

Shinsei-maru Cruise Report KS-19-8

Study on Philippine Sea plate motion history by taking
oriented core samples

Northern part of the Philippine Sea

17 May, 2019 - 26 May, 2019



Joint Usage/Research Center for Atmosphere and Ocean
Science (JURCAOS)
Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

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1. Cruise Information

- Cruise ID: KS-19-8
- Name of vessel: Shinsei-maru
- Title of cruise: Study on Philippine Sea plate motion history by taking oriented core samples
- Chief Scientist: Toshitsugu Yamazaki [Atmosphere and Ocean Research Institute, The University of Tokyo]
- Cruise period: 17 May 2019 - 26 May 2019
- Ports of departure / arrival: Yokosuka / Wakayama
- Research area: Northern part of the Philippine Sea
- Research map

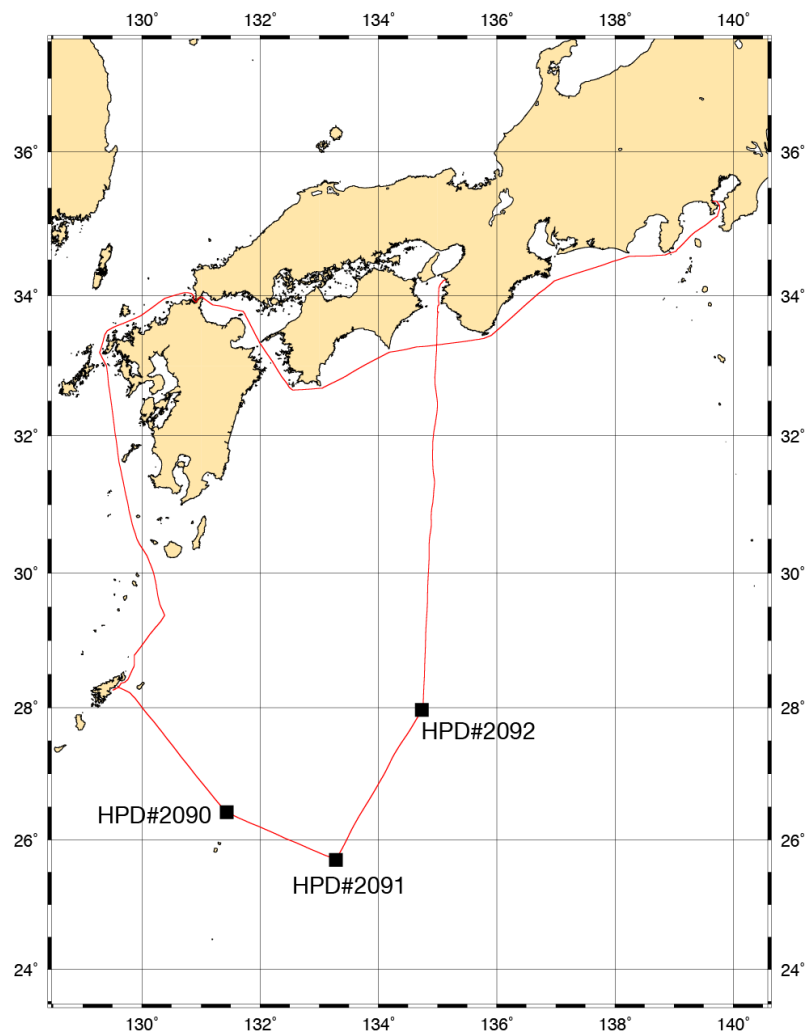


Fig. 1. Ship track map of the KS-19-8 cruise.

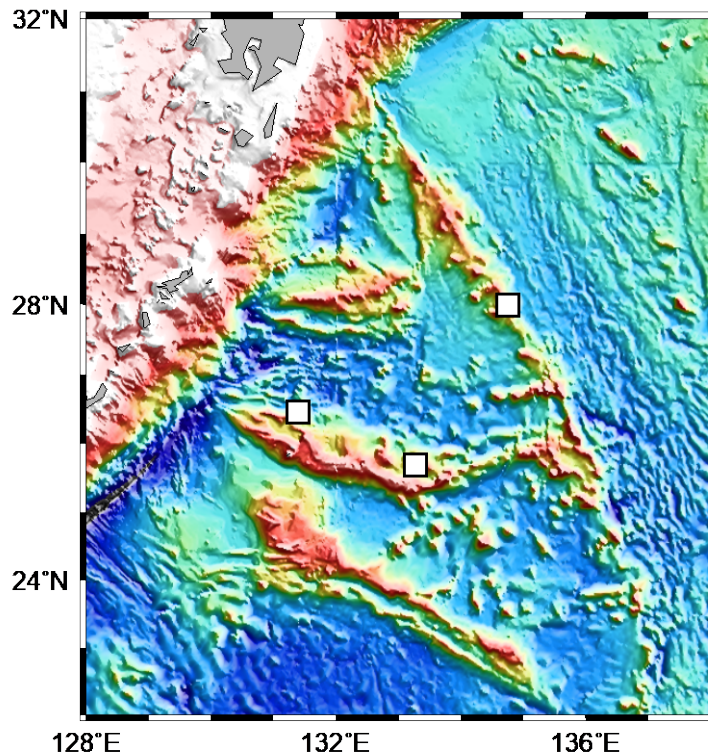


Fig. 2. Bathymetric map of the studied area.

2. Research Proposal and Science Party

- Title of proposal: Study on Philippine Sea plate motion history by taking oriented core samples
- Representative of Science Party [Affiliation]: Toshitsugu Yamazaki [Atmosphere and Ocean Research Institute, The University of Tokyo]
- Science Party (List) [Affiliation]
 Fujii Masakazu [Assistant Professor, National Institute of Polar Research]
 Yutaka Yoshimura [Graduate Student, Atmosphere and Ocean Research Institute, The University of Kokyo]
 Wei Fu [Graduate Student, Atmosphere and Ocean Research Institute, The University of Kokyo]
 Kenta Suetsugu [Engineer, Koken Boring Machine Co. Ltd.]
 Fumisato Tajima [Engineer, Koken Boring Machine Co. Ltd.]
 Mitsuyasu Katagiri [Marine Technician, Nippon Marine Enterprise Co. Ltd.]

3. Research/Development Activities

- Study on Philippine Sea plate motion history by taking oriented core samples

(1) Purpose and background.

Elucidating the plate motion history of the Philippine Sea plate is important for better understanding the subduction initiation of the Pacific plate along the eastern margin of the Philippine Sea plate in Eocene, processes of subsequent back-arc spreading, and tectonic history of the Japanese Island (e.g., Ishizuka et al., 2011; Kimura et al., 2014). Previous studies for more than 30 years revealed that the Philippine Sea plate was near the equator at about 50 Ma and moved northwards since then. However, the detailed history of the motion is still not understood well. In particular, there are two contrasting ideas for the rotation of the plate; some models invoke a large ($\sim 90^\circ$) clockwise rotation (e.g., Hall et al., 1995; Deschamps & Lallemand, 2002), whereas the others assume little rotation (e.g., Xu et al., 2012). The reason for the difficulty in determining the plate rotation is that the Philippine Sea plate is mostly submerged, and hence it is difficult to apply the paleomagnetic method usually used for reconstructing the

motion history of a landmass.

The purpose of this study is to obtain fully-oriented core samples from geologically stable parts of the Philippine Sea plate using a newly developed coring system, and to determine the rotation of the plate based on paleomagnetic analyses.

(2) Method and instruments

We used a coring system recently developed by Koken Boring Machine Co. Ltd. (see photo on the cover page), which was operated by the ROV Hyper-dolphin. The coring system can drill rock cores of more than 30 cm in length and 3 cm in diameter, and 10 cores can be stored in a core rack during a single dive of the ROV. The drilling rod consists of an inner barrel and an outer barrel with a drill bit. The inner barrel does not rotate, and has a small blade to mark an orientation line to cores. Combined with an orientation sensor (a magnetic compass and inclinometer) placed on the corer, we can recover the orientation of each core.

The coring sites were selected based on previous studies using un-oriented cores drilled by the BMS drill (Yamazaki et al., 2010). We targeted limestones of Eocene or Oligocene age with stable remanent magnetization. Relatively thick manganese crusts (~10 cm) that cover the seafloor were anticipated.

Bathymetry with a multi-narrow-beam echo-sounder SeaBeam 3020 was carried out within the survey area, in particular in the vicinity of the diving points. Magnetometry with a shipboard three-component magnetometer were performed continuously during the cruise. Calibration run of the three-component magnetometer was conducted twice.

(3) Results

Three dives of the ROV Hyper-Dolphin were conducted during this cruise (Figs. 1 and 2). Five dives were originally planned, but two were cancelled because of rough sea. The results of the three dives are summarized as follows.

i) HPD #2090 at the Daito 401 Seamount (Fig. 3)

Date: 22 May 2019

Position: 26°27.048'N, 131°23.452'E

Water depth: 1956 m

Results: Coring was conducted three times. Two oriented rock cores were obtained (Fig. 4). Core C1 is limestone of 4.5 cm in length with a thick Mn crust cover of ~17.5 cm, and Core C2 is Mn crust (total ~9.5 cm).

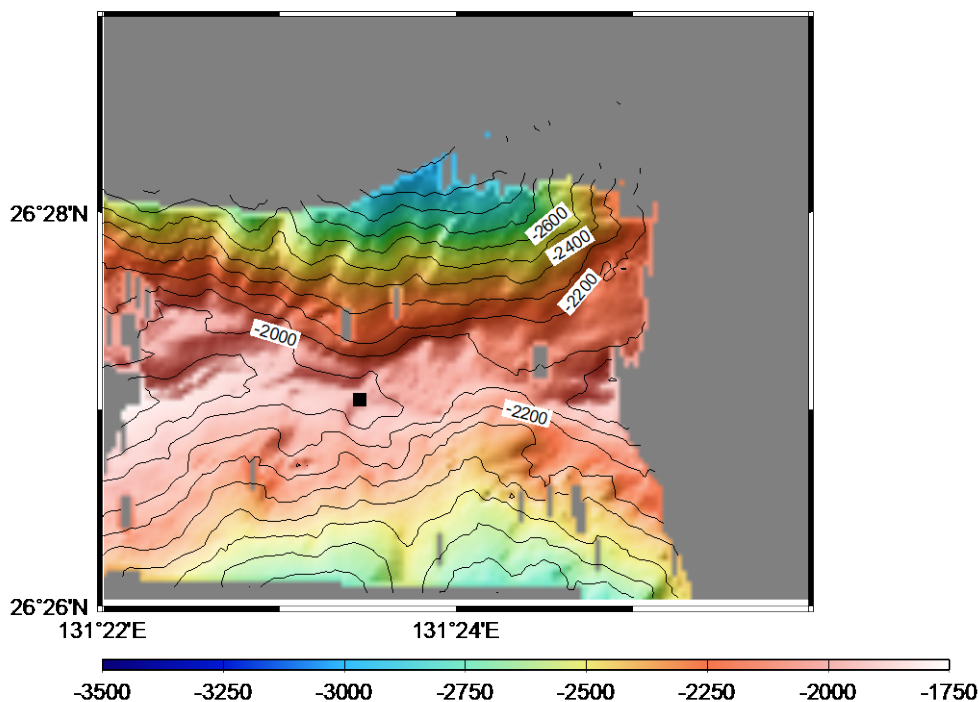


Fig. 3. Bathymetric map around the HPD #2090 dive site.

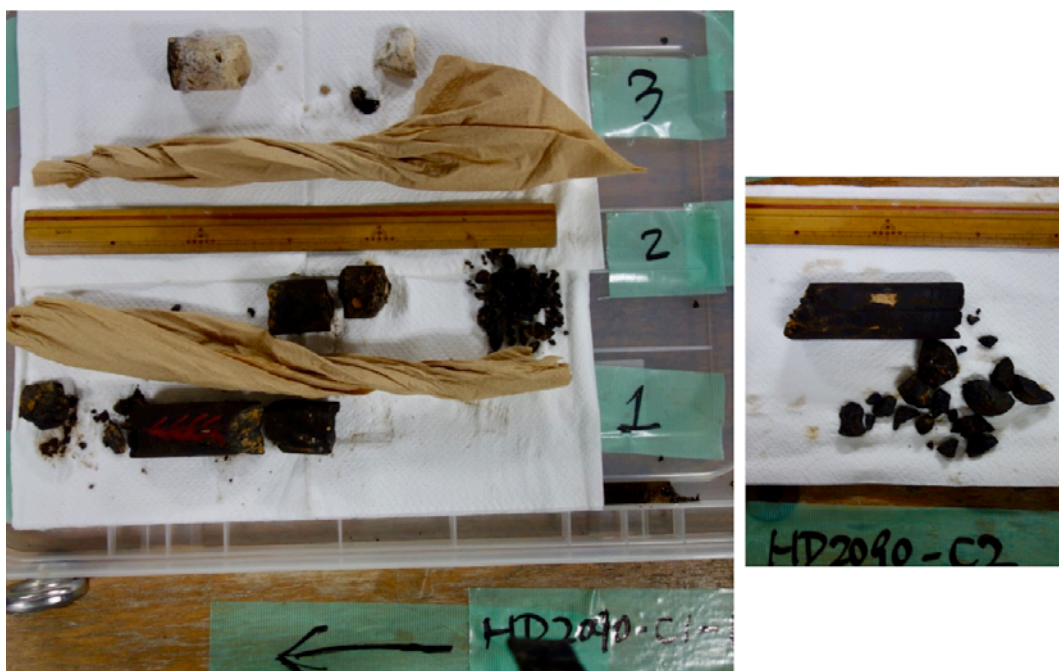


Fig. 4. Samples cored at the HPD #2090 dive site: Core 1 (left) and Core 2 (right).

ii) HPD #2091 at the Daito 3316 Seamount (Fig. 5)

Date: 23 May 2019

Position: 25°41.306'N, 133°16.419'E

Water depth: 1390 m

Results: Coring was conducted three times. Two oriented cores of Mn crusts, Cores C1 (~20 cm in total) and C2 (~6.5 cm), and one unoriented Mn crust fragments (Core C3) were obtained (Fig. 6). Core C2 was stuck in the core barrel and did not stored in the core rack. Then, drilling of Core C3 was conducted, and the samples were also stuck in the core barrel. The boundary between Cores 2 and 3 was determined by the positions of the samples in the core barrel and visual inspection of the recovered samples.

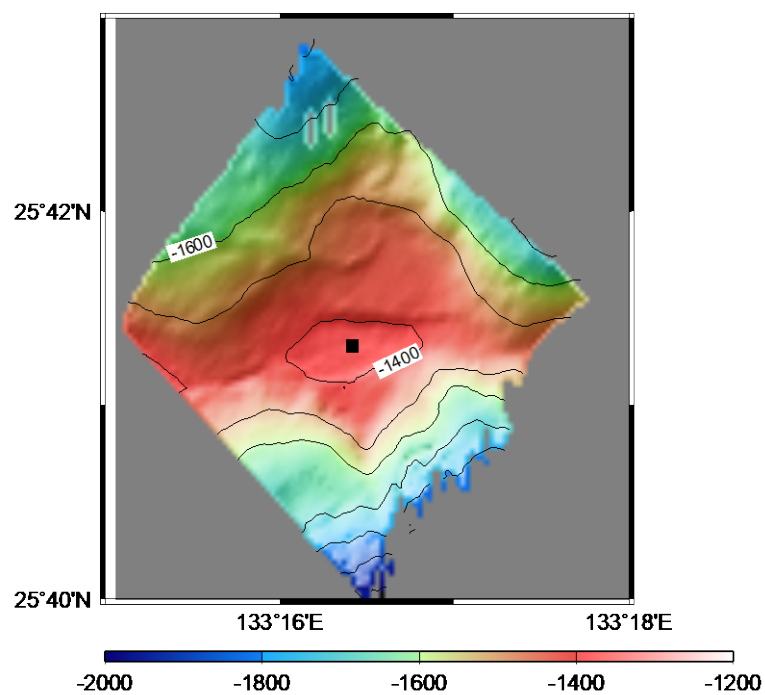


Fig. 5. Bathymetric map around the HPD #2091 dive site.

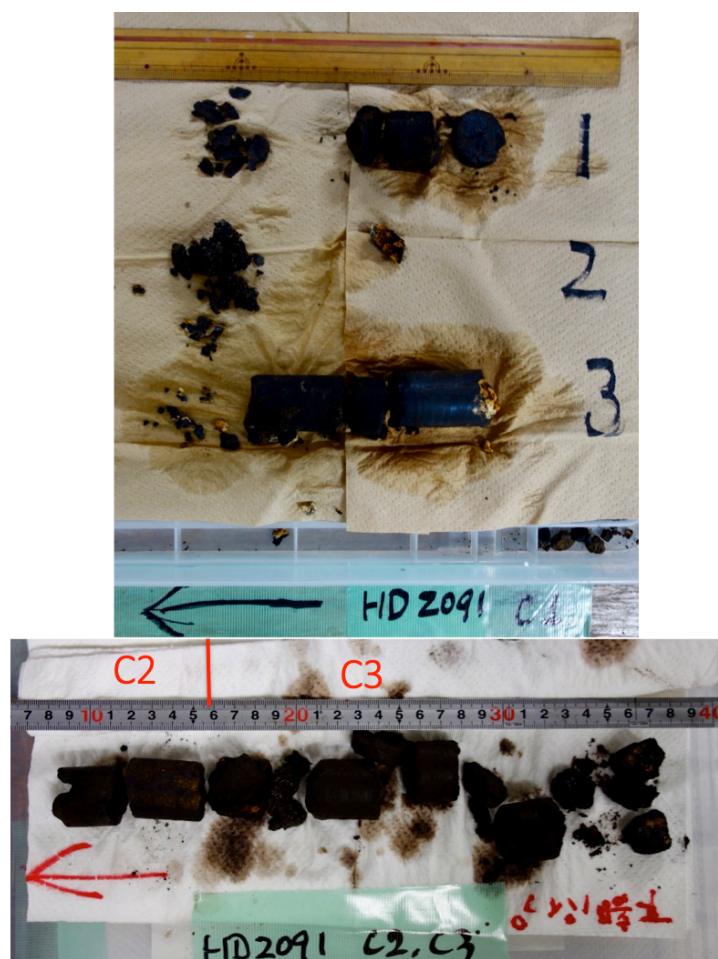


Fig. 6. Samples cored at the HPD #2091 dive site: Core 1 (top), Cores 2 and C3 (bottom).

iii) HPD #2092 at the Hyuga Seamount (Fig. 7)

Date: 24 May 2019

Position: 27°59.362'N, 134°45.125'E (Cores 1 and 2), 27°59.362'N, 134°45.129'E (Cores 3 and 4),
27°59.359'N, 134°45.121'E (Core 5)

Water depth: 1929 m

Results: Coring was conducted five times. Cores C1 through C4 are sandy limestone and fragments of Mn crust that cover the limestones (Fig. 8). The lengths of Mn crust and limestone of individual cores are, ~3 and 27cm (Core C1), ~3 and 30 cm (C2), ~10 and 15 cm (C3), ~10 and 12 cm (C4), respectively. Core C5 is unoriented core of Mn crust (~10 cm) (Fig. 8).

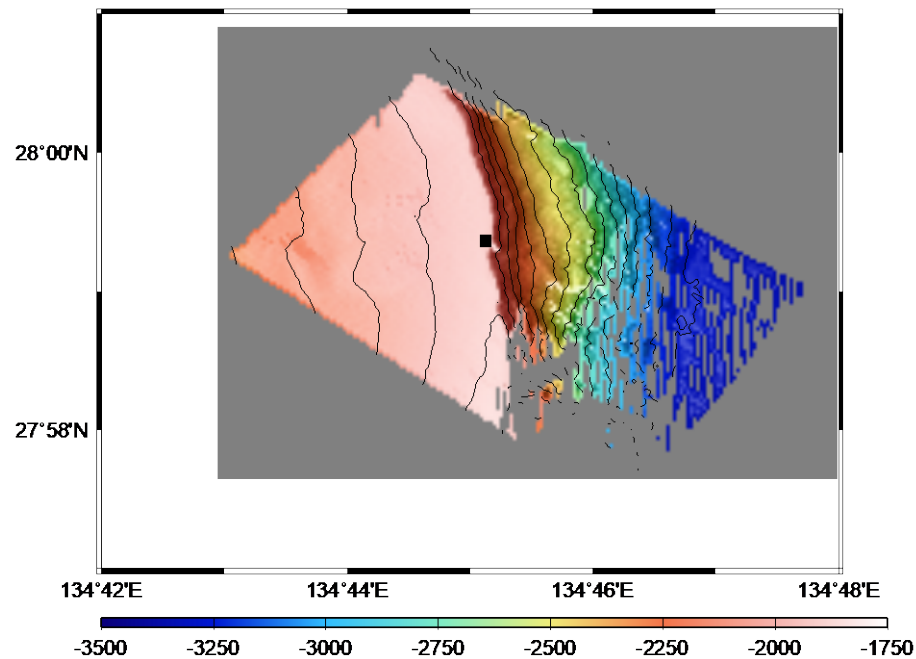


Fig. 7. Bathymetric map around the HPD #2092 dive site.



Fig. 8. Samples cored at the HPD #2092 dive site: Cores C1 through C5 from the bottom to the top.

○ 4. Cruise Log

Date	Local Time (JST:UTC+9h)	Note	Noon Position/Weather/Wind/Sea condition
17-May-19		Left Yokosuka for Research Area	EAST OF JYOGA-SHIMA
	09:00	Scientists embarked	35-05.8N,139-42.4E, 0
	10:00	Left Yokosuka for Research Area	Fine but Cloudy
	10:30	Meeting & Safety Education for Scientists	North-4 (Moderate breeze)
			2 (Sea Smooth)
			1 (Low Swell Short)
			Visibly: 8'
18-May-19		Bound for Research Area	WEST OF SHIONO-MISAKI
	09:00	Scientist meeting	33-17.8N,135-00.2E, 0
			Cloudy
			SE-6 (Strong breeze)
			4 (Sea Moderate)
			3 (Moderate Short)
			Visibly: 8'
19-May-19		Bound for Research Area	WEST OF KANMON-KO
	09:00	Scientist meeting	34-02.1N,130-41.9E, 0
			Cloudy
			SE-7 (Near gale)
			4 (Sea Moderate)
			2 (Low Swell Strong)
			Visibly: 8'
20-May-19		Bound for Research Area	WEST OF YAKU-SHIMA
	09:00	Scientist meeting	30-21.8N,130-00.0E, 0
			Rain
			NNW-3 (Gentle breeze)
			2 (Sea Smooth)
			3 (Moderate Short)
			Visibly: 6'
21-May-19		Bound for Research Area	EAST OF AMAMI
	09:00	Scientist meeting	28-17.9N,129-35.8E, 0
			Fine but Cloudy
			NW-6 (Strong breeze)
			4 (Sea Moderate)
			3 (Moderate Short)
			Visibly: 8'
22-May-19		Arrived at Research Area & HPD 2090 dive	NORTH OF DAITO-SHIMA
	04:30	Arrived at Research Area	26-27.1N,131-23.5E, 0
	05:04	Started MBES survey	Fine but Cloudy
	05:26	Finished MBES survey	North-4 (Moderate breeze)
	06:17	Released XBT	3 (Sea Slight)
	08:17	Hoisted up HPD	3 (Moderate Short)
	08:22	Launched and commenced HPD2090 dive operation	Visibly: 8'
	09:56	Landed on the sea floor (Depth=1,954m)	
	15:16	Left the sea bottom (Depth=1,956m)	
	16:35	Recovered HPD	
	19:07	Started 8 figure running	
	19:27	Finished 8 figure running	
23-May-19		HPD 2091 dive	EAST OF DAITO-SHOTO
	05:14	Started MBES survey	25-41.3N,133-16.4E, 0
	05:26	Finished MBES survey	Fine but Cloudy
	06:09	Released XBT	North-4 (Moderate breeze)
	08:14	Hoisted up HPD	3 (Sea Slight)
	08:19	Launched and commenced HPD2091 dive operation	3 (Moderate Short)
	09:23	Landed on the sea floor (Depth=1,390m)	Visibly: 8'
	13:08	Left the sea bottom (Depth=1,389m)	
	14:18	Recovered HPD	
24-May-19		HPD 2092 dive & Left Research Area for Wakayama	EAST OF KIKAI-SHIMA
	05:48	Started MBES survey	27-59.4N,134-45.1E, 0
	06:10	Finished MBES survey	Fine but Cloudy
	06:17	Released XBT	NE-3 (Gentle breeze)
	07:40	Started 8 figure running	3 (Sea Slight)
	08:00	Finished 8 figure running	3 (Moderate Short)
	08:17	Hoisted up HPD	Visibly: 8'
	08:22	Launched	
	09:56	Landed on the sea floor (D=1,954m)	
25-May-19		Bound for Wakayama	SOUTH OF KII-SUIDO
	09:00	Scientist meeting	31-28.5N,134-55.6E, 0
			Fine but Cloudy
			SW-3 (Gentle breeze)
			2 (Sea Smooth)
			2 (Low Swell Strong)
			Visibly: 8'
26-May-19		Arrived at Wakayama	
	10:00	Arrived at Wakayama	
	11:00	Scientists disembarked	

● **5. Notice on Using**

This cruise report is a preliminary documentation as of the end of cruise.

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

Users of information on this report are requested to submit Publication Report to Cooperative Research System Office.

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