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RV Kaiyo Cruise Report

KY15-07

# Researches on Benthic Ecosystem around Undersea Calderas

Apr. 24, 2015 – Apr. 29, 2015

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

## ●Contents

## 1. Cruise Information

● Cruise ID: KY15-07

● Name of vessel: RV Kaiyo

● Title of the cruise: Researches on benthic ecosystem around undersea calderas

● Title of proposal:

(1) Mechanisms of attachment and detachment of hydrothermal vent mussels

(2) Time-resolved in situ colonization experiments with the basalt rock for understanding a deep biosphere ecosystem in oceanic crust

● Cruise period: Apr. 24, 2015 – Apr. 29, 2015

● Ports of departure / call / arrival: Yokosuka (JAMSTEC) / none/ Yokosuka (JAMSTEC)

● Research area: Izu-Ogasawara Arc (Myojin Knoll and Bayonnaise knoll)

● Research Map: see appendix

## 2. Researchers

● Chief scientist: Koji INOUE [University of Tokyo]

● Representative of the science party:

(1) Koji INOUE [University of Tokyo]

(2) Satoshi MITSUNOBU [University of Shizuoka]

● Science party (List) (alphabetical order)

FUJII, Masayuki [Nihon University]

FUWA, Yuji [Nippon Marine Enterprises, Ltd.]

IKUTA, Tetsuro [JAMSTEC]

IMAI, Sakura [University of Tokyo]

INOUE, Koji [University of Tokyo]

KOITO, Tomoko [Nihon University]

MAKITA, Hiroko [JAMSTEC]

MITSUNOBU, Satoshi [University of Shizuoka]

NEMOTO, Suguru [Enoshima Aquarium]

OGINO, Tetsuya [Kyoto University]

OHASHI, Yuri [University of Shizuoka]

OKAMURA, Kei [Kochi University]

SASSA, Mieko [University of Tokyo]

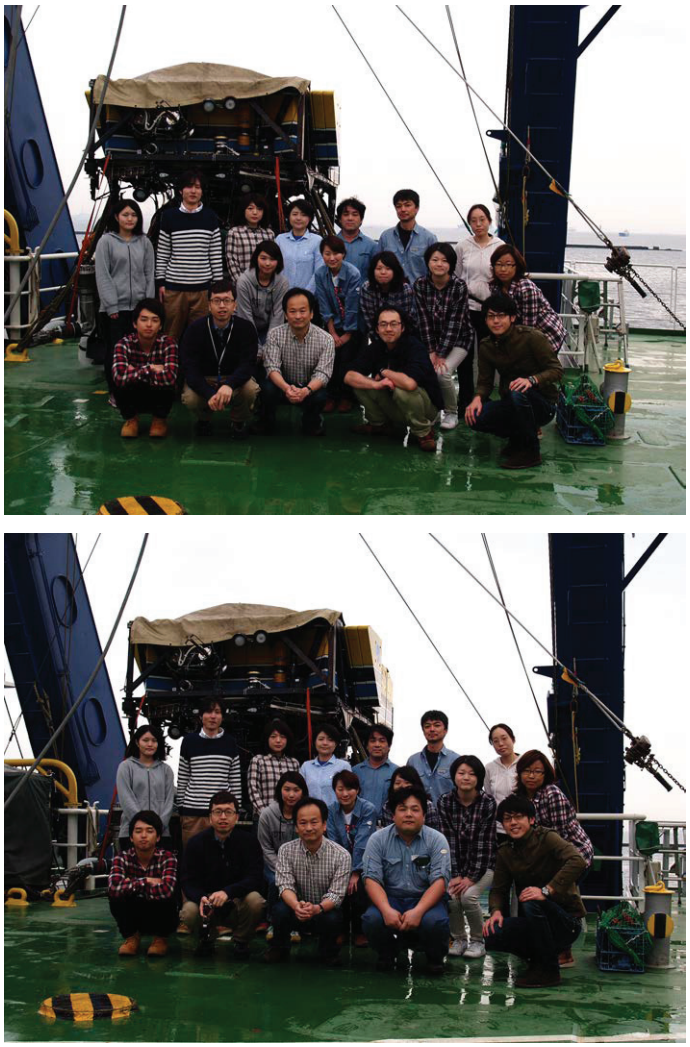
SEKINO, Yuya [JAMSTEC]

SEO, Eriko [University of Tokyo]

SHISHIDO, Kaho [Nihon University]

SUZUKI, Yumi [JAMSTEC]

TODA, Misa [University of Shizuoka]



Group photo of the scientific party of KY15-07

## 3. Observation

● Observation (Research summary)

**Proposal (1)**

Bathymodiolin mussels are major members of hydrothermal vent communities around the world. They attach to rocks and chimneys near the vents using byssal threads, and are supposed to detach themselves

and relocate when environmental conditions became unfavorable. To elucidate the mechanisms of the attachment and relocation, we had planned to visit several hydrothermal vent sites in Myojin Knoll and perform sulfide and temperature measurement around mussel (*Bathymodiolus septemdierum*) colonies, observation of the behavior of mussels after removal of some individuals from a mussel colony as well as that after change of the course of vent fluid flow by setting covers on hydrothermal vents. However, main current of the Kuroshio was just above Myojin Knoll during the cruise period, and the strong current disturbed ROV operation. During the two days assigned for our proposal, we could settle the ROV only once, and we thus could visit only one site. At this site, sulfide and temperature measurement, mussel collection and set of a cover, were performed but we could not observe mussel behavior at all. We will analyze environmental data obtained, and we seek next opportunity to complete our plan.

**Proposal (2)**

The main objective of our research project is to understand the litho-biosphere ecosystem beneath the sea-floor supported by oxidation of ferrous iron in ocean crust basalt. In order to achieve this, our group is performing a “time-resolved in situ colonization experiment with fresh basalt”. During dive #1809 in this cruise, we recovered the colonization vessels installed in hydrothermal area in Bayonnaise knoll in KY14-06 cruise, and also installed new vessels at the same areas. Seawater and sediment samples near the setting points were also collected to determine chemical conditions of the colonization. Before the recovery, temperature and DO were measured by in situ sensors at the installation points. Moreover, both water and sediment samples were also collected for on-board chemical analyses. In our future work, we will examine the microbial community and chemical species of iron in the samples to reveal the microbial community supported by basaltic iron oxidation and the biogeochemical mechanisms. The microbial communities in samples will be analyzed by molecular biological technique focusing on archaea and bacteria domains. By comparing microbial communities in the substrates and seawater, we identify potential microbial species as iron-oxidizer. The chemical species of iron (mainly oxidation states) will be determined by X-ray absorption fine structure (XAFS) with synchrotron-based X-ray spectroscopy methods. Particularly, the iron species on the target microbes will be analyzed with nano-scale X-ray microscope, scanning transmission X-ray microscopy (STXM) technique. Combining results of microbial community and direct chemical speciation, the microbial community supported by basaltic iron oxidation and its biogeochemical mechanism will be investigated, which leads to understanding the litho-biosphere ecosystem supported by iron oxidation in ocean crust basalt.

## 4. Cruise log

| Date | Local Time | Note | Position/Weather/Wind/Sea condition |
|---|---|---|---|
| 24-Apr | | **Sail out & started KY15-07** | 4/24 12:00 (JST) |
| | 09:00 | Let go all shore lines & left JAMSTEC for Research Area. | 34-52.4N 139-38.5E |
| | 10:00 | Briefing about ship's life and safety | West of suzaki |
| | 16:40 | Konpira ceremony. | Cloudy |
| | | | SSW-3(Gentle breeze) |
| | | | 2(Smooth) |
| | | | 1(Low swell short or average) |
| | | | Visibly: 6' |
| | | | |
| 25-Apr | | **Operation "HPD" Dive#1807 and #1808** | 4/25 12:00 (JST) |
| | 05:45 | Arrived at Myojin knoll. | 32-06.3N 139-53.2E |
| | 05:55 | Released XBT<32-06.2520N, 139-51.3832E> | South of aogashima |
| | 08:17 | Hoisted up HPD. | Cloudy |
| | 08:21 | HPD Launched. | NNW-3(Gentle breeze) |
| | 08:36 | HPD dove and started her operation #1807. | 2(Smooth) |
| | 09:29 | HPD landed on the sea bottom (D=1312m). | 1(Low swell short or average) |
| | 09:40 | HPD left the sea bottom (D=1309m). | Visibly: 7' |
| | 11:41 | HPD floated. | |
| | 11:55 | Recovered HPD and finished her operation. | |
| | 12:48 | Hoisted up HPD. | |
| | 12:52 | HPD Launched. | |
| | 13:05 | HPD dove and started her operation #1808. | |
| | 14:05 | HPD landed on the sea bottom (D=1319m). | |
| | 14:20 | HPD left the sea bottom (D=1297m). | |
| | 15:36 | HPD floated. | |
| | 15:49 | Recovered HPD and finished her operation. | |
| | 15:50 | Proceeded to Bayonnaise knoll. | |
| | 18:00 | Arrived at Bayonnaise knoll. | |
| | | | |
| 26-Apr | | **Operation "HPD" Dive#1809** | 4/26 12:00 (JST) |
| | 08:17 | Hoisted up HPD. | 31-57.5N 139-44.4E |
| | 08:21 | HPD Launched. | South of aogashima |
| | 08:36 | HPD dove and started her operation #1809. | Fine but Cloudy |
| | 09:29 | HPD landed on the sea bottom (D=833m). | North-3(Gentle breeze) |
| | 09:40 | HPD left the sea bottom (D=777m). | 2(Smooth) |

| | | | |
|---|---|---|---|
| | 11:41 | HPD floated. | 1(Low swell short or average) |
| | 11:55 | Recovered HPD and finished her operation. | Visibly: 7' |
| | | | |
| 27-Apr | | **Operation "HPD" Dive#1810** | 4/27 12:00 (JST) |
| | 02:30 | Proceeded to Myojin knoll. | 32-07.5N 139-50.4E |
| | 05:00 | Arrived at Myojin knoll. | South of aogashima |
| | 07:16 | Hoisted up HPD. | Fine but Cloudy |
| | 07:20 | HPD Launched. | North-3(Gentle breeze) |
| | 08:03 | HPD dove and started her operation #1810. | 1(Calm) |
| | 08:43 | HPD landed on the sea bottom (D=1100m). | 1(Low swell short or average) |
| | 15:34 | HPD left the sea bottom (D=1184m). | Visibly: 7' |
| | 16:11 | HPD floated. | |
| | 16:24 | Recovered HPD and finished her operation. | |
| | 16:30 | Proceeded to Bayonnaise knoll. | |
| | | | |
| 28-Apr | | **Freefall of umbilical cable** | 4/28 12:00 (JST) |
| | 05:00 | Arrived at freefall area. | 34-16.7N 141-16.7E |
| | 05:50 | Started freefall of umbilical cable. | Southwest of nojimazaki |
| | 10:32 | Finished freefall of umbilical cable. | Fine but Cloudy |
| | 10:33 | Started freefall of umbilical cable. | WSW-4(Moderate breeze) |
| | 15:14 | Finished freefall of umbilical cable. | 3(Slight) |
| | 15:30 | Proceeded to Yokosuka. | 1(Low swell short or average) |
| | | | Visibly: 7' |
| | | | |
| 29-Apr | | **Disembarkation scientist group & completed KY15-07** | |
| | 09:00 | Arrived at JAMSTEC. Then completed KY15-07. | |

## 5. Dive information

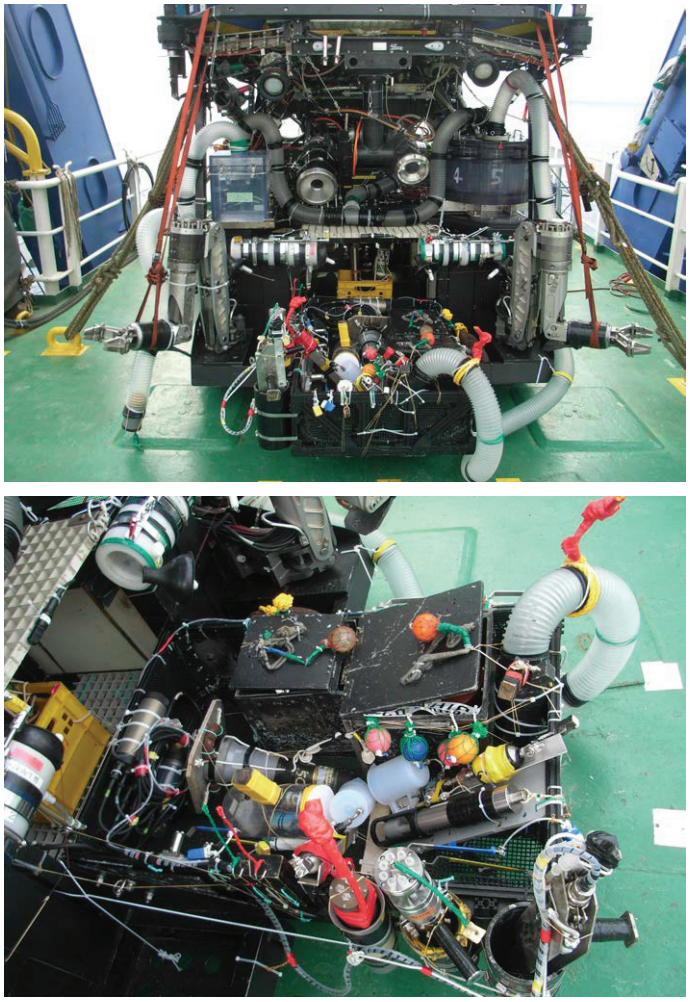
### 1) Dive #1807 (Apr. 25, 2015; Myojin Knoll; reporter, K. Inoue)

***Equipment loaded***

Suction sampler (slurp gun) with a cubic canister and a rotary canister (7 bottles), sample boxes (x2), online thermometer, sulfide sensor (self-memory type), pH and ORP sensor (self-memory type), CTD sensor (self-memory type), Niskin water sampler (x2), Van Dorn water sampler (x2), Vacuum water sampler (x2), VIRGO sampler, Marker (x4), flower pots (x3), Bait trap, ROV homer

***Sampling and Operation***

1. The ROV dived toward the hydrothermal vent site (about 1300 m in depth) at the east part of the caldera mainly for the mission of the proposal (1).
2. Water sampling using Niskin samplers at 800 m depth.
3. The ROV reached near the bottom but could not keep its position because of strong current. Thus, we recovered ROV to consider measures.



Arrangement of research equipment at dive #1807

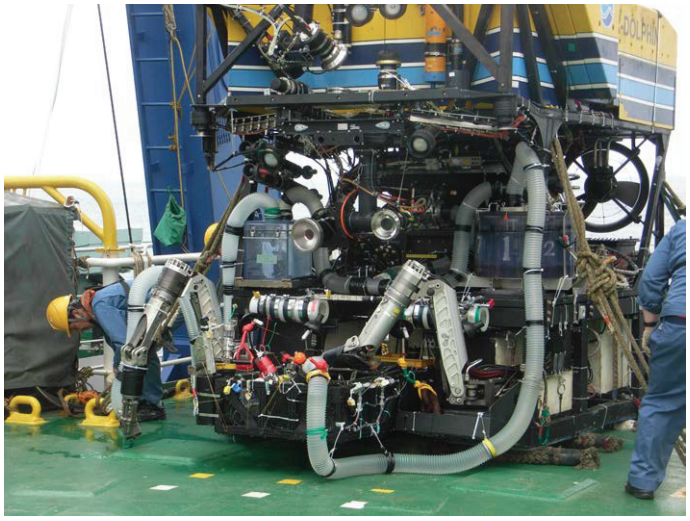
**2) Dive #1808 (Apr. 25, 2015; Myojin Knoll; reporter, K. Inoue)**

***Equipment loaded***

Suction sampler (slurp gun) with a cubic canister and a rotary canister (7 bottles), sample boxes (x2), online thermometer, sulfide sensor (self-memory type), pH and ORP sensor (self-memory type), Niskin water sampler (x2), Van Dorn water sampler (x2), Vacuum water sampler (x2), VIRGO sampler, Marker (x4), flower pots (x3), Bait trap, ROV homer

***Sampling and Operation***

1. The ROV dived toward 200 m SW of the target point of the dive #1807.
2. The ROV reached near the bottom but could not keep its position because of strong current. Thus, we recovered ROV to consider measures.



Arrangement of research equipment at dive #1808

**3) Dive #1809 (April 26, Bayonnaise Knoll submarine; reporter, S. Mitsunobu)**

***Equipment loaded***

On-line thermometer (x1), Niskin water sampler (x2), DO meter (x1), aluminum sampling box (x2), M-type corer (x2), vacuum water sampler (x2),

***Sampling and Operation***

1. Sampling of sediment samples (D = 778 m, 833 m)
2. Setting of new incubation vessels in hydrothermal and non-hydrothermal areas (D = 778 m, 833 m)
3. Recovering of vessels in hydrothermal and non-hydrothermal areas (D = 778 m, 833 m)
3. DO measurement (D = 778 m, 833 m)
4. Temperature measurements (D = 778 m, 833 m)
6. Sampling of seawaters by vacuum water sampler on the setting points (D = 778 m, 833 m)

Arrangement of research equipment at dive #1809

**4) Dive #1810 (Apr. 27, 2015; Myojin Knoll; reporter, K. Inoue)**

***Equipment loaded***

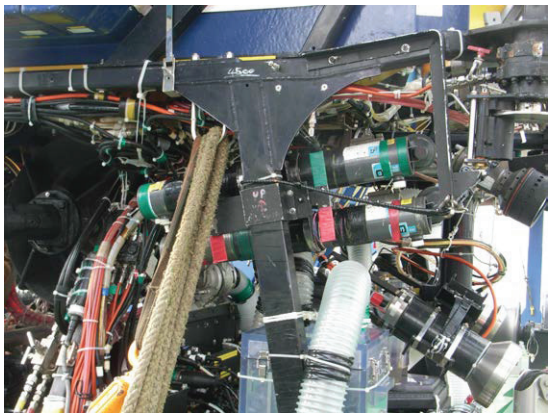
Suction sampler (slurp gun) with a cubic canister and a rotary canister (7 bottles), sample boxes (x2), online thermometer with water sampler, sulfide sensor (self-memory type), pH and ORP sensor (self-memory type), Niskin water sampler (x2), Van Dorn water sampler (x2), Vacuum water sampler (x2), VIRGO sampler, *in situ* sample treatment system, Marker (x4), flowerpots (x3), Bait trap, ROV homer

***Sampling and Operation***

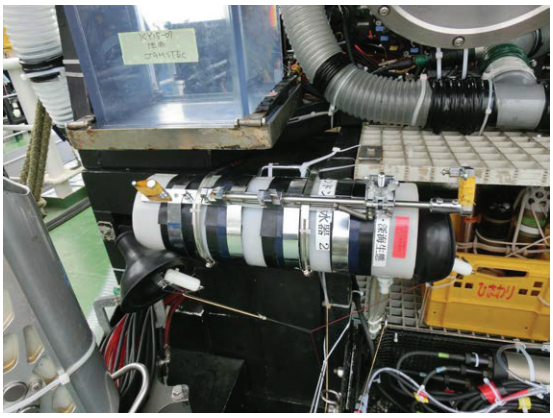
1. The ROV dived toward the hydrothermal vent site (about 1150 m in depth) at the north part of the caldera. Successfully settled in front of a mussel colony but strong current disturbed ROV movement.
2. Water sampling using Van Dorn samplers.
3. Set and recovery of a bait trap.
4. Temperature measurement and water sampling, sulfide measurement.
5. Water sampling using vacuum samplers and Virgo sampler.
6. A flowerpot was set on a vent to change the route of the fluid.
7. Mussel sampling.
8. Chimney sampling.
9. Treatment of mussels using *in situ* sample treatment system.
10. A marker was set.

Arrangement of research equipment at dive #1810

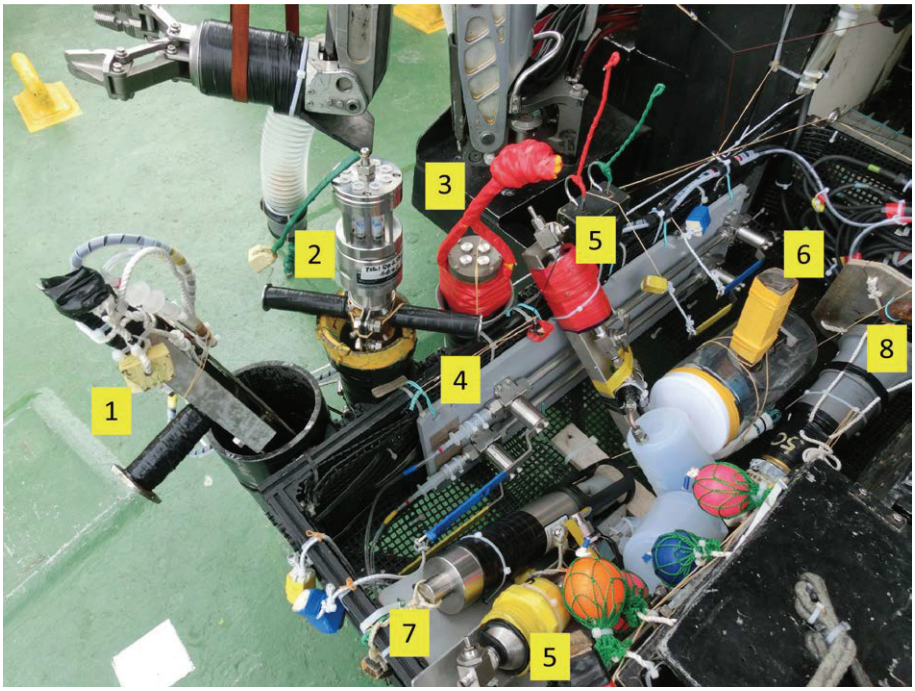
## 6. Equipment



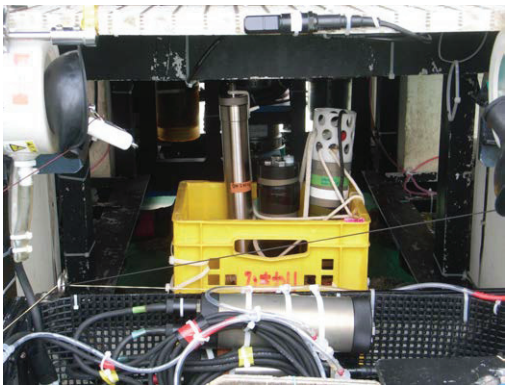
Niskin water sampler



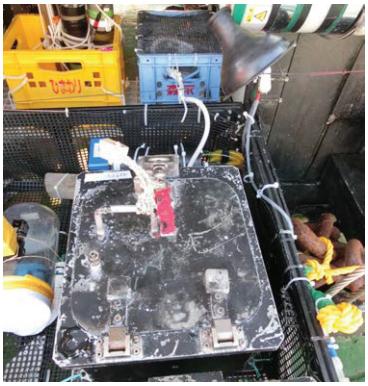
Van Dorn water sampler




Online thermometer (1), Virgo sampler (2), sulfide sensor (3), water sampler attached to the online thermometer (4), vacuum sampler (5), bait trap (6), CTD sensor (7), ROV homer



pH and ORP sensors



*in situ* sample treatment system

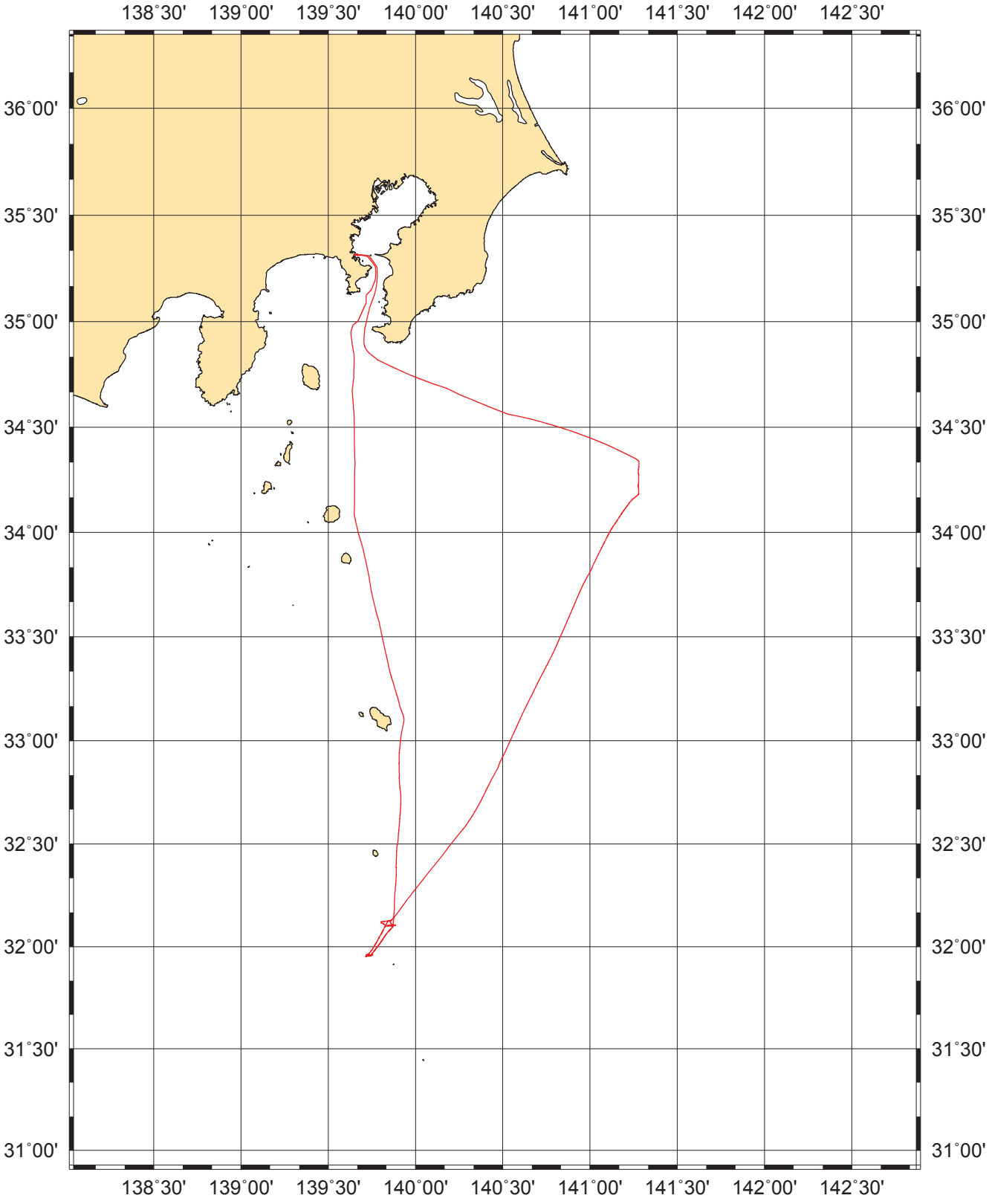
## 7. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

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 (i.e. taxonomic classifications) 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.

# Appendix

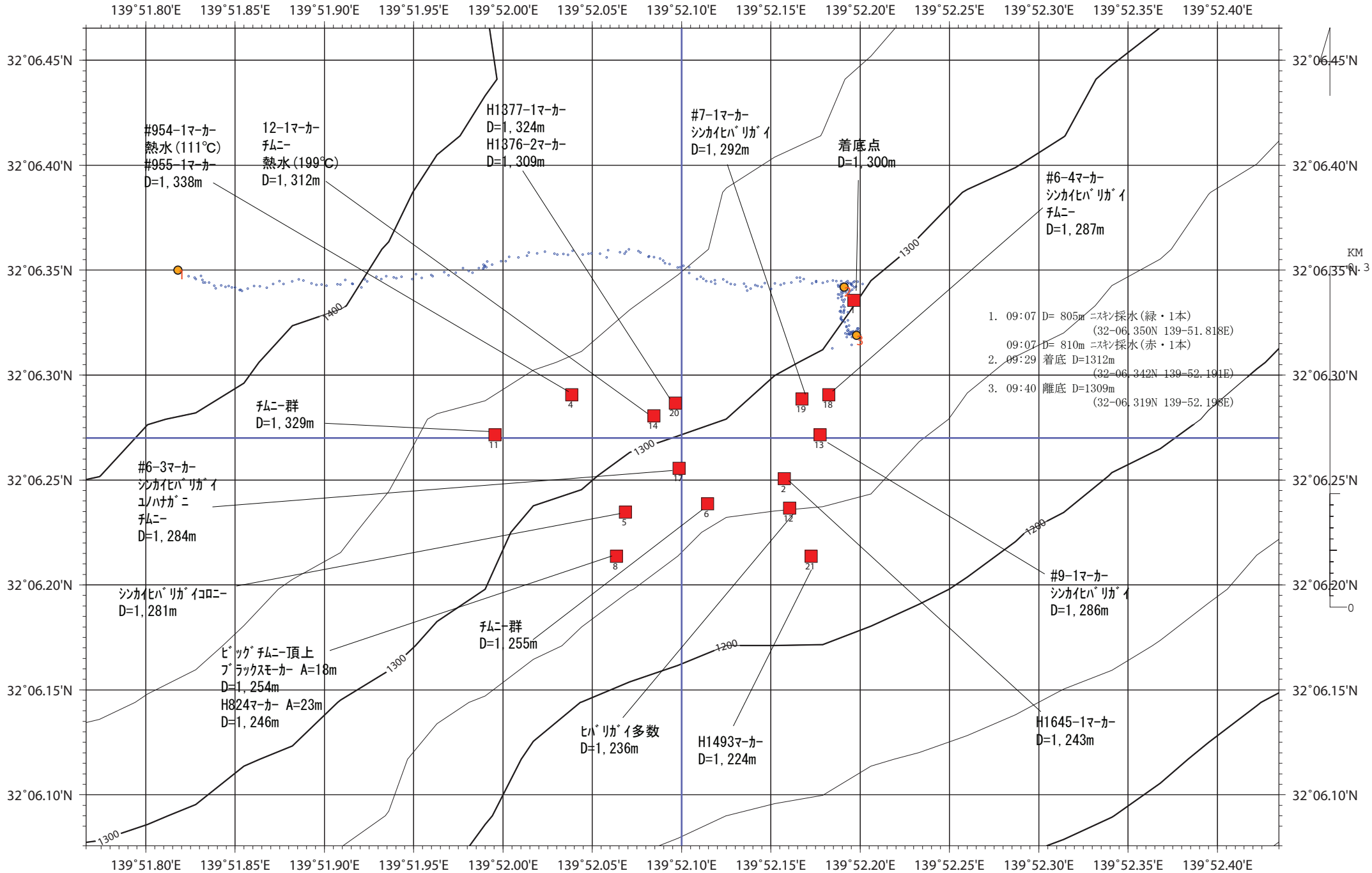
# KY15−07 Nav Track




GMT 2015 Apr 29 09:08:46 **R/V KAIYO, Mercator Projection,Data_source=SOJ**

KY15-07 MYOJIN KAIKYU
HYPER DOLPHIN 3000 #1807

2015/04/25
( 1 / 3000 )




XY Origin Lat 32-06.27000N Lon 139-52.10000E
Center Lat 32-06.27000N Lon 139-52.10000E
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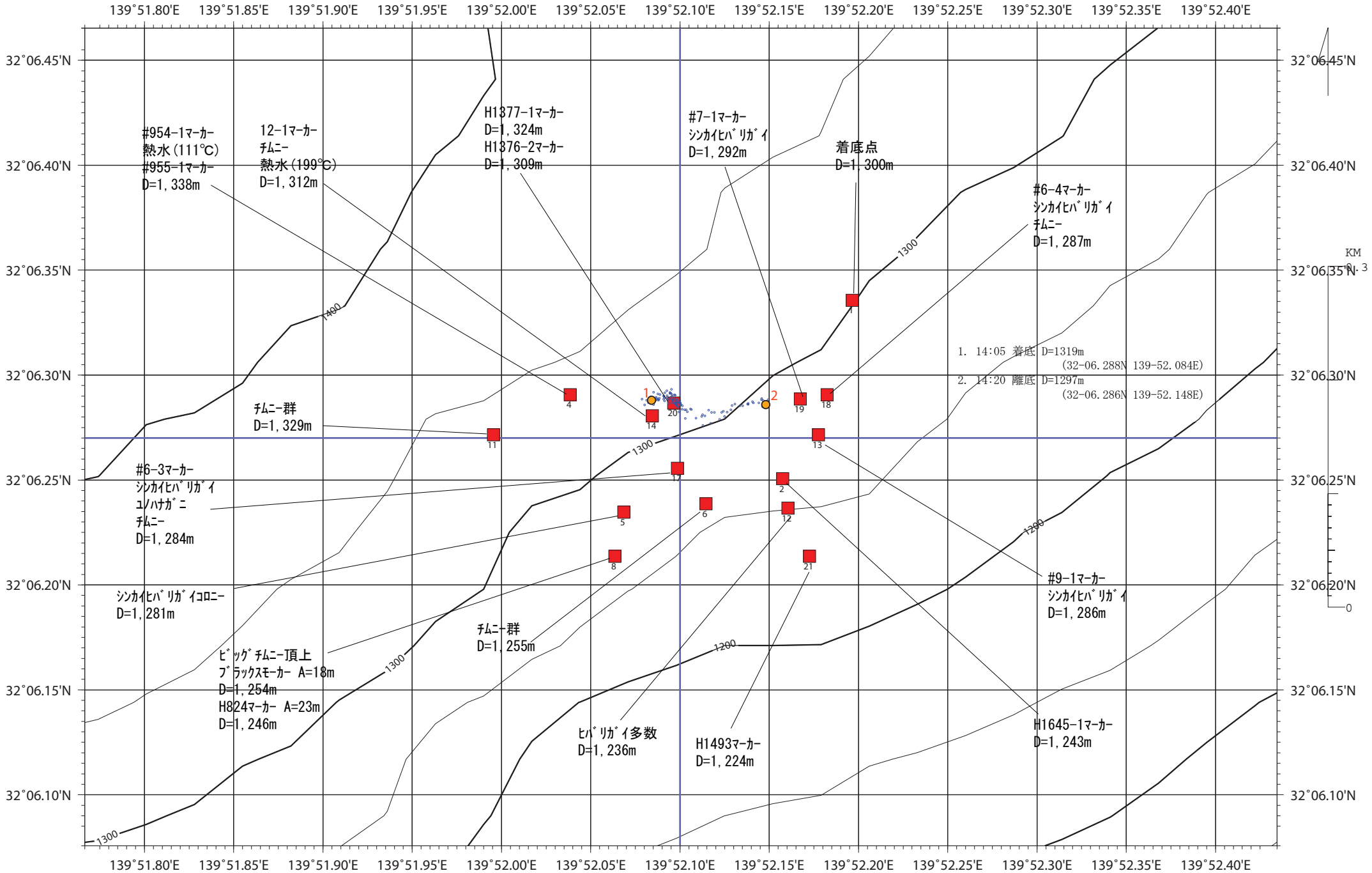
Track_File:20150425_HPD4K_No1807.xyz

(UR)Lat 32-06.46531N Lon 139-52.43445E
(LL)Lat 32-06.07569N Lon 139-51.76655E

Datum WGS-84 Proj.MER

KY15-07 MYOJIN KAIKYU
HYPER DOLPHIN 3000 #1808

2015/04/25
( 1 / 3000 )

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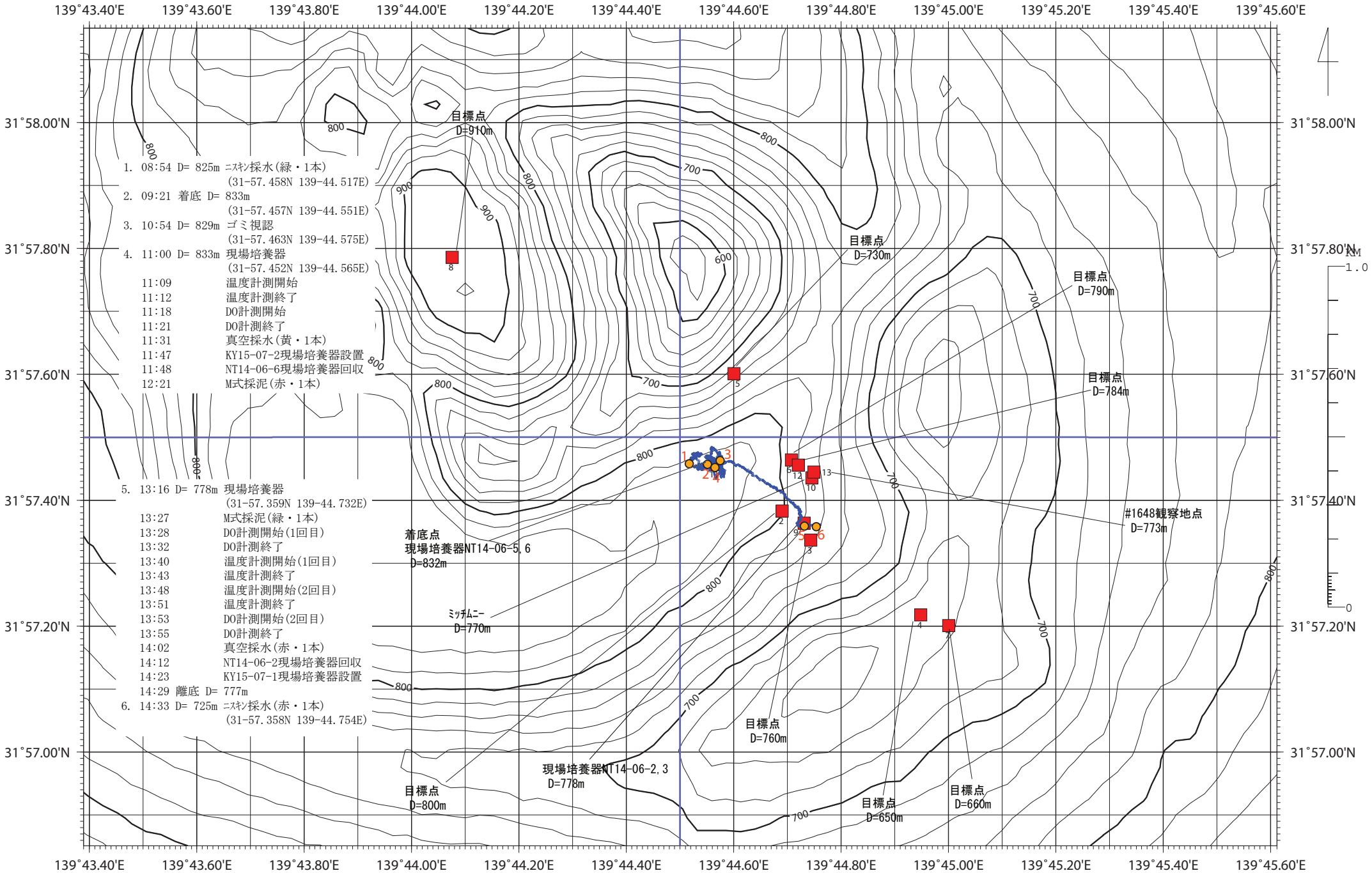
Track_File:20150425_HPD4K_No1808.xyz

(UR)Lat 32-06.46531N Lon 139-52.43445E
(LL)Lat 32-06.07569N Lon 139-51.76655E

Datum WGS-84 Proj.MER

KY15-07 BEYONESU KAIKYU
HYPER DOLPHIN 3000 #1809

2015/04/26
( 1 / 10000 )




XY Origin Lat 31-57.50000N Lon 139-44.50000E
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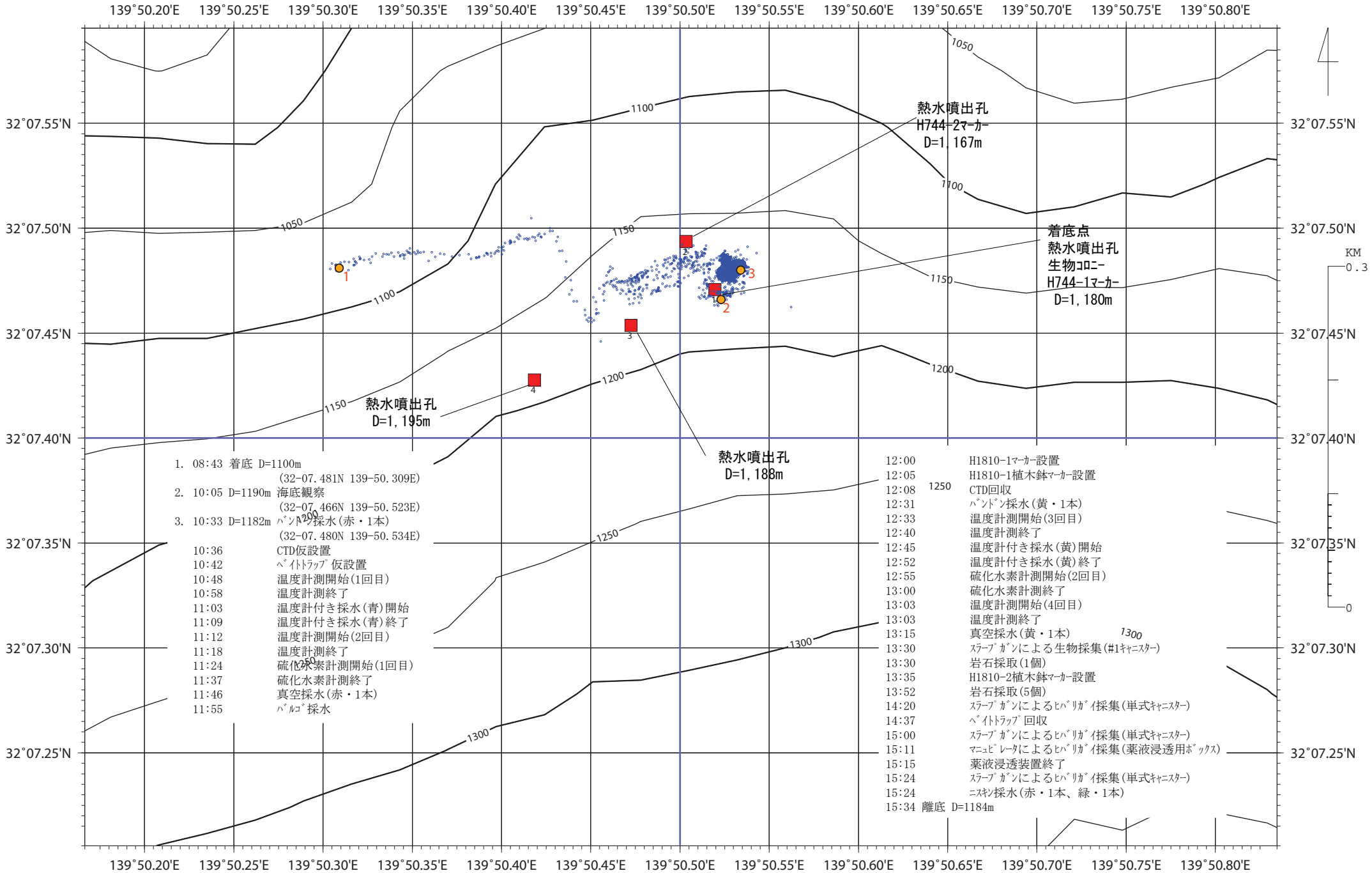
(UR)Lat 31-58.14987N Lon 139-45.61186E
(LL)Lat 31-56.85113N Lon 139-43.38914E

Datum WGS-84 Proj.MER

KY15-07 MYOJIN KAIKYU
HYPER DOLPHIN 3000 #1810

2015/04/27
( 1 / 3000 )




1. 08:43 着底 D=1100m
(32-07.481N 139-50.309E)
2. 10:05 D=1190m 海底観察
(32-07.466N 139-50.523E)
3. 10:33 D=1182m ﾊﾞﾝﾄﾝ採水(赤・1本)
(32-07.480N 139-50.534E)

| | |
|---|---|
| 10:36 | CTD仮設置 |
| 10:42 | ﾍﾞｲﾄﾄﾗｯﾌﾟ仮設置 |
| 10:48 | 温度計測開始(1回目) |
| 10:58 | 温度計測終了 |
| 11:03 | 温度計付き採水(青)開始 |
| 11:09 | 温度計付き採水(青)終了 |
| 11:12 | 温度計測開始(2回目) |
| 11:18 | 温度計測終了 |
| 11:24 | 硫化水素計測開始(1回目) |
| 11:37 | 硫化水素計測終了 |
| 11:46 | 真空採水(赤・1本) |
| 11:55 | ﾊﾞﾙｺﾞ採水 |
| 12:00 | H1810-1ﾏｰｶｰ設置 |
| 12:05 | H1810-1植木鉢ﾏｰｶｰ設置 |
| 12:08 | CTD回収 |
| 12:31 | ﾊﾞﾝﾄﾞﾝ採水(黄・1本) |
| 12:33 | 温度計測開始(3回目) |
| 12:40 | 温度計測終了 |
| 12:45 | 温度計付き採水(黄)開始 |
| 12:52 | 温度計付き採水(黄)終了 |
| 12:55 | 硫化水素計測開始(2回目) |
| 13:00 | 硫化水素計測終了 |
| 13:03 | 温度計測開始(4回目) |
| 13:03 | 温度計測終了 |
| 13:15 | 真空採水(黄・1本) |
| 13:30 | ｽﾗｰﾌﾟｶﾞﾝによる生物採集(#1ｷｬﾆｽﾀｰ) |
| 13:30 | 岩石採取(1個) |
| 13:35 | H1810-2植木鉢ﾏｰｶｰ設置 |
| 13:52 | 岩石採取(5個) |
| 14:20 | ｽﾗｰﾌﾟｶﾞﾝによるﾋﾊﾞﾘｶﾞｲ採集(単式ｷｬﾆｽﾀｰ) |
| 14:37 | ﾍﾞｲﾄﾄﾗｯﾌﾟ回収 |
| 15:00 | ｽﾗｰﾌﾟｶﾞﾝによるﾋﾊﾞﾘｶﾞｲ採集(単式ｷｬﾆｽﾀｰ) |
| 15:11 | ﾏﾆｭﾋﾟﾚｰﾀによるﾋﾊﾞﾘｶﾞｲ採集(薬液浸透用ﾎﾞｯｸｽ) |
| 15:15 | 薬液浸透装置終了 |
| 15:24 | ｽﾗｰﾌﾟｶﾞﾝによるﾋﾊﾞﾘｶﾞｲ採集(単式ｷｬﾆｽﾀｰ) |
| 15:24 | ﾆｽｷﾝ採水(赤・1本、緑・1本) |
| 15:34 | 離底 D=1184m |

XY Origin Lat 32-07.40000N Lon 139-50.50000E
Center Lat 32-07.40000N Lon 139-50.50000E
Grid_File:myojinkaikyu50.grd ContourInt:50m
Track_File:20150327_HPD4K_No1797.xyz

(UR)Lat 32-07.59530N Lon 139-50.83452E
(LL)Lat 32-07.20570N Lon 139-50.16648E

Datum WGS-84 Proj.MER