

CRUISE REPORT

JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY

R/V KAIREI KR16-14 CRUISE

COMPREHENSIVE UNDERSTANDING OF THE SHINKAI SEEP FIELD
IN THE SOUTHERN MARIANA FOREARC BASED ON SUPER-
DETAILED BATHYMETRY DATA

OCTOBER 26, 2016 TO NOVEMBER 3, 2016

(SAIPAN, USA TO NAHA, OKINAWA, JAPAN)



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Notice on 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 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.

Acknowledgements

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1. General cruise information

Cruise ID and ship name: KR16-14, R/V Kairei

Title of the cruise: Comprehensive understanding of the Shinkai Seep Field in the Southern Mariana Forearc based on super-detailed bathymetry data

Chief-Scientist: Yasuhiko Ohara (Hydrographic and Oceanographic Department of Japan, and JAMSTEC)

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Investigation area (Figs. 1 and 2): Mariana Trench

Cruise period and port calls: October 26 to November 3, 2016 (Saipan, USA to Naha, Okinawa, Japan)

Kaiko Mk-IV dive list:

Kaiko-707: Shinkai Seep Field
Kaiko-708: Shinkai Seep Field
Kaiko-710: Shinkai Seep Field
Kaiko-711: Shinkai Seep Field

2. Introduction and objectives of the cruise

Abundant chemosynthetic biological communities, principally consisting of vesicomyid clams, associated with serpentized peridotite were discovered by a Shinkai 6500 dive during YK10-12 cruise of R/V Yokosuka in September 2010. Although no seepages were confirmed, the presence of extensive chemosynthetic biological communities point to the presence of seeps that provide reducing components they require. We therefore named the area “Shinkai Seep Field (SSF)” [Ohara et al., 2012]. Following this discovery, we

conducted three further cruises (YK13-08, YK14-13 and YK15-11 cruises) to study the SSF and the forearc rift northeast of it, obtaining the following major results:

- Several sites of brucite-carbonate chimneys and biological colonies were discovered, thereby providing a rough idea of the areal extent of the SSF [Okumura et al., 2016].
- We observed growth of chimneys *in situ*, making visual comparison of the same chimneys between YK14-13 and YK15-11 cruises. This confirms the presence of active chimneys, providing sound evidence that fluid is, in fact, seeping at the SSF [Okumura et al., 2016].
- The fauna within the SSF were largely described. A new species of gastropod, *Provanna cingulata*, was discovered [Chen et al., 2016]. It belongs to a family endemic to chemosynthetic ecosystems.
- Fresh basaltic glass with backarc basin affinity (i.e., Mariana Trough-like) were discovered both within the SSF and the forearc rift northeast of it, providing a hint to understanding the geological background of the SSF [Stern et al., 2014].

Although we were able to make these important discoveries during the past three cruises, we were not successful in obtaining the *in situ* seeping fluid, the most crucial data for understanding the SSF.

In order to advance our study to the next stage, we believed that it is necessary to **grasp the detailed areal configuration of the SSF** and **understand the composition of the seeping fluid**. In order to achieve these two key objectives, we planned the present cruise, entitled “Comprehensive understanding of the Shinkai Seep Field in the Southern Mariana Forearc based on super-detailed bathymetry data”.

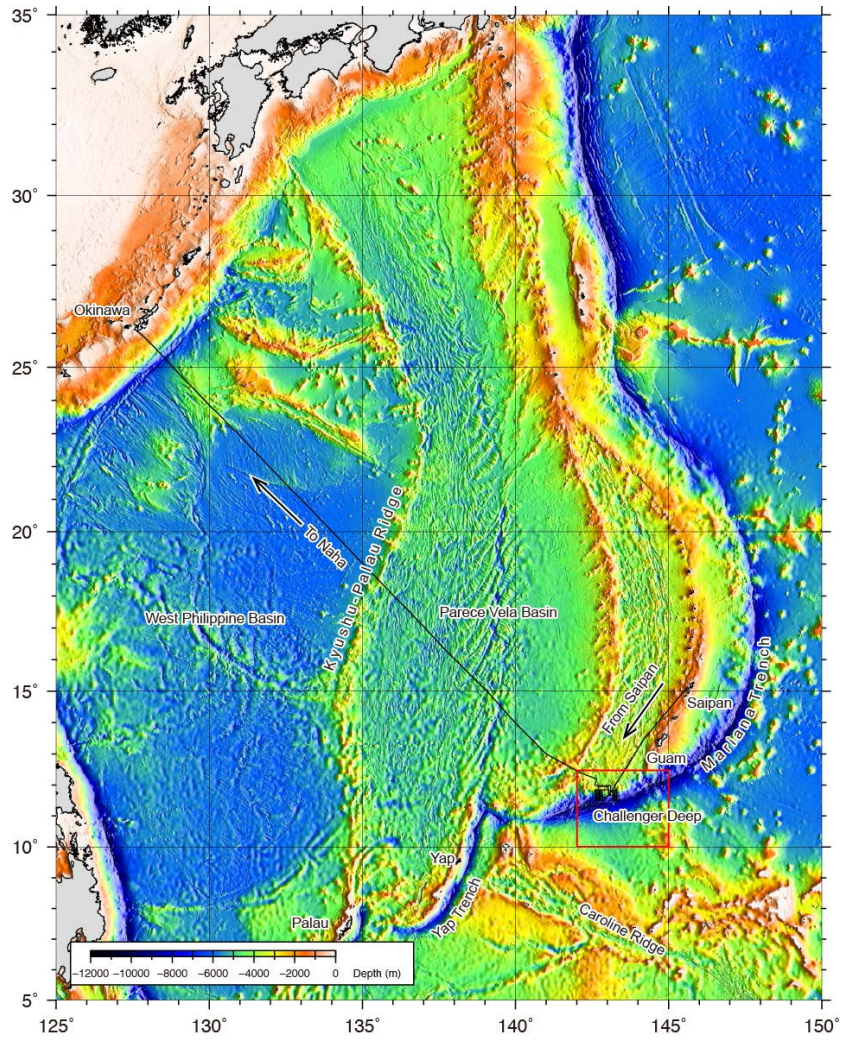


Fig. 1. Index map showing the location of studied area during KR16-14 cruise. The rectangle shown in red indicates the location of Fig. 2. Cruise track lines are also shown.

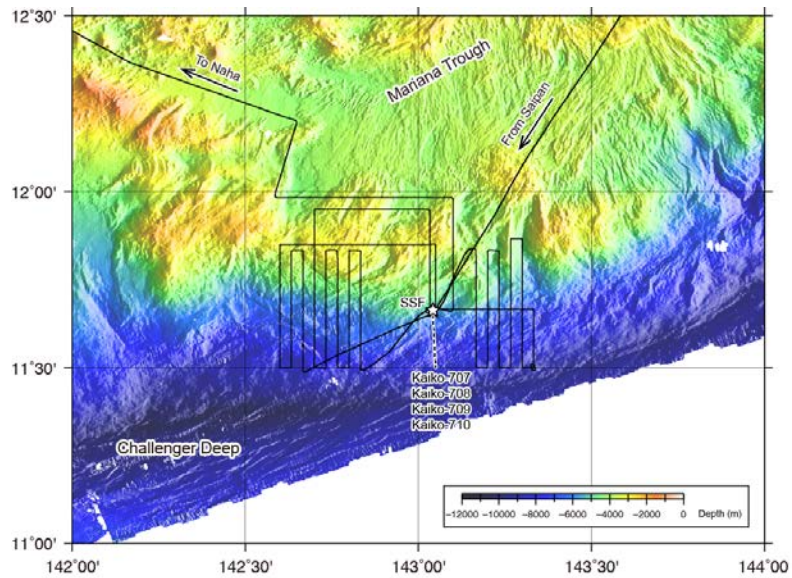


Fig. 2. Location of the dives during KR16-14 cruise. Cruise track lines are also shown. All the dives were conducted at the Shinkai Seep Field.

3. Survey items

During the KR16-14 cruise, we carried out four Kaiko Mk-IV dives in the SSF and also conducted geophysical mapping around the field. Although six Kaiko dives were planned for the cruise, two dives were canceled due to forecast of rough sea conditions.

4. Running cruise narrative

Local time	Notes
26-Oct-16	Start of R/V Kairei cruise KR16-14. Ship underway to the SSF.
8:00	Embarkation of all scientists and NHK crew.
9:00	Start of R/V Kairei cruise KR16-14.
27-Oct-16	The first dive. Kaiko-707 was conducted at the SSF.
7:39	Kaiko-707 started (Kaiko in the water).
10:44	Kaiko on bottom (5731 m).
13:31	Kaiko left bottom (5611 m).
16:25	Kaiko on deck.
28-Oct-16	The second dive. Kaiko-708 was conducted at the SSF.
7:37	Kaiko-708 started (Kaiko in the water).
10:35	Kaiko on bottom (5682 m).
13:53	Kaiko left bottom (5679 m).
16:53	Kaiko on deck.
29-Oct-16	The third dive. Kaiko-709 was conducted at the SSF.
7:45	Kaiko-709 started (Kaiko in the water).
10:46	Kaiko on bottom (5737 m).
13:52	Kaiko left bottom (5621 m).
16:50	Kaiko on deck.
30-Oct-16	The fourth dive. Kaiko-710 was conducted at the SSF.
7:37	Kaiko-710 started (Kaiko in the water).
10:35	Kaiko on bottom (5737 m).
13:30	Kaiko left bottom (5643 m).
16:22	Kaiko on deck.
31-Oct-16	The remaining two dives were canceled due to forecast of rough sea conditions. Underway to Naha at full speed. Scientists worked on archiving samples.
1:50	Kairei crossed the US EEZ line, thereby leaving US waters.
7:00	Kairei completed geophysical mapping.

1-Nov-16	Underway to Naha at full speed. Relatively rough sea condition was encountered. Scientists continued to work on archiving samples.
2-Nov-16	Underway to Naha at full speed. Relatively rough sea condition was encountered.
0:00	The shipboard time was adjusted to Japan time (UTC + 9 hours).
3-Nov-16	Kairei arrived at Naha in the morning. End of the cruise.
9:00	Kairei arrived at Naha in the morning. End of the cruise.
10:00	Disembarkation of KR16-14 scientists and NHK crew.

5. The main results of Kaiko Mk-IV dives

- **Kaiko-707:** Detailed (sub-meter order) bathymetric survey of the SSF was conducted for the first time, employing the multibeam sonar SeaBat 7125 installed on Kaiko Mk-IV (**Fig. 3**). Deployment of NHK's 4K resolution deep-sea camera observation station was also done at a vesicomid clam colony site (near the CO (= Colony) Site 4 [**Fig. 4**; Okumura et al., 2016]). A rock sample was collected after camera deployment, this was identified as a specimen of plagiogranite.
- **Kaiko-708:** CH (= Chimney) Site 4 and Site 3 [Okumura et al., 2016] were visited during this dive. Chimneys were visually observed and sampled, as well as small fragments of rocks (including troctolite and serpentinite) and two push cores. Also, four sets of cylindrical markers, named 'GATS markers' (= Geofluid Accumulating Trap System markers), were deployed in both sites. These GATS markers will trap the seeping fluid *in situ*, and their recovery is expected in a future cruise.
- **Kaiko-709:** Following the observations made in Kaiko-708, CH Site 3 was re-visited. During the Shinkai 6500 dive 1433 (cruise YK15-11 in 2015), two sets of cylindrical markers were deployed to identify the location of chimneys in CH Site 3. The two markers, which we now call 'proto-GATS markers', were apparently altered by the seeping fluid. Effects observed include overgrowth of newly formed chimney structure outside the wall of the proto-GATS marker. *In situ* sampling of potentially trapped seeping fluid was made from the two sets of proto-GATS markers using a pressure-tight water sampler (named WHATS). Faunas living both outside and inside Type II chimneys [**Fig. 5**; Okumura et al, 2016] were collected with a slurp gun. The faunas included *Provanna cingulata*, a gastropod newly discovered from the SSF during cruise YK15-11 [Chen et al., 2016]. After sampling completed, the 4K deep-sea camera observation station deployed in Kaiko-707 was recovered. On-board analysis of the fluid collected from proto-GATS marker yielded a pH value of 9.89, confirming seepage of alkaline fluid at the SSF.
- **Kaiko-710:** Further detailed (sub-meter order) bathymetric survey of the SSF was conducted, following Kaiko-707. The detailed mapping conducted during the two dives (Kaiko-707 and 710) was able to cover the main features (i.e., colonies and chimneys) of the SSF.

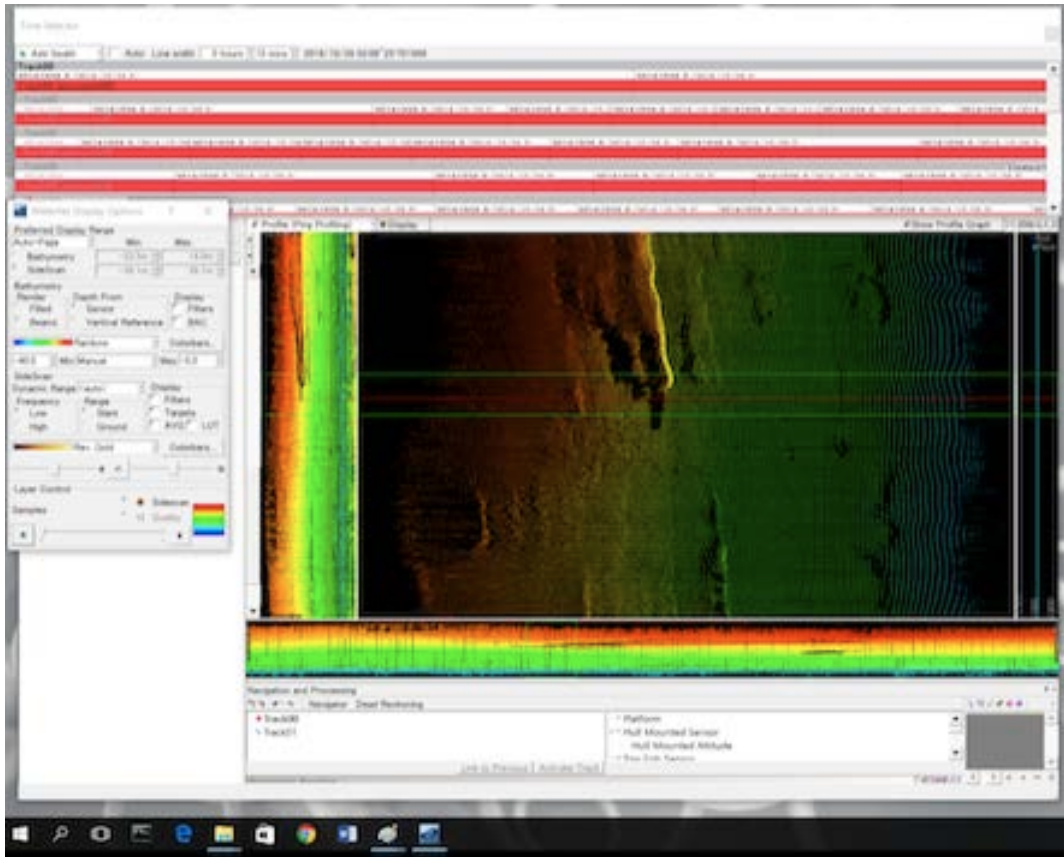


Fig. 3. An example of mapped structure within the Shinkai Seep Field. This is a capture of screen of the CleanSweep software, showing a chimney-like structure.

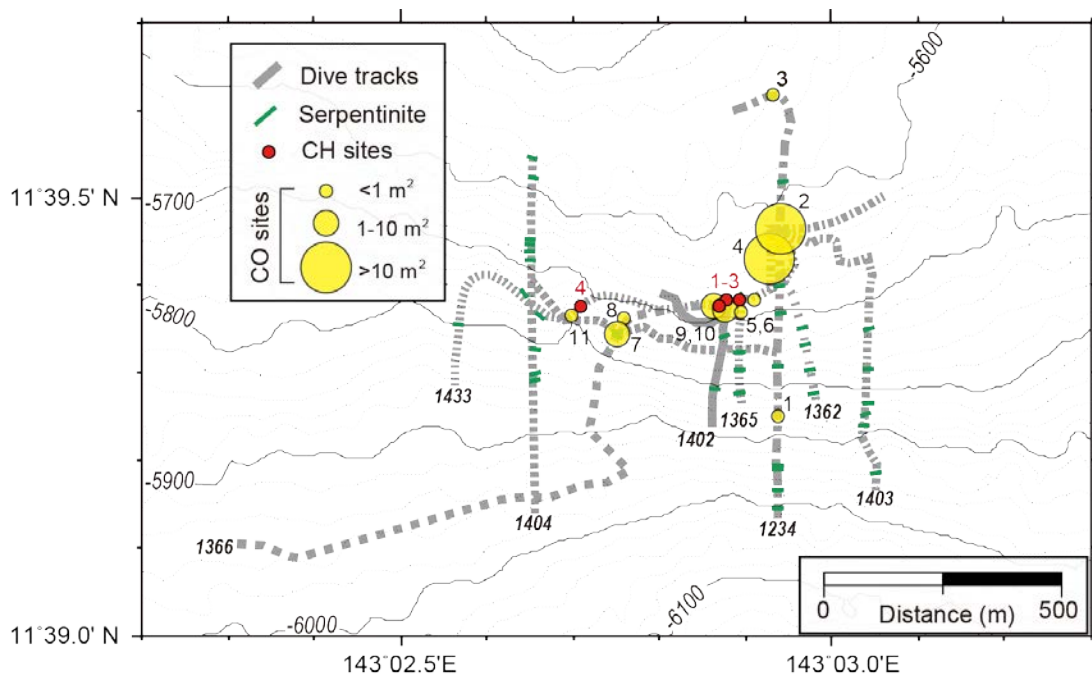


Fig. 4. Locations of chimney (CH) and vesicomimid clam colony (CO) sites within the Shinkai Seep Field [Okumura et al., 2016].

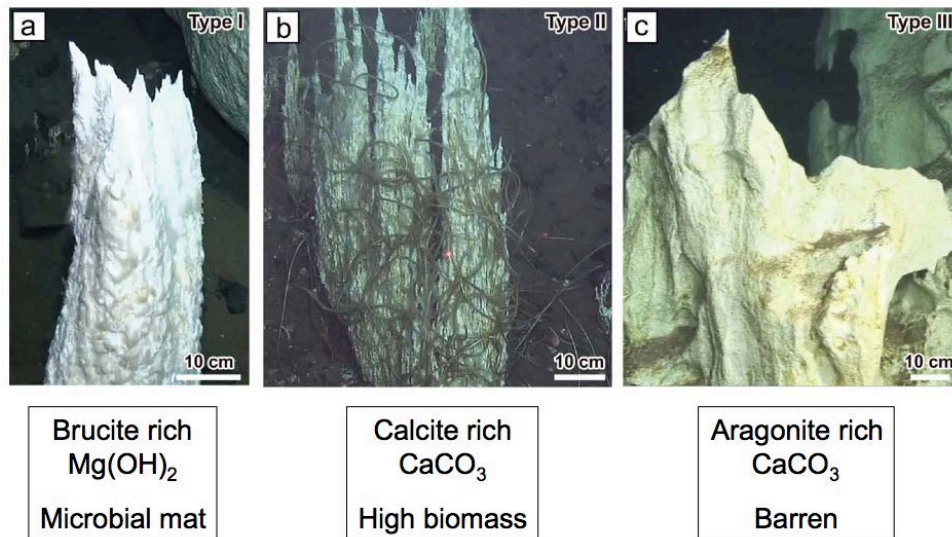


Fig. 5. Three types of chimneys within the Shinkai Seep Field [after Okumura et al., 2016].

6. References

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