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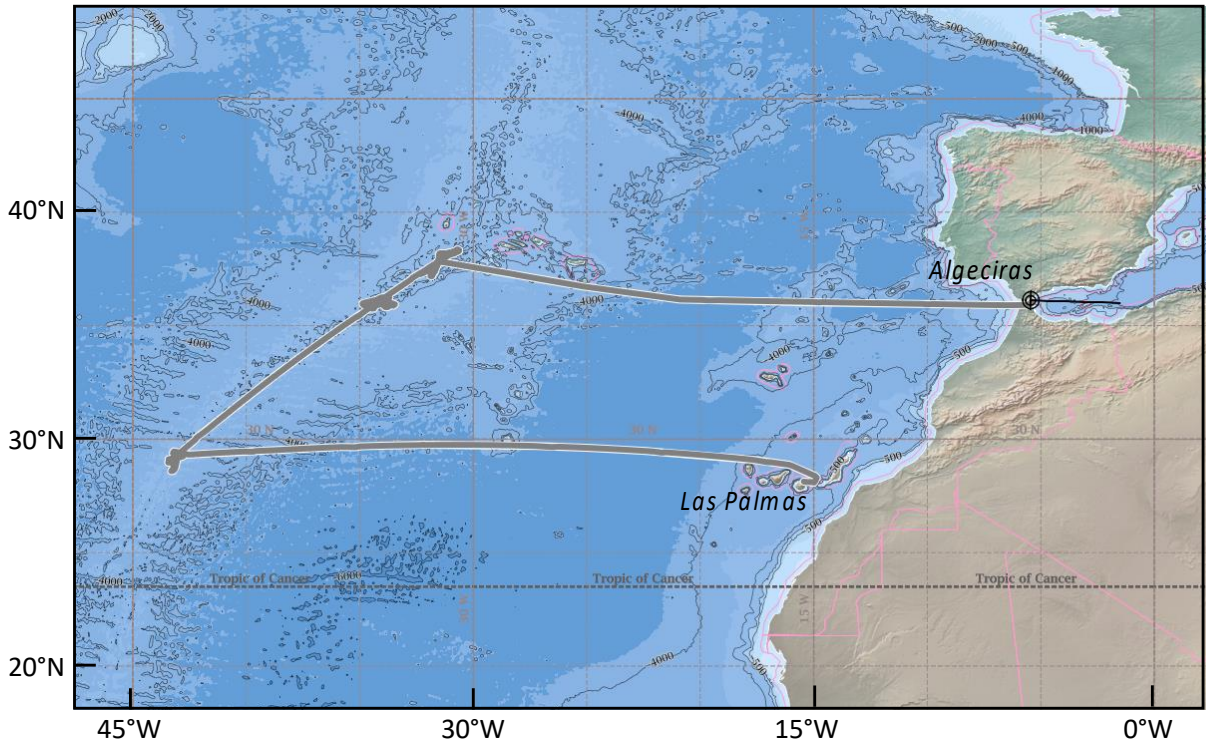
Short Cruise Report
METEOR - M190

Las Palmas (Spain) – Algeciras (Spain)
June 08 – July 10, 2023
Chief Scientist: Wolfgang Bach
Captain: Detlef Korte



Objectives

The major aims of cruise M190 of R/V Meteor was highly coordinated sampling of their fluids, rocks, and biota, as part of our joint geo-bio interface studies in the Research Area 'Ocean Floor as a Reactor' of the proposed Cluster of Excellence "The Ocean Floor – Earth's Uncharted Interface". The cruise track is shown in Fig. 3.1. The hydrothermal vents in the area of the Mid-Atlantic Ridge (MAR) between 29°10'N and 37°50'N occur in different geological settings (axial volcano vs. detachment fault vs. axial volcanic ridge) and are hence geochemically highly diverse. It was planned to conduct water column surveys to determine how closely spaced vents are in the MAR 36-38°N area and what controls their distribution. Sampling hydrothermal vents with ROV MARUM Quest 4000 allowed us to assess the diversity of the hydrothermal fluids between those km-spaced vents and determine the volcanic and faulting controls of this diversity. We also wanted to examine how the distribution of vents and variability of fluid compositions affect the genetic and metabolic diversity of symbiotic and free-living microbes. This work will show if vent microorganisms are ubiquitously spread along vents on the MAR, or if biogeographic and environmental factors influence their distribution and abundance. Water column sampling and subsequent t geochemical work will show how metals transform within the rising hydrothermal plumes. We also wanted to conduct comprehensively sampling and analyses of diffuse fluids to assess activity and pathways of subseafloor microbial metabolism.
Our main research questions were:
1) How diverse are the hydrothermal fluids between those km-spaced vents and what are the volcanic and faulting controls of this diversity? We hypothesize that proximity to the volcanic center on top of the magma plumbing system affects long-term gas flux at the segment scale. In contrast, fault-bound systems are proposed to be controlled more by water-rock equilibria.
2) How does the distribution of vents and variability of fluid compositions affect the genetic and metabolic diversity of symbiotic and free-living microbes? Are vent microorganisms ubiquitously spread along vents on the MAR, or can we detect biogeographic and environmental factors that influence their distribution and abundance?
3) How are metals transformed within the rising and neutrally buoyant parts of hydrothermal plumes and how is the fate of metals controlled by primary differences in metal:sulfide and metal:carbon ratios?
4) What can we learn from comprehensive analyses of diffuse fluids about subseafloor microbial activity? We anticipate that abundant venting of diffuse fluids in all work areas provides a window to subseafloor microbial metabolic activity, and that we can deduce how this activity depends on source fluid characteristics and hydrological constraints.

Our working program was firmly centered around doing co-located sampling of fluids, rocks, and biota in the hydrothermal vent areas to be visited.
The cruise work program on board-ship included:

- Comprehensive and systematic sampling and chemical characterization of fluids from both hot focused flow and low temperature diffuse flow vents; fluid sampling along temperature gradients in the mixing zone between hydrothermal fluid and ambient seawater; hydrothermal plume sampling.
- Determination of pH and redox potential, electrical conductivity.
- Filtration and preservation/ conditioning of fluid sample aliquots for subsequent determination of major and ultra-/trace elements by ICP-MS, ICP-OES, voltammetry in our home labs; quantification of anions by ion chromatography, voltammetry (S species), alkalinity titration (C species).
- Dihydrogen and CH_4 concentration were measured onboard the ship with a dedicated GC and an H2 analyzer in all vent fluid samples collected. Samples for total CO_2 are

stored in evacuated serum bottles. Organic components (formate, acetate, methanol, methanethiol) will be analyzed post-cruise.
- Aliquots of all samples will be secured for onshore analyses of major and trace inorganic compounds as well as Isotopic analyses of sulfide, sulfate, CH_4, CO_2, as well as Sr and B isotope ratio measurements

The ROV-based trace-metal clean fluid sampling system KIPS was used for precise *in situ*-sampling of hydrothermal vent fluids. In addition, two Ti-syringe samplers were used for to collect hot vent fluids. Plume and background seawater were sampled using the regular CTD-rosette water sampler of RV METEOR. Rocks and some of the biota samples were collected with the ROV's manipulator. Most of the biological samples were collected with scoop nets or a shovel with lid. The ROV carried three 5-L Niskin bottles, which were used to sample water in the buoyant plume and above patches of diffuse venting.

Samples for molecular ecology (fluids, sediments, chimney, plume) will be used to characterize the microbial communities and their function: In order to determine microbial diversity and abundance, samples will be investigated by light microscopy after cell staining using general DNA staining dyes (e.g. SybrGreenI) already onboard. Total cell counts will be determined, if indicated after detachment of cells from sediment or rock particles by ultra-sonication. Comparative 16S rRNA analysis, will be conducted in order to characterize the microbial diversity present within the individual samples and microbial diversity will be correlated to environmental parameters (ISMS data). The abundance of dominant or otherwise interesting, e.g. as yet undescribed, microbial taxa will be confirmed by FISH. The genetic potential of selected microbial communities will be assessed by metagenome analysis.

We systematically collected *Bathymodiolus* mussels, including hybrids from Broken Spur and will analyze the genetic connectivity to the parental *B. azoricus* and *B. puteoserpentis* populations and to other symbiont populations on the MAR. Mussel collections will be closely correlated with characterizations of the geochemical milieu in the different mussel beds, in particular by determination of dissolved gas concentrations (H_2, H_2S, CH_4, O_2, CO_2 etc.) using an *in situ* mass-spectrometer and by analysis of trace element and dissolved gas concentrations in diffuse mussel bed fluids collected with KIPS.
We will use a new genome sequence analysis protocol that will allow high-throughput individual sample processing with several hundreds of barcoded samples from diploid organisms (Therkildsen and Palumbi, 2017), Until recently, the high sequencing costs forced population genetic studies to concentrate on analyzing a few a priory selected genetic markers from a limited number of individuals, and this limited the analytical resolution. We will overcome these limitations now by using newly developed bioinformatics pipelines that allow for genome-wide SNP analyses based on low-coverage genome sequencing.

CTD work consisted of standard stations (verticals) at vent sites. Miniature Autonomous Plume Recorder (MAPR) recorded temperature, pressure, turbidity, and Eh while attached to the CTD cable. Samples for noble gas analysis (helium and neon isotopes) will be taken from vertical casts. Above most vent fields, MacLean in situ pumps were used to filter microorganisms out of large volumes of water 20-30 m above active vent fields. The pump was mounted immediately above the CTD.

Narrative

We left the harbor of Las Palmas de Gran Canaria in the morning hours of June 8th and steamed west for 150 hours to reach our first work area: Broken Spur. A CTD station was conducted at 29°44.8'N and 32°11.8'W in 4830 m water depth. Our arrival at Broken Spur in the venening hours of the 14th of June was followed a multibeam echosounder (MBES) survey. The first dive of the on the next day ROV had to be abandoned due to technical problems. A CTD cast was conducted to sample the hydrothermal plume over Broken Spur. This was followed by another MBES station. In the morning of June 16th, it was decided not to attempt another dive, because the bow thruster could not be used without risking overheating. The thruster was fixed during that same day, while we lowered the CTD another time to just above the Broken Spur vent field and used the in situ pumps to collect microorganisms from the water column for four hours. After another over-night MBES survey, we were able to conduct our first dive with the ROV to the seafloor at the Broken Spur vents in 3070 m water depth on June 17th. Sampling of the vent at Broken Spur was completed during two more successful dives on June 18th and 19th. In the course of three dives, we collected a range of collocated fluid, rock, and biota samples from the following vents: Saracen, Saracen's Head, Triple Chimney, The Spire, and Celebration. The nights were used to complete our MBES survey of previously unmapped areas in the vicinity of Broken Spur. A second station of CTD with in situ pump was also conducted with a six-hour long period of sample collection. We left Broken Spur in the evening of the 19th of June and headed northeast to the Rainbow area where we arrived at 10 a.m. on June 22nd after a 64-hour transit. The first ROV dive at Rainbow (013ROV) was used to deploy instrumentation (see chapter 5.5) at a site of diffuse venting in an area 2 km ESE of the main hydrothermal vent field. Diffuse fluids and mussels were collected in two areas of the pitted seafloor in 1950 m water depth. After the dive, a CTD single cast was carried out over the main hydrothermal vent field at Rainbow. The ROV could not dive on the 23rd due to necessary maintenance work and a longer MBES survey was conducted to map a suspected off-axis core complex southwest of Rainbow. A CTD deployment with the in situ pump over the high-temperature vent field at Rainbow took most of the night. Back operational, the ROV was used during four consecutive days to sample at the seafloor of the Rainbow massive; these dives were separated by MBES surveys to fill gaps in the maps from the off-axis areas around Rainbow. The ROV dive on the 24th was dedicated to more sampling of diffuse discharge at the Rainbow Pits. On the 25th, the dive target was a prominent feature in the southeastern corner of the area mapped by AUV during the AES cruise in 2022. In an area of otherwise smooth seafloor 4 km southeast of the Rainbow Pits site, the map shows a 500x300m terrain of irregular, >50-m high hills the nature of which we intended to explore. The observations made during the dive and rock samples recovered suggest that the hills represent sulfide mounds of an inactive hydrothermal vent site. The dives on the 26th and 27th of June allowed us to explore and sample high-temperature hydrothermal activity in the main Rainbow hydrothermal vent field at 36°13.8'N, 33°54.2'W in 2300 m water depth. High-temperature (370°C) fluids could be retrieved with the Ti-syringes and sites of diffuse venting were sampled in the typical collocated fashion for fluids, rocks, and biota (mainly *Bathymodiolus* mussels). Our journey to the northeastern sites started in the evening of the 27th. It was clear at that point in time that westward-drifting low-pressure system associated with strong winds would prevent us from diving with the ROV on the two following days. We consequently used the days of June 28 and 29 for survey work at the axial seamounts of Menez Gwen and at 38°20'N. This work started after a 15-hour transit to Menez Gwen and included a bathymetry/gas flare survey at the 38°20'N seamount. A short transit brought us back to the Menez Gwen seamount in the afternoon of the 20th of June, where a vertical CTD cast was conducted to sample the buoyant plume of the Menez Gwen vents. A gas flare survey was conducted at

Menez Gwen before Meteor was send back southwest in MBES survey mode to the Lucky Strike Seamount at 37°17'N. Our original plan was to have several dives at this relatively well investigated site. The highest priority site was Ewan, a diffuse vent field 2 km south of the main Lucky Strike vent field at the summit of this axial seamount, which had not been sampled before for fluids and mussels. We dove at Ewan on the 30th of June and completed our sampling of fluids, rocks, and biota there. The night hours we used to do CTD and in situ pumping work above the Ewan field. It was decided to move back to Menez Gwen (considered higher priority) after these two only stations in the Lucky Strike area. Our first dive at Menez Gwen (035ROV) on July 1st went to the main hydrothermal field there to recover collocated samples of fluids, rocks, and biota from 800 to 830 m water depth. The night program consisted of a CTD cast over the Bubbylon vent site, 4 km south of the Menez Gwen vents and an MBES survey. The next dive on the 2nd of July had the purpose of sampling the vents at the Bubbylon site in roughly 1000 m water depth. MBES survey work occupied the night program, before another dive at Menez Gwen vents was conducted the next day (042ROV).

Day				0	2	4	6	8	10	12	14	16	18	20	22
June	8	Thu	Start transit												
June	9	Fri	Transit												
June	10	Sat	Transit							Transit					
June	11	Sun	Transit												
June	12	Mon	Transit					001CTD							
June	13	Tue	Transit												
June	14	Wed	Transit												
June	15	Thu	1	002MBES				003ROV			004CTD				
June	16	Fr	2	005MBES				Wait	006CTD/ISP						
June	17	Sat	3	007MBES						008ROV					
June	18	Sun	4	009MBES						010ROV					
June	19	Mon	5	011CTD/ISP						012ROV					
June	20	Tue	6							Transit					
June	21	Wed	7												
June	22	Thu	8								013ROV			014CTD	
June	23	Fr	9	015MBES									016CTD/ISP		
June	24	Sat	10	017MBES						018ROV					
June	25	Sun	11	019MBES						020ROV					
June	26	Mon	12	021MBES						022ROV					
June	27	Tue	13	023MBES						024ROV				Transit	
June	28	Wed	14	Transit						*025MBES*				026MBES	
June	29	Thu	15	*027&028MBES*						Transit		029CTD		*030MBES*	
June	30	Fr	16	031MBES						032ROV				033CTD/ISP	
July	1	Sat	17			*034MBES*				035ROV				036CTD	
July	2	Sun	18	037MBES						038ROV				039MBES	
July	3	Mon	19	*040MBES*		041MBES				042ROV				043CTD/ISP	
July	4	Tue	20			044MBES		Wait	045MBES		046CTD				
July	5	Tue	Transit												
July	6	Fr	Transit							Transit					
July	7	Sat	Transit												
July	8	Sun	Transit												
July	9	Mon	Transit												
July	10	Tue	End transit												

Overview of M190 cruise activities

A CTD cast with the in situ pump took place in the night hours above the Bubbylon vent site. The nightly MBES surveys had indicated acoustic anomalies above the eastern shoulder of the central graben of the Menez Gwen seamount. The target of the final dive with the ROV was to examine the site where these anomalies seemed to originate from.

Strong surface currents on the 4th of July got in the way of launching the ROV successfully. A repeat MBES survey did not show the suspected gas flares where they were located before. A CTD station there did also not yield any evidence for hydrothermal venting. We left our work area at 5 p.m. on July 4 to begin a 5.5 day transit to Algeciras. With 12 ROV dives, 11 CTD casts, and 19 MBES surveys, the cruise was successful and got us the samples needed for our post-cruise studies within the framework of the Ocean Floor Excellence Cluster.

Acknowledgements

We thank Captain Rainer Korte and the entire crew for superb support of all science operations throughout the entire expedition. We thank the “Leitstelle” for varied advice and organizational support. Funding was provided by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany´s Excellence Strategy – EXC-2077 – 390741603.

List of participants

Name	Discipline	Institution
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Büttner, Hauke	ROV team	MARUM
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Summer, David	Geology	UTo
Wendt, Jenny	Geochemistry	MARUM
Wetzel, Silke	Symbiosis	MPIMM
Stelzner, Martin	Meteorology	DWD

Participating Institutions

MARUM	Center for Marine Environmental Research, University of Bremen, Germany
UHB	Geoscience Department, University of Bremen, Germany
CUB	Constructor University Bremen, Germany
MPIMM	Max Planck Institute for Marine Microbiology, Bremen, Germany
UAc	University Acores, Portugal
ULy	University of Lyon, France
UGö	University of Göttingen, Germany
Ums	University of Münster, Germany
UTo	University of Toronto, Canada
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe, Germany
DWD	Deutscher Wetterdienst, Geschäftsfeld Seeschifffahrt, Germany

Station list

Device Operation	Start	End	Latitude	Longitude	Device	Action
M190_0_Underway-1	6/10/23 02:18	7/8/23 10:18	29° 24,750' N	021° 44,441' W	ADCP	profile start
M190_0_Underway-1			36° 00,267' N	012° 59,609' W	ADCP	profile end
M190_0_Underway-2	6/10/23 02:38	7/8/23 10:18	29° 25,261' N	021° 48,261' W	TSG	profile start
M190_0_Underway-2			36° 00,268' N	012° 59,634' W	TSG	profile end
M190_1-1	6/12/23 08:53	6/12/23 10:59	29° 44,797' N	032° 11,794' W	CTD	in the water
M190_1-1			29° 44,796' N	032° 11,794' W	CTD	on deck
M190_0_Underway-3	6/12/23 19:39	7/8/23 10:18	29° 42,678' N	033° 50,756' W	EM122	profile start
M190_0_Underway-3			36° 00,269' N	012° 59,658' W	EM122	profile end
M190_2-1	6/14/23 17:08	6/15/23 07:20	29° 18,857' N	042° 31,298' W	EM122	profile start
M190_2-1			29° 10,071' N	043° 10,418' W	EM122	profile end
M190_3-1	6/15/23 08:45	6/15/23 09:33	29° 10,061' N	043° 10,517' W	ROV	in the water
M190_3-1			29° 10,181' N	043° 10,488' W	ROV	on deck
M190_3-2	6/15/23 12:50	6/15/23 14:41	29° 10,123' N	043° 10,449' W	ROV	in the water
M190_3-2			29° 10,180' N	043° 10,436' W	ROV	on deck
M190_4-1	6/15/23 15:22	6/15/23 22:57	29° 10,019' N	043° 10,452' W	CTD	in the water
M190_4-1			29° 10,058' N	043° 10,553' W	CTD	on deck
M190_5-1	6/16/23 00:24	6/16/23 07:05	29° 06,174' N	043° 25,105' W	EM122	profile start
M190_5-1			29° 09,830' N	043° 09,720' W	EM122	profile end
M190_7-1	6/16/23 18:18	6/17/23 07:06	29° 10,108' N	043° 10,477' W	EM122	profile start
M190_7-1			29° 09,969' N	043° 08,464' W	EM122	profile end
M190_8-1	6/17/23 08:25	6/17/23 20:47	29° 10,004' N	043° 10,367' W	ROV	in the water
M190_8-1			29° 10,070' N	043° 10,370' W	ROV	on deck
M190_9-1	6/17/23 21:12	6/18/23 07:08	29° 11,044' N	043° 10,413' W	EM122	profile start
M190_9-1			29° 09,412' N	043° 07,767' W	EM122	profile end
M190_10-1	6/18/23 08:30	6/18/23 20:06	29° 10,041' N	043° 10,414' W	ROV	in the water
M190_10-1			29° 10,122' N	043° 10,385' W	ROV	on deck
M190_11-1	6/18/23 22:23	6/19/23 07:46	29° 10,049' N	043° 10,458' W	CTD/ISP	in the water
M190_11-1			29° 10,038' N	043° 10,442' W	CTD/ISP	on deck
M190_12-1	6/19/23 08:34	6/19/23 18:56	29° 10,040' N	043° 10,445' W	ROV	in the water
M190_12-1			29° 10,125' N	043° 10,385' W	ROV	on deck
M190_13-1	6/22/23 11:11	6/22/23 18:51	36° 13,392' N	033° 53,114' W	ROV	in the water
M190_13-1			36° 13,465' N	033° 53,106' W	ROV	on deck
M190_14-1	6/22/23 19:30	6/22/23 23:26	36° 13,770' N	033° 54,193' W	CTD	in the water
M190_14-1			36° 13,761' N	033° 54,181' W	CTD	on deck
M190_15-1	6/23/23 05:01	6/23/23 16:24	35° 58,479' N	034° 50,901' W	EM122	profile start
M190_15-1			36° 12,157' N	033° 54,143' W	EM122	profile end
M190_16-1	6/23/23 17:14	6/23/23 23:46	36° 13,760' N	033° 54,189' W	CTD/ISP	in the water
M190_16-1			36° 13,748' N	033° 54,171' W	CTD/ISP	on deck
M190_17-1	6/24/23 01:10	6/24/23 07:27	36° 13,526' N	033° 40,283' W	EM122	profile start
M190_17-1			36° 11,320' N	033° 51,747' W	EM122	profile end
M190_18-1	6/24/23 08:26	6/24/23 19:54	36° 13,424' N	033° 53,103' W	ROV	in the water
M190_18-1			36° 13,499' N	033° 53,120' W	ROV	on deck
M190_19-1	6/24/23 20:36	6/25/23 07:29	36° 08,658' N	033° 53,914' W	EM122	profile start
M190_19-1			36° 11,583' N	033° 53,705' W	EM122	profile end

Device Operation	Start	End	Latitude	Longitude	Device	Action
M190_20-1	6/25/23 08:35	6/25/23 20:04	36° 12,126' N	033° 51,154' W	ROV	in the water
M190_20-1			36° 12,122' N	033° 51,223' W	ROV	on deck
M190_21-1	6/25/23 20:29	6/26/23 07:32	36° 10,874' N	033° 48,817' W	EM122	profile start
M190_21-1			36° 15,900' N	033° 56,334' W	EM122	profile end
M190_22-1	6/26/23 08:20	6/26/23 20:12	36° 13,778' N	033° 54,265' W	ROV	in the water
M190_22-1			36° 13,783' N	033° 54,117' W	ROV	on deck
M190_23-1	6/26/23 21:33	6/27/23 07:45	36° 12,968' N	033° 42,450' W	EM122	profile start
M190_23-1			36° 11,918' N	033° 53,190' W	EM122	profile end
M190_24-1	6/27/23 08:29	6/27/23 18:33	36° 13,767' N	033° 54,234' W	ROV	in the water
M190_24-1			36° 13,855' N	033° 54,101' W	ROV	on deck
M190_25-1	6/28/23 10:12	6/28/23 12:10	37° 47,914' N	031° 32,223' W	EM710	profile start
M190_25-1			37° 51,707' N	031° 30,836' W	EM710	profile end
M190_25-2	6/28/23 10:12	6/28/23 12:10	37° 47,912' N	031° 32,224' W	EM122	profile start
M190_25-2			37° 51,713' N	031° 30,834' W	EM122	profile end
M190_25-3	6/28/23 12:44	6/28/23 13:33	37° 51,103' N	031° 32,669' W	EM710	profile start
M190_25-3			37° 50,261' N	031° 29,689' W	EM710	profile end
M190_25-4	6/28/23 12:44	6/28/23 13:33	37° 51,097' N	031° 32,650' W	EM122	profile start
M190_25-4			37° 50,263' N	031° 29,698' W	EM122	profile end
M190_25-5	6/28/23 13:57	6/28/23 17:05	37° 50,966' N	031° 30,045' W	EM122	profile start
M190_25-5			37° 51,088' N	031° 29,919' W	EM122	profile end
M190_26-1	6/28/23 17:05	6/28/23 23:02	37° 51,086' N	031° 29,888' W	EM122	profile start
M190_26-1			38° 11,535' N	030° 54,490' W	EM122	profile end
M190_27-1	6/29/23 00:06	6/29/23 11:02	38° 16,690' N	030° 45,419' W	EM710	profile start
M190_27-1			38° 19,867' N	030° 35,675' W	EM710	profile end
M190_27-2	6/29/23 00:07	6/29/23 11:02	38° 16,743' N	030° 45,332' W	EM122	profile start
M190_27-2			38° 19,850' N	030° 35,633' W	EM122	profile end
M190_28-1	6/29/23 11:52	6/29/23 12:04	38° 17,556' N	030° 43,700' W	EM122	profile start
M190_28-1			38° 16,953' N	030° 43,292' W	EM122	profile end
M190_28-2	6/29/23 11:53	6/29/23 12:04	38° 17,496' N	030° 43,660' W	EM710	profile start
M190_28-2			38° 16,965' N	030° 43,303' W	EM710	profile end
M190_29-1	6/29/23 16:54	6/29/23 18:33	37° 50,703' N	031° 31,248' W	CTD	in the water
M190_29-1			37° 50,663' N	031° 31,152' W	CTD	on deck
M190_30-1	6/29/23 18:49	6/29/23 20:21	37° 50,371' N	031° 31,148' W	EM122	profile end
M190_30-1			37° 48,893' N	031° 31,455' W	EM122	profile end
M190_30-2	6/29/23 18:49	6/29/23 20:20	37° 50,360' N	031° 31,143' W	EM710	profile start
M190_30-2			37° 48,898' N	031° 31,448' W	EM710	profile end
M190_31-1	6/29/23 21:06	6/30/23 07:42	37° 45,668' N	031° 33,280' W	EM122	profile start
M190_31-1			37° 17,453' N	032° 15,518' W	EM122	profile end
M190_32-1	6/30/23 08:26	6/30/23 20:02	37° 16,623' N	032° 17,203' W	ROV	in the water
M190_32-1			37° 16,631' N	032° 17,129' W	ROV	on deck
M190_33-1	6/30/23 20:22	7/1/23 02:00	37° 16,643' N	032° 17,238' W	CTD	in the water
M190_33-1			37° 16,641' N	032° 17,269' W	CTD	on deck
M190_34-1	7/1/23 02:34	7/1/23 07:37	37° 16,409' N	032° 17,540' W	EM122	profile start
M190_34-1			37° 48,712' N	031° 32,634' W	EM122	profile end
M190_35-1	7/1/23 12:14	7/1/23 19:59	37° 50,654' N	031° 31,017' W	ROV	in the water
M190_35-1			37° 50,670' N	031° 31,051' W	ROV	on deck

Device Operation	Start	End	Latitude	Longitude	Device	Action
M190_36-1	7/1/23 20:38	7/1/23 23:38	37° 48,063' N	031° 32,236' W	CTD	in the water
M190_36-1			37° 48,082' N	031° 32,251' W	CTD	on deck
M190_37-1	7/2/23 00:16	7/2/23 07:50	37° 50,661' N	031° 31,056' W	EM122	profile start
M190_37-1			37° 48,036' N	031° 32,123' W	EM122	profile end
M190_38-1	7/2/23 08:20	7/2/23 16:58	37° 48,050' N	031° 32,169' W	ROV	in the water
M190_38-1			37° 48,040' N	031° 32,150' W	ROV	on deck
M190_39-1	7/2/23 17:13	7/2/23 22:27	37° 48,064' N	031° 31,031' W	EM122	profile start
M190_39-1			38° 16,498' N	030° 42,646' W	EM122	profile end
M190_40-1	7/2/23 22:28	7/3/23 02:49	38° 16,593' N	030° 42,773' W	EM122	profile start
M190_40-1			38° 16,491' N	030° 43,470' W	EM122	profile end
M190_41-1	7/3/23 02:53	7/3/23 07:46	38° 16,278' N	030° 43,665' W	EM122	profile start
M190_41-1			37° 51,546' N	031° 30,808' W	EM122	profile end
M190_42-1	7/3/23 08:17	7/3/23 19:46	37° 50,654' N	031° 31,085' W	ROV	in the water
M190_42-1			37° 50,576' N	031° 31,168' W	ROV	on deck
M190_43-1	7/3/23 20:32	7/4/23 01:44	37° 48,024' N	031° 32,259' W	CTD/ISP	in the water
M190_43-1			37° 48,064' N	031° 32,259' W	CTD/ISP	on deck
M190_44-1	7/4/23 02:07	7/4/23 06:39	37° 48,263' N	031° 31,662' W	EM122	profile start
M190_44-1			37° 48,738' N	031° 31,534' W	EM122	profile end
M190_45-1	7/4/23 09:43	7/4/23 13:08	37° 47,573' N	031° 30,267' W	EM122	profile start
M190_45-1			37° 49,001' N	031° 29,472' W	EM122	profile end
M190_46-1	7/4/23 13:32	7/4/23 17:03	37° 48,905' N	031° 30,891' W	CTD	in the water
M190_46-1			37° 48,951' N	031° 30,670' W	CTD	on deck
M190_47-1	7/4/23 14:07	7/4/23 14:12	37° 48,865' N	031° 30,850' W	GOFLO	in the water
M190_47-1			37° 48,844' N	031° 30,832' W	GOFLO	on deck
M190_47-2	7/4/23 14:45	7/4/23 15:20	37° 48,932' N	031° 30,887' W	GOFLO	in the water
M190_47-2			37° 48,819' N	031° 30,913' W	GOFLO	on deck
M190_47-3	7/4/23 15:22	7/4/23 15:51	37° 48,818' N	031° 30,914' W	GOFLO	in the water
M190_47-3			37° 48,930' N	031° 30,888' W	GOFLO	on deck
M190_47-4	7/4/23 15:52	7/4/23 16:06	37° 48,931' N	031° 30,902' W	GOFLO	in the water
M190_47-4			37° 48,920' N	031° 30,902' W	GOFLO	on deck
M190_47-5	7/4/23 16:07	7/4/23 16:15	37° 48,920' N	031° 30,892' W	GOFLO	in the water
M190_47-5			37° 48,907' N	031° 30,798' W	GOFLO	on deck