Cruise summary for the Natsushima Cruise NT13-13

Cruise number:	NT13-13
Research Vessel:	R/V Natsushima
Title of cruise:	FY2013 Deep sea survey by the ROV HyperDolphin at Takuyo-Daigo seamount
Chief Scientist:	Blair Thornton [Institute of Industrial Science, The University of Tokyo]
Title of proposal:	Investigation of acoustic, 3D visual mapping and sampling methods for survey of manganese crusts
Cruise period:	June 24, 2013 (Saipan) July 5, 2013 (Yokohama, Japan)
Survey site:	Takuyo-Daigo seamount

A survey of manganese crust deposits was performed at Takuyo-Daigo seamount (23°00'N, 153°20'E), Northwest Pacific using the ROV Hyper Dolphin and the R/V Natsushima between June 24, 2013 and July 5, 2013. The main purpose of the cruise was to investigate the performance of acoustic and visual instruments, developed under the 'Program for the development of fundamental tools for the utilization of marine resources' of the Japanese Ministry of Education. The instruments have been developed to perform high resolution surveys of the volumetric distribution of manganese crusts from an underwater vehicle, and consist of an acoustic device, developed to perform continuous sub-surface measurements of manganese crust thickness at depths of up to 3000m, and a vision based mapping system that generates millimeter order resolution three-dimensional (3D) reconstructions of the seafloor in actual colours. The ultimate goal of the measurements is to accurately determine the volumetric distribution of exposed manganese crusts over a wide survey area.

The acoustic and visual instruments were mounted on the ROV Hyper Dolphin together with an underwater rotary blade and rock breaker, designed to assist sampling of manganese crusts. The ROV HyperDolphin dived four times (#1540, #1541, #1543, #1544) on the southern edge of a margin of the flat top and adjacent slope in the southern-most part of the Takuyo #5 seamount in the Northwest Pacific. The acoustic and 3D image mapping system was operated over continuous ferromanganese crusts at the altitude between 1 and 2 meters above the sea floor. The very slow and constant speed of mapping (10 to 20cm per second) provided us with very important opportunity of careful observation of the morphology and material over the ferromanganese crusts. A total 10km of seafloor was mapped during the four dives at water depths between 1700 and 1400 meters. We took 16

intact, undisturbed and in-situ samples of ferromanganese crusts at 13 stops over the lines. Nine of the samples were extracted directly from the rock outcrop. Seafloor observation and sampling is important to study the mode and controlling factors of the small-scale variation in composition and configuration of the ferromanganese crusts. In addition to this, 4 seafloor sediment and 4 sea water samples were collected using a Push corer and Niskin water sampler device respectively from various depths. CTD-Do measurements were also made during all the dives. The diving operations were carried out over four consecutive days. The collected samples have been divided and prepared for chemical, mineralogical and microbiological investigation.

The mapping data obtained during this cruise is not only valuable in terms of information concerning the distribution of manganese crusts on the seamount, but also demonstrates that the system developed is capable of performing acoustic measurements of manganese crust thickness on slopes up to 30 degrees. This was possible mainly due to the active double gimbal mechanism introduced to control the direction of the acoustic probe, and the increased measuring range and dynamic beam focusing capabilities of the acoustic probe itself. It could also be established that the 2.5m range of the probe was sufficient for operation of HyperDolphin on the slopes of the seamount. The combination of acoustic sub-surface measurements and the 3D visual reconstructions are found to be powerful tools to quantitatively assess the volumetric distribution of manganese crusts and it was demonstrated that this kind of acoustic and visual survey of manganese crusts, combined with sampling, forms an effective and powerful tool to better understand the nature of manganese crusts on a large scale. The experience gained during the dives will enable engineering feedback to make further improvements to the various payloads deployed during this cruise.

The research party deeply appreciates the efforts of Captain Aoki Takafumi, Chief officer Tsuji Akihisa, Chief engineer Funae Koji, Chief electronics operator Suda Fukuo and the crew of the R/V Natsushima, Commander Ono Yoshinari and the HyperDolphin Team, and Marine Technician Satomi Minamizawa. The success of this cruise could not have been achieved without their contribution and skill. We also appreciate JAMSTEC, and in particular Yuta Yamamuro's efforts in organizing this cruise. This research is supported by MEXT (Ministry of Education, Science, & Culture) through 'Program for the development of fundamental tools for the utilization of marine resources'.