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Natsushima Cruise Report

NT10-07Leg2

Off Noma-Misaki, Kagoshima

Study on reproductive and dispersal strategy of *Osedax japonicus*.

May 2, 2010 – May 5, 2010

Japan Agency for Marine-Earth

Science and Technology

(JAMSTEC)

Contents

1. Cruise Information

Cruise number: NT10-07 Leg2

Ship name: R/V Natsushima, ROV Hyper-Dolphin

Title of the cruise: Study on reproductive and dispersal strategy of *Osedax japonicus*.

Chief Scientist: Tomoko YAMAMOTO

[Kagoshima University, Faculty of Fisheries]

Proposal number/ Title of the proposals:

S10-38 /Study on reproductive and dispersal strategy of *Osedax japonicus*.

/Tomoko YAMAMOTO [Kagoshima University, Faculty of Fisheries]

Cruise period: May 2, 2010 – May 5, 2010

Port call: May 2 Departure Kagoshima

May 5 Arrival Kagoshima

Research Area: Off Noma-Misaki, Kagoshima

The area surrounded with the following points

31°15.0'N 129°50.0'E

31°40.0'N 130°05.0'E

Cruise Schedule:

2 May Departure from Kagoshima port

Seabat Survey

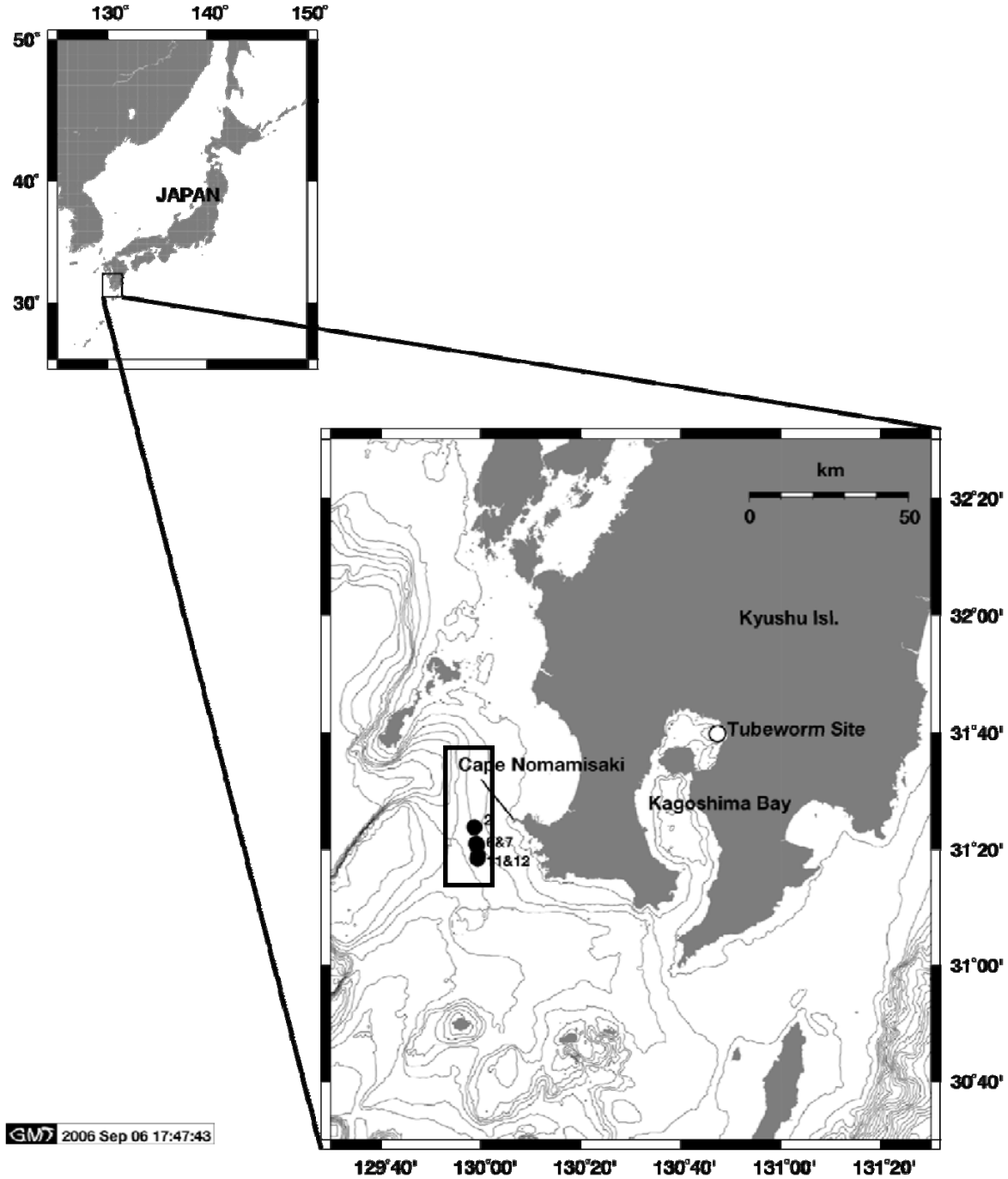
3 May HPD#1120 & #1121

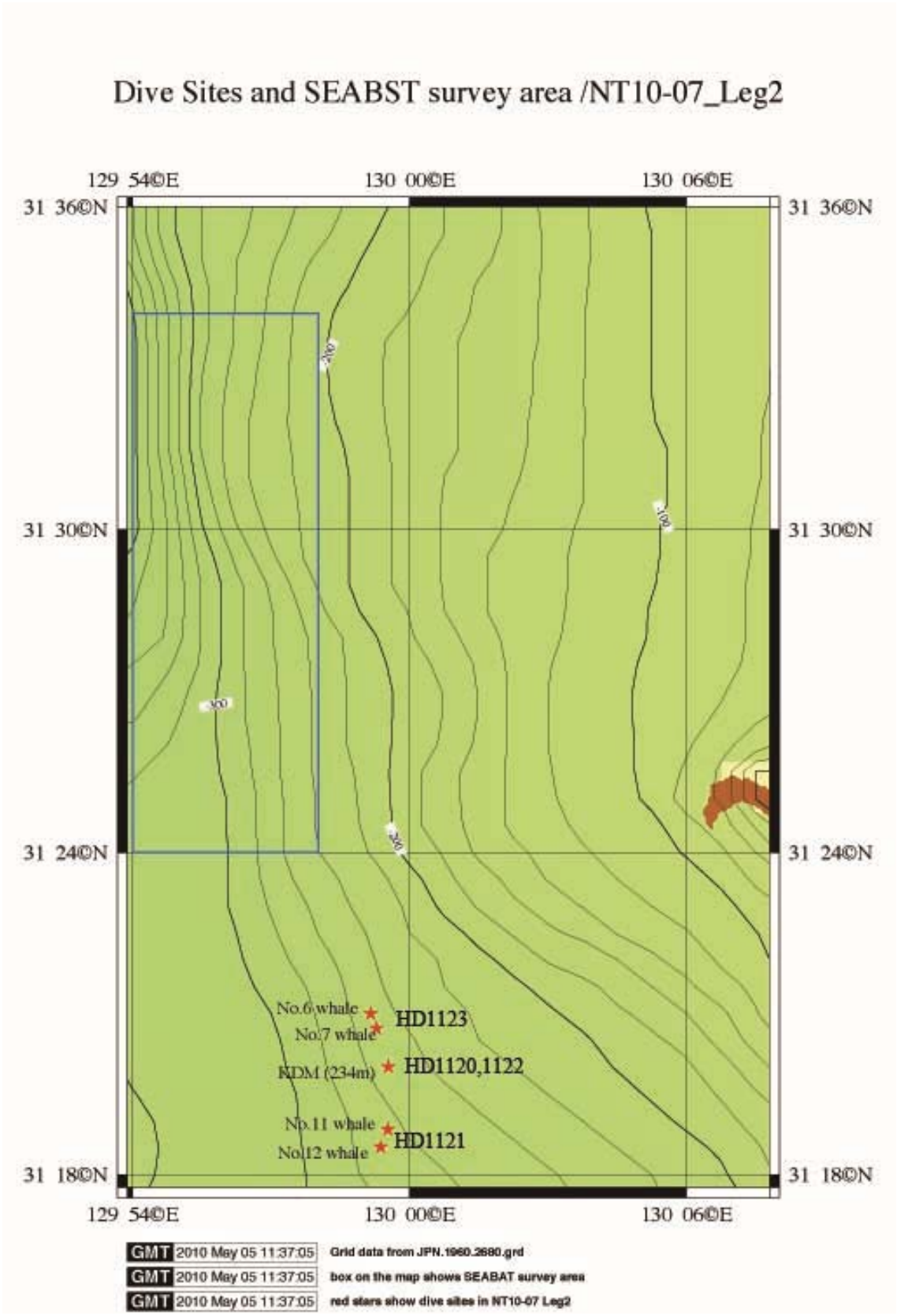
Seabat Survey

4 May HPD#1122 & #1123

5 May Arrival at Kagoshima port

Research map: Survey area of NT10-07Leg2





Stars show dive points and a blue box shows an area of seabat.

2. Researchers

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3. Observations

3.1 Proposal

Study on reproductive and dispersal strategy of *Osedax japonicus*

Tomoko YAMAMOTO (Kagoshima University)

Once large marine mammals die and their carcasses sink into deep sea, they supply a large amount of unusual organic matter to deep-sea ecosystems. After consumption of soft tissue by scavengers, bacterial decomposition of oil-rich skeleton produces an anaerobic environment. This is followed by a sulphophilic stage with sulfide efflux and carbon fixation by chemosynthetic bacteria. Thus, deep-sea whale falls are expected to support a widespread and characteristic fauna including chemosymbiotic species (see Smith and Baco 2003). *Osedax* polecats have been discovered from only whale bones naturally. Since they apparently feed on some components (lipids, collagen) of the bones, they should have an important function to the succession of whale fall community.

Whale fall is temporal and specific habitat, which occurs fortuitously in association with the death of whale. To be endemic in this unique habitat, *Osedax* species should have special strategy for reproduction and dispersal. In *Osedax*, males are dwarf and remain as small as larvae. This characteristic seems to be one of their reproductive and dispersal strategies.

We observed the sperm whale-fall ecosystems off the Cape Nomamisaki, Kagoshima, on the southwestern coast of Kyushu, Japan at depths of 219-254 m from 2003 to 2008. Twelve sperm whale (*Physeter macrocephalus*) bodies were sunk on February 1, 2002 after the mass stranding of 14 whales on January 22, 2002. They are located in waters shallower than that of whale-falls reported previously (Fujiwara et al. 2007). *Osedax japonicus* has been discovered and described here. It is one of only two species, which are reported from depths shallower than 250 m (*O. japonicus* in the Pacific Ocean and *O. mucofloris* in the Atlantic Ocean).

We think that this species should be an ideal model animal for studying reproductive and dispersal strategy of endemic species in this unique habitat. Off Nomamisaki is only one place where we can sample *O. japonicus* and their population seems to have decreased year by year.

The main objective of this cruise is to establish the sampling method of this species, and to evaluate their dispersal ability and reproductive period. We deployed the *Osedax* colonization device named "Namekujira" on 27th January. It is composed by eight frames with a cow bone and four pig bones, and expected to settle on the middle of two whale falls (No. 7 and No.11). We will recover some of frames (from KDM-1 to -8) by using Hyper-Dolphin. We will also visit and observe some of whale falls, and collect bones hopefully settled by *O. japonicus* to investigate the population diversity, male-female relationships, the mechanisms of sex-determination and host-symbiont relationships. Other benthic animals especially whale bone attached mussels is expected to be sampled for the study of larval behavior, shell morphology and microstructure. Animals in the sediment or around whale fall will be collected to see the succession of whale fall community. For understanding the food web relied on the whale-fall, we plan to measure the isotope compositions of biophile elements (C, N, S) of the animal and associated water and sediment samples. We expect to find and collect some species of deep-sea gooseneck barnacles to study their life history and general ecology.

3.2 Dive Results

HPD#1120

Date: May 3, 2010

Site: Namekujira site off Nomamisaki

Landing: Time: 08:25, Depth: 231 m

Leaving: Time: 10:13, Depth: 234m

Purpose: Recovery of frames (KDM-01-08) of Osedax colonization device (Namekujira) 234 m

Dive summary: *Osedax* colonization device (Namekujira) was searched and discovered at the depth of 234 m off Nomamisaki. Two frames (KDM-01 & 03) were recovered and one (FL-07) was deployed at the side of Namekujira. Sediment was sampled by using MBARI cores and sterile cores. Water was also sampled. Small individuals of *Osedax* sp. were found on the cow bones and pig bones in the frames

HPD#1121

Date: *May 3, 2010*
Site: No.12 and No.11 whale falls, Off Nomamisaki
Landing: 12:53, Depth: 249m
Leaving: 15:45, Depth: 246m
Purpose: Observation of whale fall and sampling animals
Dive summary: #12 whale fall was observed and we could find only ropes and wires, while we visited it during every investigation and continued observation without sampling. We visited also #11 whale fall and we could find no bones to collect. During travel from #12 to #11, some samples of gooseneck barnacle were collected.

HPD#1122
Date: May 4, 2010
Site: Namekujira site off Nomamisaki
Landing: Time: 08:23, Depth: 230 m
Leaving: Time: 09:24, Depth: 234m
Purpose: Recovery of two frames attached mammalian bones that were deployed by Kagoshima University. Two new frames attached mammalian bones at the frame site off Cape Nomamisaki.
Dive summary: Two old frames KDM-05 and -6 with mammalian bones were safely put into a bag and a sampling box, and carried to the lab. *Osedax* was attached on the cow bones and other attached animals were observed and briefly classified as shown in the sample list. A new frame FL-09 with a cow and four pig bones was settled at the position of the old frame recovered in the dive #1120.

HPD #1123
Date: *May 4, 2010*
Site: No.6 and No.7 whale falls, Off Nomamisaki
Landing: 11:27, Depth: 223m)
Leaving: 14:53, Depth: 229m)
Purpose: Investigation of succession patterns and colonization mechanisms at whale falls
Dive summary: The ROV landed and water was sampled by one bottle of Niskin (#1). The ROV moved to the No.6 whales after the landing. Just before landing near the No.6 whale,

water was sampled by one bottle of Niskin (#2). The distribution of mussels, *Osedax* and other organisms were investigated on the tip of the head bone. Firstly, the ROV tried to collect epifaunal species including juveniles of bivalves attached on whale bones using a suction sampler. Small particles including epifauna were collected by scratching the surface of a whale bone (canister No.5 and No.6). Secondary, MBARI (blue) and Sterile (yellow) cores were sampled from the sediment. A part of jaw bone with many mussels and *Osedax* was collected using manipulators and stored in a sample box. Two MBARI (green and black) and Sterile (red) cores were sampled from the sediment near the head of the No.6 whale. The sediment and sediment-dwelling infauna near the bone were collected using a scoop-sampler. A new marker (no number) was settled. Next, the ROV moved toward the No.7 whale and landed. Finally, a stalked barnacle (canister No.1), nudibranch (canister No.2) and a sea anemone (canister No.3) were collected from the net covered with whale bones and left the bottom.

3.3 Preliminary Results

Four dives and seabat survey were conducted. 4 frames with cow and pig bones were retrieved from their deployment site at 234 m depth. They were found smoothly and settled normally, and all frames with pig and cow bones were visible. These bones were already colonized by *Osedax* sp. However, colonization was not very dense, relatively heterogenous (some bones or parts of bones were not colonized whereas others were), and the individuals were small. We observed no mucus cocoons with eggs, but one individual (among the largest on these bones) was seen spawning eggs. Three new stainless steal frames with cow and pig bones were also deployed during the Leg, in order to renew available substrates for collecting *Osedax* in the future.

A jaw bone was also collected from Whale #6 deployed in 2002. This bone was densely covered with large *O. japonicus* reproductively active (large mucus cocoons with eggs, larvae and males). Females and males were collected for future genetic studies (population genetics and male/female relationship). The mytilid mussels including *Adipicola pacifica* and *Idasola* sp. were also found on the collected at the jaw bone.

Water and sediment samples were sampled to measure the isotope compositions and analyze bacterium composition. In the sediment near from whale bone, whale-fall lancelet (*Asymmetron inferum*) was also collected.

One individual of *Lyrocteis imperatoris* attached on the frame of "Namekujira" and sampled. During dives, we sampled some individuals of the gooseneck barnacle *Scalpellum stearnsii* from the sea floor and the net covering whale carcasses.

3.4 Future Studies

We will attempt to maintain live *Osedax* populations on bones as long as possible and establish the method to keep an *O. japonicus* culture constantly under laboratory conditions. By achieving this rearing, we would be able to investigate the mechanisms of symbiont acquisition, and of sex-determination in this highly dimorphic group.

With the samples and live specimens collected during this cruise, we will conduct several types of analysis and in vitro experiments including genetic studies using COI and microsatellite markers (population and male/female relationships), studies on spawning rhythms, development, sex determination. They will enable us to better understand the life cycle of this atypical *Osedax* species, and to draw hypothesis concerning the evolution history of this group and its distribution within the oceans.

To identify the shell microstructure of mytilid mussels, formalin fixed samples will be observed by SEM. Behavior of larva and juvenile will be also observed.

Some animal samples (see sample list) were provided to the geochemical analysis. The ambient seawater samples also collected together with the animals for recovering suspension solid as the possible carbon source for the benthic animals. The recovered suspension solid will be measured the carbon and nitrogen isotope compositions. In addition, we use the sediment core samples to clarify the geochemical environment developed under the whale-fall remains. The contents of ammonia, sulfide, and organic carbon together with those isotope compositions will be measured. Those geochemical data are expected to help understanding how flourish the chemosynthesis-based organisms under the remains.

As life histories of common deep-sea gooseneck barnacles, we will examine the presence of brooding, development of the ovary or number of growth lines of the fixed specimens. Also, we are rearing some gooseneck barnacle species and we will follow their growth and reproduction in aquaria kept at 15 °C.

4. Notice on using

This cruise report is a preliminary documentation as of the end of the cruise.

This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for the latest information.

Users of data or results on this cruise report are requested to submit their results to the Data Integration and Analysis Group (DIAG) of JAMSTEC.