Press Releases

August 1, 2013
JAMSTEC

Progress Report on the Round-the-World Research Expedition by the SHINKAI 6500 Manned Research Submersible –Investigations in the Caribbean Sea off the British Cayman Islands–

1. Overview
As a part of its scientific survey and investigation of diverse communities of marine organisms inhabiting and evolving in extreme environments of the oceans, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC: Asahiko Taira, President) is conducting a global research expedition for the scientific survey and investigation of ecosystems established in areas with extreme marine environments, as has already been reported on December 13, 2012. The expedition is named "QUELLE 2013," and the research will be conducted in high-temperature hydrothermal vent areas and other unique and extreme environments in the Indian, Atlantic, and Pacific Oceans; the manned research submersible, SHINKAI 6500, and its support ship, the Yokosuka, embarked on this expedition in January 2013.

Investigations in the Caribbean Sea around the British Cayman Islands have been completed and we present an overview of the research.

The SHINKAI 6500 temporarily returned to Japan on August 2 for maintenance work including exchanging its main batteries. After this, it is scheduled to conduct investigations in the Tonga and Kermadec trenches during October and November.

* The research findings from this expedition will be released when the reports are completed.

1. Objectives of Investigations in the Caribbean Sea off the British Cayman Islands
JAMSTEC is conducting comprehensive research on chemosynthetic ecosystems in deep-sea extreme environments; organisms there on the seafloor and in sub-seafloor sediments, some of which use chemical substances as energy sources. As part of this research, investigations off the Cayman Islands on the Mid-Cayman Rise, mainly in the world's deepest seafloor hydrothermal zones at depths greater than 5000 m, were conducted with the following objectives.

We note that this was the first investigation in this hydrothermal zone by a manned submersible.

(1) In hydrothermal zones with water temperatures near 400 °C, a search for extremophile microorganisms that would extend the temperature limit for living organisms.
(2)

A search for chemosynthetic biological communities in hydrothermal zones where investigations have not progressed and investigation of their habitats.

(3) A search for unique communities that possess the characteristics of biological communities from both oceans, based on the fact that the Pacific and Atlantic Oceans were linked in the past.

2. Overview of Investigations (refer to attached map)

Mid-Cayman Rise (Depth 2200 to 5200 m) in the Caribbean Sea off the British Cayman Islands

(1) Period of Operations: June 17 to July 3

(2) Details of Operations: Elucidation of how chemosynthetic microbial ecosystems came into existence in this unique thermal zone, which includes the world's deepest hydrothermal zone on the Mid-Cayman Rise.

·Underwater investigation by the SHINKAI 6500 manned research submersible

·The world's first no-cut live broadcast from the beginning to end (including images of the seafloor) of a scientific investigation with a manned submersible

·Observation of the submarine topography

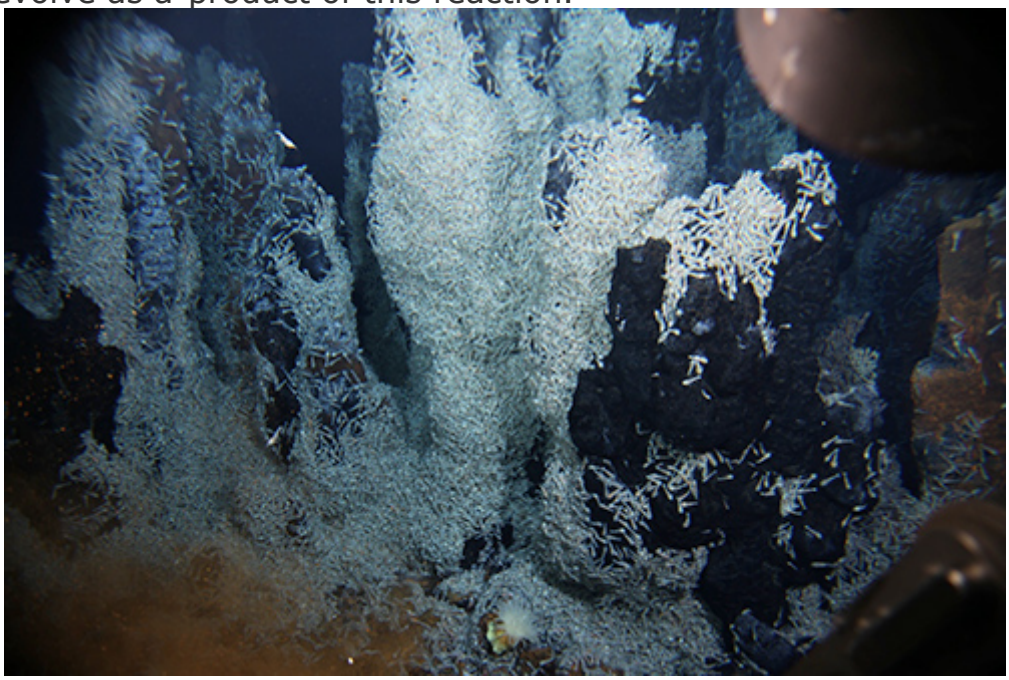
(3) Outline of Results

1. The world's first real-time broadcast of a scientific investigation by a manned submersible in the world's deepest (depth approximately 5000 m) hydrothermal zone (Beebe Hydrothermal Vent Field) was viewed by over 300,000 people who experienced the "thrill and excitement of scientific investigation by a manned submersible."
2. The hydrothermal water from two hydrothermal zones (Beebe and Von Damm hydrothermal vent fields) on the Mid-Cayman Rise was found to have extremely high concentrations of hydrogen. This showed that the water may be strongly influenced by serpentinization reactions*.
3. The chemical characteristics of the hydrothermal waters from both hydrothermal zones differ from those of previously investigated hydrothermal waters from the Pacific Ocean, Atlantic Ocean, and Central Indian Ocean Ridge. Detailed research on the hydrothermal water circulation beneath the seafloor that drives the hydrothermal activity and reactions of the hydrothermal water is planned.
4. Research on the chemosynthetic microbial ecosystems of the hydrothermal zones of ultra-slow spreading ocean ridges is unique. Future research will focus on whether hyperthermophilic subsurface lithoautorophic microbial ecosystems (HyperSlime) that use hydrogen as an energy source exist, and on whether they are similar in type to those known thus far.
5. Although the presence of Atlantic Ocean-type hydrothermal chemosynthetic organisms was confirmed, Pacific Ocean-type hydrothermal chemosynthetic organisms that may have crossed the Panama Isthmus were not observed. Also, the hydrothermal biological communities were extremely poor in biodiversity. The reasons for this will be addressed in future research.

The investigations in the Caribbean Sea were conducted jointly with collaborators including the University of Southampton (UK).

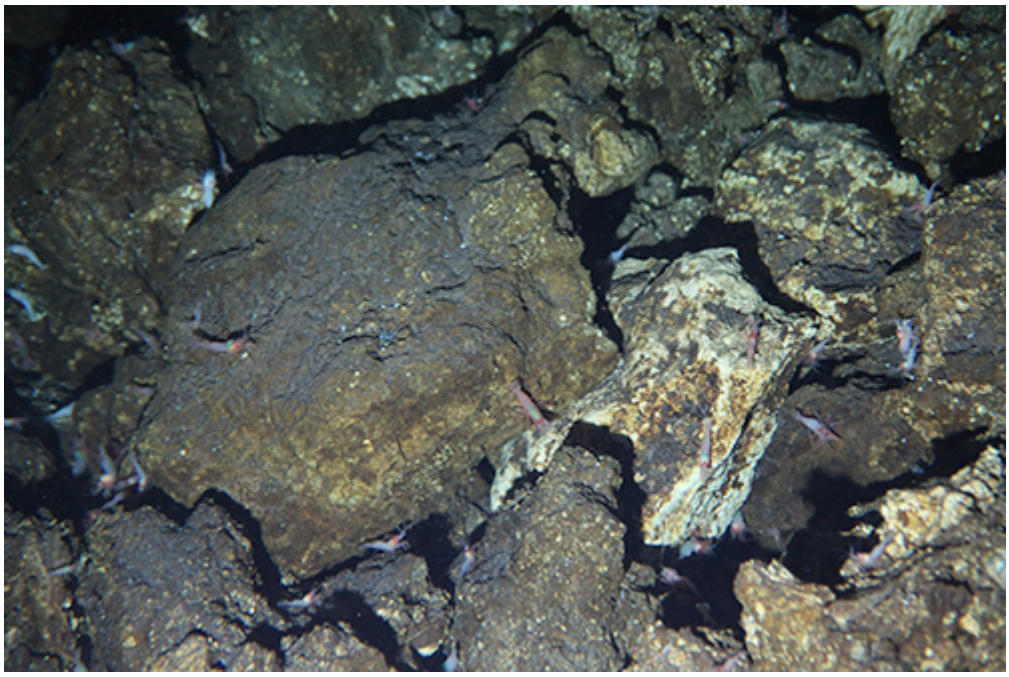
* Deep underground in the upper mantle, the main structural rock is peridotite, which is composed of olivine (a structural mineral) and other minerals. Olivine is

converted at relatively high temperatures by reaction with water into serpentine (a structural mineral), which is the main component of serpentinite rock. Hydrogen is known to evolve as a-product of this reaction.

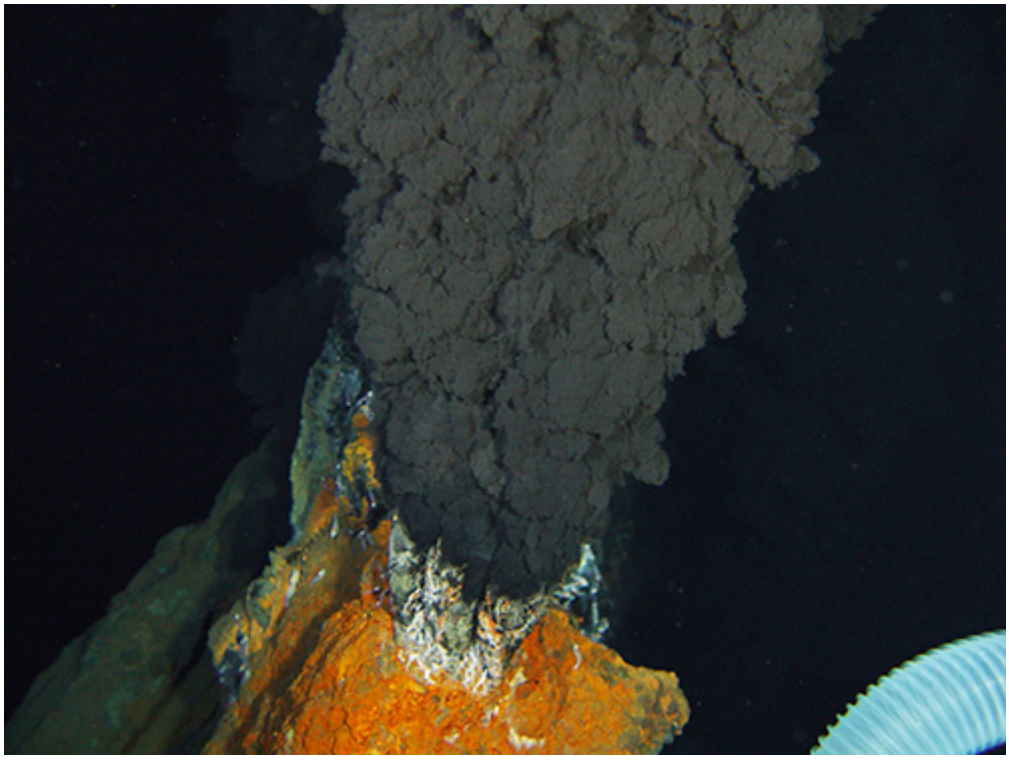


A community of *Rimicaris hybisae* on a chimney in the Beebe hydrothermal vent field seen live by three hundred thousand viewers.

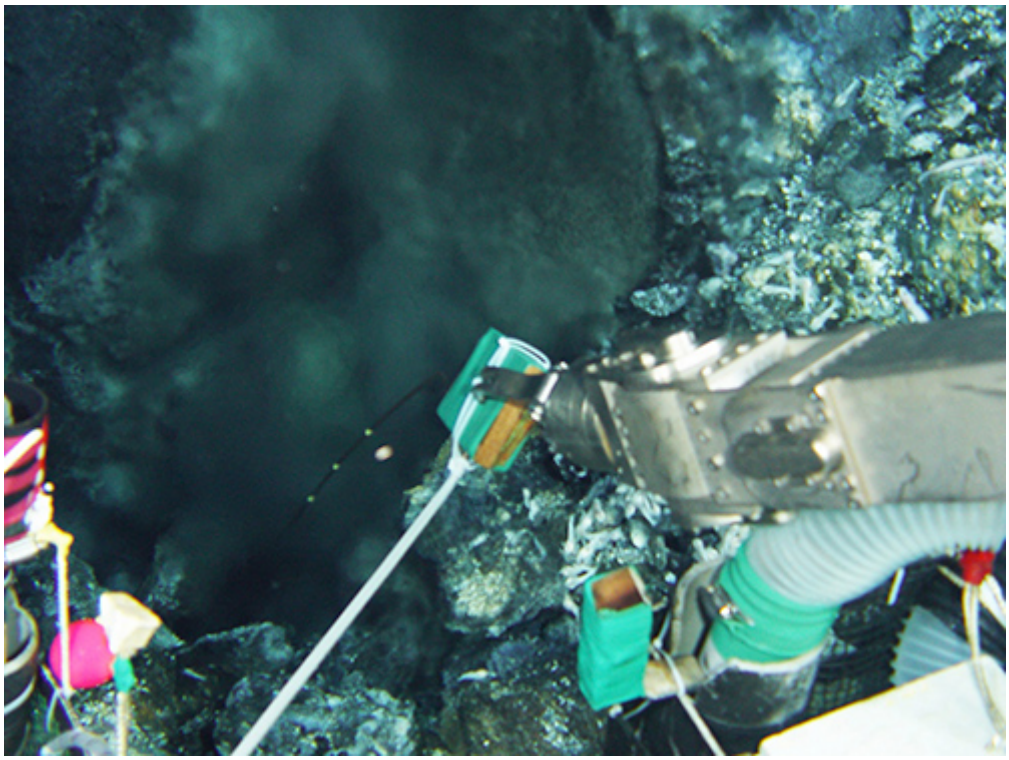
Tubeworm in the Von Damm hydrothermal vent field. It does not appear to be an immigrant species from the Pacific Ocean.



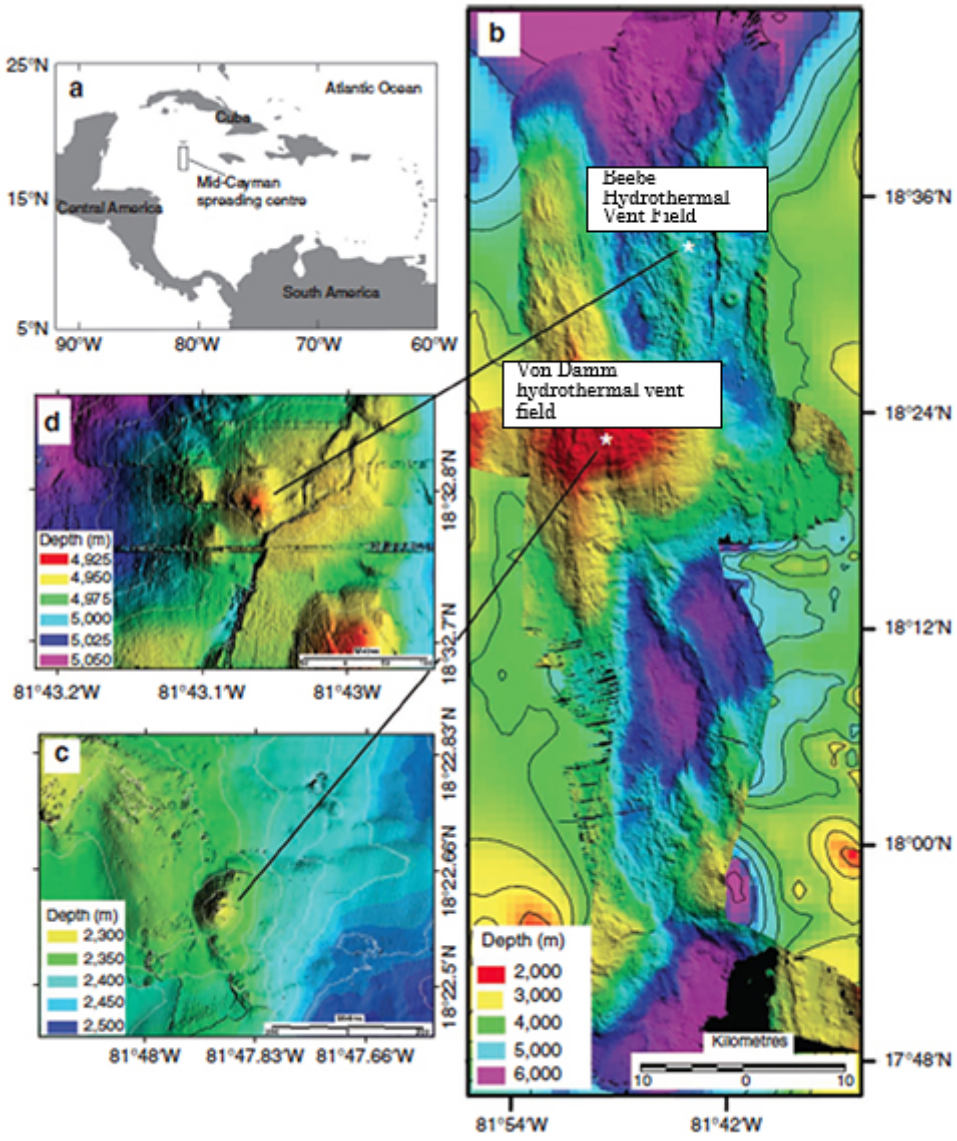
Emerald shrimp with green-colored backs in the Von Damm hydrothermal vent field



Black smoker in the Beebe hydrothermal vent field with high temperatures of about 400 °C



Collection of high-temperature hydrothermal water from a hydrothermal vent named "Hole to Hell" in the Von Damm hydrothermal vent field



Map of study area for this research expedition (Mid-Cayman Rise in the Caribbean Sea off the British Cayman Islands) adapted from Connelly, D. P., et al. (2012) Nature Communication, 3:620 DOI: 10.1038/ncomms1636

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