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S/V Yokosuka Cruise Report

YK10-13 Leg2

2010 Deep Sea Research Shinkai 6500 scientific dives: Izu-Ogasawara (Bonin) area (Ohmachi Seamount)

October 8 -15, 2010

(Guam - Kobe)

JAMSTEC

Contents

1. General cruise informations

(1) Cruise number / ship name

YK10-13 Leg2　/ S/V Yokosuka

(2) Title of the cruise

2010 Deep Sea Research / Shinkai 6500 scientific dives: Izu-Ogasawara (Bonin) area

(3) Proposal number and scientific title

S10-53　Subduction channel and its exhumation dynamics of the IBM subduction zone.

(4) Period of the cruise

From October 8 to 15, 2010

(5) Port calls

Departure: Guam (October 8, 2008)

Arrival: Kobe (October 15, 2008)

(6) Investigation area

Ohmachi Seamount (2200 - 3500 m bsl)

28º30.0' – 30º00.0'N, 140°00.0'E - 141°30.0'E

(7) Shinkai 6500 dive list

Table 1 List of Shinkai 6500 dives during YK10-13 Leg2 Cruise.

Dive no.	Pilot	Copilot	Observer	Location	keyword
6k#1239	K. Matsumoto		T. Usuki	Ohmachi Seamount	serpentinite
6k#1240	K. Chiba		K. Hirauchi	Ohmachi Seamount	serpentinite

(8) Researchers

Onboard scientists

Hayato UEDA: Faculty of Education, Hirosaki University (Chief Scientist / Representative of the proposal).

Tadashi USUKI: Institute of Earth Sciences, Academia Sinica (Co-chief scientist).

Ken-ichi HIRAUCHI: Department of Earth and Planetary Systems Science, Graduate School of Science, Hiroshima University.

Sosuke IWAI: Faculty of Education, Hirosaki University.

Mio MIURA: Faculty of Education, Hirosaki University.

Yu KANO: Faculty of Education, Hirosaki University.
Yuji KUMASAWA: Faculty of Education, Hirosaki University.
Juliane TIEDT: Institute of Geography and Geology, University of Greifswald.
Shusuke MACHIDA: Nippon Marine Enterprises ,Ltd (Marine technician).

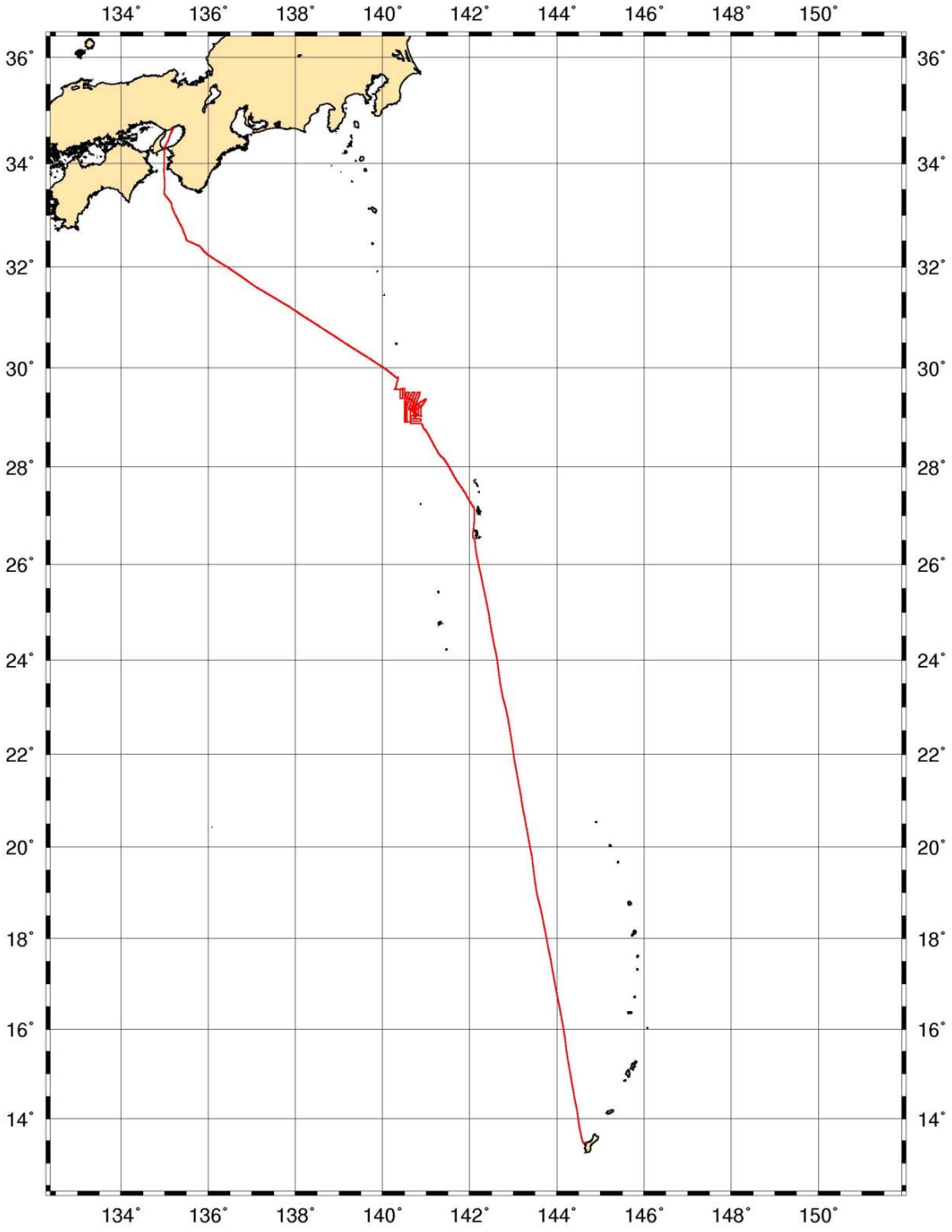

Fig. 1 S/V Yokosuka track during the YK10-13 Leg2 cruise.

Shore-base scientists

Kiyoaki NIIDA: Department of Natural History Sciences, Graduate School of Science, Hokkaido University.

Martin MESCHEDE: Institute of Geography and Geology, University of Greifswald.

Ryo MIURA: Nippon Marine Enterprises ,Ltd (Marine technician).

Toyoto AZUMA: Hidaka Mountains Museum / Department of Natural History Sciences, Graduate School of Science, Hokkaido University.

Takeshi IMAYAMA: Department of Natural History Sciences, Graduate School of Science, Hokkaido University.

Izumi SAKAMOTO: Department of Marine Mineral Resources, School of Marine Science and Technology, Tokai University.

Toru TAKESHITA: Department of Natural History Sciences, Graduate School of Science, Hokkaido University.

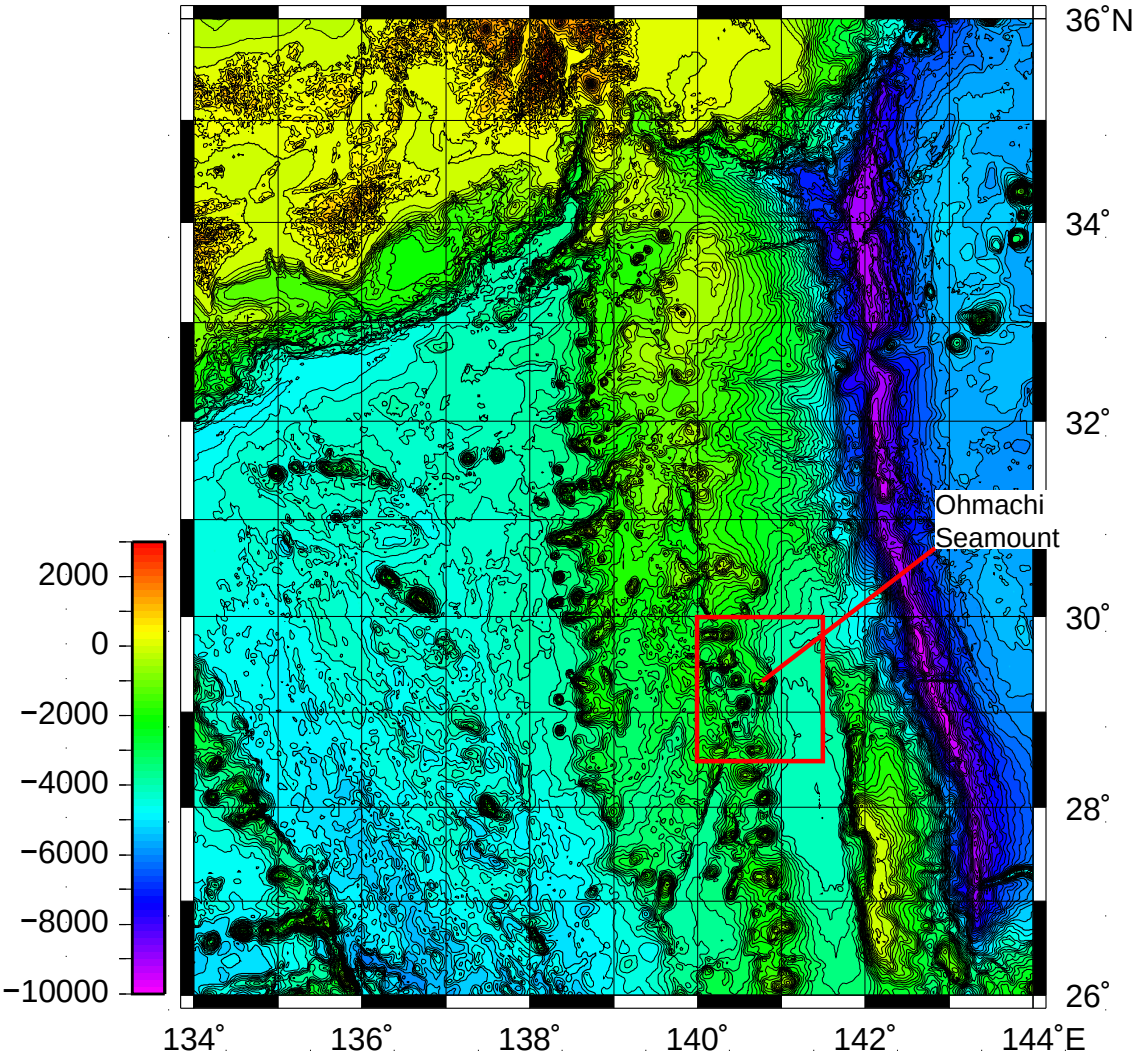

Fig. 2 Research areas of YK10-13 Leg2 Cruise.

(9) Actual schedule

2010/10/07
Position: 13-27.7N, 144-40.0E / Weather: fine but cloudy / Wind direction: ENE/ Wind force: 4/ Wave: 1 m/ Swell: 0 m/ Visibility: 8 nautical miles (12:00 JST+1h)
15:30 Onboard
15:50 Briefing about ship's life and safety

2010/10/08
Position: 13-49.0N, 144-31.5E / Weather: fine but cloudy / Wind direction: East/ Wind force: 5/ Wave: 3 m/ Swell: 2 m/ Visibility: 8 nautical miles (12:00 JST+1h)
08:30 Scientific meeting, setup the laboratory
10:00 Departure from APRA
14:00 Briefing about Shinikai6500
16:40 Pray for safety of cruise to KONPIRASAN
17:00 Proceeding to the survey area (Omachi sea mount)

2010/10/09
Position: 20-10.0N, 143-20.0E / Weather: fine but cloudy / Wind direction: ENE/ Wind force: 4/ Wave: 3m/ Swell: 2 m/ Visibility: 8 nautical miles (12:00 JST+1h)
09:30 Conduct a tour of 6K_1st
10:30 Conduct a tour of 6K_2nd
13:00 Have a look over the ship , Scientific meeting with 6k team

2010/10/10
Position: 26-47.8N, 142-05.0E / Weather: fine but cloudy / Wind direction: South/ Wind force: 3/ Wave: 2m/ Swell: 1 m/ Visibility: 8 nautical miles (12:00 JST)
00:00 Put a clock back 1hour (JST)
14:30 6k pilot meeting
15:00 Scientific meeting
16:30 Towing Proton magnetometer（Start of the geological survey）
21:00 Arrived at survey area (Omachi Seamount)
21:20 XBT
22:04 MBES mapping survey for 6k dive

2010/10/11
Position: 29-07.2'N, 140-41.9E / Weather: overcast / Wind direction: North/ Wind force: 3/ Wave: 3m/ Swell: 2 m/ Visibility: 7 nautical miles (12:00 JST)
06:29 End of the geological survey (Proton/MBES)
06:41 Proton on deck
08:45 Launch Shinkai6500 (6kDive#1239dive)
10:22 6k lands (3474m)
14:53 6k leaves the bottom (5765m)
16:30 6k on deck, Sample description
17:10 Towing Proton magnetometer（Start of the geological survey）
18:29 MBES mapping survey for 6k dive

2010/10/12
Position: 29-02.9'N, 140-43.0E / Weather: fine but cloudy / Wind direction: NE/ Wind force: 3/ Wave: 2m/ Swell: 1 m/ Visibility: 8 nautical miles (12:00 JST)
06:20 End of the geological survey (Proton/MBES)
06:32 Proton on deck
08:45 Launch Shinkai6500 (6kDive#1240dive)
10:20 6k lands (3439m)
15:01 6k leaves the bottom (2614m)

16:25 6k on deck, Sample description
17:10 Towing Proton magnetometer（Start of the geological survey）
17:32 MBES mapping survey for 6k dive

2010/10/13
Position: 30-23.5'N, 139-18.0E / Weather: fine but cloudy / Wind direction: WSW/ Wind force: 2/ Wave: 1m/ Swell: 1 m/ Visibility: 8 nautical miles (12:00 JST)
06:37 End of the geological survey (Proton/MBES)
06:52 Proton on deck
07:00 Departure from the survey area, Proceeding to KOBE

2010/10/14
Position: 34-24.1'N, 135-03.0E / Weather: cloudy / Wind direction: NNW/ Wind force: 4/ Wave: 2m/ Swell: 1 m/ Visibility: 8 nautical miles (12:00 JST)
13:30 Arrival at KOBE, custom check
15:00 Passport control

2010/10/15
08:00 Cleaning at the lab
12:00 YK10-13 Leg2 finish and disembarkation

2. Backgrounds and purposes

Serpentinite bodies accompanied by high-pressure (HP) metamorphic rocks are recently regarded as exhumed parts of subduction channels of mantle depths as the interface shear zones of upper and lower plates, where material transports were channelized. To analyze metamorphic and deformation histories is one of the most direct ways to understand physical conditions and dynamics in deep subduction interface. Although exposure of serpentinites with HP metamorphic rocks is not uncommon in ancient subduction zones (orogenic belts) on land, they commonly experienced complicated tectonic modifications after they were incorporated inside continental crusts and reached to the surface. It is thus expected that geologic structures and mineralogy of serpentinite – HP metamorphic complex exposed on sea-floor provides more primary information on architecture and dynamics of deep subduction channel.

Ohmachi Seamount is one of the sea-floor localities of serpentinite – HP metamorphic complex, and the only locality of eclogite-facies metamorphic rocks in modern intraoceanic subduction setting. Based on previous geological surveys, we have interpreted that the serpentinite – HP metamorphic complex consist of hanging-wall massive serpentinite of wedge mantle origin and the underlying serpentinite schist containing fragments of HP metabasites representing an exhumed subduction channel. This hypothesis is, however, to be tested by *in situ* observation of contact relations between serpentinite schist and HP metabasites, and by more comprehensive geological mapping covering the entire serpentinite – HP metamorphic complex, both of which had not been successfully achieved during previous surveys. This cruise mainly aims to complete these two subjects, together with obtaining metabasite samples of enough quantity for radiometric dating, and completing bathymetric mapping covering the entire seamount, by Shinkai 6500 dives and MBES mapping.

3. Research activities and methods

(1) S/V Yokosuka survey

Swath bathymetric data were acquired around the Ohmachi Seamount by multi narrow beam echo sounder (MBES). The mapped area lies between 28°50'N and 29°35'N, and between 140°17'E and 141°03'E. During the MBES mapping, geomagnetic data were acquired using shipboard three-component magnetometer, and the proton magnetometer sensor towed from stern. Observation instruments are listed below:

- SeaBeam 2112 multibeam echosounder (L-3 ELAC Nautik)
- Proton magnetometer (Kawasaki Geological Engineering PRT010)
- Shipboard magnetometer (Tierra Technica SFG-1212)

(2) Shinkai 6500 dives

Two dives (6K#1239 and #1240) were performed using Shinkai 6500 on the southwestern slope of the Ohmachi Seamount. The route of dive 6K#1239 was set tracing the southern half of the dive 6K#609 track, where amphibole schist experienced the eclogite facies were collected. Dive 6K#1240 was set to the south of the previously known exposure of serpentinite, to test the occurrence of southern extension of the serpentinite body. In both dives, payloads listed below were equipped.

Payload:

*Push core x3

*Sample boxes and separation boards for sample basket

*Clinometer plate x1

*Hammer chisel x1

4. Preliminary results

(1) MBES mapping

SeaBeam acquired bathymetric data mostly covering the Ohmachi Seamount. To combine with previously mapped areas, detailed bathymetry of the entire seamount has been completed.

(2) Shinkai 6500 dives

Dive 6k#1239 tried to revisit localities of amphibole schist experienced the eclogite facies. Shinkai 6500 approached a landslide scarp, the foot of which was a locality of amphibole schist as a float stone. Collected samples here in 6K#1239 were serpentinite (antigorite schist). Shinkai then climbed up the slope looking for another locality of amphibole schist. However, it could not find the same locality, because many small-scale ridges and gullies, which were not expressed on MBES bathymetric maps, obstructed to identify the outcrop. The submersible collected many serpentinite

and sedimentary rock samples.

Dive 6k#1240 performed seafloor geologic mapping on the southern extension of serpentinite exposure. Many rock exposures were observed especially on the lower slope. These outcrops consisted solely of volcaniclastic sandstone presumably of Paleogene horizons, and no serpentinite was exposed. This result indicates that the serpentinite body does not extend to the south of previously confirmed southern terminal (KT04-28D09: 29°03’30”). Presence of a fault is inferred between 29°03’00-30”, to the south of which the Paleogene cover sequence was relatively dropped.

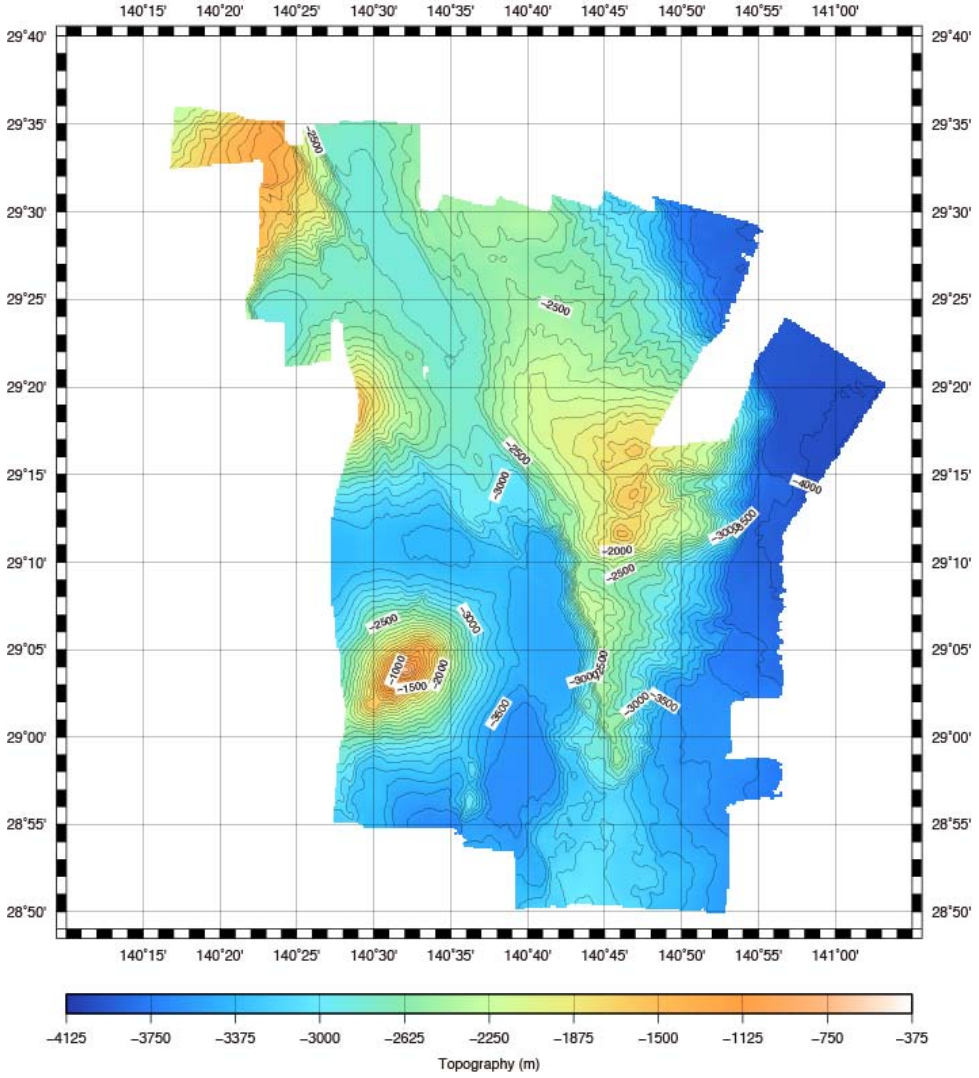

Fig. 3 Result of MBES mapping in YK10-13 Leg2 Cruise.

Preliminary Results of SHINKAI6500 Dive

Deep Sea Research Department, JAMSTEC

<table>
<tr><td>Dive No.</td><td colspan="2">6k#1239 (T. Usuki)</td><td>Date</td><td>10/10/11</td></tr>
<tr><td>Main Purpose</td><td colspan="4">To visit the localities where metamorphic rocks were corrected in the previous dive 6k#609 and collect metamorphic rock samples and observe the occurrence of them and host serpentinites.</td></tr>
<tr><td>Dive Site</td><td colspan="4">West wall of the Omachi Seamount. The landing site is near that of 6k#609.</td></tr>
<tr><td rowspan="2">Landing</td><td>Latitude</td><td>Longitude</td><td>Time</td><td>Depth</td></tr>
<tr><td>29° 7.1297’N</td><td>140° 41.8094E</td><td>10:22</td><td>3474</td></tr>
<tr><td>Lift-off</td><td>29° 7.4509’N</td><td>140° 42.1793’E</td><td>14:53</td><td>3338</td></tr>
<tr><td>Payload</td><td colspan="4">Two sample baskets with partition walls, three sediment samplers (push-corer), one chisel (Mr. manganese) and one clinometer plate (UEDAX).</td></tr>
<tr><td>Dive Summary</td><td colspan="4">The landing point was near the top of apron debris containing rubbles of serpentinite, basalt, and mudstone. At 3471 m b.s.l. we found the similar step-like outcrop of siltstone where several floats of metamorphic rocks were collected by the previous dive 6k#609 (3481 m). However, we could not find any metamorphic rocks there. Instead, we collected several highly schistose serpentinite floats. It may not be the exact locality visited by the dive 6k#609, because there is 10 m difference between the depth of the locality in this time and that of the dive 6k#609. We have also tried to find another outcrop at 3340 m b.s.l. where the metamorphic rock of eclogite origin was collected by the dive 6k#609. However, it was difficult to find the same outcrop, because there were many similar outcrops in the same depth (3340 m b.s.l.), the accuracy and precision of seafloor topographical map is not good enough to distinguish them and view from Shinkai is very restricted. Although there were many difficulties, we could collect many fresh schistose serpentinites and floats of Miocene sedimentary rock with turbidite origin at 3340 m b.s.l.</td></tr>
<tr><td>Key words</td><td colspan="4">Ohmachi Seamount, Izu-Bonin Arc, metamorphic rocks</td></tr>
</table>

Preliminary Results of SHINKAI6500 Dive

Deep Sea Research Department, JAMSTEC

Dive No.	6k#1240 (K. Hirauchi)		Date	10/10/12
Main Purpose	To observe the occurrence of basement rocks and wall morphologic features of the Ohmachi Seamount, and to take samples of rocks.			
Dive Site	West wall of the Omachi Seamount. The landing site is 600 m south of that of D09.			
Landing	Latitude	Longitude	Time	Depth
	29° 2.9971'N	140° 42.9303'E	10:20	3439
Lift-off	29° 3.2187'N	140° 44.2784'E	15:01	2614
Payload	Two sample baskets with partition walls, three sediment samplers (push-corer), one chisel (Mr. manganese) and one clinometer plate (UEDAX).			
Dive Summary	At the landing point (3439 m b.s.l.), I collected surface deposit (mud) by using a push-corer. Volcaniclastic rocks (dacitic or andesitic volcanic sandstone) are widely exposed in a steep cliff near the base of the western wall, from 3,405 m to 3,233 m b.s.l. Some of floats in the upper half of the cliff are composed of calcareous, sandy and muddy turbidites. Contrary to previous dives and dredges, there are no serpentinite outcrops in this depth range. From 3,164 m to 2,632 m b.s.l., Volcaniclastic rocks are also exposed in the western flank, with a number of floats consisting of turbiditic sandstone and mudstone.			
Key words	Ohmachi Seamount, Izu-Bonin Arc, Philippine Sea			

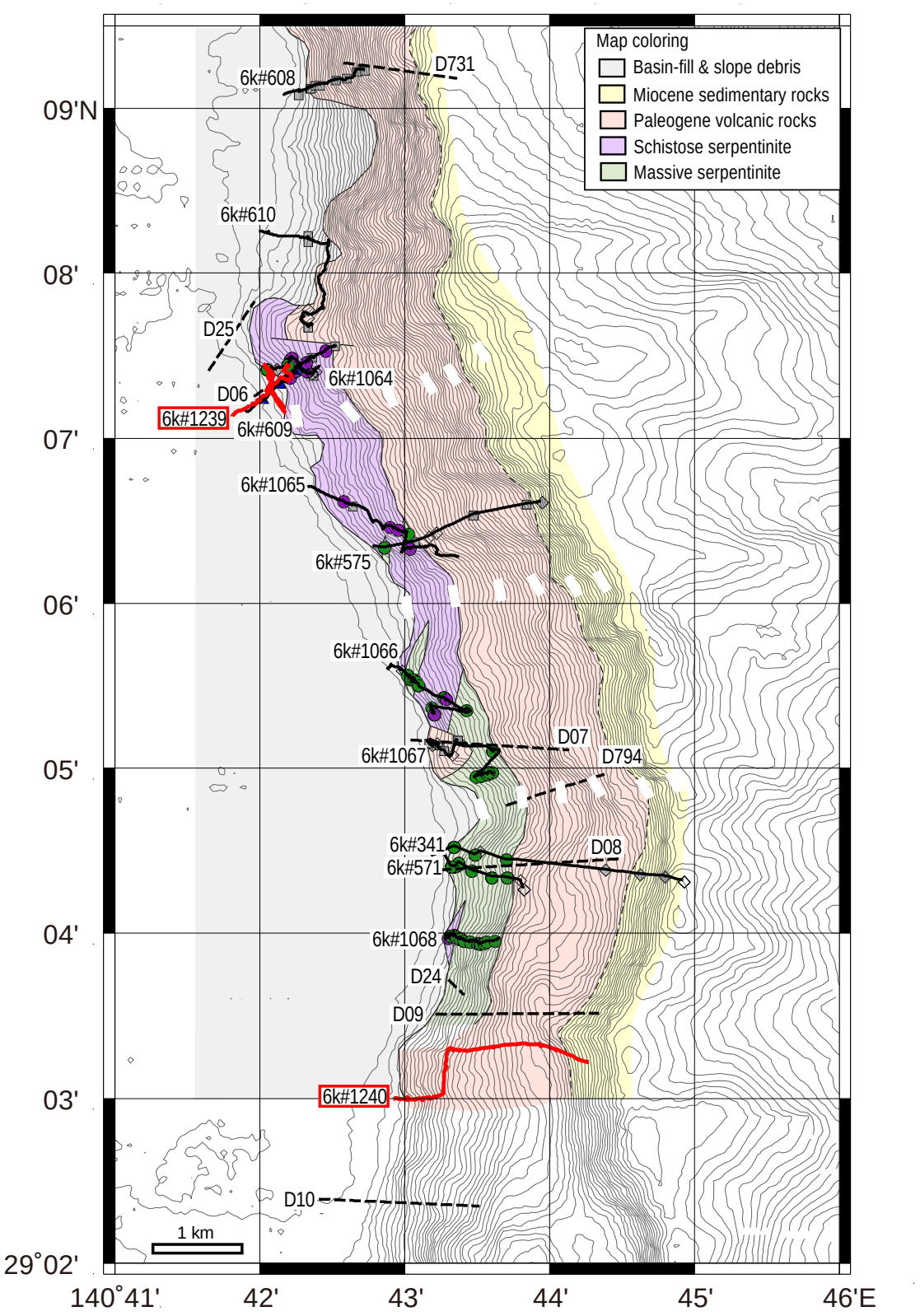

Fig. 4 6k#1239 and #1240 dive tracks plotted on preliminarily revised geological map of the Ohmachi Seamount.

Appendix: Onboard members of S/V Yokosuka YK10-13 Leg2 Cruise

SHINKAI 6500 Operation Team

Operation Manager	Toshiaki Sakurai	2st Submersible Staff	Keigo Suzuki
Sub Operation Manager	Satoshi Ogura	2st Submersible Staff	Yosuke Chida
Sub Operation Manager	Kazuhiro Chiba	2nd Submersible Staff	Akihisa Ishikawa
1st Submersible Staff	Kazuki Iijima	2nd Submersible Staff	Takuma Ohnishi
1st Submersible Staff	Keita Matsumoto	3rd Submersible Staff	Hitomi Ikeda
1st Submersible Staff	Masanobu Yanagitani	3rd Submersible Staff	Yudai Tayama
		3rd Submersible Staff	Masaya Katagiri

S/V YOKOSUKA Crews

Captain	Satoshi Susami	Able Seamen	Kuniharu Kadoguchi
Chief Officer	Takafumi Aoki	Able Seamen	Saikan Hirai
2nd Officer	Shintaro hashimoto	Sailer	Shun Abe
3rd Officer	Yumihiko Kobayashi	Sailer	Takuya Miyashita
Chief Engineer	Toshihiro Kimura	No.1 Oiler	Kiyoshi Yahata
1st Engineer	Kazunori Noguchi	Oiler	Yuki Nakahara
2nd Engineer	Saburo Sakaemura	Oiler	Daiki Sato
3rd Engineer	Kenichi Shirakata	Oiler	Yoshinori kawai
Chief Radio Operator	Masashi Takahashi	Oiler	Masami Ueda
2nd Radio Operator	Hiroki Ishiwata	Chief Steward	Takeshi Miyauchi
3rd Radio Operator	Mai Minamoto	Steward	Hiroki Fukuda
Boat Swain	Kazuo Abe	Steward	Yoshinobu Hasatani
Able Seamen	Naoki Iwasaki	Steward	Shigeto Ariyama
Able Seamen	Hatsuo Oda	Steward	Kazuma Sonoda