



## R/V Yokosuka Cruise Report

YK13-09

*In situ* experimental & sampling study to understand  
abyssal biodiversity and biogeochemical cycles, western  
Pacific

Sep 18<sup>th</sup>, 2013 – Oct 2<sup>nd</sup>, 2013

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

●**Contents**

1. Cruise information

2. Researchers

2.1 On board scientists

2.2 Shinkai 6500 operation team

2.3 Crew members

3. Observation

3.1. General purpose

3.2. In situ experiments to reveal benthic activities and biogeochemical cycles on the seafloor

Hidetaka Nomaki and YK13-09, YK13-12 scientists

3.3. Significance of nitrification in oligotrophic deep sea sediments

Takuro Nunoura, Manabu Nishizawa

3.4. Distribution, genetic diversity and food preferences of Xenophyophorean foraminifers in the abyssal plain

Masashi Tsuchiya, Hidetaka Nomaki

3.5. Unveiling the drivers of virus-prokaryotes activity and interactions in abyssal ecosystems

Eugenio Rastelli and Bruna Petani

3.6. Acknowledgment

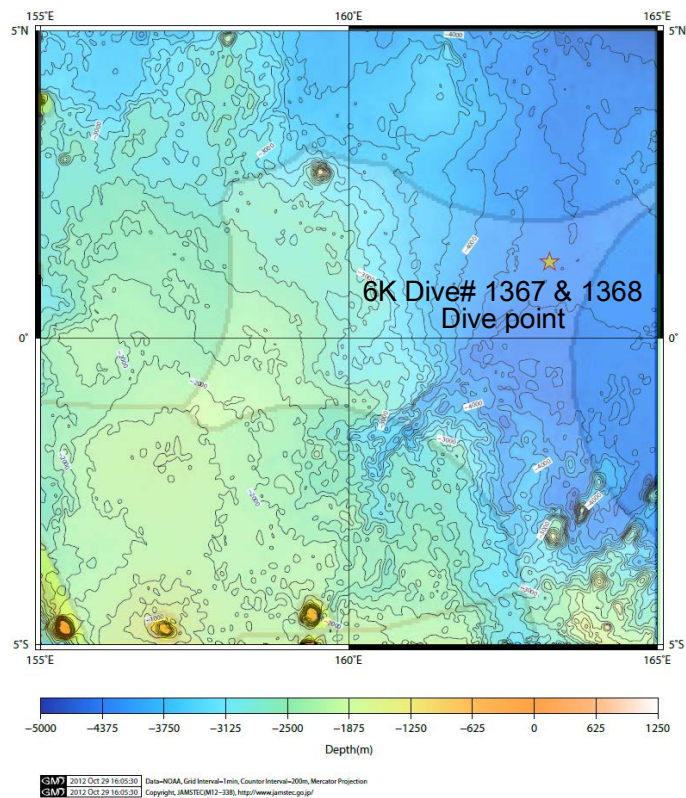
3.7. List of observation equipments

3.8. Cruise log

4. Notice on using

## 1. Cruise Information

- Cruise ID: YK13-09
- Name of vessel: R/V Yokosuka
- Title of the cruise: *In situ* experimental & sampling study to understand abyssal biodiversity and biogeochemical cycles
- Title of proposal: *In situ* experimental & sampling study to understand abyssal biodiversity and biogeochemical cycles
- Cruise period: 18<sup>th</sup> Sep to 2<sup>nd</sup> Oct, 2013
- Ports of call: Guam to Fiji
- Research area: western equatorial Pacific
- Research Map



## **2. Researchers**

### **2.1. Onboard scientists**

- Chief scientist [Affiliation]: Hidetaka Nomaki [JAMSTEC]
- Representative of the science party [Affiliation]: Hidetaka Nomaki [JAMSTEC]
- Science party (List) [Affiliation, assignment etc.]

Takuro Nunoura [JAMSTEC]

Masashi Tsuchiya [JAMSTEC]

Yuki Uejima [Kumamoto University]

Eugenio Rastelli [Polytechnic University of Marche]

Bruna Petani [Polytechnic University of Marche]

Toshimasa Nasu [Nippon Marine Enterprise]

### **2.2. Shinkai 6500 operation team**

|                         |                 |
|-------------------------|-----------------|
| Submersible Op. Manager | Kazuhiro Chiba  |
| 1st Submersible Staff   | Kazuki Iijima   |
| 1st Submersible Staff   | Mitsuhiro Ueki  |
| 1st Submersible Staff   | Keita Matsumoto |
| 2nd Submersible Staff   | Hirofumi Ueki   |
| 2nd Submersible Staff   | Fumitaka Saito  |
| 2nd Submersible Staff   | Takuma Onishi   |
| 3rd Submersible Staff   | Yudai Tayama    |

### **2.3 Crew members**

|                         |                    |
|-------------------------|--------------------|
| Captain                 | Shinya Ryono       |
| Chief Officer           | Naoto Kimura       |
| 2nd Officer             | Tetsuo Shirayama   |
| 3rd Officer             | Hiroharu Omae      |
| Chief Engineer          | Eiji Sakaguchi     |
| 1st Engineer            | Kazunori Noguchi   |
| 2nd Engineer            | Kenichi Shirakata  |
| 3rd Engineer            | Kota Kataoka       |
| Chief Radio officer     | Masamoto Takahashi |
| 2nd Electronic Operator | Hiroki Ishiwata    |
| 3rd Electronic Operator | Ryosuke Komatsu    |
| Boat Swain              | Yoshiaki Kawamura  |

|                |                    |
|----------------|--------------------|
| Quarter Master | Kazumi Ogasawara   |
| Quarter Master | Jiro Hanazawa      |
| Quarter Master | Daizuke Yanagitani |
| Sailor         | Kazuho Ikeda       |
| Sailor         | Yoshihiro Ogawa    |
| Sailor         | Kenta Nasu         |
| No.1 Oiler     | Kazuaki Nakai      |
| Oiler          | Shinya Sugi        |
| Oiler          | Masayuki Fujiwara  |
| Oiler          | Tatsuomi Chino     |
| Oiler          | Toshinori Matsui   |
| Chief Steward  | Sueto Sasaki       |
| Steward        | Shinsuke Tanaka    |
| Steward        | Masanao Kunita     |
| Steward        | Kazuma Sonoda      |
| Steward        | Shiho Shimizu      |

### **3. Observation**

#### **3.1. General purpose**

Abyssal plain covers roughly half areas of the Earth Surface, thus consist largest marine ecosystem on Earth and contains abundant benthic fauna living on and in the sediment. Abyssal plain ecosystem has been thought to be sustained by POM fluxes from the photic zone, which originated from photosynthesis. Since surface productivity of the ocean differs largely with latitude, distance from land, upwelling intensity, and so on, organic matter fluxes to the seafloor also varied with oceanic settings. Those differences in POM fluxes to the seafloor are believed to be major controlling factor of benthic diversity, biomass, sediment community oxygen consumption, etc. On the other hand, recent studies on sediment metagenomics reveal that some chemolithoautotrophic microbes may inhabit even in the “normal” deep-sea floor where no active hydrothermal vent or hydrocarbon seepage exist. However, there is no report on chemoautotrophic production rate at the deep-sea floor. In this study, we carried out sediment samplings and in situ incubation experiments to investigate diversity and biomass of benthos and relevant biogeochemical cycles at the deep-sea floor under different surface productivities.

#### **3.2. In situ experiments to reveal benthic activities and biogeochemical cycles on the seafloor**

Hidetaka Nomaki and YK13-09, YK13-12 scientists

We carried out 3 different in situ incubation experiments together with sediment geochemistry investigation at the 1N site ( $1^{\circ}15\text{N}$ ,  $163^{\circ}15\text{E}$ , water depth = 4277m) during dives #1367 and #1368 on 24th Sep and 26th Sep, respectively. The first incubation is to reveal the chemoautotrophic carbon production rate at the deep-sea floor using in situ incubation cores. The 2<sup>nd</sup> incubation is to reveal consumption of diatom and cyanobacteria by heterotrophic organisms in sediments using in situ incubation boxes. The third incubation is to reveal the effects of holothurians on microbial community and consumption rates of diatom and cyanobacteria using holothurians cages. All of the incubation were carried out for 2 days incubation and ~50 days incubation, which will be retrieved during YK13-12 cruise.

We collected sediment samples with push corer, water samples with Niskin water sampler, and megabenthos samples with slurp gun (suction sampler).

On board, sediment samples were sliced into different depth layers and subsampled for viral, microbial, geochemical, and meiofaunal analyses. Water samples were filtered on board and the filters were kept frozen. Megabenthos samples were preserved with either ethanol, formalin, or kept frozen.

### **3.3. Significance of nitrification in oligotrophic deep sea sediments**

Takuro Nunoura, Manabu Nishizawa (JAMSTEC)

Nitrification; oxidation of ammonia and nitrite to nitrite and nitrate, respectively, is one of the most dominant chemolithotrophic metabolisms in deep sea environments, and likely play significant roles in nitrogen cycle in marine sedimentary habitats. In fact, the presence and predominance of putative ammonia-oxidizing thaumarchaeotes in benthic archaeal communities has been reported. However, little is known about their in situ activity and significance in benthic nitrogen cycle. In this cruise, we took abyssal plain sediments from the north pacific gyre and equatorial pacific sites, and will examine the significance of nitrifier communities using molecular biological and stable isotopic approaches. Moreover, we conducted in situ incubation analyses to examine nitrification activity at the equatorial pacific site. The stable isotopic pore water chemistry and molecular biological approaches to the samples obtained by the in situ incubation will provide novel insights into the benthic nitrogen cycle under the relatively oligotrophic ocean.

### **3.4. Distribution, genetic diversity and food preferences of Xenophyophorean foraminifers in the abyssal plain**

Masashi Tsuchiya, Hidetaka Nomaki (JAMSTEC)

#### **Background**

Although foraminifers form an ecologically important link between bacteria and macrobenthos in biological and physical cycles in nature, not enough studies have been conducted to clarify this. Studies on protists are indispensable to clarify the biological diversity of the deep-sea floor.

A large unicellular foraminifera, Xenophyophore, have large cell up to 10 ~ 15 cm in diameter, making their body with reticulate, bush or fan-like structures. Several studies have been conducted for classification and time-lapse observation (e.g. Gooday et al. 1993). Recently, molecular phylogenetic studies and ultrastructural observation were carried out for Xenophyophore, *Shinkaiya lindsayi* (Lecroq et al. 2009). Interestingly, they have two kinds of cytoplasm, stercomare and granellae, although they are unicellular eukaryotes that accumulate heavy metals (Swinbanks and Shirayama 1986, Lecroq et al. 2009). However, the accumulation mechanisms of heavy metals and the ecological role of Xenophophore in the deep-sea are not clear.

#### **Purpose**

This study aims to clarify the genetic/environmental background of heavy metal accumulation and the ecological roles of Xenophyophore in the deep-sea population by using molecular techniques and stable isotope measurements. In this cruise, we collected Xenophyophore to illustrate their food preferences. We also carried out visual observation from the Shinkai 6500 to understand the distribution and density of Xenophyophores.

### **Research results**

- 1) Dive #1367 and 1368 were conducted at the 1N site (1°15.0'N, 163°14.8'E, 4,277 m).
- 2) Visual observation were done for landscape, sediment facies, distribution of organisms, and carried out sampling.
- 3) Sampling of sediment cores for SI analyses and DNA analyses, stored in -80°C.

Sampling of four types of Xenophyophores

### **3.5. Unveiling the drivers of virus-prokaryotes activity and interactions in abyssal ecosystems**

Eugenio Rastelli and Bruna Petani

*(Department of Life and Environmental Sciences, Polytechnic University of Marche, Italy)*

**Introduction:** Viruses are by far the most abundant biological entities in the world's oceans (approximately  $4 \times 10^{30}$ , Suttle 2007). Recent estimates suggest that every kg of deep-sea sediment contains  $10^{12}$  viruses and  $10^{11}$  prokaryotes (Sogin et al 2006). Recent studies revealed that viral infection in aquatic sediments can be the major cause of mortality for benthic prokaryotes (Danovaro et al 2008). Viral lysis transforms infected microbes into organic detritus, which can then be used again by non-infected prokaryotes and/or contribute to biogeochemical cycles. Extracellular DNA is likely to play a key role in both processes (Dell'Anno & Danovaro 2005) and can be a reservoir of genes (1 kg of deep-sea sediment can contain  $10^{13}$  copies of 16S rRNA genes; Corinaldesi et al 2011).

**Purpose:** During the YK13-09 cruise organised by JAMSTEC (09-2013), the goal of the Italian research team (UNIVPM) was to investigate the dynamics in virus – prokaryotes activity and interactions in the abyssal ecosystem in the Pacific Ocean and compare the results with the data acquired during the previous year's cruises in the Ogasawara trench and abyssal plain (11-2011) and Japan trench (12-2012). Additional experiments using in situ incubation were conducted in collaboration with JAMSTEC to study the response of benthic communities to food inputs and prokaryotic chemosynthetic processes.

**Materials and methods:** Seawater samples were collected during the YK13-09 cruise in station 1N, from



the sea surface and the bottom of the abyssal ecosystem in the Pacific Ocean. Surface and sub-surface sediments were collected from the same station.

Additional experiments (*in situ* temperature incubations of replicated mesocosms) were conducted on board and *in situ* for sediment samples.

On these samples, UNIVPM research team will conduct analyses for the determination of:

Viral abundance; total prokaryotic abundance; relative importance of Bacteria and Archaea on total prokaryotic abundance; viral production Prokaryotic heterotrophic production; extracellular enzymatic activities; organic matter composition and turnover; prokaryotic benthic diversity through next generation sequencing; DNA Metagenomics; RNA analysis and transcriptomics.

Moreover, several antibiotics were used to inhibit Archaeal or Bacterial activity in selected sets of samples, in order to study the effects of the host inhibition on viral production.

**Future work:** The comparison of the new results with those obtained previously during JAMSTEC cruises in the Ogasawara trench and Abyssal plain (2011) and Japan trench (2012) and from future cruises (Mariana Trench, 2014) will allow to gain more information about the functioning of the trench ecosystem in relation to the surrounding abyssal environment. Discussion and collaboration with the other groups of scientists will lead to a more complete knowledge of the connectivity between different trenches and will shed new lights on the deep-sea ecology and ecosystem functioning of these areas.

### **References**

Danovaro, R. et al (2008). *Nature* 454: 1084-1087; Corinaldesi, C. et al (2011). *Mol. Ecol.* 20: 642-654. 5. Dell'Anno, A. & Danovaro, R. (2005). *Science* 309: 2179; Sogin, M. et al (2006). *PNAS* 32: 12115-12120; Suttle, C.A. (2007). *Nature Rev. Microbiol.* 5: 801-812;

### **3.6. Acknowledgment**

We thank to the captain and crew members of R/V Yokosuka for their strong supports during the cruise. We also thank to the submersible operation manager and the Shinkai 6500 operation team for their skilful operation of the submersible.

### **3.7. List of observation equipments**

In situ incubation core (inner diameter: 8.2cm, length: 32cm)

In situ incubation box (Surface area: 900 cm<sup>2</sup>)

Holothurian cage (Surface area: ~600 cm<sup>2</sup>)

Niskin water sampler (5L)

H-type push corer (inner diameter: 8.2cm, length: 32cm)

Suction sampler with multiple canister

### 3.8. Cruise log

| Date      | Local Time  | Description  | Note | Position/Weather/Wind/Sea condition |
|-----------|-------------|--|------|-------------------------------------|
| 17-Sep-13 |             | <b>Scientists onboard.</b>   |      | 9/17 12:00 (UTC+10h)                |
|           | 13:30       | Scientists onboard.  |      | APRA bay                            |
|           | 15:00-16:30 | Carried out Scientists meeting.                                      |      | 13-27.7N,144-40.0E                  |
|           |             |  |      | Fine but cloudy                     |
|           |             |  |      | NW-4 (Moderate breeze)              |
|           |             |  |      | 2 (Sea smooth)                      |
|           |             |  |      | 1 (Low swell sea)                   |
|           |             |  |      | Visibly: 8'                         |
|           |             |  |      |                                     |
| 18-Sep-13 |             | <b>Let go all shore lines &amp; left SUVA for Research area.</b>     |      | 9/18 12:00 (UTC+10h)                |
|           | 10:00       | Let go all shore lines & left SUVA for Research area(OFF East Guam). |      | OFF West Guam                       |
|           | 11:00-11:30 | Carried out shipboard education & training for scientists            |      | 13-44.8N,144-48.4E                  |
|           | 13:00-13:30 | Carried out SHINKAI 6500 team & Scientists meeting.                  |      | Cloudy                              |
|           | 16:40-17:00 | Carried out KONPIRA pray.  |      | NW-3(Gentle breeze)                 |
|           |             |  |      | 3 (Sea slight)                      |
|           |             |  |      | 3(Moderate short)                   |
|           |             |  |      | Visibly: 8'                         |
|           |             |  |      |                                     |
| 19-Sep-13 |             | <b>Proceeding to research area.</b>                                  |      | 9/19 12:00 (UTC+10h)                |
|           | 08:30-09:00 | Carried out Scientists meeting.                                      |      | OFF East GUAM                       |
|           |             |  |      | 12-00.0N,149-15.0E                  |
|           |             |  |      | Overcast                            |
|           |             |  |      | SW-6 (Strong Breeze)                |
|           |             |  |      | 4 (Sea moderate)                    |
|           |             |  |      | 4 (Moderate long)                   |
|           |             |  |      | Visibly: 6'                         |
|           |             |  |      |                                     |
| 20-Sep-13 |             | <b>Arrived at research area(OFF east Guam).</b>                      |      | 9/20 12:00 (UTC+10h)                |

|           |             |  |                          |                           |
|-----------|-------------|--|--------------------------|---------------------------|
|           | 09:30       | Arrived at research area(OFF east Guam).                           |                          | OFF East GUAM             |
|           | 09:40       | Carried out released XBT   |                          | 12-03.0N,154-00.0E        |
|           | 09:50       | Com'ced surface water samplinng.                                   | 12-01.1448N,153-48.9850E | Cloudy                    |
|           | 09:55       | Finished surface water samplinng.                                  | 12-01.2068N,153-49.0577E | South-4 (Moderate breeze) |
|           | 10:00       | Com'ced towing proton magnetometer.                                |                          | 4 (Sea moderate)          |
|           | 11:16-12:02 | Carried out MBES site survey.                                      |                          | 4 (Moderate average)      |
|           | 13:11       | Com'ced MBES mapping survey.                                       |                          | Visibly: 8'               |
|           |             |  |                          |                           |
| 21-Sep-13 |             | <b>Suspended SHINKAI 6500 submergence due to rough sea.</b>        |                          | 9/21 12:00 (UTC+10h)      |
|           | 04:50       | Finished MBES mapping survey.                                      |                          | OFF North-West POMPEI     |
|           | 05:30       | Suspended SHINKAI 6500 submergence due to rough sea.               |                          | 11-08.5N,154-47.8E        |
|           | 06:03       | Recovered proton magnetometer.                                     |                          | Cloudy                    |
|           | 06:10       | left YOKOSUKA for Research area(OFF East Guam).                    |                          | NW-3 (Gentle breeze)      |
|           |             | & Com'ced shifting to next research area(Vicinity of the Equator). |                          | 3 (Sea slight)            |
|           |             |  |                          | 4 (Moderate average)      |
|           |             |  |                          | Visibly: 8'               |
|           |             |  |                          |                           |
| 22-Sep-13 |             | <b>Transit to research area</b>                                    |                          | 9/22 12:00 (UTC+10h)      |
|           | 13:00-14:00 | Scientists meeting.  |                          | OFF North POMPEI          |
|           | 24:00       | shift local time to UTC+11h.                                       |                          | 07-23.7N,158-15.5E        |
|           |             |  |                          | Fine but cloudy           |
|           |             |  |                          | SSE-3 (Gentle breeze)     |
|           |             |  |                          | 2 (Sea smooth)            |
|           |             |  |                          | 2 (Low swell long)        |
|           |             |  |                          | Visibly: 8'               |
|           |             |  |                          |                           |
| 23-Sep-13 |             | <b>Transit to research area</b>                                    |                          | 9/23 12:00 (UTC+11h)      |
|           | 11:30-11:50 | Scientists meeting.  |                          | OFF North-West Naul       |
|           | 13:00-13:30 | 6K team & Dive Scientists meeting.                                 |                          | 03-34.2N,161-23.1E        |
|           |             |  |                          | Fine but cloudy           |
|           |             |  |                          | SE-2 (Light breeze)       |
|           |             |  |                          | 2 (Sea smooth)            |
|           |             |  |                          | 1 (Low swell sea)         |

|           |             |  |                          |                             |
|-----------|-------------|--|--------------------------|-----------------------------|
|           |             |  |                          | Visibly: 8'                 |
| 24-Sep-13 |             | <b>SHINKAI6500 Operation Dive#1367</b>             |                          | 9/24 12:00 (UTC+11h)        |
|           | 04:20       | Arrived at research area(Vicinity of the Equator). |                          | OFF West-North-West<br>Naul |
|           | 04:35       | Released XBT                                       |                          | 01-15.0N,163-15.0E          |
|           | 05:00-05:47 | Carried out MBES site survey.                      |                          | Fine but cloudy             |
|           | 09:04       | SHINKAI6500 dove & started her operation #1367.    |                          | SSW-3 (Gentle breeze)       |
|           | 10:56       | SHINKAI 6500 landed on sea bottom ( D=4277m ).     |                          | 2 (Sea smooth)              |
|           | 15:16       | SHINKAI 6500 left sea bottom ( D=4254m ).          |                          | 2 (Low swell long)          |
|           | 16:56       | SHINKAI 6500 refloated.                            |                          | Visibly: 8'                 |
|           | 17:23       | Recovered SHINKAI 6500 & finished above operation. |                          |                             |
|           | 17:55       | Com'ced towing proton magnetometer.                |                          |                             |
|           | 20:14       | Com'ced MBES mapping survey.                       |                          |                             |
|           |             |  |                          |                             |
|           |             |  |                          |                             |
| 25-Sep-13 |             | <b>Carried MBES mapping suevey.</b>                |                          | 9/25 12:00 (UTC+11h)        |
|           | 08:15-09:00 | scientific meeting                                 |                          | OFF North-West Naul         |
|           | 11:23       | Recovered proton magnetometer.                     |                          | 01-14.8N,163-16.1E          |
|           | 11:35       | Com'ced surface water samplinng.                   | 01-15.0075N,163-15.0063E | Fine but cloudy             |
|           | 11:41       | Finished surface water samplinng.                  | 01-15.0044N,163-14.8917E | SE-2 (Light breeze)         |
|           | 11:44       | Com'ced towing proton magnetometer.                |                          | 2 (Sea smooth)              |
|           |             |  |                          | 2 (Low swell long)          |
|           |             |  |                          | Visibly: 8'                 |
|           |             |  |                          |                             |
| 26-Sep-13 |             | <b>SHINKAI6500 Operation Dive#1367</b>             |                          | 9/26 12:00 (UTC+11h)        |
|           | 05:16       | Finished MBES mapping survey                       |                          | OFF West-North-West<br>Naul |
|           | 06:06       | Recovered proton magnetometer.                     |                          | 01-14.8N,163-16.1E          |
|           | 09:00       | SHINKAI6500 dove & started her operation #1368.    |                          | Fine but cloudy             |
|           | 10:55       | SHINKAI 6500 landed on sea bottom ( D=4277m ).     |                          | SE-2 (Light breeze)         |
|           | 12:58       | Com'ced surface water samplinng.                   | 01-15.0277N,163-14.7608E | 2 (Sea smooth)              |
|           | 13:02       | Finished surface water samplinng.                  | 01-15.0375N,163-14.7334E | 2 (Low swell long)          |
|           | 15:16       | SHINKAI 6500 left sea bottom ( D=4255m ).          |                          | Visibly: 8'                 |
|           | 16:52       | SHINKAI 6500 refloated.                            |                          |                             |

|           |             |  |  |                              |
|-----------|-------------|--|--|------------------------------|
|           | 17:17       | Recovered SHINKAI 6500 & finished above operation. |  |                              |
|           | 17:50       | Com'ced proceeding to SUVA.                        |  |                              |
|           |             |  |  |                              |
| 27-Sep-13 |             | <b>proceeding to SUVA.</b>                         |  | 9/27 12:00 (UTC+11h)         |
|           | 13:30-14:00 | Scientists meeting.                                |  | OFF South-West Naul          |
|           |             |  |  | 01-58.6S,165-37.1E           |
|           |             |  |  | Fine but cloudy              |
|           |             |  |  | ENE-3 (Gentle breeze)        |
|           |             |  |  | 2 (Sea smooth)               |
|           |             |  |  | 1 (Low swell sea)            |
|           |             |  |  | Visibly: 8'                  |
|           |             |  |  |                              |
| 28-Sep-13 |             | <b>proceeding to SUVA.</b>                         |  | 9/28 12:00 (UTC+11h)         |
|           | 09:00-10:00 | Onboard scientist seminar.                         |  | OFF North-East SANTA<br>CRUZ |
|           |             |  |  | 05-58.6S,165-37.1E           |
|           |             |  |  | Fine but cloudy              |
|           |             |  |  | WNW-2 (Light breeze)         |
|           |             |  |  | 2 (Sea smooth)               |
|           |             |  |  | 1 (Low swell sea)            |
|           |             |  |  | Visibly: 8'                  |
|           |             |  |  |                              |
| 29-Sep-13 |             | <b>proceeding to SUVA.</b>                         |  | 9/29 12:00 (UTC+11h)         |
|           | 13:00       | Practiced boat station drill                       |  | OFF East SANTA CRUZ          |
|           |             |  |  | 09-37.1S,171-15.9E           |
|           |             |  |  | Cloudy                       |
|           |             |  |  | East-5 (Fresh breeze)        |
|           |             |  |  | 3 (Sea slight)               |
|           |             |  |  | 1 (Low swell sea)            |
|           |             |  |  | Visibly: 8'                  |
|           |             |  |  |                              |
| 30-Sep-13 |             | <b>proceeding to SUVA.</b>                         |  | 9/30 12:00 (UTC+12h)         |
|           |             |  |  | OFF North-West FIJI          |
|           |             |  |  | 12-56.9S,173-12.4E           |
|           |             |  |  | Fine but cloudy              |

|          |             |  |  |                      |
|----------|-------------|--|--|----------------------|
|          |             |  |  | SE-5 (Fresh breeze)  |
|          |             |  |  | 4 (Sea moderate)     |
|          |             |  |  | 3 (Moderate short)   |
|          |             |  |  | Visibly: 8'          |
|          |             |  |  |                      |
| 1-Oct-13 |             | <b>proceeding to SUVA.</b>                                     |  | 10/1 12:00 (UTC+12h) |
|          | 18:00-18:30 | Scientists meeting.  |  | OFF West FIJI        |
|          |             |  |  | 17-15.4S,175-31.7E   |
|          |             |  |  | Fine but cloudy      |
|          |             |  |  | SE-6 (Strong breeze) |
|          |             |  |  | 4 (Sea moderate)     |
|          |             |  |  | 3 (Moderate short)   |
|          |             |  |  | Visibly: 8'          |
|          |             |  |  |                      |
| 2-Oct-13 |             | <b>Arrived at SUVA</b>   |  |                      |
|          | 09:00       | Sent out 1st shore line, arrived at SUVA,completed<br>YK13-09. |  |                      |
|          |             |  |  |                      |

#### 4. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

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.