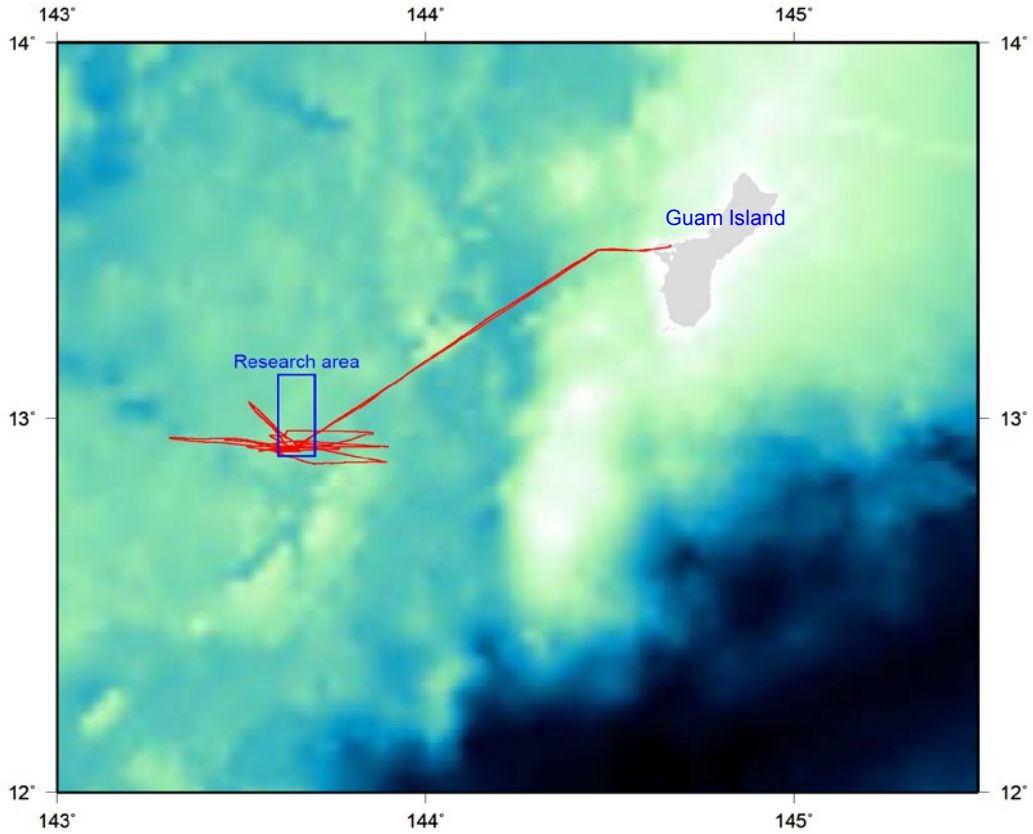
Cruise period: 14 September, 2012~22 September, 2012

Ports of call: Apra port, Guam

Research area: Southern Mariana Trough

Research map:

Navigation track of NT12-24



2. Overview of the observation

The purpose of this cruse is to clarify chemical linkage between iron-oxidizing microbial activity and host vent fluids in the Urashima and Snail hydrothermal vent site at the Southern Mariana Trough (SMT). The iron-oxidizing microbial communities in deep-sea hydrothermal sites are so far observed at Loihi seamount of Hawaii, Lilliput hydrothermal vent site in the Mid-Atlantic Ridge, and Tarama seamount in the Southern Okinawa Trough, as well as Snail and Urashima hydrothermal vent sites in the SMT. Previous studies on the hydrothermal sites hosting iron-oxidizing bacterial communities have revealed that these sites are low-temperature hydrothermal vent sites where high-temperature end-member fluids can not be obtained. For the reason, sub-seafloor hydrothermal (geochemical) processes controlling the presence of iron-oxidizing bacteria have not been well understood. The two hydrothermal vent sites at the SMT, Snail and Urashima sites, are among the best place to study geochemical linkage between hydrothermal fluids and iron-oxidizing microbial activity due to the following reasons: (1) the Urashima site is the only site where both iron-oxidizing bacterial activity and high-temperature fluid venting have been observed, and (2) there are two drilled boreholes in Snail site, which allow us to approach directly iron-oxidizing bacterial communities below the seafloor. In the NT12-24 cruise, therefore, we have conducted 7 ROV (Hyper Dolphin: HPD) dives at the two hydrothermal vent sites, and successfully obtained the following results.

In the Urashima hydrothermal vent site, we conducted 6 HPD dives. During the dives, we sampled 4 black smoker fluids, 1 white smoker fluid, 4 clear shimmering fluids, and 4 iron-mat fluids. Maximum temperature of the fluids were 271 ºC for black smoker fluids, 243 ºC for white smoker fluid, 160 ºC for clear shimmering fluids, and 53 ºC for iron-mat fluids. We also sampled active chimney fragments, iron-mat samples, as well as inactive chimney fragments. All of the samples were collected from the newly discovered vents in the Urashima hydrothermal site.

In the Snail hydrothermal vent site, we conducted 1 HPD dive. During the dive, we sampled 1 hydrothermal fluid from a borehole and 1 shimmering fluid from an iron-mat mound. Maximum temperature of the fluids was 46 ºC for borehole fluid or 52 ºC for iron-mat fluid. We also sampled 2 iron-mat and 2 inactive-chimney samples. Furthermore, we recovered two in-situ colonization systems from the boreholes, which were set in Oct 2010. We succeeded in setting of Yamanaka-type in-situ pore water extraction system on a hydrothermal mound covered with iron mats and recovering it.

Except for a few fluid chemistry data, chemical analyses and microbiological studies on the fluid and chimney samples will be conducted on shore. The results of the shore-based studies will provide important insights into biogeochemical linkage between iron-oxidizing microbial activity and chemical compositions of hydrothermal fluids.