

- Cruise number: NT08-17 Leg1 & Leg2
- Ship name: Natsushima, Hyper-Dorphan
- Title of the cruise: ROV Hyper Dolphin research dive, deep sea research, FY2008
- Chief Scientist Kaoru Kubokawa
[Ocean Research Institute, University of Tokyo]
- Representative of Science Party
 - (1)Kaoru Kubokawa [ORI, Univ. of Tokyo]
Evolution of chordates: Studies on physiological mechanisms of the chordates in hydrogen sulfide-rich environment
 - (2)Toshio Yamanaka [Okayama University]
Study of the hydrothermal and fumarolic activities occurred in Wakamiko crater: their distribution and evolution
- Cruise period : August 4, 2008, August 15, 2008
- Port call: Kagoshima Bay
- Research Area: Kagoshima Bay and Off Noma-Misaki (Fig. 1)

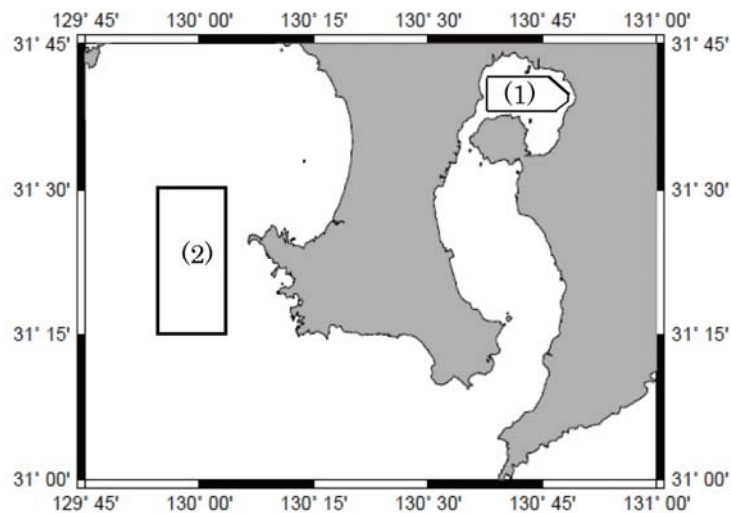


Fig. 1 Research area in Kagoshima

(1) Wakamiko crater (Depth : 50~220m)

The area surrounded with the following points,
 31° 37.8'N 130° 37.5'E, 31° 42.0'N 130° 37.5'E
 31° 42.0'N 130° 46.5'E, 31° 40.4'N 130° 48.8'E
 31° 39.0'N 130° 48.8'E, 31° 37.8'N 130° 47.5'E

(2) Whale-falls off the Cape Noma-Misaki (Depth : 200~350m)

The area surrounded with the following points
 31° 15.0'N 129° 55.0'E,
 31° 30.0'N 130° 06.0'E

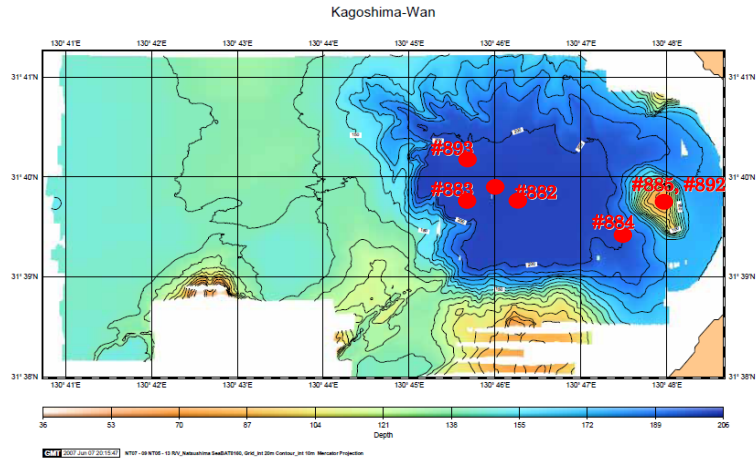


Fig. 2. Dive points of #882-886, #892 and #893 in Wakamiko calder. Area (1) in Fig. 1

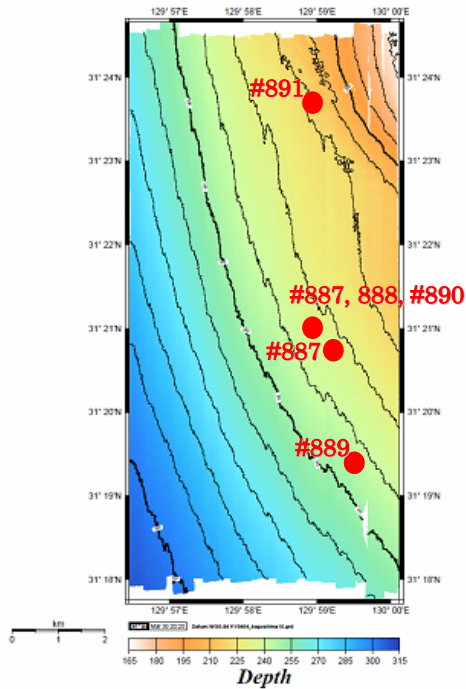


Fig. 3. Dive points of #887 - #891 in whale-falls off Noma-Misaki. The name of whale carcasses are 2, 6, 7 and 11 from North to South. Area (2) in Fig. 1.

● Overview of Observation

1) Study of the hydrothermal and fumarolic activities occurred in Wakamiko crater: their distribution and evolution

Purpose and Background:

Based on the previous geochemical and geophysical studies about the Aira caldera and its active crater, Wakamiko, we hypothesized that the fumarolic and hydrothermal discharges observed on the crater floor were reflect the activities of different volcanoes, because there are two active volcanos, Aira and Sakurajima, are lied back to back. Accordingly, the main purpose of this study is to clarify the detailed distribution of the fumaroles and hydrothermal sites in the crater and of the chemical species derived from the fumarolic and hydrothermal activities in the water column. In addition, we investigate the distribution of the altered minerals influenced of the acidic volcanic gases and hot hydrothermal fluids through the crater-fill sediments. Those results will be

contributed to confirm the hypothesis. Furthermore, for understanding the time series changes of the volcanisms, we will compare the results with the previous data obtained from the crater. It will be contributed to predict the eruption of the volcanoes.

Methods and Instruments:

For accomplish the purpose, we sampled seawater (Niskin bottle), hydrothermal fluids (ROCS with temperature probe), fumarolic gases (vacuum water sampler), sediments (push corer) and hydrothermal precipitations (by manipulator). In addition, some equipments were installed for geochemical and geophysical measurements; GAMOS for *in site* H₂S concentration mapping, CTD-DO for water column chemistry, Medusa for hydrothermal fluid velocity measurement, SAHF for geothermal heat flow measurement, DAI-PACK as side-scan sonar and sub-bottom profiler, Seabat for detailed bathymetry imaging.

Research results:

During the cruise, we successfully obtained many samples such as the hydrothermal fluid samples (T_{max} = 111°C) from three vents, hydrothermal precipitations mainly composed of sulfide and carbonate minerals from two chimneys, and fumarolic gases from three sites (Dives H#883, 886, 893). And we carried out the DAI-PACK measurement along ca. 7km survey line (Dive H#882), GAMOS measurement at every dive in the Kagoshima Bay (Dives H#882 ~ 886), SAHF measurement at 4 points, and Medusa measurement of eight days.

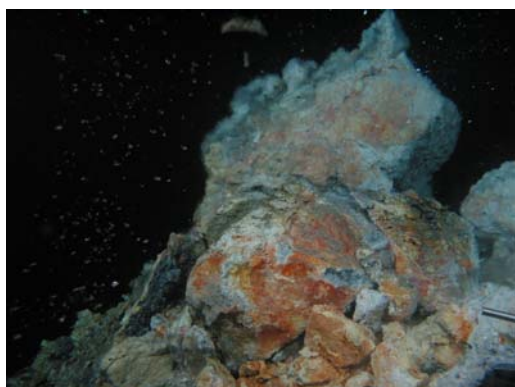


Fig.3. The hydrothermal vent in Wakamiko Crater.

2) Evolution of chordates: Studies on physiological mechanisms of the chordates in hydrogen sulfide-rich environment

Purpose:

The sperm whale-fall ecosystems were observed off the Cape Noma-Misaki, Kagoshima, Japan at depths of 219-254 m by the Hyper-Dolphin. Whale-fall ecosystems are clarified to be based on a chemosynthetic ecosystem. The succession of this unique ecosystem, which rapidly progressed from 2003 to 2008 has been studied from the beginning to the end. The purpose of this cruise is the study on the composition and diversity of the whale-fall fauna from an adaptation and evolution perspective. Furthermore, we concentrate on the ecology, development and evolution of two unique animals, *Osedax japonicus* (a bone-eating worm) and *Asymmetron inferum* (a whale-fall lancelet) that are exclusively present in the whale-fall ecosystem. The whale-fall lancelet is a new species of the subphylum Cephalochordata. It is included in primitive chordates and is the only chordate found in the sulphophilic community in the anaerobic sand sediment under the whale-fall bones. Phylum Chordata consists of subphyla Vertebrata, Urochordata, and Cephalochordata. Urochordates including tunicates have been found on the sea floor in the Wakamiko crater in Kagoshima Bay, especially around the hydrothermal vent. We hypothesize that they have physiologically and/or ecologically adapted to these extreme sulphophilic and anaerobic environments. In this study, we discuss the process of evolution in extreme environments including whale-fall ecosystems

and hydrothermal vents.

Methods and Instruments:

Biological and geochemical samples were collected using manipulators, a scoop-sampler, a suction sampler and sediment corers installed on the ROV. Whale bones were collected using manipulators. Biological sorting was conducted using three sieves with different mesh sizes in the lab. Water temperature was measured using the SBE 19 CTD profiler.

Research results:

In 2008, the whale bones began to appear weathered and became buried in the sediments and the whale-fall animal community including lancelets showed a decrease in abundance. In 887, 889, 890, 891 and 893 dives, we observed the condition of four whale-falls and collected the animals from among the whale bone fauna. At least hundred species including lancelets, ctenophores, arthropods, mollusks, annelids, cnidarians and two unique cnidarians, *Osedax japonicus* and *Lyrocteis imperatoris* found in the whale bone fauna were collected. A sample of whale bones was also collected to observe the spawning and development of *O japonicus* in the laboratory. Tunicates, annelids and arthropods were also collected from the Wakamiko crater. Additionally, in 893 dive, we observed the distribution of tunicates from the center to the west edge of the crater.

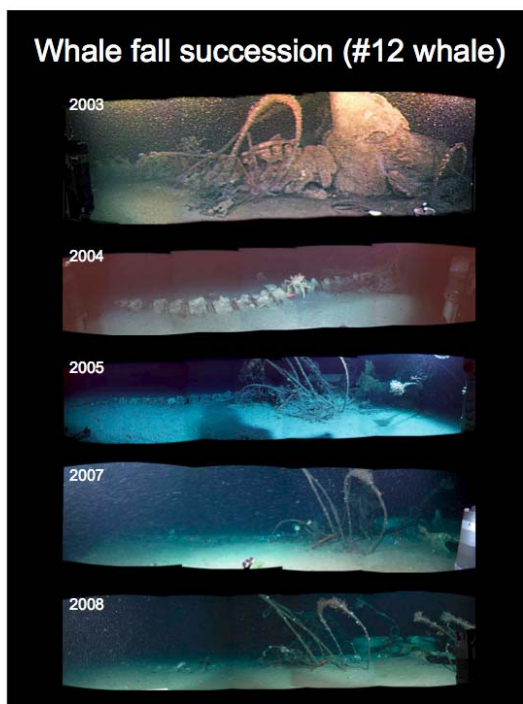


Fig.5. Observation of succession of #12 whale carcass from 2003 to 2008.



Fig.6. Habitats of tunicates in Wakamiko crater.