NATSUSHIMA Cruise Report NT 08 - 18

Goto Submarine Canyon

16 Aug. 2008 - 20 Aug. 2008

Japan Agency for Marine-Earth Science and Technology JAMSTEC

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I. Cruise Information

Cruise Number : NT08-18 Ship Name : Natsusima, Hyper Dolphin Title of the cruise: Goto Submarine Canyon Cruise Title of proposal: Tectonic reconstruction of the early stage of the back arc rifted basin:early stage core complex formation and hydrothermal circulation Cruise Period : 16 Aug 2008 - 20 Aug 2008 Port call : Kagoshima to Hakata Research Area : Goto Submarine Canyon Research map : Fig. 1 Chief Scientist : Shoichi Kiyokawa (Kyushu University) Representative of Science Party : Shoichi Kiyokawa (Kyushu University)

II. List of Participants

Scientific Participants

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III.Cruise Summary

The Cruise NT08-18 was made in the northernmost Okinawa Trough from the 16th August to the 20th August 2008, and included two main purposes: 1) Geological observation of Goto submarine Canyon and 2) Detailed geometry survey of GSC. The survey was conducted by means of HYPER DOLPHIN and its mother vessel NATSUSHIMA toward the GSC.

We had 2 dives at the middle of GSC. Sampling of mud, bedrocks, sand-pipes, measuring CTD was carried out on #894 and #895 Dives. We had topographic survey by SEABAT at night. Rapid current flows at the bottom of the valley. Direction of flow varies according to location. Reverse current was observed. Four depressions are discovered through geometry survey. Each depression has 3 - 15 km length, and is deepest at the downstream edge. Sand, silt, and mud are deposited at the bottom of one of depressions. Step-like terrace was found at the downstream edge of depressions. Surface of terraces are flat with thin cover of deposits. Current-perpendicular ripples are found at the slope and bottom of the valley. Some sand chimneys were found in the middle of the valley.

IV.Objective

Goto submarine Canyon is located at the northernmost edge of the Okinawa Trough Back-arc Basin(Fig.1). Age and cause of forming the canyon is not clear so far. According to our seismic reflection survey and on-land field survey in neighboring area, Goto Submarine Canyon can be formed during extension of the northern Okinawa Trough rifting.

Main objective of this cruise is (1) acquiring high resolution topography data, (2) observing the lithology and structure of the canyon slope, using Hyper Dolphin and SEABAT.

V. Observation and sampling

We had two dives to transect the middle Goto Submarine Canyon by HYPER DOLPHIN. Outcrops on the northern slopes of the canyon were mainly investigated. We acquired rock, sediments, bivalves, and sand chimneys. CTD measurement was carried out during dives.

We also conducted detailed topographic survey using SEABAT.

VI.Preliminary Results

SEABAT survey

1. Clear lineaments and four depressions are discovered at the bottom of the northern slope by SEABAT survey. Northern cliff of the Canyon is steeper than that of the southern cliff of the canyon. There are three oriented lineaments; such as NW-SE, N-S and NS-SW strikes. There are at least 3 lineaments preserved along the north cliff. Depressions are identified along NW-SE and NW-SE strike lineaments (Fig.5). Depressions have 3 - 15 km length, 0.5 - 2 km width, ~ 50 m depth(Fig.2).

HYPER DOLPHIN survey

1. Rapid current was observed at the bottom of the canyon. Current in the bottom of the canyon identified from SE to NW in the morning and NW to SE in the afternoon. At least, current speed is 1 knot. Current ripples and dunes are found on the bottom of the canyon and surface of the cliff. Most orientation of ripples shows NW - SE which is consistent to that of recent current. The direction of strong currents are probably related to the tide.

2. Northern slope of the canyon consists of 5~8 steps of cliff which elevations are 10 m at most(Fig.4). Cliffs are composed of thick sandstone, siltstone and conglomerate which cemented by carbonates(Fig.8).

Non active calcareous sand chimneys were found near cliffs. They all are lying on the ground and covered with soft corals(Fig.9). Each sand chimneys

have 10 - 30 cm in diameter and have been broken into several pieces whose length are less than 1 m.

Bedded aggregate of bivalves are found on the canyon floor(Fig.7).

On the other hand, little outcrops are observed on the southern slope of the canyon. Southern slope is covered with a few centimeter of sand and silt with current ripples.

3. CTD data recorded slightly higher-T and Dissolved Oxygen anomalies at the bottom of the northern slope of the lineament(Fig.6).

VII.Future Plans

We are going to study history of Goto Submarine Canyon.

We are going to correlate geometry and seismic sections to clarify tectonic evolution of the northern Okinawa Trough area.

VIII.Acknowledgements

We are grateful to Captain Mr. Koji Sameshima and all crew members for their safe navigation and their skillful handling of "R/V NATSUSHIMA". Great thanks are due to Commander Mr. Kazuya. Mitsufuji and "HYPER DOLPHIN" operation team for taking us to deep sea floor and accurate operations in sampling. We also thank Miss Misumi Aoki, Nippon Marine Enterprise, Ltd., for her attentive supports. We thank all the JAMSTEC personnel who have supported us. Finally, we would like to appreciate all the person who supported directly or indirectly this cruise.



Fig. 1 Map of Northern Okinawa Trough and Goto Submarine Canyon.



Fig.2. Detailed Map of Goto Submarine Canyon, dived points. Seismic reflection lines acquired in previous studies are also shown in yellow lines.



Fig. 3. Detailed Map around dive point. Light blue circles are track of HPD, blue stars indicate sampling points. Red lines indicate route of cross section shown in Fig.4.Seismic reflection lines acquired in previous studies are shown in yellow lines.



Fig.4 Route section of dive # 894 and 895. Location of sections are shown in fig.3.



Fig.5. Whale's view of Goto Submarine canyon looking southeast. NW-SE lineaments are clearly shown at the bottom of the northern slope. Cliffs can be observed at the middle of the canyon.



Fig.6. Dissolved oxygen data of #894 dive. Positive anomaly is observed at 16:40.



Fig.7. Aggregate layer of bivalves.



Fig.8. Outcrop on the cliff.



Fig.9. Sand chimney



Fig.10. Sand chimney grabbed by manupilater.