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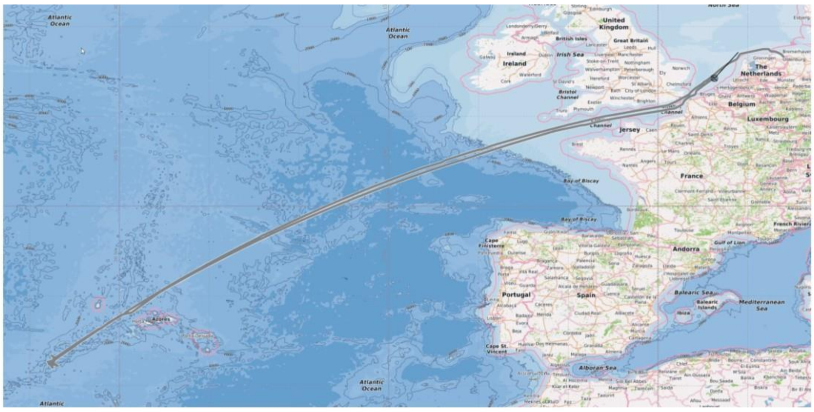
R/V METEOR

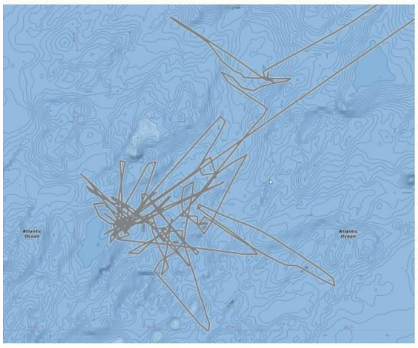
Short Cruise Report

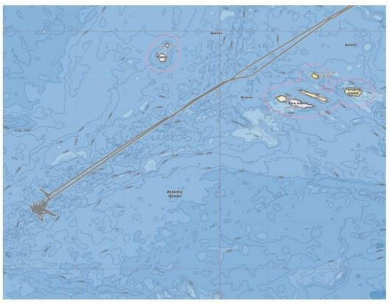
Cruise M176/2

Emden, Germany - Emden, Germany
September 1st – October 6th 2021

Chief Scientist: Eric P. Achterberg
Captain: Detlef Korte







FS METEOR
M176-2
Emden - Emden
01.09.2021 - 06.10.2021

Objectives

The main aim: The main scientific aim is to obtain a mechanistic and quantitative understanding of the processes that set the hydrothermal flux of trace elements and their isotopes (TEIs) to the deep ocean interior on the Mid-Atlantic Ridge (MAR) at the Rainbow site.

The major questions that we will address on the proposed cruise are:

1. What are the length and timescales over which transfer of dissolved Fe and Mn into colloidal and particulate phases occurs within the hydrothermal plume at Rainbow on the MAR?
2. To which degree are the micronutrients Fe, Cu, Zn, Ni complexed by ligands, including siderophores, contributing to their stabilization in the hydrothermal plume and facilitating distal transport?
3. What is the role of nanoparticles in determining the strength of hydrothermal Fe and other trace metal fluxes at Rainbow?
4. How does the composition of suspended particles change with distance from the source areas in the non-buoyant plume?
5. Is there a decoupling of scavenged-type elements from Fe and Mn in the dispersing hydrothermal plume at Rainbow?
6. How do dissolved REE deficits & stable Ba isotope signatures evolve with distance from vent sites?
7. Are the Rainbow vent systems a source of Hg, and what are the transformations of Hg species along the dispersing plume?
8. What are the roles of the Rainbow field vent processes and surface ocean productivity in F, Mg, Ca, Sr and Li cycling and F activity in the North Atlantic Ocean?
9. Do Fe and light co-limit phytoplankton growth in North Atlantic waters hosting residual nitrate? Does Fe availability therefore play a role in regulating the timing of the spring bloom onset?
10. Can phytoplankton take up a range of dissolved organic nitrogen (DON) compounds? Does the availability of other trace elements (Fe, Zn) play a role in regulating utilization of the DON pool?
11. Can boundaries between high and low N_2 fixation regions be predicted by switches in the Fe:N supply ratio to surface waters?

We have the following major goals that we want to achieve for the proposed cruise:

- Obj 1. Determine the distribution, and physical and chemical speciation of TEIs, including micronutrients (such as Cd, Co, Cu, Fe, Mn, Mo, Ni, V, Zn, Cr), non-biologically essential elements (such as Al, Pb, Hg, Ti, Zr, Hf, Nb, U, W and REEs), major elements (F,Ca, Mg, Sr, K, S, Li) and a range of isotope systems (incl. Th, Ra, Ba, Fe) in high resolution sampling along the Rainbow plume.
- Obj 2. Quantify the fluxes of these TEIs and micronutrients to the deep ocean from the ocean crust and away from the Rainbow venting sites, and assess the role of physical and chemical speciation of TEIs for their fluxes and flux attenuation.
- Obj 3. Assess, using chemical tracers and physical oceanography, the mixing and advection of these TEIs away from the Rainbow hydrothermal vent sites into the ocean interior.
- Obj 4. Determine the supply of TEIs (including micronutrients) to the surface ocean from atmospheric deposition, and measure their surface ocean concentrations.
- Obj 5. Explore the relationship between macro- and micro-nutrient concentrations and fluxes, irradiance, ocean productivity, phytoplankton community composition, nutrient utilization and limitation, and diazotrophy in the North Atlantic Ocean.

Narrative

August 30 and 31, 2021- A group of GEOMAR scientists and technicians travelled to the vessel on the morning of August 30 to unload the containers and set up the equipment for the cruise. The CTD sensors, LADCP and other instruments were installed on August 30. A smaller GEOMAR party had already set up and tested the GEOMAR winch container with a new cable guiding deck block on the Meteor in July (prior to cruse M176). On August 31, the remaining cruise participants travelled from Jacobs University and Kiel to the Meteor in Emden and assisted with mobilization, and installed their laboratories. We sailed in the morning of September 1 with very calm weather in the North Sea. In the North Sea the wind and waves were still a little demanding for some of the cruise participants, but all got over their sea-sickness within the first few days of the cruise.
We conducted a test station on September 4 (2021) once we were in international waters southwest of Ireland. We tested the new GEOMAR titanium (Ti) CTD with new Niskin bottles and also with older Go Flo bottles, and also the GEOMAR stainless steel (SS) CTD with LADCP. The test station was important and a range of challenges with the CTD systems were identified and rectified.

September 4 - 27, 2021- The cruise started sampling surface waters from our trace metal clean tow fish for biological and chemical variables as soon as we were in international waters south of Ireland (September 4, 2021). The surface waters were sampled for nitrogen fixation, nutrients and trace elements to establish the rates of nitrogen fixation, types of diazotrophs present (using nifH gene analysis), and the chemical environment of the diazotrophs. This sampling activity continued until we reached the EEZ of the Azores and had to be halted then until we reached the Rainbow hydrothermal vent region in international waters southwest of the Azores (September 9, 2021). The tow fish was subsequently deployed throughout the cruise whilst the vessel was moving.
In addition, we have sampled for aerosols whilst in international waters. The aerosol collector was placed on the monkey deck of the Meteor and filters changed every 48 h. Sampling was halted on September 27. The first station to sample the hydrothermal plume that is positioned at about 2100 m nearthe Rainbow vent field was conducted on September 9, 2021. We had learned a lot from our test stations on September 4 and had fixed some of our problems in the meantime. The first sampling day was therefore very successful, and all equipment and sampling gear worked well. We have been deploying 3 different CTDs (titanium GEOMAR CTD, stainless steel GEOMAR CTD, stainless steel METEOR CTD) on a daily basis, a multicorer (MUC) andalso a set of 6 in situ pumps. The deployments of all CTDs have been successful. The deployment of the in situ pumps was halted after the first 4 sampling days because of malfunctioning; the in situ pumps were replaced by large volume water collection using 3CTD deployments at each station from Sept 13.
Our daily sampling routine started at 0530 h and finished at about 1800 h, and was similar each day. Our nights are occupied by CTD/LADCP surveying operations through the hydrothermal plume. Over the cruise we built up a 3 dimensional picture of the plume movement in the study area, which will provide important context to our geochemical results. On a daily basis we therefore sampled in detail the non-buoyant hydrothermal plume emanating from the Rainbow vent field using the trace metal clean titanium GEOMAR CTD. This CTD is operated by a dedicated winch system with a Kevlar cable, thereby preventing contamination of the samples during the sample collection. We sampled just above and just below the plume, which means between 1700 m and 2300 m, with the plume maxima being at ca. 2100 m. On our Ti rosette with 24 bottles, we sampled 2 bottles at each depth, and therefore 12 depths above, in and below the plume. Once ondeck 12 Niskin bottles are removed from the frame and taken to our trace metal clean

container where the water is filtered into a large number of different bottles for analysis at sea and in the home laboratories. We collected particles from the plume for trace element and synchrotron analyses, and we collected waters that were subsequently filtered on-board through various different filter pore sizes. The collection of various size fractions along the plume will provide detail on chemical transformations and allow us to decipher how much material (e.g. iron) is removed by sinking and remains in solution and may ultimately be available to phytoplankton growth in the surface ocean.
We sampled the other 12 Niskins from the titanium CTD for helium isotopes, DIC, DOC, oxygen which we will use as a tracer of the hydrothermal fluid inputs to the ocean. Helium is a conservative tracer and allows us to follow the plume and determine the fluxes of elements.
Following the malfunctioning of the in situ pumps, we deployed instead daily from 13.09.2021 another 3 CTDs (stainless steel) for the collection of Ra and Th isotopes to allow us to assess time scales of plume movement and trace element scavenging processes. Large volume samples (110 L) were obtained from these deployments for Ra isotopes and pumped over Mn cartridge for short-lived Ra analysis on board and long-lived Ra in Kiel. For Th isotopes we also measured on-board (Th 234) and subsequently on land (Th 230).
An additional titanium CTD was deployed daily (in the afternoon) to 300 m depth for collection of samples for biological variables. Biological rate experiments of nitrification and dinitrogen fixation were conducted using the water from the titanium CTD and tow fish. Phytoplankton resource limitation experiments were conducted in the ship-board laboratory and also in incubation tanks on the aft deck.
Each afternoon, a MUC deployment was conducted to obtain sediment cores. These deployments were successful for all stations in obtaining surface sediments. However, the collection of intact cores was not successful in all instances. Nevertheless on xx occasions we obtained cores which could be used for porewater extraction and slicing. Our sampling routine was similar over a period of 19 days. On September 27, 2021, we conducted the last sampling station, and after completion of the sampling activities we halted all sampling in the early evening of September 27, 2021. The last biological experiments on the ship were ended on September 30, 2021. The biological samples were stored for analysis in the home laboratories in Germany. The weather in the study area has been kind and we have not lost any station time as a result of poor weather.

September 27-October 6, 2021-In this time period we sailed back to Emden, and no sampling was conducted by the ship's science party during this period. The ship's ADCP and TSG was functioning whilst the vessel was in international waters and departure- Cruise M176/2 mobilised in Emden on August 30 and 31, 2021. A group of GEOMAR scientists and technicians travelled to the vessel on the morning of August 30 to unload the containers and set up the equipment for the cruise. The CTD sensors, LADCP and other instruments were installed on August 30. A smaller GEOMAR party had already set up and tested the GEOMAR winch container with a new guiding deck block on the Meteor in July (prior to cruse M176). On August 31, the remaining cruise participants travelled from Jacobs University and Kiel to the Meteor in Emden and assisted with mobilization, and installed their laboratories. We sailed in the morning of September 1 with very calm weather in the North Sea. In the North Sea the wind and waves were still a little demanding for some of the cruise participants, but all got over their sea-sickness within the first few days of the cruise.

We conducted a test station on September 4 (2021) once we were in international waters southwest of Ireland. We tested the new GEOMAR titanium (Ti) CTD with new Niskin **bot-**tles and also with older Go Flo bottles, and also the GEOMAR stainless steel (SS) CTD with LADCP. The test station was important and a range of challenges with the CTD systems were identified and rectified.

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Figure 1 Winch with Kevlar conducting wire (Photo: E. Achterberg)

In addition, we have sampled for aerosols whilst in international waters. The aerosol collector was placed on the monkey deck of the Meteor and filters changed every48 h.

The first station to sample the hydrothermal plume at 2100 m near the Rainbow vent field was conducted on September 9, 2021. We had learned a lot from our test stations on September 4 and had fixed some of our problems in the meantime. The first sampling day was therefore very successful, and all equipment and sampling gear worked well.

We have been deploying 3 different CTDs (titanium GEOMAR CTD, stainless steel GEOMAR CTD, stainless steel METEOR CTD) on a daily basis, a multicorer (MUC) and also a set of 6 in situ pumps. The deployments of all CTDs have been successful. The deployment of the in situ pumps was halted after the first 5 sampling days because of malfunctioning; the in situpumps were replaced by large volume water collection using 3 CTD deployments.

Figure 2 Deployment of titanium CTD frame. (Photo: C. Rohleder)

The daily sampling routine started at 0530 h and finished at about 1800 h, and was similar each day. Our nights are occupied by CTD LADCP surveying operations through the hydrothermal plume. Over the cruise we built up a 3 dimensional picture of the plume movement in the study area, which will provide important context to our geochemical results.

On a daily basis we therefore sampled in detail the non-buoyant hydrothermal plume emanating from the Rainbow vent field using the trace metal clean titanium CTD. This CTD is operated by a dedicated winch system with a Kevlar cable (Fig. 1), thereby preventing contamination of the samples during the sample collection. We sampled just above and just below the plume, which means between 1700 m and 2300 m, with the plume maxima being at ca. 2100 m. Once on deck Niskin bottles are removed from the frame and taken to our trace metal clean container where the water is filtered into a large number of different bottles for analysis at sea and in the home laboratories. We collected particles from the plume for trace element and synchrotron analyses, and we collected waters that were subsequently filtered on-board through various different filter pore sizes. The collection of various size fractions along the plume will provide detail on chemical transformations and allow us to decipher how much material (e.g. iron) is removed by sinking and remains in solution and may ultimately be available to phytoplankton growth inthe surface ocean.

We also sampled the Niskins from the titanium CTD for helium isotopes which we will use as a tracer of the hydrothermal fluid inputs to the ocean. Helium is a conservative tracer and allows us to follow the plume and determine the fluxes of elements.

Following the malfunctioning of the in situ pumps, we deployed instead daily from 14.09.2021 another 3 CTDs (stainless steel) for the collection of Ra and Th isotopes to allow us to assess time scales of plume movement and trace element scavenging processes. Large volume samples (110 L) were obtained from these deployments for Ra isotopes and pumped over Mn cartridge for short-lived Ra analysis on board and long-livedRa in Kiel. For Th isotopes we also measured on-board (Th 234) and subsequently on land (Th 230).

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We also sample Niskins from the titanium CTD for helium isotopes which we use as a tracer of the hydrothermal fluid inputs to the ocean. Helium is a conservative tracer andallows us to follow the plume and determine the fluxes of elements. We are deploying daily another 3 CTDs (stainless steel) for the collection of Ra and Th isotopes to allow us to assess time scales of plume movement and trace element scavenging processes. These CTD operations are replacing the use of the malfunctioningin situ pumps. Large volume samples (110 L) are collected for Ra isotopes and pumped over Mn cartridge for short-lived Ra analysis on board and long-lived Ra in Kiel. For Th isotopes we also measure both on-board (Th 234) and on land (Th 230).

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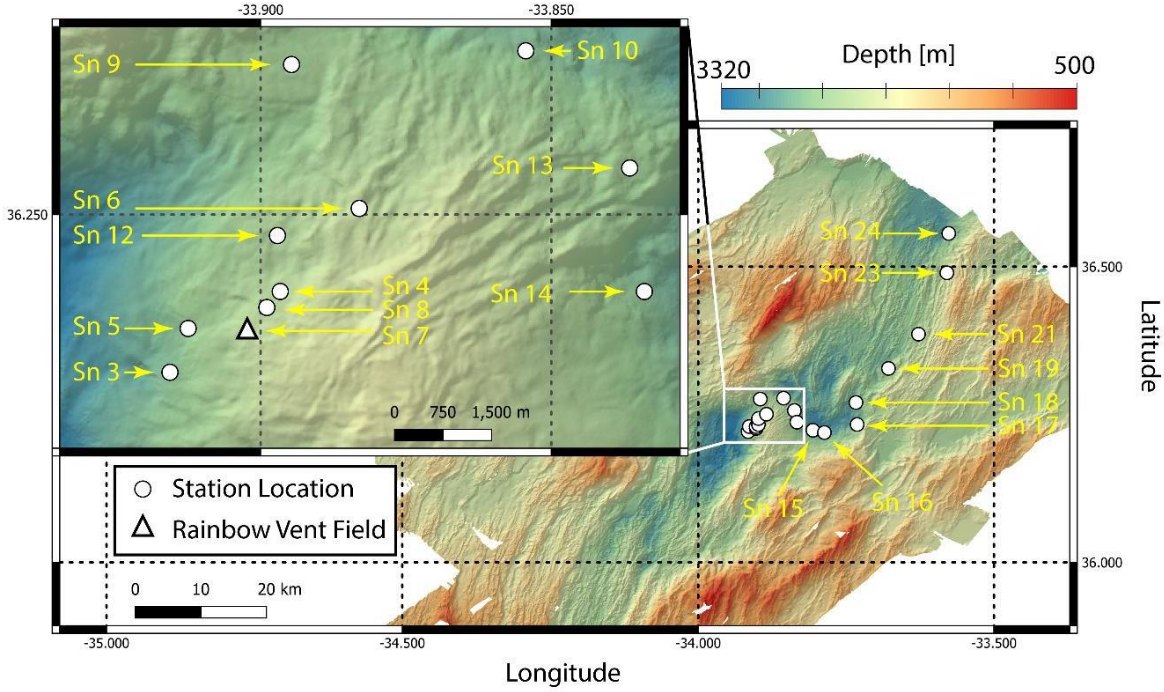

Fig. 3: Map of stations for M176/2.

Acknowledgements

All the members of the RainbowPlume team are very grateful to the DFG, the German Research Fleet Coordination Centre at the Universität Hamburg, the shipping company BRIESE RESEARCH and LPL Projects + Logistics GmbH for providing their outstanding support to science and ship logistics, which made this cruise possible. The careful managing of the COVID situation was outstanding, and allowed us to conduct our successful cruise. We also like to sincerely thank the captain, officers and crew on the METEOR who did a fantastic job at facilitating our research and making our life as pleasant as possible on board.

Cruise participants (scientific party)

	Name	First	Working group/Duty	Affiliation	Status
1*	Achterberg	Eric	Chief Scientist	GEOMAR	Chief
2*	Pöhle	Sandra	Deputy Chief Sci	Jacobs U	Scientist P
3*	Blum	Leah	Oxygen analysis	GEOMAR	HiWi FT
4*	Mutzberg	Andre	Nutrient analysis	GEOMAR	Technician
5*	Schott	Thorsten	CTD MUC sampling	GEOMAR	technician
6*	Zhang	Zhouling	TEI sampling-Ba isotopes	GEOMAR	Postdoc FT
7*	Klose	Lukas	TEI ultrafiltration, ligands	Jacobs U	Postdoc FT
8*	Menon	Vignesh	TEI ultrafiltration, ligands	Jacobs U	PhD
9*	Steiner	Zvi	TEI sampling and data,	GEOMAR	Scientists
10*	Jia	Qi	TEI collection	GEOMAR	PhD
11*	Gosnell	Kati	Hg analysis	GEOMAR	GEOMAR
12*	Jasinski	Dominik	TE sampling	GEOMAR	Technician
13	Torres-	Natalie	Hg work	Marseille	PhD
14*	Vieira	Lucia	Ra isotopes	GEOMAR.	Postdoc FT
15*	Wen	Zuozhu	N2 fixation analysis	GEOMAR	Postdoc FT
16*	Yuan	Zhongwei	Bioassay experiments	GEOMAR	PhD
17*	Li	Fengji	Phycosphere work	GEOMAR	Postdoc FT
18	Zhou	Linbin	TEI sampling	GEOMAR	Postdoc FT
19*	Galley	Chris	CTD/ADCP/Multibeam	GEOMAR	PhD
20*	Rohleder	Christian	Weather	DWD	Technician
21*	Krüger	Sarah	Sediment core slicing	GEOMAR	HiWi FT
22*	Liu	Jing	Nitrogen cycling	GEOMAR	PhD
23*	Battermann	Paul	Ra	CAU	HiWi
24	Glock	Nicholas	Sediment work	GEOMAR	scientist
25	Von Keitz	Tabea	Datamanagement/sampling	GEOMAR	Hiwi
26*	Gilliard	Delphine	Cr and Th	U Lausanne	PhD
27*	Reza	Zawed	Biology	GEOMAR	Hiwi

Stationsliste M176/2

ISP= in situ pumps. CTD used: METEOR stainless steel CTD (METEOR CTD), GEOMAR Physical Oceanography Stainless steel CTD (CTD GEOMAR), and GEOMAR Ultra Clean Titanium CTD (CTD Ultra Clean).

Station	Date / Time UTC 2021	Device	Latitude N	Longitude W	Max Depth (m)	Comments
M176/2_1-1	04/09 07:23	Towfish	47° 32,685'	011° 51,631'	4644	Test Station,
M176/2_1-1	04/09 07:27	Towfish	47° 32,623'	011° 51,665'	4648	
M176/2_1-2	04/09 08:48	CTD Ultra Clean	47° 31,652'	011° 52,972'	4676	Test Station GEOMAR winch
M176/2_1-3	04/09 10:03	CTD METEOR	47° 31,587'	011° 53,381'	4679	Test Station
M176/2_1-4	04/09 10:44	CTD Ultra Clean	47° 31,782'	011° 53,987'	4679	Test Station, GEOMAR winch
M176/2_1-5	04/09 11:16	Towfish	47° 31,830'	011° 54,593'	4684	
M176/2_1-5	06/09 07:33	Towfish	43° 31,579'	021° 41,287'	3280	
M176/2_1-5	06/09 08:45	Towfish	43° 25,660'	021° 54,806'	3808	
M176/2_1-5	06/09 15:19	Towfish	42° 44,240'	023° 16,380'	3607	
M176/2_0_UW-3	04/09 13:15	P-70 Parasound	47° 22,197'	012° 17,136'	4744	
M176/2_0_UW-3	07/09 02:25	P-70 Parasound	41° 45,766'	025° 07,756'	3545	
M176/2_0_UW-3	08/09 21:32	P-70 Parasound	36° 33,135'	033° 27,038'	2530	
M176/2_0_UW-2	04/09 13:15	Multibeam	47° 22,192'	012° 17,154'	4744	
M176/2_0_UW-2	07/09 02:25	Multibeam	41° 45,751'	025° 07,780'	3545	
M176/2_0_UW-2	08/09 21:32	Multibeam	36° 33,145'	033° 27,023'	2416	
M176/2_0_UW-1	04/09 13:15	ADCP	47° 22,163'	012° 17,250'	4743	
M176/2_0_UW-1	07/09 02:25	ADCP	41° 45,742'	025° 07,794'	3545	
M176/2_0_UW-1	08/09 21:32	ADCP	36° 33,073'	033° 27,132'	2461	
M176/2_2-1	06/09 15:27	CTD Ultra Clean	42° 44,280'	023° 16,454'	3609	GEOMAR winch
M176/2_2-2	06/09 15:59	CTD METEOR	42° 44,272'	023° 16,568'	3606	W2,
M176/2_2-3	06/09 16:35	CTD Ultra Clean	42° 44,288'	023° 16,437'	3608	GEOMAR winch
M176/2_2-4	06/09 17:00	Towfish	42° 44,340'	023° 16,599'	3608	
M176/2_2-4	07/09 01:51	Towfish	41° 47,931'	025° 04,552'	3598	
M176/2_3-1	09/09 00:36	CTD GEOMAR Tow Yo	36° 14,383'	033° 53,362'	2174	W2, Posidonia
M176/2_3-2	09/09 01:45	Towfish	36° 14,332'	033° 53,593'	2306	
M176/2_3-2	09/09 01:52	Towfish	36° 14,226'	033° 53,682'	2303	Abbruch
M176/2_3-3	09/09 06:26	CTD Ultra Clean	36° 13,417'	033° 54,794'	2649	GEOMAR winch
M176/2_3-4	09/09 09:01	CTD GEOMAR isp	36° 13,454'	033° 54,826'	2679	W2, mit ISP
M176/2_3-5	09/09 14:08	Video Multi Corer	36° 13,450'	033° 54,735'	2609	W12
M176/2_3-6	09/09 16:53	CTD METEOR	36° 13,489'	033° 54,828'	2631	W3,
M176/2_3-8	09/09 17:58	CTD Ultra Clean	36° 13,475'	033° 55,077'	2659	GEOMAR winch
M176/2_3-9	09/09 18:32	Towfish	36° 13,883'	033° 55,193'	2786	
M176/2_3-9	09/09 21:32	Towfish	36° 18,440'	033° 50,933'	2885	
M176/2_4-1	09/09 22:15	CTD GEOMAR Tow Yo	36° 13,278'	033° 53,411'	2027	W2, Posidonia
M176/2_4-2	10/09 05:48	CTD Ultra Clean	36° 14,235'	033° 53,831'	2340	GEOMAR winch
M176/2_4-3	10/09 08:20	CTD GEOMAR isp	36° 14,249'	033° 53,912'	2380	W2, mit ISP
M176/2_4-4	10/09 13:26	Video Multi Corer	36° 14,194'	033° 53,866'	2502	W12
M176/2_4-5	10/09 17:43	CTD Ultra Clean	36° 14,211'	033° 53,848'	2353	GEOMAR winch
M176/2_4-6	10/09 18:17	Towfish	36° 14,319'	033° 54,040'	2494	
M176/2_4-6	10/09 23:22	Towfish	36° 14,436'	033° 54,717'	2614	
M176/2_5-1	10/09 23:45	CTD GEOMAR Tow Yo	36° 14,052'	033° 54,968'	2677	W2, Posidonia
M176/2_5-2	11/09 06:00	CTD Ultra Clean	36° 13,783'	033° 54,182'	2332	GEOMAR winch
M176/2_5-3	11/09 08:19	CTD GEOMAR isp	36° 13,808'	033° 54,399'	2427	W2, mit ISP
M176/2_5-4	11/09 13:12	CTD METEOR	36° 13,820'	033° 54,104'	2283	W3,
M176/2_5-5	11/09 14:44	CTD Ultra Clean	36° 13,763'	033° 54,174'	2308	GEOMAR winch

M176/2_5-6	11/09 15:32	Grab	36° 13,779'	033° 54,093'	2267	W3
M176/2_6-1	11/09 18:24	CTD GEOMAR Tow Yo	36° 13,428'	033° 53,235'	1989	W2, Posidonia
M176/2_6-2	12/09 02:07	Towfish	36° 16,895'	033° 55,494'	2224	
M176/2_6-2	12/09 05:13	Towfish	36° 14,927'	033° 52,809'	2220	
M176/2_6-3	12/09 05:48	CTD Ultra Clean	36° 15,065'	033° 52,968'	2339	GEOMAR winch
M176/2_6-4	12/09 08:33	CTD GEOMAR isp	36° 15,076'	033° 52,879'	2321	W2, mit ISP
M176/2_6-5	12/09 13:29	CTD METEOR	36° 15,020'	033° 52,943'	2419	W3,
M176/2_6-6	12/09 14:28	CTD Ultra Clean	36° 15,066'	033° 52,941'	2476	GEOMAR winch
M176/2_6-7	12/09 15:32	Video Multi Corer	36° 15,122'	033° 52,874'	2408	W12, Posidonia
M176/2_7-1	12/09 18:13	CTD GEOMAR Tow Yo	36° 12,733'	033° 53,736'	2186	W2, Posidonia
M176/2_7-2	13/09 05:32	CTD Ultra Clean	36° 13,836'	033° 54,159'	2337	GEOMAR winch
M176/2_7-3	13/09 08:26	CTD GEOMAR isp	36° 13,862'	033° 54,030'	2289	W2, ISP, Posidonia
M176/2_7-4	13/09 13:26	CTD METEOR	36° 13,827'	033° 54,135'	2299	W3, Posidonia
M176/2_7-5	13/09 15:54	CTD Ultra Clean	36° 13,825'	033° 54,113'	2300	GEOMAR winch
M176/2_7-6	13/09 16:36	Video Multi Corer	36° 13,913'	033° 54,176'	2357	W12, Posidonia
M176/2_8-1	13/09 19:33	CTD GEOMAR Tow YO	36° 14,652'	033° 52,272'	2053	W2, Posidonia
M176/2_8-2	14/09 01:21	Towfish	36° 16,368'	033° 54,882'	2541	
M176/2_8-2	14/09 05:18	Towfish	36° 14,065'	033° 54,180'	2436	
M176/2_8-3	14/09 05:43	CTD Ultra Clean	36° 14,076'	033° 53,979'	2271	GEOMAR winch
M176/2_8-4	14/09 08:25	CTD GEOMAR	36° 14,022'	033° 53,973'	2288	W2, Posidonia
M176/2_8-5	14/09 10:42	CTD METEOR	36° 14,093'	033° 53,954'	2293	W3, Posidonia
M176/2_8-6	14/09 14:18	CTD Ultra Clean	36° 14,078'	033° 53,966'	2358	GEOMAR winch
M176/2_8-7	14/09 14:59	Video Multi Corer	36° 14,069'	033° 53,967'	2283	W12, Posidonia
M176/2_8-8	14/09 17:07	CTD METEOR	36° 14,072'	033° 53,946'	2288	W3, Posidonia
M176/2_9-1	14/09 19:18	CTD GEOMAR Tow Yo	36° 13,818'	033° 53,026'	2063	W2, Posidonia
M176/2_9-2	15/09 05:41	CTD Ultra Clean	36° 16,556'	033° 53,710'	2512	GEOMAR winch
M176/2_9-3	15/09 08:28	CTD GEOMAR	36° 16,576'	033° 53,765'	2521	W2, Posidonia
M176/2_9-4	15/09 10:59	CTD METEOR	36° 16,450'	033° 53,825'	2497	W3, Posidonia
M176/2_9-5	15/09 13:09	Video Multi Corer	36° 16,559'	033° 53,696'	2507	W12, Posidonia
M176/2_9-6	15/09 15:42	CTD Ultra Clean	36° 16,559'	033° 53,701'	2509	GEOMAR winch
M176/2_9-7	15/09 16:18	CTD METEOR	36° 16,524'	033° 53,693'	2507	W3, Posidonia
M176/2_10-1	15/09 18:25	CTD GEOMAR Tow YO	36° 15,513'	033° 52,621'	2343	W2, Posidonia
M176/2_10-2	16/09 02:27	Towfish	36° 10,558'	033° 44,215'	1624	
M176/2_10-2	16/09 05:23	Towfish	36° 18,506'	033° 51,219'	2780	
M176/2_10-3	16/09 06:00	CTD Ultra Clean	36° 16,693'	033° 51,300'	2688	GEOMAR winch
M176/2_10-4	16/09 08:52	CTD GEOMAR	36° 16,676'	033° 51,261'	2663	W2, Posidonia
M176/2_10-5	16/09 11:11	CTD METEOR	36° 16,734'	033° 51,246'	2704	W3, Posidonia
M176/2_10-6	16/09 13:23	Video Multi Corer	36° 16,697'	033° 51,266'	2697	W12, Posidonia
M176/2_10-7	16/09 15:49	CTD Ultra Clean	36° 16,683'	033° 51,299'	2676	GEOMAR winch
M176/2_10-8	16/09 16:41	CTD METEOR	36° 16,676'	033° 51,313'	2659	W2, Posidonia
M176/2_11-1	16/09 19:09	CTD METEOR	36° 13,860'	033° 54,175'	2320	W3, Posidonia
M176/2_11-2	16/09 21:25	CTD GEOMAR To Yo	36° 14,244'	033° 54,873'	2655	W2, Posidonia
M176/2_11-3	17/09 02:54	CTD METEOR	36° 13,798'	033° 54,123'	2305	W2, Posidonia
M176/2_12-1	17/09 05:34	CTD Ultra Clean	36° 14,799'	033° 53,839'	2419	GEOMAR winch
M176/2_12-2	17/09 08:17	CTD GEOMAR	36° 14,832'	033° 53,858'	2419	W2, Posidonia
M176/2_12-3	17/09 10:17	CTD METEOR	36° 14,719'	033° 53,811'	2416	W3, Posidonia
M176/2_12-4	17/09 12:13	Video Multi Corer	36° 14,786'	033° 53,888'	2418	W12, Posidonia
M176/2_12-5	17/09 15:35	CTD Ultra Clean	36° 14,776'	033° 53,796'	2417	GEOMAR winch
M176/2_12-6	17/09 16:09	CTD METEOR	36° 14,780'	033° 53,864'	2419	W3, Posidonia
M176/2_13-1	17/09 18:25	CTD GEOMAR Tow Yo	36° 14,120'	033° 51,977'	2127	W2, Posidonia
M176/2_13-2	18/09 02:31	Towfish	36° 16,270'	033° 48,448'	2775	
M176/2_13-2	18/09 05:12	Towfish	36° 18,189'	033° 47,369'	2944	
M176/2_13-3	18/09 06:05	CTD Ultra Clean	36° 15,518'	033° 50,216'	2692	GEOMAR winch
M176/2_13-4	18/09 08:51	CTD GEOMAR	36° 15,490'	033° 50,183'	2654	W2, Posidonia

M176/2_13-5	18/09 10:56	CTD METEOR	36° 15,527'	033° 50,154'	2628	W3, Posidonia
M176/2_13-6	18/09 12:49	Video Multi Corer	36° 15,474'	033° 50,186'	2569	W12, Posidonia
M176/2_13-7	18/09 15:06	CTD METEOR	36° 15,516'	033° 50,157'	2641	W3, Posidonia
M176/2_13-8	18/09 16:48	CTD Ultra Clean	36° 15,495'	033° 50,181'	2618	GEOMAR winch
M176/2_14-1	18/09 18:05	CTD GEOMAR Tow Yo	36° 11,721'	033° 48,540'	2434	W2, Posidonia
M176/2_14-2	19/09 00:09	Towfish	36° 14,557'	033° 47,595'	2990	
M176/2_14-2	19/09 02:03	Towfish	36° 07,553'	033° 48,798'	1848	
M176/2_14-3	19/09 05:37	CTD Ultra Clean	36° 14,222'	033° 50,062'	2722	GEOMAR winch
M176/2_14-4	19/09 08:21	CTD GEOMAR	36° 14,212'	033° 50,026'	2665	W2, Posidonia
M176/2_14-5	19/09 10:27	CTD METEOR	36° 14,207'	033° 50,071'	2664	W3, Posidonia
M176/2_14-6	19/09 12:14	Video Multi Corer	36° 14,205'	033° 50,027'	2690	W12, Posidonia
M176/2_14-7	19/09 14:58	CTD Ultra Clean	36° 14,175'	033° 50,007'	2712	GEOMAR winch
M176/2_14-8	19/09 15:36	CTD METEOR	36° 14,190'	033° 50,081'	2666	W3, Posidonia
M176/2_15-1	19/09 17:58	CTD GEOMAR Tow Yo	36° 15,032'	033° 51,998'	2117	W2, Posidonia
M176/2_15-2	19/09 23:24	Towfish	36° 17,630'	033° 55,299'	2055	
M176/2_15-2	20/09 05:23	Towfish	36° 13,439'	033° 48,933'	2934	
M176/2_15-3	20/09 05:53	CTD Ultra Clean	36° 13,510'	033° 48,380'	2953	GEOMAR winch
M176/2_15-4	20/09 09:50	CTD METEOR	36° 13,345'	033° 48,254'	2905	W3, Posidonia
M176/2_15-5	20/09 12:15	Video Multi Corer	36° 13,374'	033° 48,469'	2900	W12, Posidonia
M176/2_15-6	20/09 14:43	CTD METEOR	36° 13,516'	033° 48,392'	3078	W3, Posidonia
M176/2_15-7	20/09 16:30	CTD Ultra Clean	36° 13,491'	033° 48,357'	3249	GEOMAR winch
M176/2_15-8	20/09 17:03	CTD METEOR	36° 13,527'	033° 48,353'	3236	W3, Posidonia
M176/2_16-1	21/09 05:48	CTD Ultra Clean	36° 13,189'	033° 47,159'	3065	GEOMAR winch
M176/2_16-2	21/09 08:27	CTD METEOR	36° 13,211'	033° 47,181'	3064	W3, Posidonia
M176/2_16-3	21/09 11:04	CTD METEOR	36° 13,169'	033° 47,165'	3040	W3, Posidonia
M176/2_16-4	21/09 12:53	Video Multi Corer	36° 13,204'	033° 47,145'	3065	W12, Posidonia
M176/2_16-5	21/09 15:14	CTD METEOR	36° 13,213'	033° 47,145'	3065	W3, Posidonia
M176/2_16-6	21/09 16:59	CTD Ultra Clean	36° 13,182'	033° 47,148'	3061	GEOMAR winch
M176/2_17-1	21/09 19:05	Towfish	36° 12,608'	033° 46,139'	2675	
M176/2_17-1	22/09 01:36	Towfish	36° 07,542'	033° 49,634'	2102	
M176/2_17-2	22/09 05:41	CTD Ultra Clean	36° 13,964'	033° 43,957'	2880	GEOMAR winch
M176/2_17-3	22/09 08:50	CTD GEOMAR	36° 14,032'	033° 43,891'	2814	W2, Posidonia
M176/2_17-4	22/09 11:02	CTD METEOR	36° 13,941'	033° 43,896'	2458	W3, Posidonia
M176/2_17-5	22/09 13:09	Video Multi Corer	36° 13,977'	033° 43,938'	2623	W12, Posidonia
M176/2_17-6	22/09 15:51	CTD Ultra Clean	36° 13,983'	033° 43,924'	2715	GEOMAR winch
M176/2_17-7	22/09 16:35	CTD METEOR	36° 13,987'	033° 43,859'	2778	W3, Posidonia
M176/2_17-8	22/09 19:24	Video Multi Corer	36° 14,064'	033° 43,812'	2941	W12, Posidonia
M176/2_18-1	23/09 05:41	CTD METEOR	36° 16,146'	033° 43,979'	2749	W3, Posidonia
M176/2_18-2	23/09 07:55	CTD Ultra Clean	36° 16,149'	033° 44,022'	2750	GEOMAR winch
M176/2_18-3	23/09 10:54	CTD METEOR	36° 16,184'	033° 43,973'	2750	W3, Posidonia
M176/2_18-4	23/09 12:44	Video Multi Corer	36° 16,236'	033° 44,098'	3052	W12, Posidonia
M176/2_18-5	23/09 13:37	CTD GEOMAR	36° 16,174'	033° 44,013'	2749	W2, Posidonia
M176/2_18-6	23/09 17:07	CTD Ultra Clean	36° 16,177'	033° 43,985'	2751	GEOMAR winch
M176/2_19-1	23/09 20:00	Towfish	36° 16,054'	033° 43,760'	2760	
M176/2_19-1	24/09 05:26	Towfish	36° 19,634'	033° 40,588'	2510	
M176/2_19-2	24/09 05:46	CTD Ultra Clean	36° 19,628'	033° 40,706'	2505	GEOMAR winch
M176/2_19-3	24/09 08:35	CTD GEOMAR	36° 19,616'	033° 40,636'	2509	W2, Posidonia
M176/2_19-4	24/09 10:44	CTD METEOR	36° 19,688'	033° 40,686'	2508	W3, Posidonia
M176/2_19-5	24/09 12:35	Video Multi Corer	36° 19,601'	033° 40,675'	2510	W12, Posidonia
M176/2_19-6	24/09 14:37	CTD Ultra Clean	36° 19,654'	033° 40,682'	2507	GEOMAR winch
M176/2_19-7	24/09 15:08	CTD METEOR	36° 19,728'	033° 40,757'	2506	W3, Posidonia
M176/2_20-1	24/09 17:01	Towfish	36° 19,616'	033° 40,631'	2509	
M176/2_20-1	24/09 18:15	Towfish	36° 14,345'	033° 53,246'	2167	
M176/2_20-2	24/09 18:34	CTD Ultra Clean	36° 13,871'	033° 54,158'	2319	GEOMAR winch
M176/2_21-1	24/09 23:29	CTD GEOMAR Tow Yo	36° 22,956'	033° 42,292'	2742	W2, Posidonia

M176/2_21-2	25/09 06:08	CTD Ultra Clean	36° 23,193'	033° 37,578'	2310	GEOMAR winch
M176/2_21-3	25/09 08:48	CTD GEOMAR	36° 23,258'	033° 37,639'	2306	W2, Posidonia
M176/2_21-4	25/09 10:46	CTD METEOR	36° 23,261'	033° 37,597'	2305	W3, Posidonia
M176/2_21-5	25/09 12:33	Video Multi Corer	36° 23,267'	033° 37,587'	2304	W12, Posidonia
M176/2_21-6	25/09 14:21	CTD Ultra Clean	36° 23,226'	033° 37,554'	2311	GEOMAR winch
M176/2_21-7	25/09 14:52	CTD METEOR	36° 23,235'	033° 37,536'	2310	W3, Posidonia
M176/2_22-1	25/09 18:35	CTD GEOMAR Tow YO	36° 12,781'	033° 43,223'	1911	W2, Posidonia
M176/2_22-2	26/09 02:20	Towfish	36° 15,418'	033° 45,920'	2678	
M176/2_22-2	26/09 05:09	Towfish	36° 28,619'	033° 35,255'	2320	
M176/2_23-1	26/09 05:33	CTD Ultra Clean	36° 29,486'	033° 34,734'	2179	GEOMAR winch
M176/2_23-2	26/09 08:01	CTD GEOMAR	36° 29,455'	033° 34,736'	2178	W2, Posidonia
M176/2_23-3	26/09 09:46	CTD METEOR	36° 29,425'	033° 34,755'	2201	W3, Posidonia
M176/2_23-4	26/09 11:26	Video Multi Corer	36° 29,438'	033° 34,651'	2184	W12, Posidonia
M176/2_23-5	26/09 13:30	CTD Ultra Clean	36° 29,519'	033° 34,778'	2178	GEOMAR winch
M176/2_23-6	26/09 14:04	CTD METEOR	36° 29,476'	033° 34,780'	2175	W3, Posidonia
M176/2_23-7	26/09 15:50	Towfish	36° 30,032'	033° 35,523'	2438	
M176/2_23-7	26/09 18:00	Towfish	36° 32,251'	033° 35,605'	2764	
M176/2_24-1	26/09 19:00	CTD GEOMAR Tow Yo	36° 33,429'	033° 31,408'	1806	W2, Posidonia
M176/2_24-2	27/09 06:01	CTD Ultra Clean	36° 33,390'	033° 34,643'	2940	GEOMAR winch
M176/2_24-3	27/09 09:13	CTD GEOMAR	36° 33,405'	033° 34,626'	2933	W2, Posidonia
M176/2_24-4	27/09 11:37	CTD METEOR	36° 33,316'	033° 34,649'	2933	W3, Posidonia
M176/2_24-5	27/09 13:37	Video Multi Corer	36° 33,351'	033° 34,672'	2937	W12, Posidonia
M176/2_24-6	27/09 16:08	CTD Ultra Clean	36° 33,430'	033° 34,882'	3017	GEOMAR winch
M176/2_24-7	27/09 17:02	CTD METEOR	36° 32,912'	033° 33,644'	2413	W3, Posidonia