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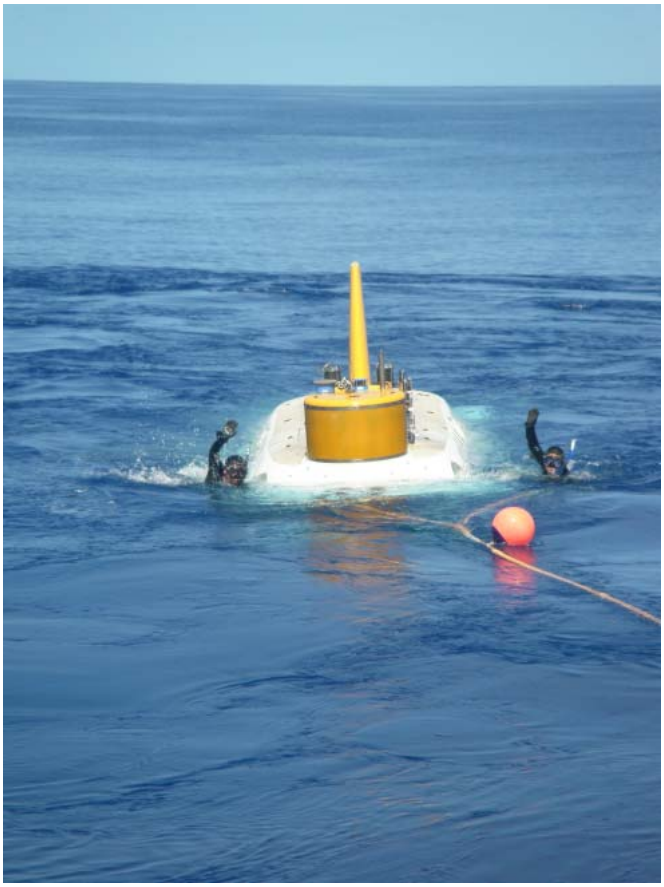
YOKOSUKA Cruise Report
YK10-05

“New insights into the oceanic lithosphere from petit-spot volcanoes around the Marcus Island”

Western Pacific around the Marcus Island



May 16, 2010 to June 5, 2010

Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

Contents page

1. Cruise Information

Cruise ID: YK10-05
Name of vessel: R/V YOKOSUKA

Title of the cruise: New insights into the oceanic lithosphere from petit-spot volcanoes around the Marcus Island

Title of the proposal: New insights into the oceanic lithosphere from petit-spot volcanoes around the Marcus Island

Cruise period: May 16 to June 5, 2010
Ports of call: Yokosuka Branch, JAMSTEC to Takamatsu Port
Research area: Around the Marcus Island (Minami-torishima), western Pacific

Research maps: Figs. 1-1, 1-2 and 1-3.

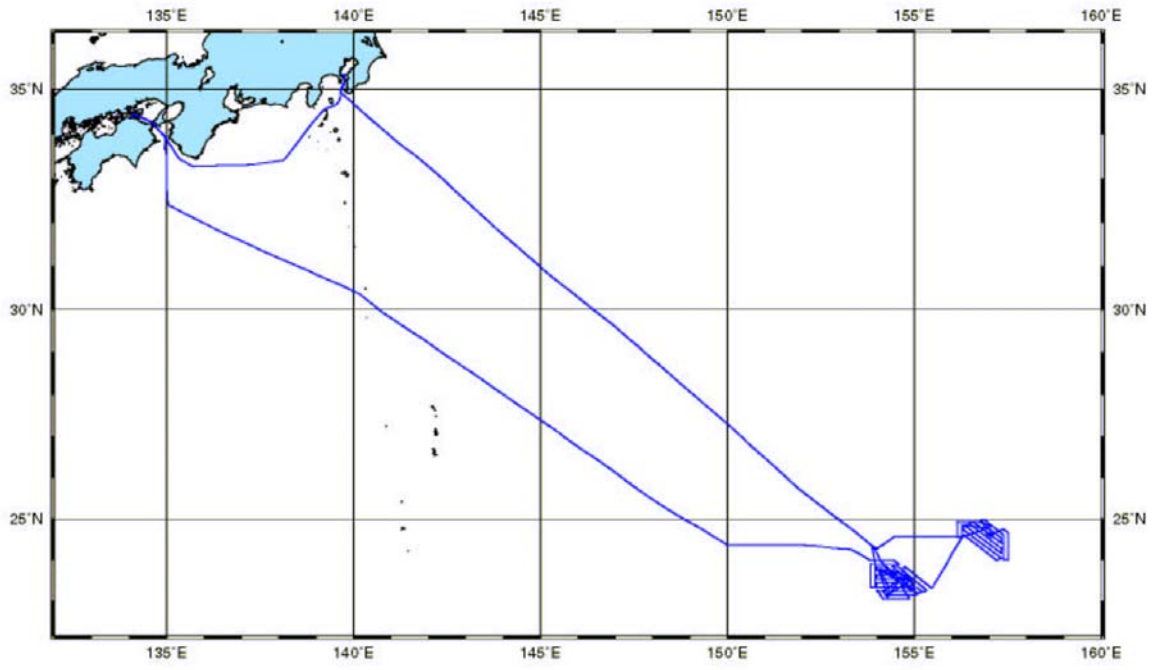


Fig. 1-1. Cruise track during the YK10-05 research cruise.

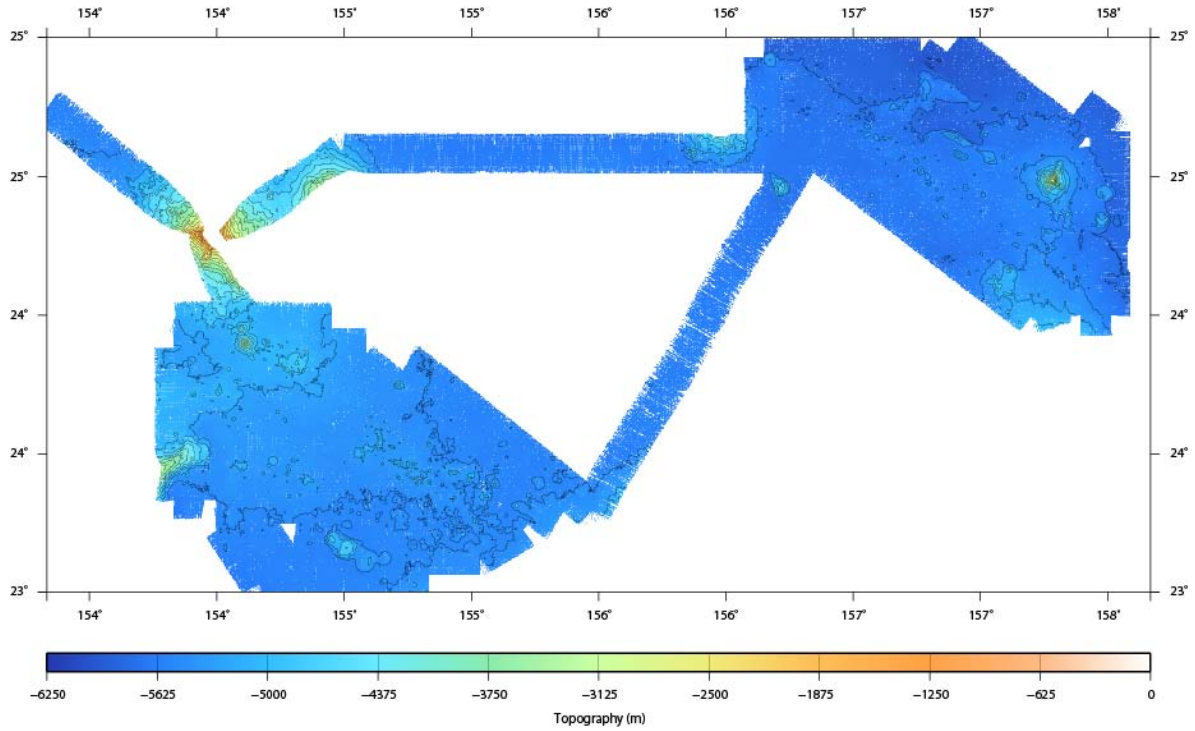


Fig. 1-2. Bathymetric map of survey areas around the Marcus Island (Minami-torishima).

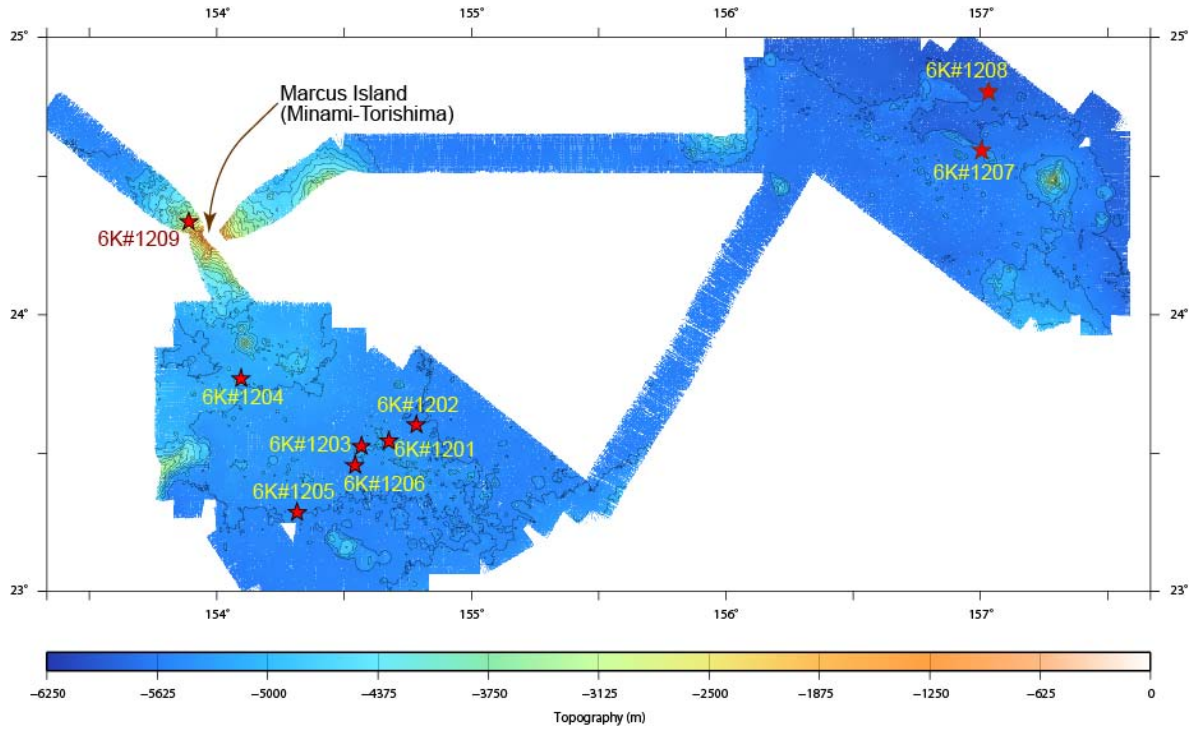


Fig. 1-3. Nine dive sites of 6K#1201 to 1209 by submersible *SHINKAI6500* on the bathymetric map of Fig. 1-2.

2. Researchers & Crews

Chief Scientist

Hirano, Naoto　　Assistant Professor, Tohoku University

Chief researcher of the project;

"New insights into the oceanic lithosphere from petit-spot volcanoes around the Marcus Island"

Onboard Researchers

Vice-chief Scientist	Machida, Shiki	Research Assistant, Waseda University
Scientist	Morishita, Taisei	Foreperson of Investigators, Japan Coast Guard
Scientist	Ishii, Teruaki	Researcher, Fukada Geological Institute
Scientist	Shimizu, Kenji	Researcher, JAMSTEC
Scientist	Ijuin, Yu	Postgraduate Student, Tohoku University
Scientist	Machida, Satoshi	Postgraduate Student, Tohoku University
Scientist	Hosoi, Jun	Postgraduate Student, Ibaraki University
Scientist	Suzuki, Takahito	Postgraduate Student, Kanazawa University
Scientist	Kato, Jinya	Postgraduate Student, Tokyo Institute of Technology
Scientist	Imada, Saori	Postgraduate Student, Tokyo Institute of Technology
Marine Technician	Hosoya, Shinichi	Nippon Marine Enterprises, Ltd.

Shore-based Researchers

Scientist	Nakanishi, Masao	Associate Professor, Chiba University
Scientist	Morishita, Tomoaki	Adjunct Associate Professor, Kanazawa University
Scientist	Oikawa, Mituhiro	Investigator, Japan Coast Guard
Scientist	Anthony Koppers	Associate Professor, Oregon State University
Scientist	Yamamoto, Junji	Assistant Professor, Kyoto University
Scientist	Matsubara, Noritaka	Research Assiatant, University of Hyogo

Crews of the R/V YOKOSUKA

Captain	Ukekura, Eiko
Chief Officer	Aoki, Takafumi
2nd Officer	Shirayama, Tetsuo
3nd Officer	Ito, Masashi
Chief Engineer	Kikkawa, Hiroyoshi
1st Engineer	Matsukawa, Kimio
2nd Engineer	Sakaemura, Saburo
3rd Engineer	Ikeguchi, Kenta

Chief Radio Off.	Akama, Hideyuki
2nd Elect. Off.	Ishiwata, Hiroki
3rd Elect. Off.	Minamoto, Mai
Boatswain	Abe, Kazuo
Able Seaman	Toguchi, Tadahiko
Able Seaman	Oda, Hatsuo
Able Seaman	Ichikawa, Nobuyuki
Able Seaman	Hirai, Saikan
Sailor	Yanagitani, Daisuke
Sailor	Abe, Shun
Sailor	Miura, Kozo
Oiler	Kawai, Yoshinori
Assistant Oiler	Ueda, Masanori
Assistant Oiler	Suzuki, Yuta
Assistant Oiler	Matsui, Toshinori
Chief Steward	Miyauchi, Takeshi
Steward	Ariyama, Shigeto
Steward	Kirita, Koji
Steward	Abe, Takahiro
Steward	Ito, Kei

Shinkai 6500 Operation team

Senior pilot operation manager	Sakurai, Toshiaki
Pilot assistant operation manager	Chiba, Kazuhiro
Chief pilot mechanic	Yoshiume, Tsuyoshi
Pilot chief mechanic	Matsumoto, Keita
Pilot / mechanic chief acoustic navigater	Yanagitani, Masanobu
Pilot mechanic	Ueki, Hirofumi
Pilot mechanic	Chida, Yosuke
Co-pilot mechanic	Suzuki, Keigo
Co-pilot mechanic / acoustic navigater	Saitou, Fumitaka
Co-pilot mechanic / acoustic navigater	Oonishi, Takumi
Mechanic	Tayama, Yudai
Mechanic	Ikeda, Hitomi

3. Objectives & Background

by Naoto Hirano

Until recently, no present-day volcanic activity had been documented on the cool, thick, and old Cretaceous lithosphere; however, Hirano et al. (2001; 2006; 2008) reported the presence of anomalously young alkali-basalt lavas (0 to 8 Ma Ar-Ar ages) on the subducting, ~130 Ma Pacific Plate. Volcanic eruption of the newly discovered lava field occurred on approximately 600 km ESE off the northern Japan Trench based on the present absolute motion of the Pacific Plate (Gripp and Gordon, 1990). This point coincides with the flexural part of the outer rise at present, so that we need to explain how and why such young lavas erupted on the aseismic ocean floor.

Hirano et al. (2006) proposed that magma from the asthenosphere may have escaped along plate fractures that occur in the flexed outer-rise of the Pacific Plate (Fig. 3-1). Based on their model, petit-spot volcanoes could be ubiquitous in the ocean basins, as a constant source of small-degree mantle melts may presently be stored in the asthenosphere, ready to escape to the surface whenever and wherever the oceanic plate flexes and forms fissures. In this paper we present the results of an exploratory search for petit-spot volcanoes on the outer-rises of subduction zones in the north- and southwest Pacific Ocean.

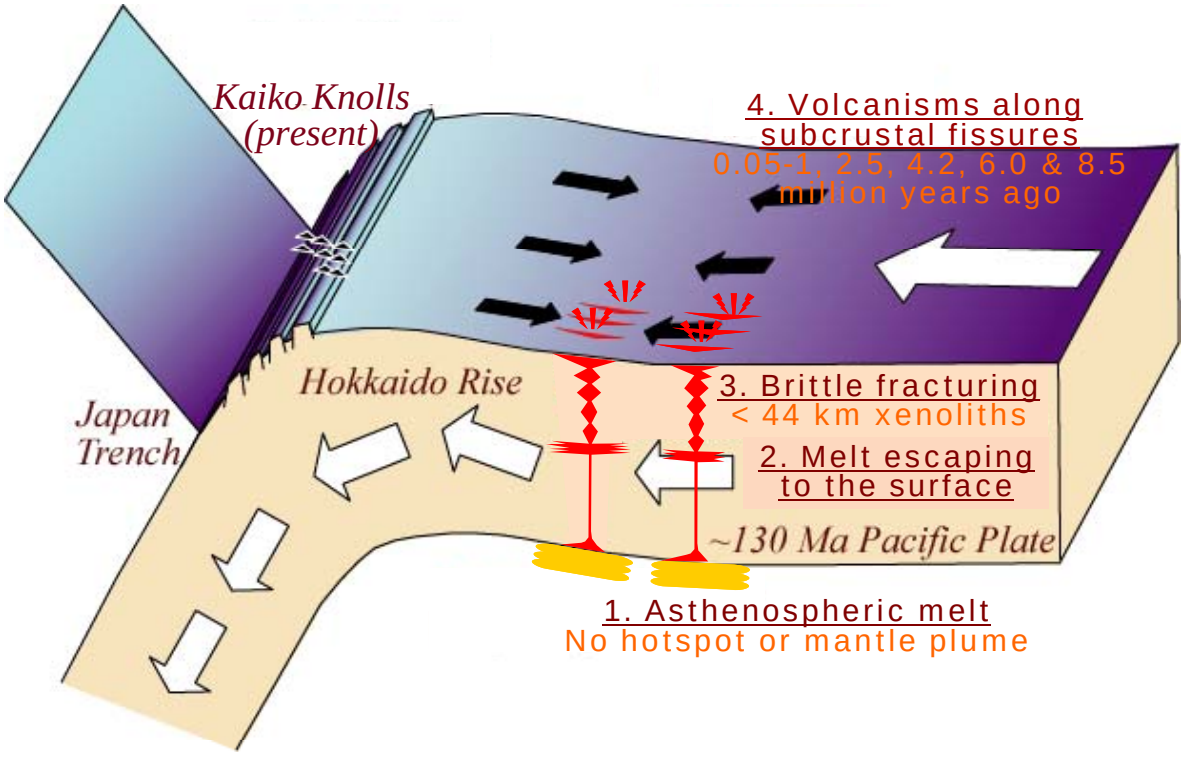


Fig. 3-1. Model of the formation of petit-spot volcanoes modified after Hirano et al. (2006).

The plate tectonics theory suggested by Morgan (1968) was breakthrough of the Earth Science to be able to explain many phenomena on the Earth (e.g. earthquake, volcanoes, oceanic plate evolution, continental moving). Plate motions are Earth's most important tectonic processes, because a tectonic plate moves on the nearly spherical surface of Earth and because a plate works as excellent approximation to be rigid, and plate motions can be represented simply as rigid body rotations. In the limiting case of geologically recent motion, the time derivative of rigid-body rotation can be described by angular velocity, which is an axial vector. The assumption of plate rigidity allows geometrically precise and rigorously testable predictions to be made. The observed near rigidity of the plates also permits the treatment of plate kinematics separately from dynamics. Abundant data describe the geologically recent motion across narrow boundaries linking nearly all the major plates, permitting many tests of plate tectonic predictions.

The dynamics of the Earth's interior is reflected in process at the Earth's surface: due to mantle convection, lithospheric plates experience stress and move in response, based on the overlaying rigid plate (lithosphere) on the ductile asthenosphere, which is the engine of the plate tectonics. The asthenosphere is approximately 200 km thick and, owing to its depth below the Earth's surface. Here the mantle deforms by plastic flow in response to applied pressures above 100 MPa (lithosphere). This zone is considered coincidental with the low-velocity zone of the upper mantle. The asthenosphere is solid even though it is at very hot temperatures of about 1600 ^{o}C due to the high pressures from above. However, at this temperature, minerals are almost ready to melt and they become ductile and can be pushed and deformed like silly putty in response to the warmth of the Earth. These rocks actually flow, moving in response to the stresses placed upon them by the churning motions of the deep interior of the Earth. The flowing asthenosphere carries the lithosphere of the Earth, including the continents, on its back. Although scientists had originally believed that asthenosphere will be melting when the plate tectonics theory suggested, a model that the hydrogens in water in determining the structure of the lithosphere- asthenosphere boundary behave as the role of phase transformation in controlling the density and plastic flow properties of Earth's materials and that the asthenosphere is not necessarily melting (Karato, 1990; Karato and Jung, 1998). However, we do not know "What is asthenosphere?" "Which is that melting or not?" yet.

It thus is important to search for other examples of petit-spot volcanoes. This may help us to address some important first order questions. For example, are the petit-spot volcanoes observed by Hirano *et al.* (2006) isolated features or are they a phenomenon that always accompanies plate flexure? In this cruise, we will look at acoustic reflective data (i.e., sidescan data) that was collected during modern shipboard bathymetrical surveys. These reflectivity data provide us with a powerful tool to help locate the petit-spot volcanoes, because they are too small to be reliably detected by multibeam bathymetry, as they are only 1

to 2 km in diameter and only a few hundred meters in height. In addition, the specific nature of the asthenosphere below the Cretacesou and/or Jurassic Pacific Plate, the geophysical data are ambiguous (Shimamura *et al.*, 1983; Shinohara *et al.*, 2008). The study and documentation of petit-spots on the Pacific Plate provide a practical way of establishing the Earth's asthenosphere as a zone of partial melting.

Oikawa and Morishita (2009) shows the precise bathymetric data acquired by Japan Coast Guard around the Marcus Island. The clusters of small conical volcanoes were discovered in this area located at southeast of Marcus Island (Minami−Tori Shima). Almost all cones which belong to the cluster are hundred meters in height and less than 10 km in diameter. They mentioned that their morphological characteristics are very similar to petit-spot volcanoes near Japan Trench, northwestern Pacific Plate (Hirano et al., 2006). The scope of this cruise is for searching the petit-spot volcanoes sites A & B near the Marcus Island (Minami-Tori Island), and observing the Cretaceous seamount volcano of the Marcus Island at the site C on the western Pacific Plate (Fig. 3-2). Strongly vesicular and undifferentiated lavas for petit-spot may have occurred the peculiar eruption on the abyssal plain. We observed the eruption style and the stratigraphy of volcanoes using the submersible *SHINKAI 6500*.

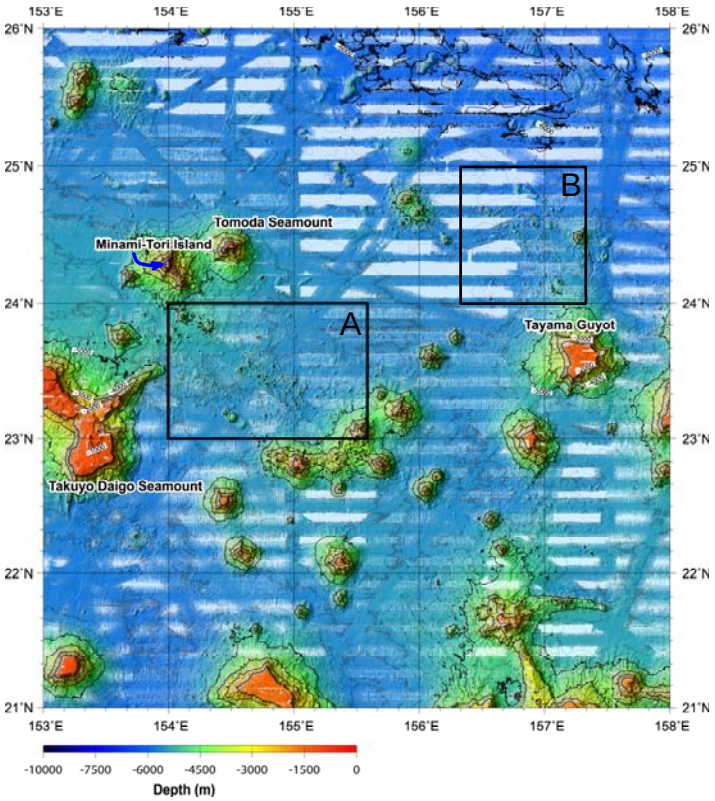


Fig. 3-2. Research areas, Sites A and B, around the Marcus Island. Site C is northwestern part of the island. Bathymeric data are from Oikawa and Morishita (2009).

4. Observation

4.1. Activities

4.1.1. Cruise Log

2010/05/16

13:00	Onboard
14:00	Departure from YOKOSUKA(JAMSTEC)
15:00-15:30	Briefing about ship's life and safety
15:30-16:00	Scientific meeting
16:40-17:00	Pray for safety of cruise to KONPIRASAN

2010/05/17

Weather: fine but cloudy / Wind direction: NNE/ Wind force: 3/ Wave: 2 m/ Swell: 1 m/ Visibility: 8 nautical miles (12:00 JST)

09:00-09:30	Shinikai6500 team and scientists meeting
10:30-11:10	Tour of ship
13:30-15:30	Briefing about Shinikai6500
15:00-17:00	Setup the laboratory
18:30-19:00	Scientific Seminar (by Hirano) and Meeting

2010/05/18

Weather: fine but cloudy / Wind direction: NE/ Wind force: 6/ Wave: 4 m/ Swell: 4 m/ Visibility: 8 nautical miles (12:00 JST+1h)

10:00-11:30	Tour of Shinikai6500
14:00-15:00	Engine room excursion
15:00-17:00	Setup the laboratory
18:30-19:45	Scientific Seminar (by Machida, Sa. & Hosoi) and Meeting

2010/05/19

Weather: cloudy / Wind direction: NE/ Wind force: 6/ Wave: 4 m/ Swell: 3 m/ Visibility: 9 nautical miles (12:00 JST+1h)

07:40	Arrived at survey area “C”
07:44	XBT
07:50	Proton magnetometer deployed
08:54-11:08	MBES mapping survey for 6K dive
12:45	Arrived at survey area “A”
12:47	XBT
13:20-20:24	MBES mapping survey for 6K dive
18:30-19:30	Scientific Seminar (by Suzuki & Imada) and meeting

21:36 Start of the geological survey

2010/05/20

Weather: fine but cloudy/ Wind direction: ENE/ Wind force: 5/ Wave: 4 m/ Swell: 4 m/ Visibility: 7 nautical miles (12:00 JST+1h)

05:30 End of the geological survey
06:21 Proton magnetometer on deck
08:54 Launch Sinkai6500 (6K#1201dive)
11:13 6K lands (5,386m)
14:41 6K leaves the bottom (5,273m)
16:49 6K on deck
17:20 Proton magnetometer deployed
17:57-19:21 MBES mapping survey for 6K dive
19:30-20:30 Scientific Meeting
20:32 Start of the geological survey

2010/05/21

Weather: fine but cloudy/ Wind direction: ENE/ Wind force: 4/ Wave: 3 m/ Swell: 4 m/ Visibility: 8 nautical miles (12:00 JST+1h)

04:38 End of the geological survey
06:21 Proton magnetometer on deck
09:00 Launch Sinkai6500 (6K#1202dive)
11:18 6K lands (5,430m)
14:51 6K leaves the bottom (5,396m)
17:03 6K on deck
17:33 Proton magnetometer deployed
19:30-20:30 Scientific Meeting
19:48-20:20 MBES mapping survey for 6K dive
20:28 Start of the geological survey

2010/05/22

Weather: fine but cloudy/ Wind direction: South/ Wind force: 2/ Wave: 2 m/ Swell: 2 m/ Visibility: 7 nautical miles (12:00 JST+1h)

06:12 End of the geological survey
06:24 Proton magnetometer on deck
08:52 Launch Sinkai6500 (6K#1203dive)
11:00 6K lands (5,196m)
14:49 6K leaves the bottom (4,943m)
17:04 6K on deck
17:44 Proton magnetometer deployed
19:15-19:45 Scientific Meeting

19:40-20:30 MBES mapping survey for 6K dive
23:07 Start of the geological survey

2010/05/23

Weather: fine but cloudy/ Wind direction: West/ Wind force: 2/ Wave: 1 m/ Swell: 1 m/ Visibility: 8 nautical miles (12:00 JST+1h)

02:00 End of the geological survey
06:18 Proton magnetometer on deck
08:53 Launch Sinkai6500 (6K#1204dive)
10:57 6K lands (5,194m)
14:50 6K leaves the bottom (4,808m)
17:04 6K on deck
17:35 Proton magnetometer deployed
19:15-19:45 Scientific Meeting
19:34-20:07 MBES mapping survey for 6K dive
20:43 Start of the geological survey

2010/05/24

Weather: fine but cloudy/ Wind direction: ENE/ Wind force: 4/ Wave: 3 m/ Swell: 3 m/ Visibility: 8 nautical miles (12:00 JST+1h)

03:02 End of the geological survey
05:34-05:46 Eight figure turn
06:19 Proton magnetometer on deck
08:52 Launch Sinkai6500 (6K#1205dive)
11:05 6K lands (5,463m)
14:52 6K leaves the bottom (5,233m)
17:06 6K on deck
17:35 Proton magnetometer deployed
19:15-19:45 Scientific Meeting
18:58-19:31 MBES mapping survey for 6K dive
21:41 Start of the geological survey

2010/05/25

Weather: fine but cloudy/ Wind direction: NE/ Wind force: 3/ Wave: 2 m/ Swell: 2 m/ Visibility: 8 nautical miles (12:00 JST+1h)

04:08 End of the geological survey
06:22 Proton magnetometer on deck
08:49 Launch Sinkai6500 (6K#1206dive)
11:07 6K lands (5,391m)
14:50 6K leaves the bottom (5,141m)
16:57 6K on deck

17:24 Proton magnetometer deployed
19:15-20:15 Scientific Meeting
19:09-23:08 Start of the geological survey
23:10 Transit to survey area “B”

2010/05/26

Weather: fine but cloudy/ Wind direction: East/ Wind force: 3/ Wave: 2 m/ Swell: 3 m/ Visibility: 8 nautical miles (12:00 JST+1h)

05:45 Arrived at survey area “B”
05:53 XBT
06:17 Start of the geological survey

2010/05/27

Weather: fine but cloudy/ Wind direction: SE/ Wind force: 4/ Wave: 3 m/ Swell: 3 m/ Visibility: 8 nautical miles (12:00 JST+1h)

Start of the geological survey
10:00 Rock party
12:35-13:25 MBES mapping survey for 6K dive
14:00-15:30 Scientific Seminar (by Ijuin & Kato)
16:00-17:00 Green Beach party
16:52-17:06 Eight figure turn

2010/05/28

Weather: fine but cloudy/ Wind direction: SE/ Wind force: 3/ Wave: 2 m/ Swell: 2 m/ Visibility: 8 nautical miles (12:00 JST+1h)

04:02 End of the geological survey
06:20 Proton magnetometer on deck
08:54 Launch Sinkai6500 (6K#1207dive)
11:07 6K lands (5,503m)
14:51 6K leaves the bottom (5,226m)
17:12 6K on deck
17:39 Proton magnetometer deployed
18:41-19:18 MBES mapping survey for 6K dive
19:15-19:45 Scientific Meeting
20:25 Start of the geological survey

2010/05/29

Weather: fine but cloudy/ Wind direction: South/ Wind force: 3/ Wave: 2 m/ Swell: 2 m/ Visibility: 8 nautical miles (12:00 JST+1h)

03:29 End of the geological survey
06:18 Proton magnetometer on deck
08:47 Launch Sinkai6500 (6K#1208dive)

11:09 6K lands (5,784m)
15:00 6K leaves the bottom (5,637m)
17:23 6K on deck
17:45 Transit to survey area “B”
19:15-19:45 Scientific Meeting
20:25 Start of the geological survey

2010/05/30

Weather: overcast/ Wind direction:SW/ Wind force: 6/ Wave: 4 m/ Swell: 4 m/ Visibility: 6 nautical miles (12:00 JST+1h)

03:04 End of the geological survey
07:00 Arrived at survey area “C”
08:52 Launch Sinkai6500 (6K#1209dive)
10:29 6K lands (3,709m)
15:24 6K leaves the bottom (3,089m)
17:06 6K on deck
17:30 Transit to survey area “C”
18:45 Arrived at survey area “A”
19:45-20:20 Scientific Meeting
19:00 Start of the geological survey

2010/05/31

Weather: fine but cloudy/ Wind direction: SSW/ Wind force: 6/ Wave: 4 m/ Swell: 4 m/ Visibility: 8 nautical miles (12:00 JST+1h)

08:21 End of the geological survey
08:30 Transit to “TAKAMATSU”
18:30-20:00 Scientific Seminar (by Machida, Sh.) and Meeting

2010/06/01

Weather: rain/ Wind direction: NE/ Wind force: 5/ Wave: 3 m/ Swell: 4 m/ Visibility: 6 nautical miles (12:00 JST+1h)

Transit to “TAKAMATSU”

15:30-16:30 Scientific Seminar (by Morishita)
18:30-19:00 Scientific Meeting

2010/06/02

Weather: cloudy / Wind direction: NE/ Wind force: 5/ Wave: 4 m/ Swell: 4 m/ Visibility: 7 nautical miles (12:00 JST)

Transit to “TAKAMATSU”

09:00-09:30 Seminar for crews

2010/06/03

Weather: fine but cloudy / Wind direction: ENE/ Wind force: 5/ Wave: 3 m/ Swell: 3 m/

Visibility: 10 nautical miles (12:00 JST)

Transit to “TAKAMATSU”

15:00-16:00 Cleaning the laboratory

2010/06/04

Weather: fine but cloudy / Wind direction: ESE/ Wind force: 2/ Wave: 1 m/ Swell: 1 m/

Visibility: 7 nautical miles (12:00 JST)

13:15 Arrival at “TAKAMATSU”, YK10-05 finish and disembarkation

2010/06/05

Weather: fine

12:00 All onboard researchers disembarked.

4.1.2. 6K Dive Logs

YK10-05 cruise operated the nine dives 6K#1201 to 6K#1209, at the Sites A and B (see Fig. 3-2), and Site C (northwestern slope of Marcus Island), western Pacific. 6K#1201 to 1206 dives were conducted at Site A. 6K#1207 and 1208 dives were done at Site B. The last dive of this cruise, 6K#1209 dive, dove at Site C on the northwestern slope of Marcus Island (Minami-Torishima). The dive logs, related information and corrected samples, however, are confidential matters.

4.1.3. Multibeam Survey

Multi-narrow beam echo sounder (SeaBeam2112.004) surveyed bathymetry and acoustic reflectivity of western Pacific, which was powerful tool to search the volcanoes during YK10-05. The track lines are shown in Fig. 1-1. The data are confidential matters.

4.1.4. Magnetometers & Gravity Meter

During the YK10-05 cruise, geophysical surveys, whose items included were gravity and geomagnetics, were conducted aboard the R/V Yokosuka. The aim of the geophysical surveys was to provide a detailed geophysical characterization of the lithosphere and seamounts in the western Pacific on and off-axis ridge flanks, which will be used to unravel tectonic evolution and crustal structure.

Shipboard gravity anomaly will be used for analysis of the crustal structure combined with bathymetry and seismic reflection data. Analysis of lithospheric flexure and deformation using satellite derived gravity anomaly combined with the shipboard gravity anomaly may be helpful as well.

4.2. Methods & Instruments

4.2.1. R/V Yokosuka

R/V Yokosuka is designed serve as the mother vessel for Shinkai 6500 and Autonomous Underwater Vehicle Urashima. It has silent engine an advanced acoustic navigation systems and an underwater telephone for its state of the art operations.

There are 4 laboratories on Yokosuka, No.1～No.3 laboratories and No.1 Study room. No.1 Lab. has dry space. permanent installations are video editing system, PC and printer. No.2 Lab. has semi - dry and wet space. There are two freezers (-40 & -80 deg.C), incubator, Milli-Q, fumigation chamber at dry one, and wet one has rock saw. No.3 Lab. has dry space with storage.No.1 Study room has dry space, there are gravity meter, data acquisition system of gravity meter, 3 axis fluxgate magnet meter and also proton magnet meter, work station for data processing, and A0 size plotter.

Table 4-2-1. The principal specifications of R/V Yokosuka

Length overall	105.2 m
Beam overall	16.0 m
Depth	7.3 m
Draft	4.5 m
Gross tonnage	4,439 tons
Service speed	16knot
Complement	
Crew	27 persons
Submersible operation staff	18 persons
Researchers	15 persons
Total	60persons
Main propulsion system	Diesel engines: 2,206kW x 2
Main propulsion method	Controllable pitch propeller x 2

4.2.2. Sea Beam, Magnetometer & Gravity Meter

Yokosuka is equipped with various kinds of underway geophysical equipment, Multi Narrow Beam Echo Sounder (Sea Beam 2112.004, Sea Beam Instruments, Inc.), Gravity meter (Type S-63, LaCoste & Romberg Gravity Meters Inc.), Ship borne 3 axis magnet meter (Type SFG-1212, Tierra Technica Inc.), and Proton magnet meter (Type STC 10, Kawasaki Geological Engineering Co., Ltd.).

Table 4-2-2. The specifications of MBES

measurement depth (m)	100～11,000
measurement range (deg.)	90～150
measurement frequency(kHz)	12
measurement method	cross fan beam style
accuracy	0.2%(center)～0.5%(outer)
beam width(deg.)	2
beam interval(deg.)	1
swath width(deg.)	150(～300m) 120(～4500m) 100(～8,000m) 90(～11,000m)
sampling rate(m sec.)	1.33 or 2.67
roll(deg.)	±20
pitch(deg.)	±7.5

Table 4-2-3. The specifications of Gravity meter

measurement range (m Gal)	12,000
drift	3mGal per month or less
stabilized platform	
platform pitch(deg.)	±22
platform roll(deg.)	±25
platform period(min.)	4 to 4.5
beam interval(deg.)	1
control system	
recording rate(Hz)	1
serial out put	RS-232
system performance	
resolution(mGal)	0.01
static repeatability(mGal)	0.05
50,000m Gal horizontal acceleration(mGal)	0.25
100,000m Gal horizontal acceleration(mGal)	0.50
100,000m Gal vertical acceleration(mGal)	0.25
dimension(cm)	71×56×84
weight(kg)	Meter:86, UPS:30

Table 4-2-4. The specifications of 3 axis magnet meter

system	ring core fluxgate
number of component	directly 3 axis
cable length(m)	50
sensor dimension(mm)	ϕ 280×130H
measurement range (nT)	±100000
resolution (nT)	1

Table 4-2-5. The specifications of Proton magnet meter

measurement range (nT)	3～7×10^4
resolution (nT)	0.01
sampling rate	10sec,20sec,1min,manual,external
time of applying field(sec.)	3 to 10
sensor dimension(mm)	ϕ 200×1050
weight(kg)	28.6(in the air), 6.2(in the sea)

5. Preliminary Results confidential matters

6. Future Studies & Research Interest confidential matters

7. Bibliography

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8. Notice of 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 latest information.

Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.

The rock samples and data during 6K dives and onboard multibeam surveys on this cruise are absolutely confidential matters during 2 years after YK10-05 cruise.

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1201-R01		160	130	80	1750
#1201-R02		110	85	30	600
#1201-R03		250	240	50	4800
#1201-R04		175	125	40	950
#1201-R05SC					20
#1201-unknown					140
				total	8260

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1202-R01				
#1202-R02				
#1202-R03	43	27	27	23
#1202-R04	170	115	90	990
#1202-R05	135	75	75	280
#1202-R06	130	95	50	520
#1202-R07	130	130	55	700
#1202-R08	105	85	45	530
#1202-R09	135	125	55	880
#1202-R10	80	60	40	150
#1202-R11	65	50	20	60
#1202-R12	95	80	40	310
#1202-R13	120	70	60	440
#1202-R14	200	118	105	1600
			total	6483

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1203-R01	250	150	85	1600
#1203-R02	105	90	80	400
#1203-R03	100	45	40	200
#1203-R04	240	270	115	2250
#1203-R05	130	90	50	340
#1203-R06	440	360	125	10700
#1203-R07	160	160	60	1320
#1203-R08	400	230	90	6200
#1203-R09	100	80	40	180
#1203-R10	470	300	180	10200
#1203-R11	290	240	90	5580
#1203-R12	330	300	90	7750
#1203-R13	220	180	70	2320
#1203-R14	260	210	70	1750
#1203-R15	315	110	170	10600
#1203-R16SC				650
#1203-R17	360	260	200	15200
#1203-R18	330	200	160	9200
#1203-R19	110	70	50	330
#1203-R20	170	150	100	2400
#1203-R21	220	140	90	2800
#1203-R22	170	130	120	2350
#1203-R23	200	170	120	3700
#1203-R24	230	200	130	4600
#1203-R25	240	170	160	6500
#1203-R26	155	125	120	1800
#1203-R27	200	180	120	3550
#1203-R28	270	185	200	10200
#1203-R29	290	155	45	1600
#1203-R30	185	180	40	900
#1203-R31	85	90	65	750
			total	127920

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1204-R01	180	145	80	1530
#1204-R02	90	85	40	210
#1204-R03	55	55	9	50
#1204-R04	53	24	15	30
#1204-R05	180	135	95	1500
#1204-R06	170	135	130	900
#1204-R07	120	90	35	350
#1204-R08	245	140	120	2530
#1204-R09	100	75	75	410
#1204-R10	150	110	95	1320
			total	8830

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z		Wt (g)
#1205-R01		230	180	130	6300
#1205-R02		100	92	66	650
#1205-R03		160	125	40	1200
#1205-R04		235	155	60	2100
#1205-R05		220	100	80	2200
#1205-R06		135	85	40	380
#1205-R07	?	?	?		420
#1205-R08	?	?	?		250
#1205-R09		270	205	155	10000
#1205-R10		240	160	65	2750
#1205-R11SC					150
#1205-R12		195	190	145	7700
#1205-unknown1		210	190	22	900
#1205-unknown2					200
				total	35200

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1206-R01	200	170	80	2200
#1206-R02	215	140	80	1600
#1206-R03	370	300	125	4450
#1206-R04	360	125	45	1900
#1206-R05	250	210	140	8650
#1206-R06	130	85	70	600
#1206-R07	180	140	50	1450
#1206-R08	250	195	120	3550
#1206-R09	420	330	250	22500
			total	46900

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1207-R01	80	110	90	850
#1207-R02	100	90	70	800
#1207-R03	100	70	70	750
#1207-R04	70	70	90	700
#1207-R05	80	75	90	750
#1207-R06SC				540
#1207-R07	210	90	80	2150
#1207-R08	120	80	35	550
#1207-R09	200	140	160	5200
#1207-R10	200	140	120	5500
#1207-R11	90	50	35	200
#1207-R12	90	60	40	400
			total	18390

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1208-R01	130	90	45	400
#1208-R02	80	60	50	250
#1208-R03	95	65	55	250
#1208-R04	125	100	65	850
#1208-R05	130	110	70	1150
#1208-R06	125	110	70	1000
#1208-R07	105	95	85	750
#1208-R08	145	115	70	1200
#1208-R09	140	140	65	1050
#1208-R10	120	100	60	650
#1208-R11	180	125	110	2000
#1208-R12	160	85	40	550
#1208-R13	70	60	50	200
#1208-R14	230	150	140	4000
#1208-R15	160	150	120	2050
			total	16350

Cruise:YK10-05

Sample No.	Diamiter (mm) X	Y	Z	Wt (g)
#1209-R01	210	140	55	2250
#1209-R02	180	115	100	3500
#1209-R03	150	90	60	1850
#1209-R04	160	80	65	950
#1209-R05	225	185	20	2400
#1209-R06	340	190	80	6800
#1209-R07	120	90	55	1000
#1209-R08	110	90	80	1100
#1209-R09	110	75	70	600
#1209-R10	140	120	65	1400
#1209-R11	50	40	39	100
#1209-R12	180	95	70	1850
#1209-R13	300	220	170	10750
#1209-R14	430	210	210	21450
#1209-R15	130	100	90	1100
#1209-R16	150	110	60	1200
#1209-R17	350	220	110	9650
#1209-R18	540	350	220	18500
#1209-R19	200	150	150	6050
#1209-R20	220	130	94	4150
#1209-unknown			?	
			total	96650

YK10-05 Rock Party

6K #1201	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1201-R01	1000																						○
6K #1201-R02	300																						○
6K #1201-R03	2000						1700	block															○
6K #1201-R04	400	block	300	block	100	block																	○
6K #1201-R05 (archive)																							○
6K #1201-unknown	0																						○

YK10-05 Rock Party

6K #1202	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
~~6K #1202-R01 (lost)~~																							
~~6K #1202-R02 (lost)~~																							
6K #1202-R03	10	block																					○
6K #1202-R04	250	block	500	block																			○
6K #1202-R05	100	block																					○
6K #1202-R06	250	block																					○
6K #1202-R07	350	block																					○
6K #1202-R08	100	block									50	chip	100	block									○
6K #1202-R09	400	block																					○
6K #1202-R10	100	block																					○
6K #1202-R11	40	block																					○
6K #1202-R12	150	block																					○
6K #1202-R13	250	block																					○
6K #1202-R14	800	block																					○
6K #1202-unknown																							○

YK10-05 Rock Party

6K #1203	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1203-R01	350	block	500	block	50	chip																	○
6K #1203-R02	250	block																					○
6K #1203-R03	150	block																					○
6K #1203-R04	500	block	750	block																			○
6K #1203-R05	180	block																					○
6K #1203-R06	3000	block	3500	block	50	chip	550	block	440	block													○
6K #1203-R07	250	block											500	block									○
6K #1203-R08	3500	block			50	chip																	○
6K #1203-R09	70	chip					50	chip															○
6K #1203-R10	3000	block	2500	block																			○
6K #1203-R11	3500	block																					○
6K #1203-R12	3750	block											4000	block									×
6K #1203-R13	1500	block																					○
6K #1203-R14	1100	block																					○
6K #1203-R15	2500	block	3000	slab	700	slab	500	slab	350	slab													○
6K #1203-R16	400	block																					○
6K #1203-R17	3500	block	5500	block	50	chip																	×
6K #1203-R18			2500	block	300	slab			2000	chip			2000										○
6K #1203-R19	100	block	150	block	50	chip																	○
6K #1203-R20	700	block	800	block																			○
6K #1203-R21	450	block	1000	block																			○
6K #1203-R22	700	block	600	block																			○
6K #1203-R23	800	block	900	block					350	chip	50	chip											○
6K #1203-R24	1300	block	1500	block			300	slab															○
6K #1203-R25	1200	block	1500	block	50	chip			280	chip													○
6K #1203-R26	800	block											1000	block									×
6K #1203-R27	650	block	800	block			400	slab															○
6K #1203-R28	2000	block	3500	block	500	slab			300	chip	50	chip											○
6K #1203-R29	950	block																					○
6K #1203-R30	500	block																					○
6K #1203-R31	400	block																					○
6K #1203-unknown	?																						○

YK10-05 Rock Party

6K #1204	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1204-R01	700	block																					○
6K #1204-R02	100	block																					○
6K #1204-R03	20	block																					○
6K #1204-R04	whole	block																					○
6K #1204-R05	500	block	600	block			50	slab	120	block													○
6K #1204-R06	400	block	200	block									200	block									○
6K #1204-R07	200	block																					○
6K #1204-R08	1000	block																					○
6K #1204-R09	150	block							50	block													○
6K #1204-R10	400	block																					○
6K #1204-unknown	?																						○

YK10-05 Rock Party

6K #1205	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1205-R01	2000	block	1000	slab	50	chip			300	slab													○
6K #1205-R02	200	block	200	slab	50	chip																	○
6K #1205-R03	400	block	400	slab	50	chip																	○
6K #1205-R04	600	block	600	slab	50	chip																	○
6K #1205-R05	600	block			100	slab																	○
6K #1205-R06	100	block	100	slab																			○
6K #1205-R07	150	block																					○
6K #1205-R08	100	block																					○
6K #1205-R09	2000	block	5000	slab	50	chip			300	slab													○
6K #1205-R10	800	block	1000	slab	50	chip																	○
6K #1205-R11	50	block							30	block													○
6K #1205-R12	2000	block	2000	slab	50	chip			330	slab													○
6K #1205-unknown1	300	block			50	chip																	○
6K #1205-unknown2	whole	block																					○

YK10-05 Rock Party

6K #1206	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1206-R01	700	block	500	slab	50	chip	10	slab	150	slab			500	block									○
6K #1206-R02	500	block			50	chip	50	block	100	slab			700	block									○
6K #1206-R03	1200	block	1200	slab	50	chip	10	slab	200	slab			1250	block									○
6K #1206-R04	600	block			50	chip	20	chip					400	block									○
6K #1206-R05	2800	block	800	slab	50	chip	10	slab	800	slab			4450	block									○
6K #1206-R06	200	block			50	chip							250	block									○
6K #1206-R07	500	block			50	chip							750	block									○
6K #1206-R08	1000	block	600	slab	50	chip							1000	block									○
6K #1206-R09	7000	block	4000	slab	50	chip	10	chip					10000	block									○
6K #1206-unknown	whole	block																					○

YK10-05 Rock Party

6K #1207	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1207-R01			475	block			450	block															×
6K #1207-R02	400	block	400	block																			×
6K #1207-R03					700 (half of this for 6K)		390	block											375	block			×
6K #1207-R04																							×
6K #1207-R05											375	slab	375	block									×
6K #1207-R06	160	block	170	block	50	chip																	○
6K #1207-R07	450	block	530	block	50	chip																	○
6K #1207-R08	100	block	150	block	50	chip																	○
6K #1207-R09	500	block	750	block	50	chip																	○
6K #1207-R10	800	block	970	block	50	chip																	○
6K #1207-R11																							○
6K #1207-R12			200	block																			○
6K #1207-unknown																							○

YK10-05 Rock Party

6K #1208	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1208-R01	170	block																					○
6K #1208-R02	130	block																					○
6K #1208-R03	150	block																					○
6K #1208-R04	180	block									200	slab											○
6K #1208-R05	280	slab																					○
6K #1208-R06	560	block																					○
6K #1208-R07	410	block																					○
6K #1208-R08	280	slab																					○
6K #1208-R09	630	block																					○
6K #1208-R10	360	block																					○
6K #1208-R11	480	block							530	block	200	slab											○
6K #1208-R12	260	block																					○
6K #1208-R13	100	block																					○
6K #1208-R14							2000	block															○
6K #1208-R15	450	slab							500	slab													○
6K #1208-unknown																							○

YK10-05 Rock Party

6K #1209	Hirano		Machida Shiki		Ishii		Shimizu		Morishita		Suzuki		Hosoi		Ijuin		Machida Satoshi		Imada		Kato		archive
Rock No.	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	weight (g)	style	
6K #1209-R01	1100	block			50	chip			210	slab													○
6K #1209-R02	800	block	900	block	50	chip			50	chip													○
6K #1209-R03	450	block	500	block	50	chip			50	chip													○
6K #1209-R04	200	block	300	block	50	chip			50	chip													○
6K #1209-R05	1300	block			50	chip																	○
6K #1209-R06	3500	block																					○
6K #1209-R07	600	block																					○
6K #1209-R08	650	block																					○
6K #1209-R09	130	block	150	block	50	chip			50	chip													○
6K #1209-R10	300	block	380	block					50	chip													○
6K #1209-R11					50	chip																	○
6K #1209-R12	950	block							50	chip													○
6K #1209-R13	5700	block			350	slab																	○
6K #1209-R14	5100	block	5500	block	350	slab			300	slab													○
6K #1209-R15	700	block																					○
6K #1209-R16	600	block							180	slab													○
6K #1209-R17	1500	block	1600	block	1000	block	1000	block															○
6K #1209-R18	3800	block	5500	block	350	slab			400	slab													○
6K #1209-R19	1500	block	1700	block	50	chip			50	chip													○
6K #1209-R20	1500	block	1500	block	50	chip			50	chip													○
6K #1209-unknown																							○

YK10-05 Rock Party

	Hirano	Machida Shiki	Ishii	Shimizu	Morishita	Suzuki	Hosoi	Ijuin	Machida Satoshi	Imada	Kato
DIVE No.	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)	weight (g)
6K #1201	3700	300	100	1700							
6K #1202	2800	500				50	100				
6K #1203	38050	29000	1800	1800	3720	100	7500				
6K #1204	3470	800		50	170		200				
6K #1205	9300	10300	500		660						
6K #1206	14500	7100	450	110	1250		19300				
6K #1207	2410	3645	950			375	375			375	
6K #1208	4440			2000	1030	400					
6K #1209	30380	18030	2500	1000	1490						
total	109050	69675	6300	6660	8320	925	27475			375	