Press Releases

October 21, 2013
JAMSTEC

Progress report on QUELLE2013 – an around-the-world voyage by the SHINKAI 6500 Surveys at Tonga Trench in the South Pacific Ocean

In an effort to study a variety of marine organisms which have evolved to live in extreme environments, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), led by President Asahiko Taira, has begun a project called QUELLE2013. This project began in January 2013, using the manned research submersible SHINKAI 6500 and its support vessel YOKOSUKA. QUELLE2013 is a global-scale voyage of scientific surveys and research on ecosystems in hydrothermal vent areas and other unique and extreme environments in the Indian, Atlantic and Pacific oceans.
SHINKAI 6500 has just completed a survey of the Tonga Trench[*1], and is scheduled to survey from the end October to early November at the Kermadec Trench[*2] in the South Pacific Ocean, and come back to Japan in early December.

The detailed research results from these surveys will released in due course via voyage reports and articles in scientific journals. Here, we present a brief summary of the just-completed survey of the Tonga Trench in the South Pacific Ocean.

1. Objectives of the survey of the Tonga Trench
This survey is part of JAMSTEC's comprehensive studies on chemosynthetic and other marine organisms living in the deep seafloor, and in other extreme environments. The main survey area is the 10,850 meter-deep Horizon Deep in the Tonga Trench – the world's second deepest place in the ocean. The objectives of the survey were to: (i) describe the environmental characteristics of the "hadal zone", including depths of greater than 10,000 meters, and sample the organisms living in this environment, and (ii) find out exactly what is going on there, unravel the correlation between organisms and their habitats, and learn how the trench environment was created.

This is the first exploration with a manned research submersible in the Tonga Trench. For the first time, sediment was sampled and video footage was taken by using a sediment sampling lander system with a video camera attachment. Also for the first time, the oxygen profile was measured in the upper layer of the seabed, using a separate sediment profiling lander. This was the second time, however, that video footage, sediment samples, and oxygen profiles have been taken at water depths greater than 10,000 meters by JAMSTEC in an oceanic trench (please refer to the press release issued on March 18, 2013 about JAMSTEC's research at the Challenger Deep in the Mariana Trench).

JAMSTEC plans to analyze and compare the data and samples obtained from the Tonga Trench with those from the Mariana Trench, and thereby determine if there is any difference in environmental conditions and living species between the first and second deepest trenches in the world.

2. Outline (see the attached map)

(1)Horizon Deep, Tonga Trench at depths of 6,250 – 10,800 meters

Period: October 7 to 15, 2013

Details:

i) Topographic and geological survey in and around the Horizon Deep at depths of 3,000 – 10,820 meters.

- Outcrops on the landward (western) slope of the trench were observed and rock samples were obtained, using SHINKAI 6500.
- Data on the submarine topography, gravity and magnetism were measured, using instruments on the vessel.

ii) Observation of living environments and survey of the depth distribution of organisms in and around the Horizon Deep at depths of 6,250 – 10,800 meters

- Visual observation was conducted during dives of SHINKAI 6500.
- In-situ observation and measurements were conducted: including video recording, sediment sampling and water sampling by the sediment sampling lander with a video camera attachment; and water temperature, salinity, and the dissolved oxygen profiles of seafloor sediments by the sediment profile lander with a CTD attached.
- Depth distribution of organisms was studied based on samples collected by SHINKAI 6500 and the two lander systems. Such organisms include fish, shrimps and other organisms living near the seabed as well as organisms living attached to the seabed, crawling on the seabed or living buried in sediments of the seabed.

(2) Geological and biological survey in the north-central part of the Tonga Trench at depths of 5,500 – 6,500 meters

Period: October 16 – 20, 2013

Details:

i) Geological survey of the landward (western) slope of the trench

- Data on the submarine topography, gravity and magnetism were measured, using instruments on the vessel.
- Visual observation was conducted and rock samples were obtained, using SHINKAI 6500.

3. Summary of research achievements

(1) A detailed bathymetric chart of an area around the Horizon Deep of the Tonga Trench was drawn. Geological features in the fastest-moving subduction zone were successfully revealed.

(2) At depths of 10,805 meters and 6,250 meters at the Horizon Deep of the Tonga Trench, the following was successfully achieved: (i) sampling of organisms living on, in or near the seabed, (ii) sampling of undisturbed sediment in the upper layer of the seabed, (iii) sampling of bottom water, (iv) measurement of oxygen profile, and (v) video recording of the seafloor with a high-definition camera. This video recording and the observation of seabed sediments are the very first to be made at the deepest point of the Tonga Trench. JAMSTEC plans to compare the observation data with the data obtained at the Challenger Deep.

(3) A supergiant (>20 centimeters long) hadal amphipod, *Alicella gigantea*, was successfully sampled. This was first time this supergiant amphipod has been sampled in the Tonga Trench. This amphipod has only been previously sampled in the South Pacific Ocean at the the Kermadec Trench. In addition, other amphipod species (e.g. *Hirondellea dubia*) and other hadal organisms were observed and sampled.

(4) Marine geological survey was carried out on the landward (western) slope of the Tonga Trench. Rock and core samples were successfully collected, which will provide a clue to geological features and genesis of the Tonga Trench and Arc.

4. Future schedules

October 21 to 22	YOKOSUKA and SHINKAI 6500 are open to the public in Nukualofa, Tonga.
October 24 to November 2	Surveys are conducted at the Kermadec Arc, New Zealand.
November 3 to 4	YOKOSUKA and SHINKAI 6500 are open to the public in Auckland, New Zealand.
Mid-November	Surveys are conducted in and around the equatorial Pacific Ocean.
Early-December	YOKOSUKA and SHINKAI 6500 arrive at the Yokosuka Headquarters, Japan.

* The above schedules are subject to change due to weather, work progress or other conditions.

*1 The Tonga Trench is an oceanic trench off Tonga with a maximum depth of 10,850 meters in the Horizon Deep. The depth is second only to the Challenger Deep of the Mariana Trench with a maximum depth of 10,911 meters. The Tonga Trench is the fastest-moving plate boundary in the world where the Pacific Plate is subducting at a rate of 20-plus centimeters per year. For reference, a plate is subducting about four centimeters per year around the Nankai Trough.

*2 Just like the Tonga Trench, the Kermadec Trench is a large oceanic trench with a maximum depth of 10,047 meters, which is the world’s third deepest point in the oceans. The Kermadec Arc, which includes many active submarine volcanoes, runs parallel (landward) with the trench.

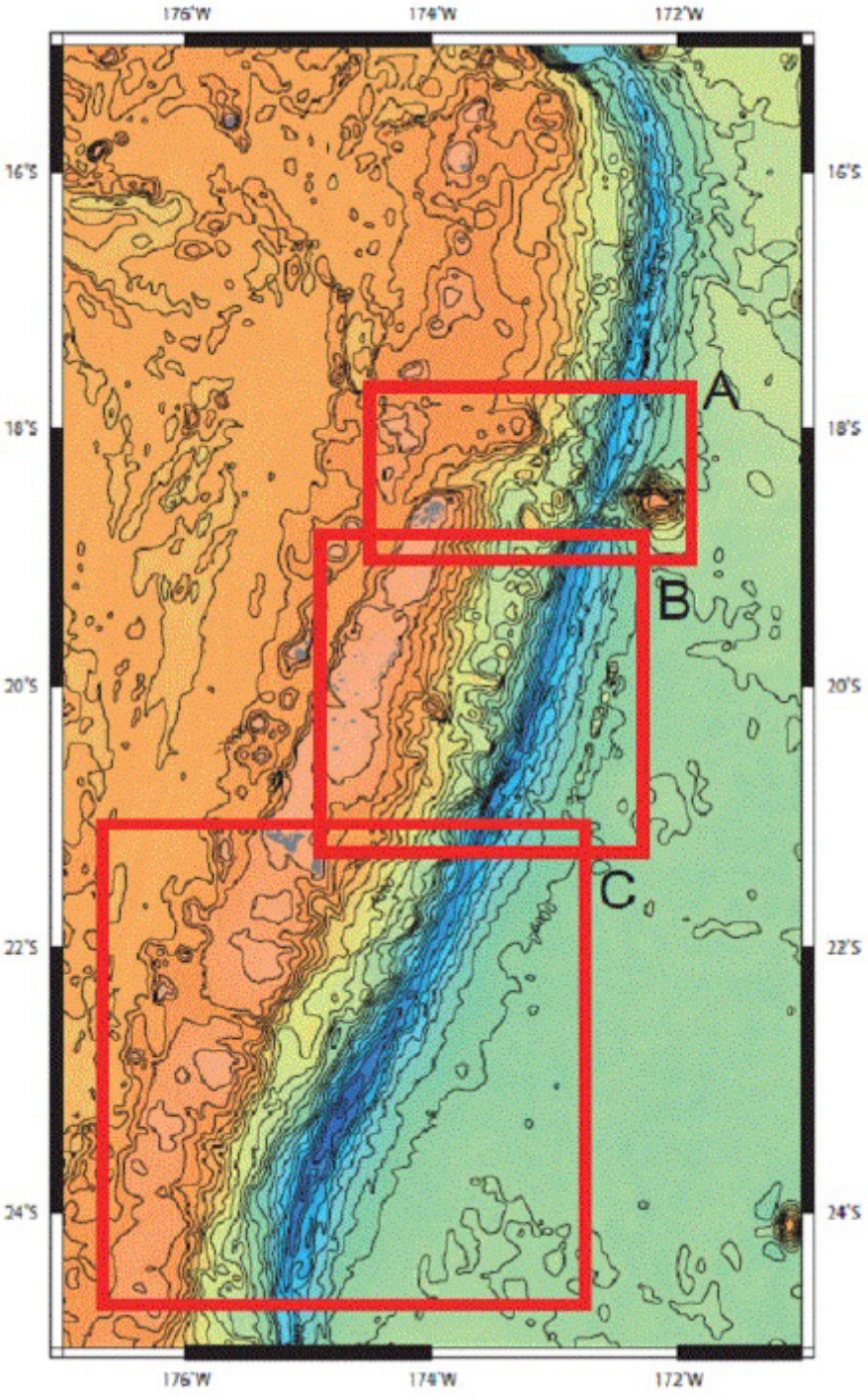

Figure 1.
Map of this research cruise (Tonga Trench in the South Pacific Ocean)
A : Northern Tonga Trench
B : Central Tonga Trench
C : Horizon Deep of Tonga Trench

Figure 2.
JAMSTEC’s free-fall sediment sampling lander system with video camera attatchment. For these surveys, it was equipped with water samplers and a CTD instrument.

Figure 3.
A sediment profiling lander. After the instrument has landed at the seafloor the central titanium cylinder move 20 cm into the seabed in small steps of 250 µm. At each step the O_2 concentration is recorded and thereby the oxygen distribution in the sediment is recorded. From the data the scientist can caculate how much oxygen the seabed is consuming and how much organic material that is degraded in the seabed.

Figure 4.
A 24 cm-long supergiant amphipod, *Alicella gigantea*, which was sampled at a depth of 6,250 meters on the seaward (eastern) slope on the Horizon Deep. It was the first supergiant amphipod to be sampled in the Tonga Trench.

Figure 5.
The 10,850 meter-deep seafloor of the Horizon Deep. Swarms of *Hirondellea dubia* – amphipods closely related to *Hirondellea gigas* (found in the Mariana Trench) – are swimming, while elasipod sea cucumbers are moving around on the seabed.

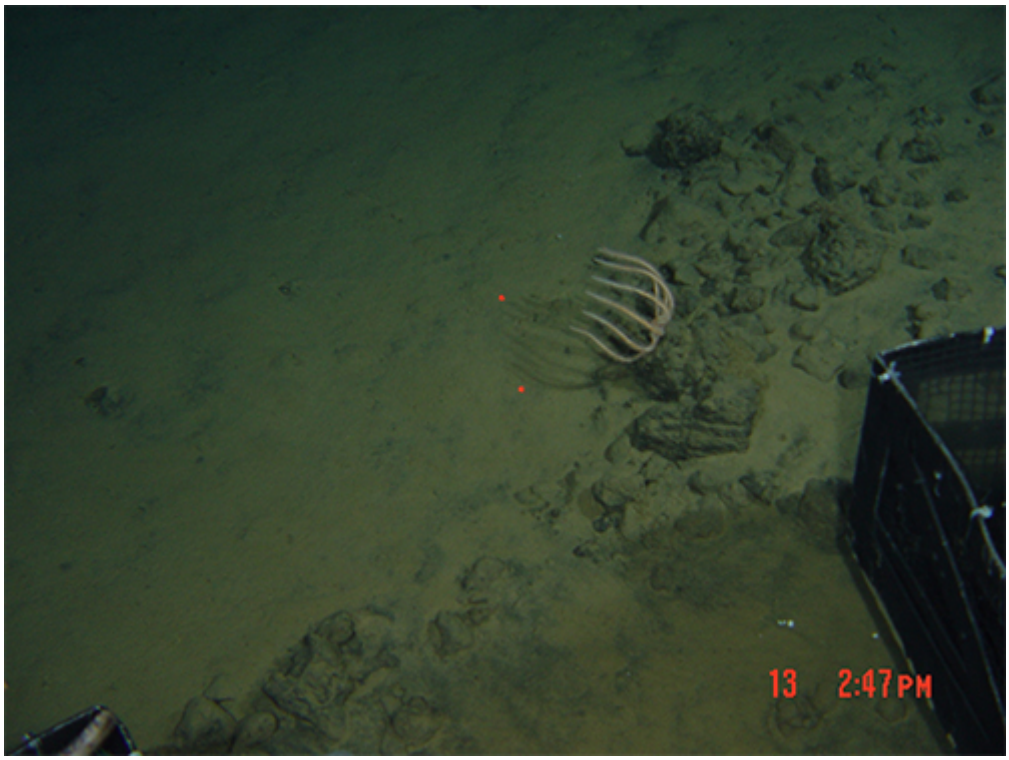

Figure 6.
A cliff located at a depth of 6,121 meters on the landward (western) slope of the Horizon Deep. A starfish is clinging to a sedimentary rock.

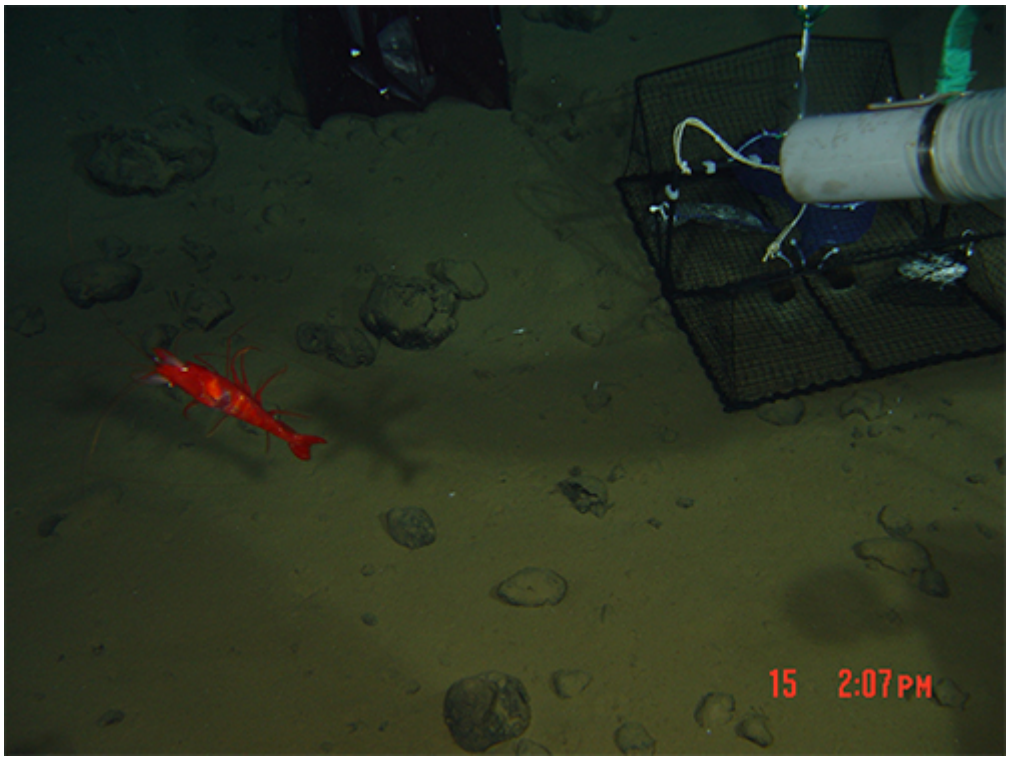

Figure 7.
A big red shrimp and a baited trap being installed.

Figure 8.
The seaward (eastern) slope at a depth of 6,254 meters. A big red shrimp is swimming against the background of pebbly mud.

Figure 9.
Peridotites sampled at a depth of 5,917m. The condition is relatively fresh and have not disintegrated at the seabed.

Figure 10.
Basalt rocks sampled at a depth of 6,088m. Foaming can be seen.

Figure 11.
Sandstones sampled at a depth of 6,150m. It is including a quartz.

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