

Cruise Summary

1. Cruise Information

Cruise ID: KY14-01

Name of vessel: Kaiyo

Title of the cruise: Post-drilling investigation of hydrothermal activities and ecosystem in Iheya North field and exploration of hydrothermal activities in the Iheya North Knoll

Chief scientist [Affiliation]: Ken Takai [JAMSTEC]

Representative of the Science Party [Affiliation] : Ken Takai [JAMSTEC]

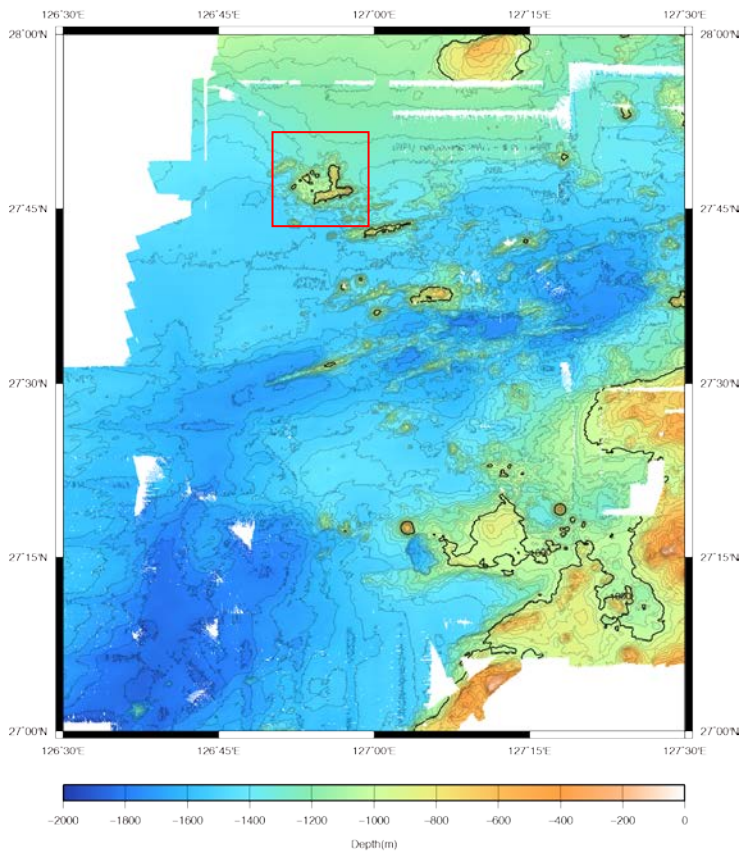
Title of proposal: Post-drilling investigation of hydrothermal activities and ecosystem in Iheya North field and exploration of hydrothermal activities in the Iheya North Knoll

Cruise period: January 8th, 2014 ~ January 31st, 2014

Ports of call: Yokohama ~ Naha

Research area: Mid Okinawa Trough

Research map



2. Overview of the Observation

In KY14-01 cruise, we have totally conducted 11 dives of HyperDolphin in three different hydrothermal vent sites including newly discovered two sites in the Iheya North Knoll, Mid Okinawa Trough. In the first half of this cruise, we encountered quite bad sea conditions and thus, we conducted only two dives. In the first half, we planned to conduct the complete mapping of seafloor hydrothermal events in the Iheya North field, which had been highly affected by scientific drilling operations of Chikyu in September, 2010, using SeaXeroxs and Serpent Camera. Only one but exceptionally long dive of hyperDolphin, the SeaXeroxs and Serpent Camera surveys covered major hydrothermal event area, for example, huge hydrothermal mound area (NBC, SBC, ESBC, CBC, C0016B artificial hydrothermal vent and E18 vent), newly created hydrothermal vents and diffuse area (C0014G artificial hydrothermal vent) and diffusing flow area (C0013E artificial hydrothermal vent). These detail seafloor mapping will provide not only post-drilling impact on the whole landscape of the Iheya North field but also the world's first quantitative estimation of biomass and migration-colonization pattern shifts in the macrofaunal components in the vent-endemic chemosynthetic ecosystem that have responded to episodic environmental change events.

During the dive surveys in the Iheya North field in this cruise, I (Ken Takai) found that NBC mound structure and landscape had been considerably changed since the drilling operation. In two years after the drilling operation, high temperature hydrothermal fluid discharge was quite focused at the newly created vent (C0016A) and rapid growing big chimney was outstanding. However, during this cruise, more than three years later, the hydrothermal discharge from C0016A vent became weak. Instead, many diffusing flows and their total fluxes were highly increased from middle parts of NBC close to top of the mound. According to the increased side discharge flows, lots vent-endemic faunal communities increased their populations in the middle parts. This was an important observation of NBC mound structure and landscape that should be recorded at this stage.

In this cruise, we have established state-of-art in situ chemical measurements using Unisense multichemical sensors, particularly to characterize physical and chemical conditions of zonation of macrofaunal populations. We tested H₂, H₂S, DO and N₂O concentration sensors this time and will develop CH₄ concentration sensor next. Although operation and manipulation of sensors were still to be developed, the obtained data seemed to be excellent. We certainly detected tiny but clear difference of chemical environments of different representative fauna such as *Paralvinella*, *Shinkaia* and *Bathymodiolus*. The in situ chemical conditions were quite important to estimate their metabolic activities and rates of energy and carbon species derived from the hydrothermal fluid inputs. In addition, we conducted lots of onboard metabolic experiments of representative faunal species and chimney structures.

The most outstanding achievement during this cruise is discovery of two new hydrothermal vent fields in

the Iheya North Knoll other than the Iheya North field (Iheya North Original field). Since November 2013, JAMSTEC Submarine Hydrothermal System Research Team had conducted the exploration of systematic submarine hydrothermal activities in the Mid Okinawa Trough by means of next generation surveys called as HOT EXPRESS (Hydrothermalisms in Okinawa Trough Exploration by Polyphasic Research Survey). R/V Natsushima, R/V Yokosuka and AUV Urashima had detected quite solid visualized signals of hydrothermal activities several km south from the Iheya North Original field. The detail topographic mapping also identified possible hydrothermal mounds and chemical sensors indicated the hydrothermal plumes at around the signature positions. Based on these survey data, we conducted three dives of HyperDolphin at the most likely area in the southern parts of the Iheya North Knoll. Without any hesitation, we successfully found high-temperature hydrothermal fluid vents, hydrothermal mounds, widespread faunal communities, and seafloor hydrothermal deposits in the two candidate fields. The hydrothermal fluids of the two new fields (Iheya North Natsu field and Iheya North Aki field) seemed to be physically and chemically similar to those of the Iheya North Original field, and the faunal compositions quite resembled each other. These three hydrothermal fields likely had common sunseafloor hydrothermal fluid sources such as subseafloor hydrothermal fluid reservoir and whole hydrothermal fluid flow paths. This implied that Iheya North Original, Natsu and Aki fields comprised one gigantic hydrothermal system (>3 km horizontal extension at the seafloor events). The spatial magnitude was the largest among the hydrothermal systems ever found in the Okinawa Trough. More importantly, these two new hydrothermal fields were realistically surveyed, discovered and explored in 4.5 days totally. Our HOT EXPRESS scheme was a revolutionary method to uncover the previously unknown hydrothermal systems in the Okinawa Trough.