

What is “QUELLE” ?

The name of this voyage, “QUELLE”, is an acronym for “Quest for the Limit of Life”. It also means “roots” or “origin” in German.

Is this the first around-the-world voyage for the *Shinkai 6500*?

This great voyage by the *Shinkai 6500* and its support vessel *Yokosuka* is the first in 15 years, since the 1998 cruise MODE '98 (Mid-Oceanic Ridge Diving Expedition). Taking the eastern route around the world for MODE '98, surveys were conducted along the Mid-Atlantic Ridge after passing through the Panama Canal, and the Southwest Indian Ridge was surveyed after passing through the Suez Canal, making *Shinkai 6500* the first manned submersible to conduct a survey in the Indian Ocean.

Why the southern hemisphere?

Why the deep sea?

During the decade following the year 2000, scientists from over 80 nations participated in the “Census of Marine Life”, furthering our understanding of the diversity and distribution of marine organisms. Deep-sea zones below 2500 m, the open ocean away from land, and especially the greater part of the southern hemisphere, however, were found to be as yet largely unexplored. That is why we are going to the southern hemisphere and the deep sea.



Shinkai 6500 lowered to the ocean surface from support vessel *Yokosuka*

Shinkai 6500 submersible

Shinkai 6500 is a deep submergence vehicle that can dive to depths of 6500 meters. It carries one researcher and two pilots.

Shinkai 6500 was completed in 1989, and since its first research dive in 1991 has conducted surveys around Japan as well as throughout the Pacific Ocean, and in the Atlantic and Indian Oceans.

Support Vessel *Yokosuka*

The support ship *Yokosuka* performs surveys of the deep-sea floor by acting as a support ship for the *Shinkai 6500*.

About JAMSTEC

On April 1, 2004, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), formerly the Japan Marine Science and Technology Center, was inaugurated as an independent administrative institution. JAMSTEC has the main objective to contribute to the advancement of academic research in addition to the improvement of marine science and technology infrastructure by supporting fundamental research on and development of the sea.



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Quest for the Limit of Life An around-the-world voyage by the *Shinkai 6500* QUELLE 2013

The *Shinkai 6500* will visit extreme deep-sea environments and reveal the habitable limits of life and its unique survival strategies.

On January 5, 2013, the RV *Yokosuka*, carrying the manned research submersible *Shinkai 6500*, will depart from the headquarters of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in Yokosuka, Japan. This will begin the challenge of “QUELLE 2013,” a round-the-world voyage of *Shinkai 6500*, which will spend about one year visiting the Indian Ocean, the South Atlantic, the Caribbean Sea, and the South Pacific Ocean.

Shinkai 6500 will visit hydrothermal vent fields, submarine seepage sites, the ultra-hadal zone of deep sea trenches and other extreme environments, where it will shed light on the habitable limits of life and its unique survival strategies.

QUELLE 2013 may even answer the question of how the Earth became a planet brimming with life.

1

Central Indian Ocean Ridge, Rodrigues Triple Junction area, Indian Ocean Looking for insights into the early evolution of life

There is active hydrothermal activity in this area, which is a habitat for unusual organisms such as the scaly-foot gastropod, a snail with scales made of iron sulfides. It is very likely that hydrogen was a source of energy for early life; this marine area has sites spouting hot water with high hydrogen concentrations. The mission here will be to attempt to understand early evolution by studying the resident organisms.



The scaly-foot gastropod

The *Shinkai 6500* surveying hydrothermal vents near Okinawa, Japan.

2

Rio Grande Rise, Sao Paulo Ridge, Sao Paulo Plateau The first dive of a human-occupied research submersible in the South Atlantic

The Rio Grande Rise is an immense ridge, that rises more than 5000 m above the ocean floor in the South Atlantic. This survey will discover how marine communities change with depth and geology. We expect to find a variety of organisms and habitats.

Sao Paulo Ridge, where material derived from the Earth's mantle is exposed at the sea floor. Recently chemosynthetic communities* were discovered in areas surrounding a similar environment in the Marianas Trench in the Western Pacific. We expect to find similar chemosynthetic communities in the Sao Paulo Ridge area.

The Sao Paulo Plateau has extensive natural gas and oil fields, and possibly the world's most extensive chemosynthetic communities. If chemosynthetic communities are found here, they would be the first discovered in the South Atlantic.

* Chemosynthetic communities: Biological communities based on energy from chemical sources, such as hydrogen sulfide and methane emitted from hydrothermal vents.

3

Near the Cayman Islands, a British territory in the Caribbean Sea Are there organisms living at 500°C at deep hydrothermal fields?

The Cayman Rise is said to have 500 °C seawater spouting from hydrothermal vents. Here we will survey the habitable limits of life and reveal survival strategies in extreme environments, such as symbiosis between macro- and microorganisms.

At one time the Pacific and Atlantic oceans were connected, and there was exchange of organisms between them. However, 3 million years ago a land bridge connected South and North America, separating the two oceans and isolating the resident organisms from each other. We will survey how organisms originating in the Pacific evolved in the Atlantic, and explore their adaptations and subsequent evolution.

4

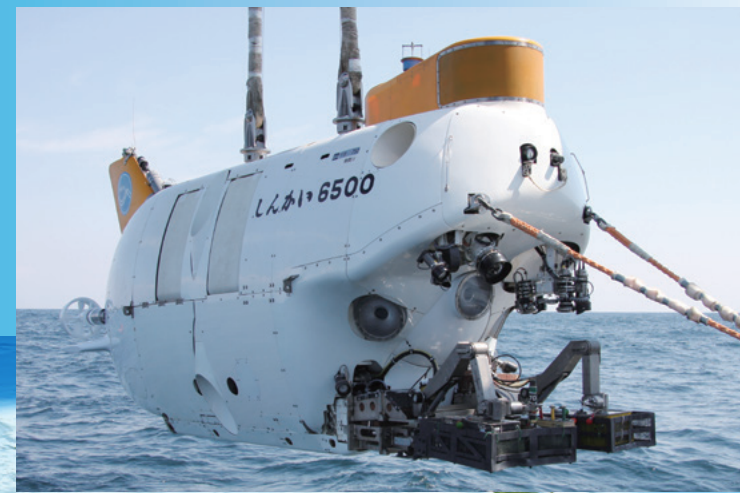
Tonga and Kermadec trenches To the world's second-deepest submarine trench

At JAMSTEC, we have investigated the Challenger Deep in the Marianas Trench, the deepest known point in the world's oceans (10,911 m). However, we have not yet investigated the world's second-deepest trench - the Tonga Trench (10,830 m depth). By investigating the Tonga Trench and comparing the deepest and the second-deepest areas in the world's oceans, we will be closer to understanding ultra-deep-sea ecosystems. The Louisville Seamount Chain is quickly subducting into the Tonga and Kermadec trenches. We will investigate a number of these seamounts to find out how communities change with depth.

Quest for the Limit of Life

An around-the-world voyage by the *Shinkai 6500*

QUELLE 2013



Shinkai 6500 submersible



Support Vessel Yokosuka

Caribbean Sea, near the Cayman Islands (British territory)

- A highly diverse deep-sea hydrothermal field; the deepest yet discovered
- A singular biocoenosis (ecosystem) that links the Pacific and Atlantic oceans

3 Call at San Juan, Puerto Rico (USA), mid-June

Call at Cristobal, Panama, early July

Call at Rio de Janeiro, Brazil, early May

Call at Santos, Brazil, late May

Sao Paulo Ridge

Sao Paulo Plateau

Rio Grande Rise

- A unique marine environment created by an immense seamount rising over 5000 m from the ocean floor
- A vast submarine oil field in the deep ocean at a depth of 3600 m

Call at Cape Town, South Africa, early April

Call at Port Louis, Mauritius, late March

Central Indian Ridge

Rodrigues Triple Point area

- A deep-sea hydrothermal field inhabited by chemosynthetic communities including highly unusual organisms such as the scaly-foot gastropod

START

Leave Yokosuka January 5, 2013

Temporary return to Japan, early August (Battery replacement for *Shinkai 6500*)

Call at Guam (USA) mid-September

GOAL

Return to home port, late November

Call at Suva, Fiji, early and late October

Tonga Trench

Kermadec Trench

Call at Auckland, New Zealand, late November

- An active region of plate convergence with the world's second-greatest ocean depth (10,850 m)
- The Louisville Seamount Chain, which is subducting into the Tonga and Kermadec trenches
- Submarine volcanic activity in the active back-arc region, landward of the trenches