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MIRAI “Cruise Report”
MR21-02

Performance confirmation test

Off Shikoku, Kumano-nada, South part of Suruga Trough, Izu-Ogasawara Trench, Suruga Bay

May 14, 2021-May 19, 2021

Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

1. Cruise Information

● Cruise ID: MR21-02
● Name of vessel: MIRAI
● Title of cruise: Performance confirmation test.
● Chief Scientist [Affiliation]: Hiroshi OCHI [JAMSTEC]
● Cruise period: May 14, 2021 – May 19, 2021
● Ports of departure / call / arrival: Shimonoseki / Shimizu
● Research area: Off Shikoku, Kumano-nada, South part of Suruga Trough, Izu-Ogasawara Trench and Suruga Bay
● Research map

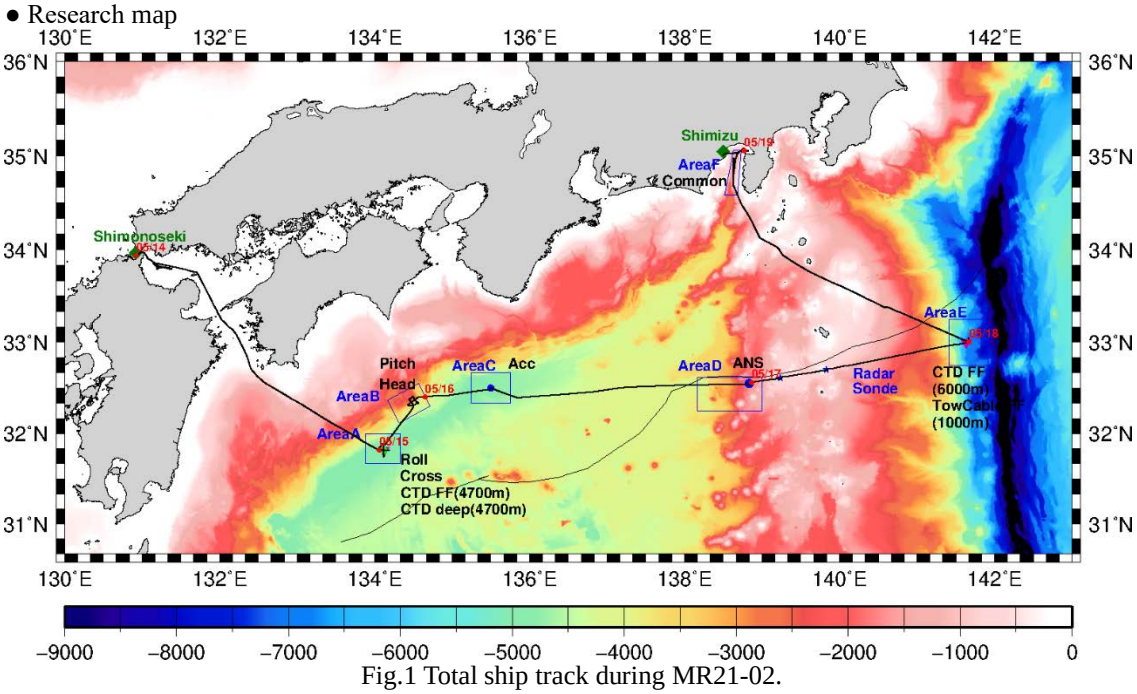


Fig.1 Total ship track during MR21-02.

2. Research Proposal and Science Party

● Title of proposal
1. Performance confirmation test of “MIRAI”.
2. Preparation of fluorine measurement for MR21-04.
3. Performance test of un-contacted power supply and communication swivel for CTD.

● Representative of Science Party [Affiliation]
1. Performance confirmation test of “MIRAI”.
Hiroshi OCHI [JAMSTEC]
2. Preparation of fluorine measurement for MR21-04.
Masahiro SHIGEMITSU [JAMSTEC]
3. Performance test of un-contacted power supply and communication swivel for CTD.
Yosaku MAEDA [JAMSTEC]

● Science Party (List) [Affiliation, assignment etc.]
Hiroshi OCHI [JAMSTEC]
Jyunya ISHIWATA [JAMSTEC]
Ryuta TANAKA [JAMSTEC]
Chiaki IGARASHI [JAMSTEC]
Masahiro SHIGEMITSU [JAMSTEC]
Yosaku MAEDA [JAMSTEC]
Subaru KISO [JAMSTEC]
Kosuke NAKANO [JAMSTEC]
Takushi YOSHIDA [Nippon Marine Engineering]

Tatsumi DEGUCHI [Nippon Marine Engineering]
Hiroshi UCHIDA [JAMSTEC] (non-embarkation)
Jyunya NIIKURA [JAMSTEC] (non-embarkation)

3. Research/Development Activities

● Performance confirmation test of “MIRAI”.

Engine trial was conducted and the dock maintenance was finished.
Test of various equipment onboard "MIRAI" before starting research cruise were carried out.

Acoustic Doppler current profiler (ADCP)
Maximum detected bottom depth: 1,181m
Alignment estimation: -0.233degree
Background noise: confirm the best ship speed for observation is around 11.5kt.
Maximum current measurement depth: 615m at 4, 6 and 8kt. 639m at 11.5kt and over. 711m at 0kt.

Expendable bathy thermographs and expendable conductivity temperature and depth (XBT/XCTD)
XBT (Probe: T-5) and XCTD (Probe: XCTD-1) launch test were conducted by auto launcher. It was confirmed that XBT/XCTD system on “MIRAI” has no problem for observation.
One XBT and one XCTD were launched during CTD casting. Those results are shown in Fig.2. Temperature profile of XCTD fit well to CTD down cast. Temperature profile of XBT had slightly difference from CTD down cast. It looks like same shape but difference of depth is larger in deeper depth area, which means the difference becomes large with the time. This difference would be caused by equation of depth calculation in Tsurumi-seiki’s software. So if you need precise temperature profile, you have to consider using XCTD.

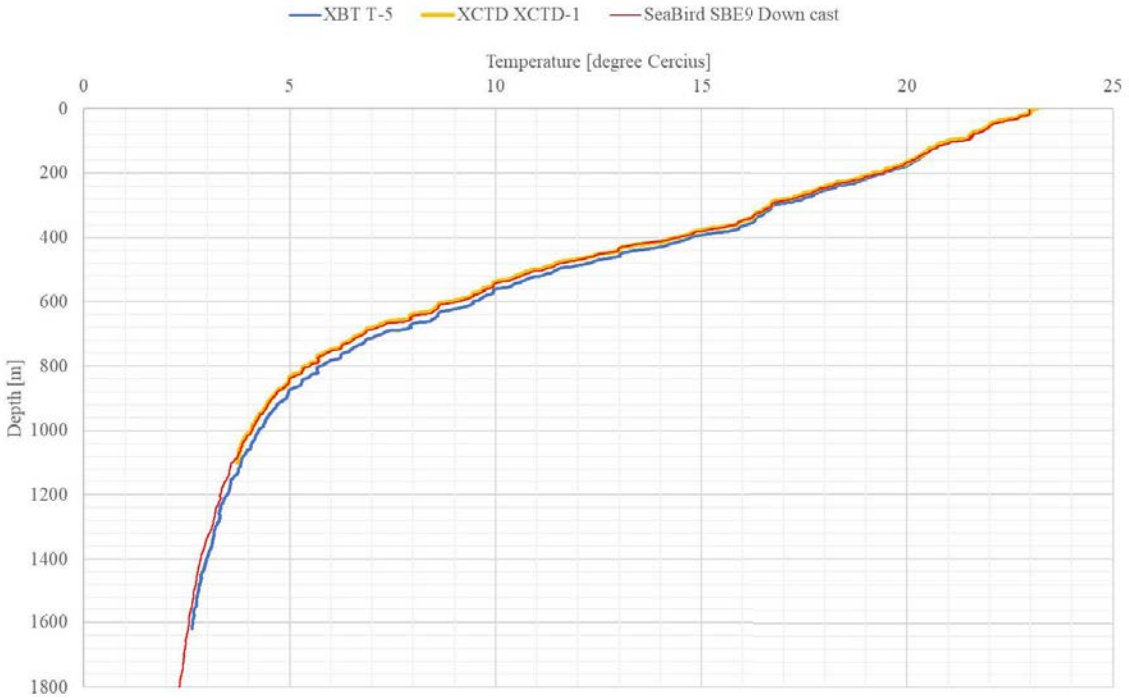


Fig.2 The temperature profile compare between XBT, XCTD and SeaBird SBE9.

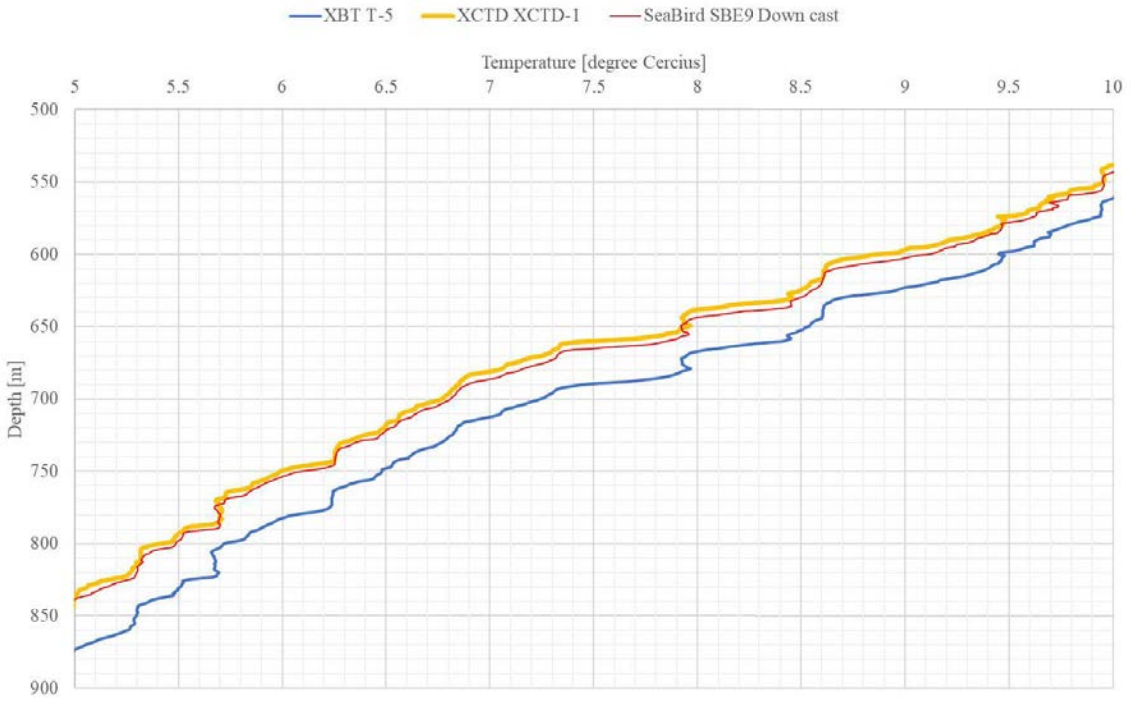


Fig.3 Zoomed in around 700m depth of Fig.2.

Multi-beam echo sounder (MBES) and Sub-bottom profiler (SBP)

Roll, pitch and heading bias test, depth accuracy test, noise test and continuous operation test for MBES were conducted. Continuous operation test for SBP were conducted.

All tests cleared for observation.

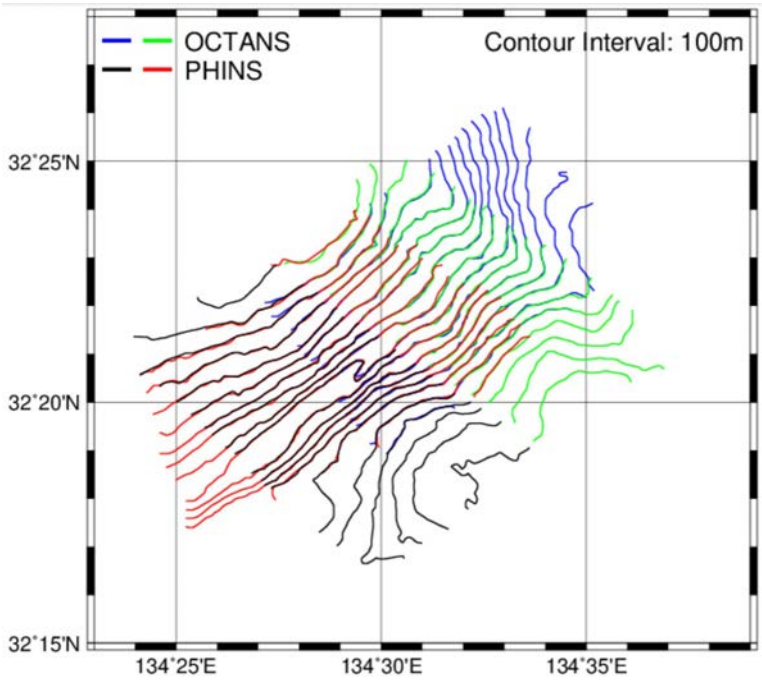


Fig.4 Result of total bias check test.

Acoustic navigation system (ANS)

In this cruise, the new transponder mooring system as shown in Fig.5 was tested. It was carried out at deploy, release and recovery of a transponder mooring system. From this result, this new transponder

mooring system is set to standard system on “MIRAI”.
Estimated constant data: +0.031degree (Roll), -0.289degree (Pitch), +2.79degree (Heading) with PHINS (VRU).
Tracking transponder, and transmitting command were fine.

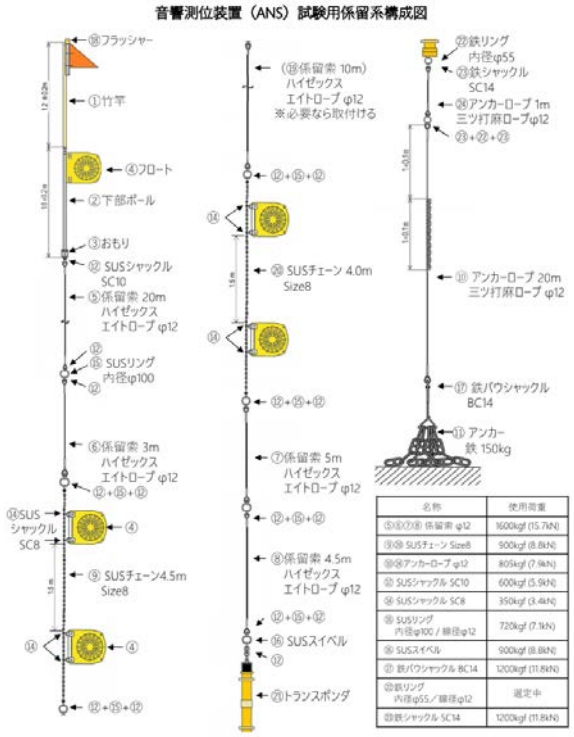


Fig.5 New transponder mooring system.

Fig.6 Acoustic transponder.

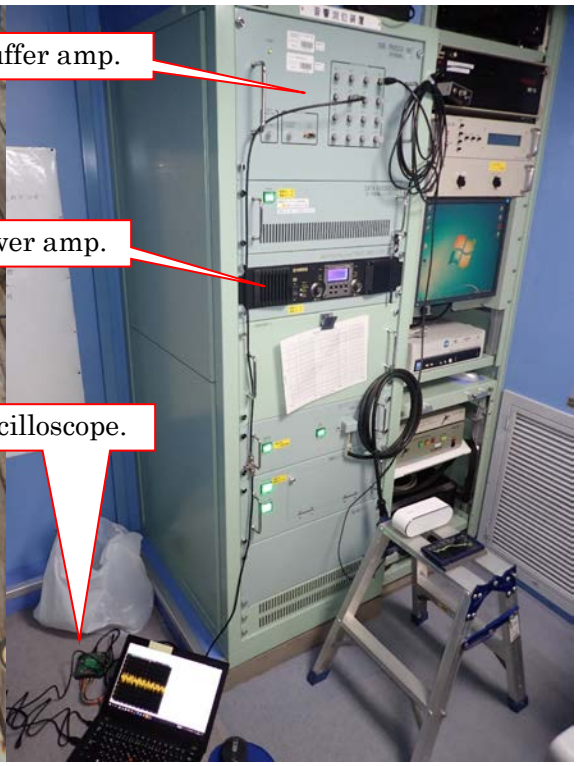


Fig.7 ANS processing unit and monitor.

Gravity meter

Continuous operation test from 14th May at Shimonoseki to 19th May at Shimizu was conducted. Measured drift value through continuous operation test was +0.095 [mGal/6 days], which was +0.481 [mGal/Month]. It was good quality compared with maker nominal value (3.0 [mGal/month]). By cross line survey, it was confirmed that gravity anomaly was measured at good precision, which difference was less than +/-1.0 [mGal] at cross point.

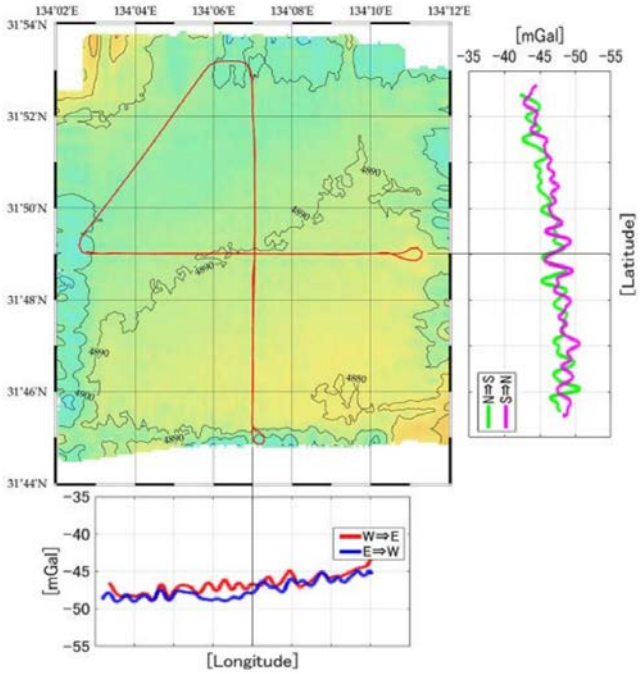


Fig.8 Result of cross line survey.

Cesium magnetometer

Cross line survey was conducted. Data will be analyzed after cruise by data management office (DMO) of JAMSTEC. It was confirmed that there are no influence of ships magnetization.

Fig.9 Tow fish of Cesium magnetometer.

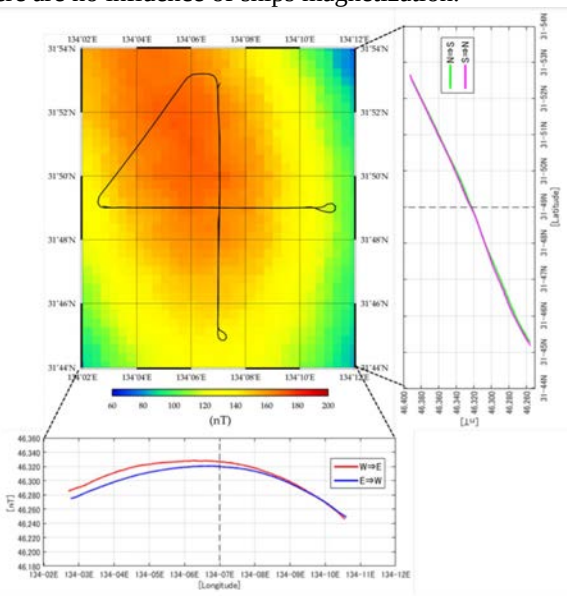
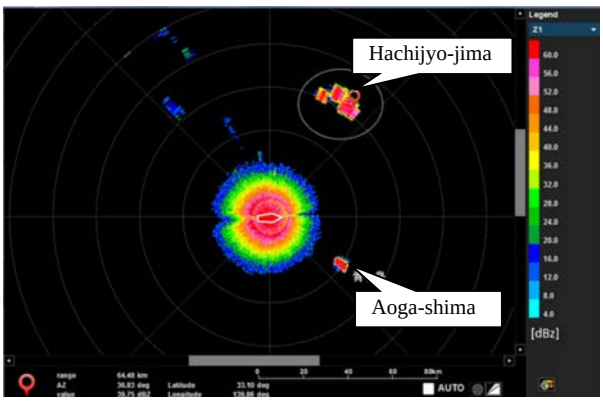


Fig.10 Result of cross line survey.

Doppler RADAR

Doppler RADAR was operated at far from Honsyu (main island of Japan) over 200 km area. At dock maintenance of this year, data processing unit and its software algorithm were replaced. In this cruise, transmit and received radio wave data were corrected and system was confirmed well worked. After this cruise, parameters of software were adjusted based on real transmitted/received data.

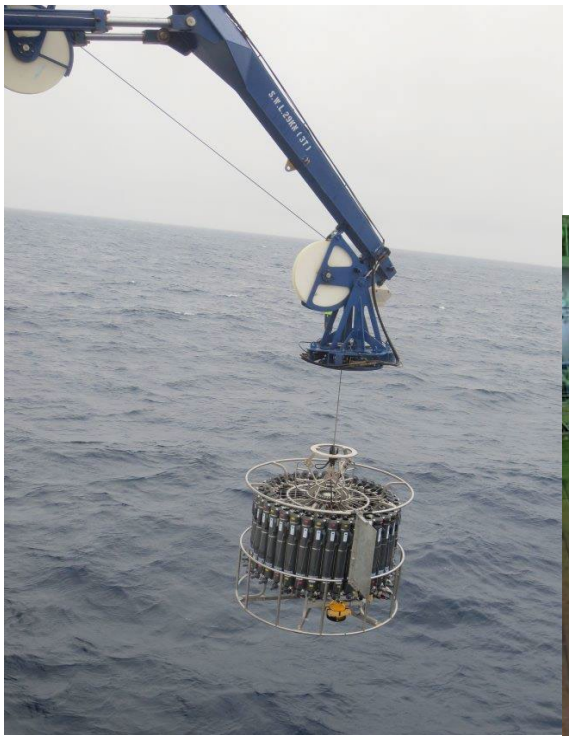
Processing unit of Doppler RADAR.



PPI scan window at near Hachijyo-jima.

CTD winch

Free fall was carried out twice, which were down to 4,800 m and to 6,000 m. And CTD cast was carried out once to 4,800 m. Water sampling was also done at 36 different depth. Sampled water were used for check several analyzers.



Start a cast of CTD and water sampling system.

Waiting Niskin bottles back.

We also check many items shown below.

Shipboard three components magnetometer (STCM)

Radiosonde

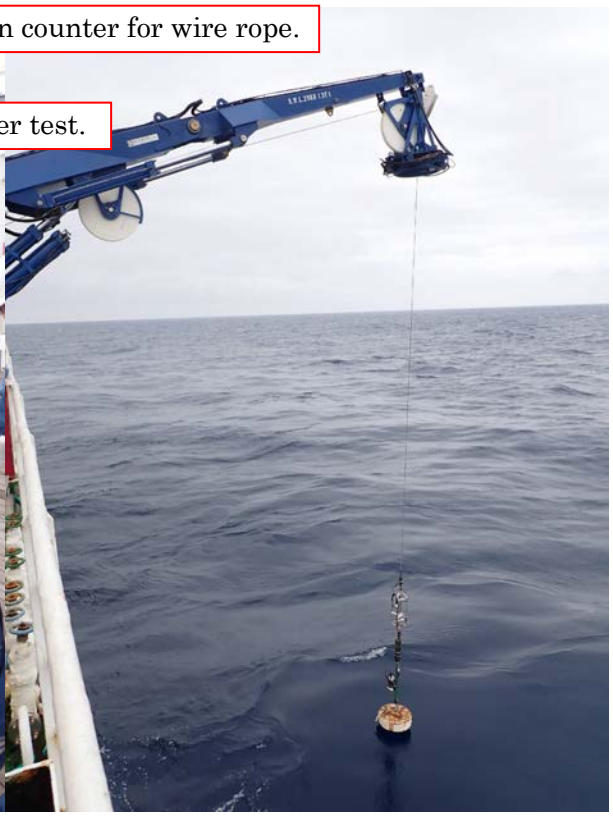
Meteorological oceanographic observational equipment, SOAR
Ceilometer
Satellite data receiving system
Radio navigation system
Shipboard data management system
Towing winch.
CTD system
Autosal
DO meter
Nutrients analyzer
TCO2 measuring system
Total alkalinity titrator
Gas chromatograph
High performance liquid chromatography
Spectro fluorometer
Absorption spectrophotometer
Continuous sea surface water monitoring
pCO2 measurement system
Mass spectrometer for biological production
Water purification system, Refrigerator, Freezer, Ice machine, Deep freezer, Evaporator, Clean draft, Clean bench, Draft chamber, Clean room

We checked out all those items works good and those are ready for research cruise.

● Preparation of fluorine measurement for MR21-04.
A setup of the measurement systems of CFCs and SF6 for MR21-04 was conducted.

● Performance test of un-contacted power supply and communication swivel for CTD.
In CTD observation using a fiber rope, it is inevitable that twists due to casting will accumulate. In actual ocean observations, CTD observations are performed extremely frequently, and due to the accumulation of the twists of the rope deterioration of the rope and the frequent truncation of the tip. By maintaining a healthy condition as much as possible, it is required to become not a truncation the rope length often and to reduce the economic and time cost for replacing the rope. JAMSTEC has been developing a "non-contact power supply and communication swivel for CTD" that rotates with low torque to stabilize the posture and sway of the CTD and to release the twist of the rope at the same time. In this cruise, an operation test was conducted during the freefall of the CTD winch.

Configuration of the test.


Test system goes into the sea.

○ 4. Cruise Log

Date and time are represented in JST.

May 14,2021	
12:30	Departed at quay of Mitsubishi Shipbuilding Co. Ltd. Shimonoseki. Compass adjust was carried out at off Shimonoseki.
15:00	Compass adjuster got off “MIRAI”. Move to Suoh-nada and engine trial was carried out.
19:00	Dock personnel got off “MIRAI”, and dock maintenance was finished. Start sailing to area A.
May 15,2021	
09:00	Evacuation drill.
10:30	Meeting with crews.
12:40-15:40	CTD winch Free Fall. Maximum wire out was 4,800m.
16:42-20:23	CTD cast and water sampling between 4,800m depth and surface.
20:25	Deploy cesium magnetometer and start towing.
20:51-	"figure-8 turns" for measuring ship's magnetization. And cross line run for Cesium magnetometer, STCM and Shipboard gravity meter.
May 16,2021	
-02:46	Recover cesium magnetometer. Sailing to area B.
05:27-11:37	Roll, pitch and heading bias measurement of MBES. Start sailing to area C.
15:21	Launch XBT
16:02-18:10	Depth sounding precision test of MBES.
18:33-20:24	Noise measurement of MBES and ADCP. Start sailing to area D.

May 17,2021	
05:48	Start the Doppler RADAR test.
08:17	Launch XBT.
08:30	Arrived at area D.
08:50-09:04	Deploy a transponder mooring system.
09:25	Touch down to the bottom. Depth of transponder: 1,674m
09:28-10:07	Survey run for ANS calibration.
10:22-11:48	Getting data for estimating ANS constant data.
12:15-13:32	Run on the strait observation line for confirming ANS constant data.
14:42	Sent a release command to a transponder.
15:05	The mooring system came up to the surface.
15:24	Finish recovering the mooring system.
	Start sailing to area E.
17:30	Launch radiosonde.
20:30	Launch radiosonde.
May 18,2021	
04:42	Arrived at area E.
05:30	Launch radiosonde.
08:00-11:31	CTD winch free fall. Maximum wire out was 6,000m.
12:32-13:46	Towing winch free fall. Maximum wire out was 1,000m.
	Start sailing to area F.
May 19,2021	
06:30	Arrived at area F.
06:34	Launch XCTD.
06:39-08:30	Run along the common observation line at Suruga Bay for MBES.
15:30	Arrived at Shimizu port.

● 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.
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