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# Short Cruise Report
# RV METEOR
# Cruise M178 (GPF 21-2_061)

## Emden - Las Palmas
## 21.11.2021 - 19.12.2021
## Chief Scientist: Dr. Felix Gross
## Captain: Rainer Hammacher

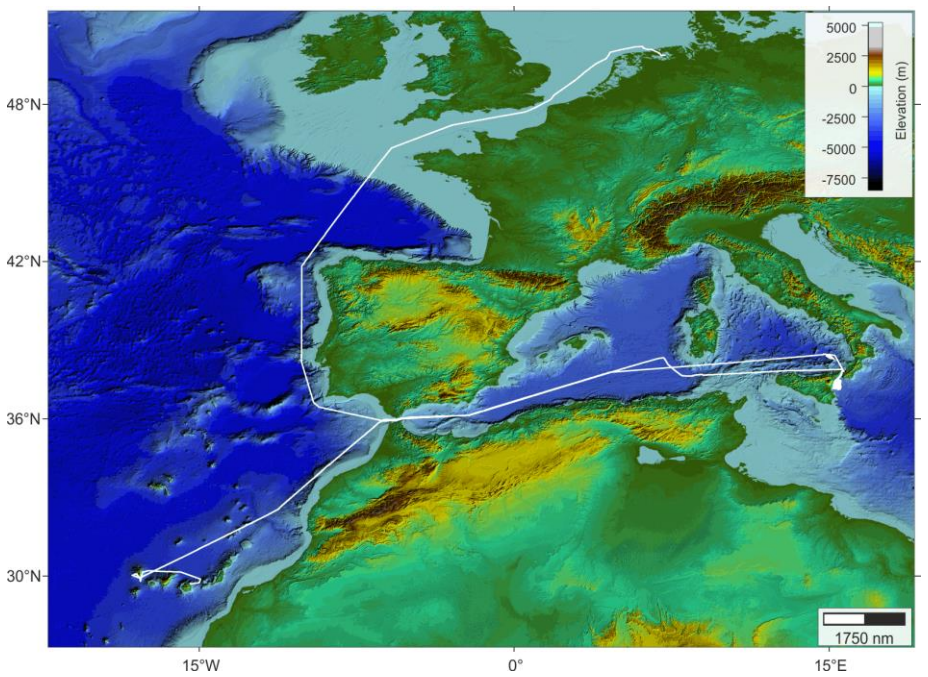


Fig. 1: Track chart of cruise M178 (Emden – Sicily – La Palma – Las Palmas)

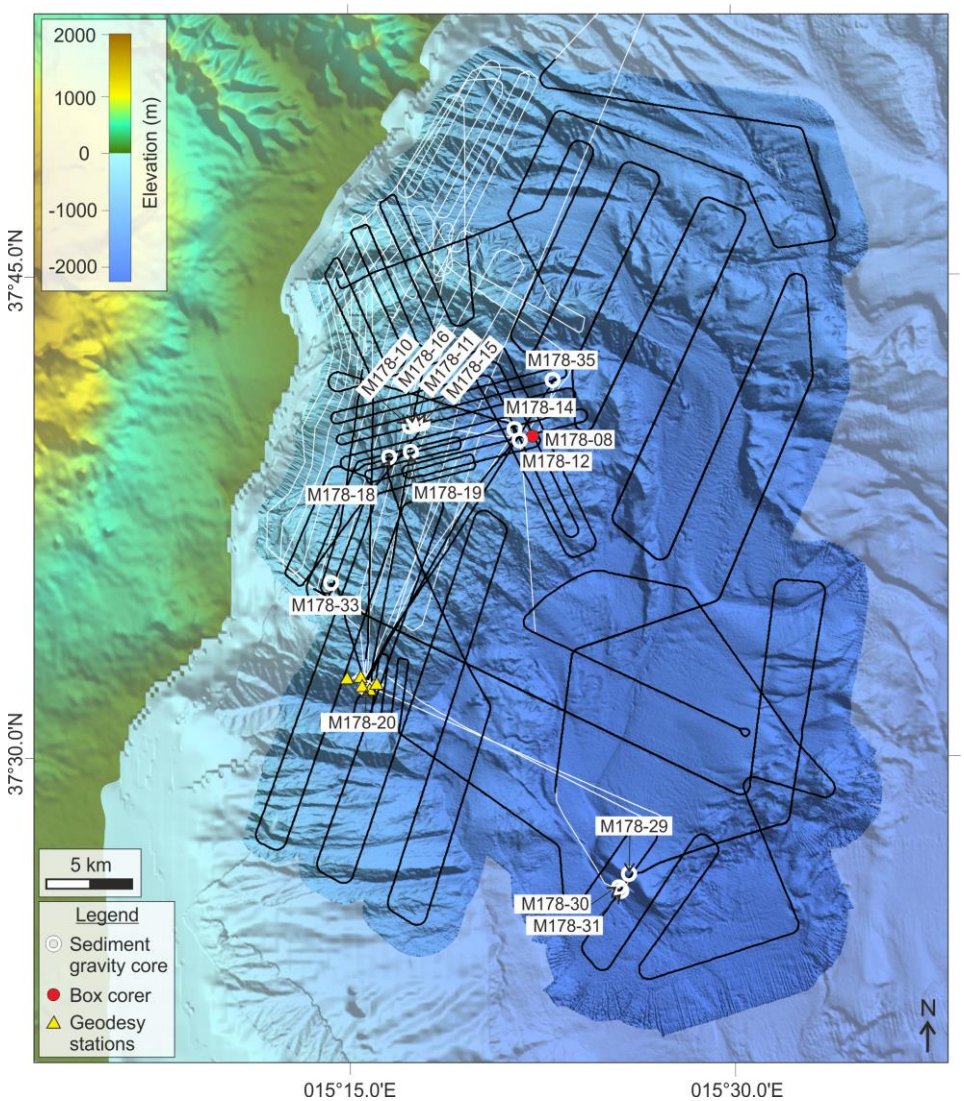


Fig. 2: Track and station chart offshore Mt Etna.
Ship tracks: white lines; Parasound profiles: black lines.

## Objectives

Mt Etna experienced a series of extraordinary eruptions in February 2021 that impacted most dramatically in the nearshore summit region and have been the focus of intense monitoring. However, understanding potential changes to the magmatic system requires observation of the entire volcanic system, including the submarine eastern flank. The goal of this research is to determine any changes that the volcano has undergone in response to the eruptions. Repeated measurements are key for accomplishing the scientific goals and for understanding geologic systems through time. These measurements are essential for the assessment of potential hazards such as subsurface landslides and their impact on exposed coastal communities, infrastructure, and ecosystems, especially in vulnerable areas. The M178 expedition to Mt Etna will replicate measurements from previous cruises to provide a holistic view of how external and internal forces alter geological environments such as the continental margin offshore Mt Etna.

The main objectives of the planned geophysical and geological measurements are:

1) Investigate the hypothesis that volcanic earthquakes are related to small- to medium-scale mass movements at Mt Etna, which is an important factor in understanding overall submarine slope instability and movement.

2) Perform repeat surveys of the continental slope offshore Mt Etna using hydroacoustic methods in order to record any changes in the continental slope caused by recent volcanic eruptions.

3) Investigate creeping submarine mass movement by uploading data from seafloor geodetic stations offshore Mt Etna. The data will provide information on how the already-known slope movement is related to the current volcanic and seismic activity.

4) Baseline Multibeam and oceanographic survey offshore the active volcano Cumbre Vieja, Canary Islands to obtain information about the state of the submerged flank and guide future hazard assessments. Especially the lessons learnt from Mt Etna’s unstable flank may be an advantage of this assessment.

In addition to investigating the scientific questions, an additional goal of this expedition is to create a virtualization of ongoing marine research activities through the implementation of an immersive virtual cruise.

**Narrative**

On Sunday, November 21st, it was time to cast off for the voyage M178 HazELNUT. During our transit to the working area offshore Sicily, we travelled through several famous European sea areas, including the White Cliffs of Dover on Monday, 22.11. The weather conditions were perfect and strong tailwinds from the east meant that we were able to make good progress through the English Channel. After leaving the English Channel, we set a southwesterly course through the Bay of Biscay. On Thursday the 25th of November, we passed the famous "end of the world" lighthouse at Cape Finisterre. The tailwind followed us as we changed directions and enabled us to make very good time even when passing the Portuguese coast. We reached the Strait of Gibraltar on Friday evening (26.11), and then entered the Mediterranean Sea later that night.

On the morning of November 30th, we arrived in our first working area north of the volcanic island Stromboli. The first task was the sea acceptance test for the newly installed transducers of the deep-water multi-beam echo-sounder. After a short profile run, however, it quickly became clear that although the new transducers were working perfectly, other components of the complex system were a cause of concern for the hydro-acoustics team. In close cooperation with RV METEOR's Scientific Technical Service, the manufacturer was able to quickly identify the source of the problem by means of a remote examination. The solution to this problem is most likely to replace some components in the pre-amplifier unit of the multi-beam echo-sounder system. We were, however, only be able to pick up these components in the port of Las Palmas. This means that a reliable mapping at water depths greater than ~1000 m and an opening angle of larger than 100° (50°/50°) was unfortunately not possible in the working area offshore Stromboli or Etna.

We reached our main working area offshore Sicily: Mount Etna, on Wednesday, 1.12. Within a few hours, the six seafloor geodesy stations that were deployed last year during expedition SO277 with the research vessel Sonne were safely recovered. The preliminary data looks promising and five of the six stations were then prepared for their deployment at the end of the work offshore Mt Etna. During the following night, the hydro-acoustic team started the first Parasound P70 survey and was able to locate several promising sites for sampling of hemipelagic, volcanoclastic and syn-tectonic sedimentary sequences in the prominent amphitheater structure at Mt Etna’s continental margin.

Geology station work was supposed to begin with box corer sampling on December 2nd. This sampling was intended to provide us with information about the shallow seafloor conditions. Unfortunately, a steel cable connecting the device to the onboard crane broke, and the box corer was lost on the seafloor. Subsequent attempts to recover the device using a dredge over multiple hours were unsuccessful and the search for the device had to be abandoned in the evening. In spite of this, the geology team was able to begin the first sediment gravity core stations on 3rd December. Over the course of the next few days, hydro-acoustic surveys for seafloor and sub-seafloor mapping continued during overnight, while the geology team recovered sediment cores using a gravity corer during the daytime hours. The length of the barrels was adjusted from 5 m to 10 m according to the sediment coverage seen on the Parasound profiles. All of the cores were split, sampled for porewater and methane, described and packed in D-Tubes immediately after their recovery.

On December 6th, we were able to successfully deploy all five geodesy stations in a record time of just one day. The stations were gently set down again at the same positions as we retrieved them from a week ago with an accuracy of about 2 m on the seafloor at water depths between 1000 and 1200 m. We were able to ascertain that all stations were able to

communicate with each other right away. They will remain on the seafloor and will measure the flank movement of Etna for the next one to two years.

After further hydroacoustic mapping to finalize coring locations, the geology team was able to continue with station work. In addition to the core stations on the prominent amphitheater structure, cores were also taken on the Timpe Plateau, on the southern fault zone and on a diapir structure southwest of the continental margin in front of Etna. In total, the geology team recovered 14 gravity cores, which have a total length of more than 70 m.

We set off for Las Palmas on the morning of the 9th of December, highly satisfied that most of the objectives of the trip were exceeded despite the ongoing difficulties with the deep-water multibeam echosounder and the loss of the box corer. During the night of 10.12, we were met by the first winds of the Mistral south of Sardinia. Over the next two days, we were exposed to gusts of up to 10 Bft and wave heights of up to 6 m. In order to weather out this storm, we had to change to a north-westerly course on Saturday, 11.12. On Sunday, the situation improved and we were able to steer a westerly course towards Las Palmas again. There we expected to receive the spare parts for the pre-amplifier unit of the deep-water multibeam echosounder on 16.12. In the morning of December 14th, we passed through the Strait of Gibraltar, which led us from the Mediterranean Sea to the Atlantic Ocean. Later that day, we received the permit to conduct research at the island of La Palma within Spanish waters. However, it quickly became clear to us that we would not be able to implement the new marine mammal protection measures for hydroacoustic surveying that need to be observed in Spanish waters at such short notice. The obligation to take along specially qualified marine mammal observers meant that we were not able to carry out hydroacoustic surveys offshore the active volcano Cumbre Vieja. For this reason, we postponed picking up spare parts for the deep-water echo sounder in Las Palmas and headed directly to La Palma. Our research permit allowed us to perform water column profiling with a CTD probe (measuring conductivity, temperature and depth). We completed a total of 9 CTD stations in water depths between 1000 and 3000 m along three profiles around the southern part of La Palma.

On December 19th, we arrived at the port of Las Palmas at 9 am and loaded all the core samples and geodesy equipment into a reefer container that was waiting onshore for us. With this, the successful cruise M178 HazELNUT reached its culmination at Gran Canaria.

**Acknowledgements**

The scientific party of RV METEOR Cruise M178 gratefully acknowledges the very friendly and most effective cooperation with Captain Hammacher and his crew. Their great flexibility and their perfect assistance substantially contributed to making this cruise a scientific success. We also appreciate the valuable support of the Leitstelle Deutsche Forschungsschiffe (German Research Fleet Coordination Centre) at the University of Hamburg. The expedition was funded by the Deutsche Forschungsgemeinschaft.

**Teilnehmerliste**

| | | | |
|---|---|---|---|
| 1. | Gross, Felix, Dr. | Fahrtleiter / *Chief Scientist* | CAU |
| 2. | Barrett, Rachel, Dr. | Hydroacoustics | CAU |
| 3. | Bonforte, Alessandro, Dr. | Hydroacoustics | INGV |
| 4. | Filbrandt, Christian | Marine Geodesy | GEOMAR |
| 5. | Gambino, Salvatore | Hydroacoustics | UniCat |
| 6. | Hadré, Emma | Hydroacoustics | AWI |
| 7. | Heinrich, Mirja, Dr. | Geology/Volcanology | GEOMAR |
| 8. | Heinrich, Sven | Geology Technician | CAU |
| 9. | Hundsdörfer, Marie | Virtualisation | CAU |
| 10. | Kolling, Henriette, Dr. | Geology | CAU |
| 11. | Matzerath, Peter | Geology / CTD | CAU |
| 12. | Morgenweck, Lea | Geology | CAU |
| 13. | Petersen, Florian, Dr. | Marine Geodesy | CAU |
| 14. | Raeke, Andreas | DWD Technician | DWD |
| 15. | Urlaub, Morelia, Dr. | Marine Geodesy | GEOMAR |
| 16. | Vollert, Jannes | Virtualisation/Media | CAU |
| 17. | Wolf, Josephin | Geology/Media | CAU |

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|---|---|
| CAU | Christian-Albrechts-Universität zu Kiel, Germany |
| GEOMAR | GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany |
| DWD | Deutscher Wetter Dienst |
| INGV | Instituto Nationale di Gefisica e Volcanologia, Italy |
| UniCat | University of Catania, Italy |
| AWI | Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany |

# Station List M178

| Station | Date / Time UTC | Device | Latitude | Longitude | Depth (m) | Comment |
|---|---|---|---|---|---|---|
| M178_1-1 | 30-11-21 09:15 | XSV | 39° 03,552' N | 014° 53,459' E | - | Two attempts, both probes defective |
| M178_1-2 | 30-11-21 10:00 | CTD | 39° 03,439' N | 014° 52,953' E | 3150 | |
| M178_2-1 | 30-11-21 11:20 | EM122 | 39° 03,965' N | 014° 53,126' E | 3169 | Start of survey |
| M178_2-1 | 30-11-21 16:58 | EM122 | 38° 51,695' N | 015° 10,658' E | 1820 | End of survey |
| M178_2-2 | 30-11-21 19:38 | EM122 | 39° 03,868' N | 014° 58,345' E | 2958 | Start of survey |
| M178_2-2 | 30-11-21 21:43 | EM122 | 39° 00,778' N | 015° 16,539' E | 2460 | End of survey |
| M178_3-1 | 01-12-21 08:29 | Geodesy Station | 37° 32,458' N | 015° 15,438' E | - | HPT Modem operation |
| M178_4-1 | 01-12-21 09:44 | Geodesy Station | 37° 32,518' N | 015° 15,107' E | - | Station #3 |
| M178_4-2 | 01-12-21 10:30 | Geodesy Station | 37° 32,483' N | 015° 15,743' E | - | Station #2 |
| M178_4-3 | 01-12-21 11:24 | Geodesy Station | 37° 32,355' N | 015° 15,732' E | - | Station #1 |
| M178_4-4 | 01-12-21 12:30 | Geodesy Station | 37° 32,454' N | 015° 16,034' E | - | Station #5 |
| M178_4-5 | 01-12-21 13:03 | Geodesy Station | 37° 32,202' N | 015° 15,896' E | - | Station #4 |
| M178_4-6 | 01-12-21 13:37 | Geodesy Station | 37° 32,363' N | 015° 16,016' E | 1212 | Station #6 |
| M178_5-1 | 01-12-21 14:03 | EM122 | 37° 31,653' N | 015° 17,975' E | 1773 | Start of survey |
| M178_5-1 | 01-12-21 15:17 | EM122 | 37° 27,781' N | 015° 27,223' E | 2064 | End of survey |
| M178_6-1 | 01-12-21 16:49 | CTD | 37° 32,340' N | 015° 15,518' E | 1114 | |
| M178_7-1 | 01-12-21 18:08 | P-70 and EM122 | 37° 40,326' N | 015° 21,364' E | 1589 | Start of survey |
| M178_7-1 | 02-12-21 07:39 | P-70 and EM122 | 37° 39,656' N | 015° 22,184' E | 1576 | End of survey |
| M178_8-1 | 02-12-21 08:22 | Box Corer | 37° 40,001' N | 015° 22,220' E | 1579 | |
| M178_8-2 | 02-12-21 19:44 | CTD | 37° 39,949' N | 015° 22,210' E | 1580 | |
| M178_9-1 | 02-12-21 20:52 | EM710 and EM122 | 37° 40,037' N | 015° 20,124' E | 1518 | Start of survey |
| M178_9-1 | 03-12-21 07:43 | EM710 and EM122 | 37° 41,176' N | 015° 17,640' E | 663 | End of survey |
| M178_10-1 | 03-12-21 08:14 | Gravity Corer | 37° 40,311' N | 015° 17,399' E | 643 | |
| M178_11-1 | 03-12-21 11:01 | Gravity Corer | 37° 40,385' N | 015° 17,781' E | 637 | |
| M178_12-1 | 03-12-21 13:03 | Gravity Corer | 37° 39,866' N | 015° 21,711' E | 1582 | |
| M178_12-2 | 03-12-21 14:37 | Gravity Corer | 37° 39,865' N | 015° 21,713' E | 1582 | |
| M178_12-3 | 03-12-21 16:12 | CTD | 37° 39,866' N | 015° 21,712' E | - | Releaser test, with Posidonia and Hydrophone |
| M178_13-1 | 03-12-21 18:17 | P-70 and EM122 | 37° 33,841' N | 015° 22,318' E | 1961 | Start of survey |
| M178_13-1 | 04-12-21 06:24 | P-70 and EM122 | 37° 32,227' N | 015° 15,536' E | 1120 | End of survey |
| M178_14-1 | 04-12-21 07:58 | Gravity Corer | 37° 40,221' N | 015° 21,500' E | 1588 | |
| M178_15-1 | 04-12-21 11:06 | Gravity Corer | 37° 40,411' N | 015° 17,885' E | 625 | |
| M178_16-1 | 04-12-21 13:51 | Gravity Corer | 37° 40,374' N | 015° 17,642' E | 636 | |
| M178_17-1 | 04-12-21 14:39 | P-70 and EM122 | 37° 40,204' N | 015° 17,729' E | 635 | Start of survey |
| M178_17-1 | 05-12-21 06:04 | P-70 and EM122 | 37° 31,737' N | 015° 20,410' E | 1844 | End of survey |
| M178_18-1 | 05-12-21 08:36 | Gravity Corer | 37° 39,348' N | 015° 16,578' E | 722 | |
| M178_19-1 | 05-12-21 10:09 | Gravity Corer | 37° 39,516' N | 015° 17,426' E | 629 | |
| M178_20-1 | 05-12-21 13:45 | Gravity Corer | 37° 32,164' N | 015° 15,672' E | 1174 | |
| M178_20-2 | 05-12-21 15:19 | Gravity Corer | 37° 32,163' N | 015° 15,673' E | 1177 | |
| M178_21-1 | 05-12-21 17:28 | P-70 and EM122 | 37° 41,656' N | 015° 15,927' E | 448 | Start of survey |
| M178_21-1 | 05-12-21 22:05 | P-70 and EM122 | 37° 46,459' N | 015° 19,589' E | 917 | End of survey |
| M178_22-1 | 05-12-21 22:06 | EM710 and EM122 | 37° 46,512' N | 015° 19,610' E | 952 | Start of survey |
| M178_22-1 | 06-12-21 05:46 | EM710 and EM122 | 37° 45,077' N | 015° 15,689' E | 480 | End of survey |
| M178_23-1 | 06-12-21 09:00 | Geodesy Station | 37° 32,480' N | 015° 15,463' E | - | Positioned with Posidonia, HPT modem and anchor weight |
| M178_24-1 | 06-12-21 11:18 | Geodesy Station | 37° 32,107' N | 015° 15,774' E | - | Positioned with Posidonia, HPT modem and anchor weight |
| M178_25-1 | 06-12-21 13:05 | Geodesy Station | 37° 32,198' N | 015° 15,496' E | - | Positioned with Posidonia, HPT modem and anchor weight |
| M178_26-1 | 06-12-21 15:03 | Geodesy Station | 37° 32,270' N | 015° 16,037' E | - | Positioned with Posidonia, HPT modem and anchor weight |
| M178_27-1 | 06-12-21 16:53 | Geodesy Station | 37° 32,240' N | 015° 15,656' E | - | Positioned with Posidonia, HPT modem and anchor weight |

| Station | Date / Time UTC | Device | Latitude | Longitude | Depth (m) | Comment |
|---|---|---|---|---|---|---|
| M178_28-1 | 06-12-21 18:11 | EM710 and EM122 | 37° 36,139' N | 015° 12,358' E | 366 | Start of survey |
| M178_28-1 | 07-12-21 06:44 | EM710 and EM122 | 37° 35,420' N | 015° 13,328' E | 503 | End of survey |
| M178_28-2 | 07-12-21 06:44 | P-70 and EM122 | 37° 35,408' N | 015° 13,346' E | 509 | Start of survey |
| M178_28-2 | 07-12-21 11:11 | P-70 and EM122 | 37° 28,034' N | 015° 32,152' E | 2151 | End of survey |
| M178_29-1 | 07-12-21 12:55 | Gravity Corer | 37° 26,349' N | 015° 25,982' E | 1985 | |
| M178_30-1 | 07-12-21 15:11 | Gravity Corer | 37° 25,928' N | 015° 25,614' E | 2111 | |
| M178_31-1 | 07-12-21 17:02 | Gravity Corer | 37° 25,813' N | 015° 25,712' E | 2122 | |
| M178_32-1 | 07-12-21 18:41 | P-70 and EM122 | 37° 28,699' N | 015° 23,027' E | 2064 | Start of survey |
| M178_32-1 | 08-12-21 06:00 | P-70 and EM122 | 37° 47,402' N | 015° 22,730' E | 1281 | End of survey |
| M178_33-1 | 08-12-21 09:55 | Gravity Corer | 37° 35,451' N | 015° 14,337' E | 536 | |
| M178_34-1 | 08-12-21 11:03 | Geodesy Station | 37° 32,305' N | 015° 15,529' E | - | HPT Modem operation |
| M178_35-1 | 08-12-21 13:09 | Gravity Corer | 37° 41,747' N | 015° 22,994' E | 1473 | |
| M178_36-1 | 09-12-21 01:11 | EM710 and EM122 | 37° 42,362' N | 015° 23,882' E | 1606 | Start of survey |
| M178_36-1 | 09-12-21 03:00 | EM710 and EM122 | 37° 45,030' N | 015° 22,432' E | 1248 | End of survey |
| M178_36-2 | 09-12-21 03:00 | P-70 and EM122 | 37° 45,056' N | 015° 22,416' E | 1235 | Start of survey |
| M178_36-2 | 09-12-21 06:59 | P-70 and EM122 | 37° 50,811' N | 015° 23,208' E | 1109 | End of survey |
| M178_37-1 | 17-12-21 08:55 | CTD | 28° 31,963' N | 018° 11,590' W | - | |
| M178_38-1 | 17-12-21 11:16 | CTD | 28° 33,828' N | 018° 04,392' W | - | |
| M178_39-1 | 17-12-21 12:46 | CTD | 28° 34,662' N | 018° 02,567' W | - | |
| M178_40-1 | 17-12-21 14:05 | CTD | 28° 35,320' N | 017° 59,556' W | - | |
| M178_41-1 | 17-12-21 19:01 | CTD | 28° 22,721' N | 017° 49,722' W | - | |
| M178_42-1 | 17-12-21 21:14 | CTD | 28° 14,177' N | 017° 47,630' W | - | |
| M178_43-1 | 18-12-21 00:56 | CTD | 28° 40,168' N | 017° 42,065' W | - | |
| M178_44-1 | 18-12-21 02:35 | CTD | 28° 41,131' N | 017° 37,156' W | - | |
| M178_45-1 | 18-12-21 04:49 | CTD | 28° 43,629' N | 017° 29,420' W | - | |