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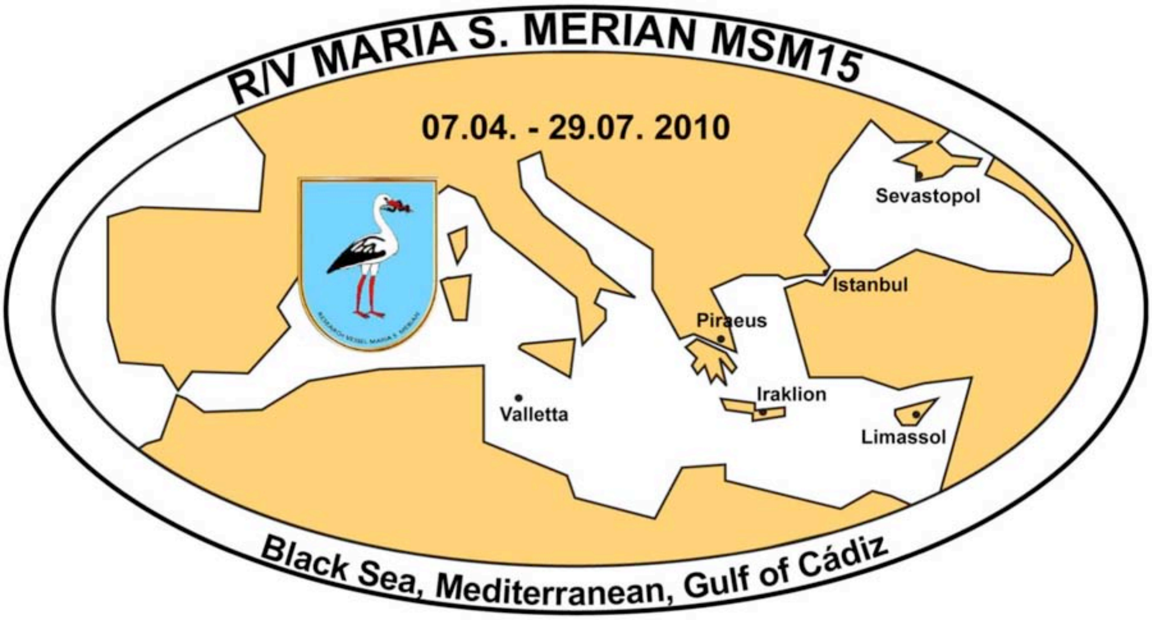
Short Cruise Report
MERIAN MSM15-1
"HYPOX"



Istanbul – Eregli – Sevastopol - Istanbul

12.04.2010 – 08.05.2010

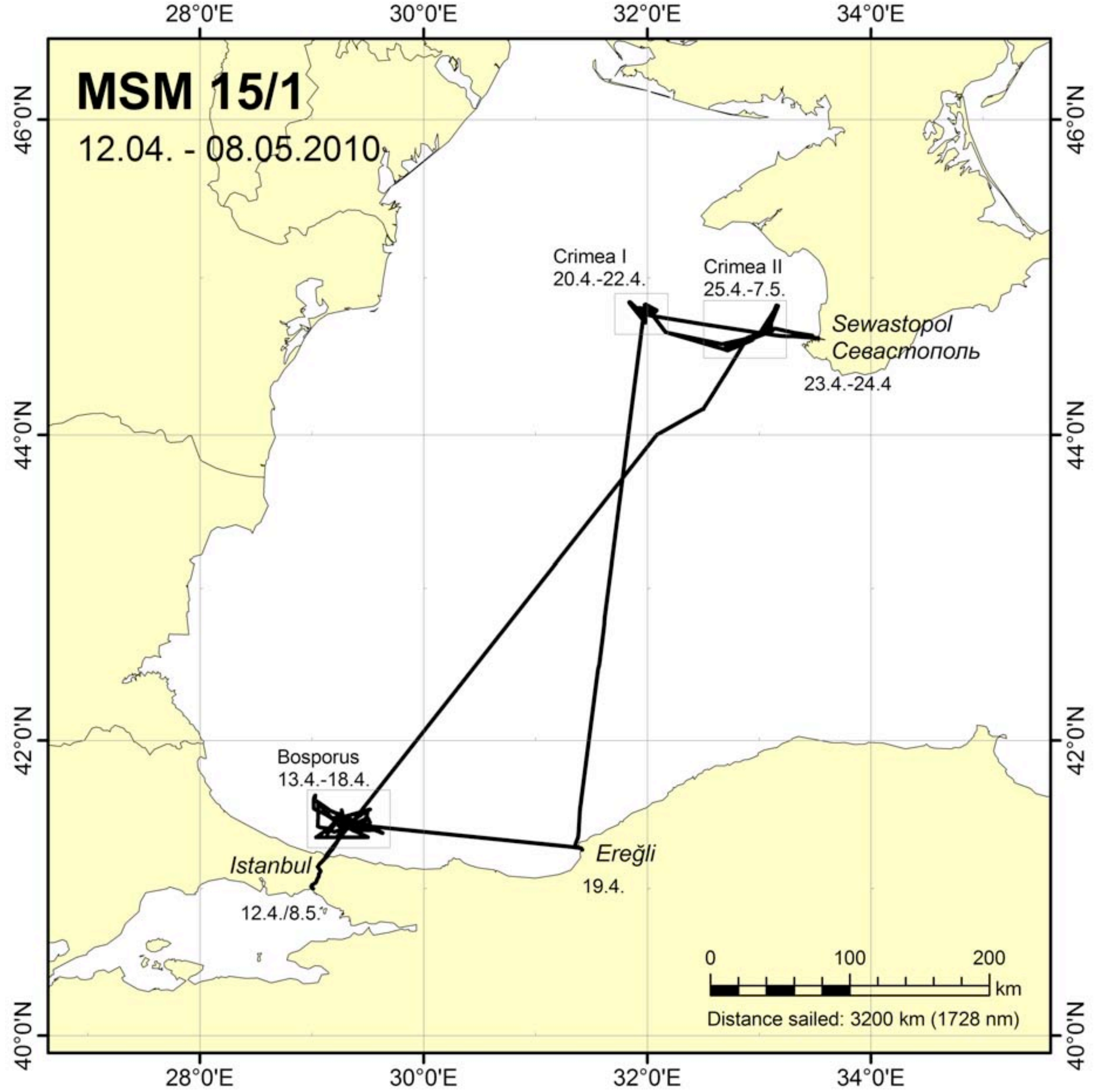
Chief Scientist: Antje Boetius

Captain: Karl Friedhelm von Staa

Objectives

Hypoxic conditions in aquatic ecosystems will increase in dimension and frequency as a consequence of global change. Ocean warming decreases oxygen concentrations, increases the stratification of water bodies and decreases the deep-water circulation. In combination with eutrophication, strong feed-back mechanisms are observed, leading to a further decrease in oxygen availability, to a decline of the water quality and the health of aquatic ecosystems, and to an increased production of greenhouse gases. The research cruise MSM 15/1 was a major activity of the Project HYPOX "In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies" of the EU 7th framework program "ENV.2008.4.1.2.1. Monitoring and observing oxygen depletion throughout the differ-ent Earth system components". HYPOX investigates the effect of oxygen depletion on biogeochemical processes in aquatic ecosystems. Hence, the research cruise HYPOX (MSM 15/1) aimed to quantify the concentration and uptake of oxygen at the anoxic boundaries in the water column and at the sediment water interface of the Black Sea, in parallel with the measurement of nitrogen, carbon, sulfur and iron fluxes. The Black Sea is an ideal study system for this purpose: The high productivity and export of organic matter has lead to the formation of the largest anoxic basin on earth. The limited exchange of water between the Black Sea and the Mediterranean through the Istanbul strait and the strong freshwater input by the rivers of the Black Sea catchment area cause a strong pycnocline and chemocline in 50-100 m water depth. Climate change in combination with increasing nutrient input causes strong regional effects. The warm, saline and oxygen rich Mediterranean water flows from Istanbul Strait below the less dense water masses in the Black Sea. Oxygen rich filaments reach beneath the pycnocline and strongly influence biogeochemistry. Climate change is expected to affect the transport of Mediterranean water into the Black Sea with important consequences for the ecosystems and their functioning. Off the Crimean peninsula, strong variations in oxygen and sulphide concen-trations were observed in 130-165 m depth, caused by regional circulation patterns. Internal waves cause the temporary aeration of anoxic areas of the shelf or transport poisonous sulfide into suboxic and hypoxic depths, thus affecting the benthic community. In addition to the aims of the HYPOX project, the expedition contributed to the Global Earth Observation System of Systems (GEOSS) and to the network programs ESONET and EMSO, by using newly developed underwater technology for long-term measurements of oxygen and other elements. During the research cruise MSM 15/1 we used new in situ observatories and new research methods to investigate the temporal and spatial dynamics of transport and turnover rates of oxygen and sulphide, and their effects on the biogeochemistry and the diversity of the pelagic and benthic communities.

Fig. 1 Trackplot of MSM15-1



Narrative

The scientific crew of expedition MSM15/1 embarked MERIAN in the port of “Haydarpasa” on 10 April, for unpacking 6 containers and setting up labs and instruments. The scientific team comprised 23 scientists, students, technicians, and engineers from seven institutions and 8 countries. We left the port of Haydarpasa on 12 April in the afternoon, as we had to wait for a convoy of ships moving north towards the Black Sea. The first measurements started on 12 April, 4 hours after leaving port. The main focus for the first week was to investigate the inflow of oxic water bodies from the Marmara Sea into the anoxic Black Sea at high resolution. Already the first CTD casts along the main canyon north east of the Bosporus inflow showed that Intrusions of warm and salty oxic waters were virtually absent. Consequently, we planned a Marmara plume search strategy in the canyons and on the shelf edge for the next days, with repeated CTD-Rosette casts at water depths from 60 to 1200 m on the continental margin. In the night of 13 April we started a coring transect from 300 m to 75 m water depth up the crest between the two main canyons. The canyons are characterized by thick layers of extremely fine, fluidic sediments, which were sampled with different gravity cores of Istanbul Technical University (ITU), the Swiss Federal Institute of Aquatic Science and Technology (EAWAG) and MARUM. The coring program continued throughout the nights of April 14-18, to investigate traces of hypoxia in the geological record, noble gases, isotope geochemistry and biomarkers. At the same sites, we collected samples for the analysis of macro-, meio- and microfauna, to identify benthic communities and key species specific for different concentrations of oxygen, using the TV guided multiple corer and the box corer. On 16 April we completed the survey for evidence of recent Maramara water inflow on the shelf and in the main canyons, finding only one site at 600 m water depth with a density profile indicative of a Mediterranean water mass. The fine scale distribution of water column chemical parameters was investigated here with a new “Pump CTD”. Close by, the “PROVOR“ float equipped with an autonomous CTD and an oxygen sensor was deployed for continuous profiling of the water column. On 17 April we carried out a long TV-guided MUC transect across the entire biogeochemical sampling area from 300 m water depth onto the shelf. At 300 m water depths we observed gas bubbling from the seafloor during sampling, in 220-200 m water depths we found large mats of sulfide oxidizing bacteria as a first sign of minimal supplies of oxygen and at 180 m we could see the first larger animals such as polychaete worms and starfish. After having finished our work in the Bosporus area, we returned to Port Eregli in the morning of 19 April, for an exchange of scientific crew. Unfortunately, due to the Europe-wide cancellation of flights due to volcanic ash clouds, only three of the eight new scientists arrived in time for our departure from Port Eregli in the afternoon of the 19 April.

Reaching the Crimean shelf in the morning of the 20 April, we started immediately with the first MEDUSA transect. This system monitors the seafloor with a video-camera towed by the ship. It carries several sensors to characterize the properties of the surrounding water, including oxygen, salinity, temperature, methane, and turbidity. The MPI team added another module with five different oxygen sensors. The seafloor between 100-140 m water depth showed a complex microstructure of ripples and cracks alternating with outcrops of carbonates. This indicates temporarily strong currents and could be related to the high density of canyons and channels visible in the bathymetry of the region. Below 200 m water depth in permanent anoxia, we found soft, muddy sediments covered by layers of sedimented fluff. On 21 April we continued with long MEDUSA transects at the depths of 160m, 140m and 120m, to monitor the spatial variability of oxygen. Close by, at about 240 m water depth are two large fields of gas seeps, which we also explored with MEDUSA, to test the hypothesis that the gas ebullition influences the position of the chemocline. A first analysis of the data from all sensors indicated that the boundary between hypoxia and anoxia is found at 175 m. Alternating with MEDUSA we carried out box core sampling for the Ukranian Institute of Biology of the Southern Seas (IBSS) and seafloor mapping with the high-resolution multibeam sonar EM1002 of MERIAN, to fill gaps in our bathymetry map. Just before finishing the monitoring work on 22 April, we deployed three moorings with hydrographical and oxygen sensors, to record temporal variation in the hypoxic region of the shelf edge between 160 and 120 m water depth. When we were just about done with the last MEDUSA transect, the captain informed us of a navy exercise covering our entire working area for an unknown period of time. However, for another exchange of crew, we had to enter the port of Sevastopol anyway on the 23 April. After some consideration with different authorities, we steamed to a new site west off Sevastopol in the evening of 24 April, as the military exercises were announced to continue til 29 April.

We started with the first JAGO dive already in the morning of 25 April, after a night of CTD sampling and bathymetric mapping of the new working area off Crimea. The first dive was dedicated to exploring the 10-25 µM oxygen zone at 160-150 m water depth. This was followed by some sensor calibrations and another JAGO dive to the <10 µM oxygen zone. In the evening of 25 April, MOVE was deployed with many different payloads, including a benthic chamber, a seafloor scanner, oxygen optodes and sediment profilers as well as a high resolution camera (“Megacam”).

The third week of the cruise MSM15/1 started with rough seas, prohibiting the planned JAGO and MOVE dives. As an alternative program, we deployed four autonomous in situ instruments, which measure oxygen concentrations and consumption together with a variety of environmental parameters. In addition to the Multifiber Optode (MUFO) and the Benthic Boundary Layer (BBL) profiler mentioned earlier, we use the eddy correlation system “EDDY” for integrated measurements of oxygen consumption at scales of 10-100 square meters of seafloor, and a “Lander” system. The Lander system combines a benthic chamber with a microprofiler for high-resolution measurements of benthic processes. The weather improved already in the afternoon of the 27 April, and we were able to dive with JAGO to the anoxic zone of the Crimean Shelf, followed by a MOVE deployment. We have to look hard to find some life: our first analyses show that benthic biomass and activity is extremely low in the hypoxic zone of the Crimean shelf. This is probably due to the high fluctuation in oxygen availability across the 25 miles long transect from 200-100 m water depth. The strong temporal variation between 0-150 µM may inhibit the development of benthic communities despite the high food supply, because only very few organisms can handle daily fluctuations within this range. Accordingly, the next MOVE and JAGO dives showed that oxygen conditions changed strongly during a phase of stronger currents probably associated with the wind force. The zone between 160-140 m turned from a hypoxic area (5-25 µM oxygen) to an anoxic zone. At the same time, we recorded a few µM of oxygen at the deep, usually anoxic site. This high temporal variability in oxygen supply was also confirmed by the four autonomous instruments, which we deployed a few times in the area. On 29 April we continue the exploration work with JAGO with dives to the 125 and 150 m zone. Oxygen is still low at 125 m, and very little benthic life can be observed, but at least a few fish swim by. The 150 m dive investigated the patchy bacterial mats of the hypoxic zone, which were associated with thick accumulations of sedimented organic matter of 4-6 cm in diameter.

On 29 April we could steam to the first working area, to recover our moorings after the ending of the military exercise in the morning of the 30 April. We finished sampling of this area with a day of TV-guided multiple coring. The former working area on the steeper slope of the Ukrainian shelf was much more difficult to sample as our new site on the Crimean shelf, due to the dense littering with bivalve shell debris. Hence, in the night of the 30 April we returned to this area to deploy two of the three long term moorings at depths of 150 and 135m, together with the four in situ tools. On May 1 and 2 we place our third mooring and carry out several dives to retrieve samples, and to compare the rates of biogeochemical processes with or without benthic fauna at our reference site at 100m closer to the Crimean coast. Unfortunately, more military exercises are announced in the southwestern deeper section of our sampling area, hence we finalized sampling of the 200m zone with the TV MUC and the EAWAG gravity core. Till the 5 May we had to stay in the shallower section and repeated some previous measurements, to get a better record of the temporal variations of oxygen.

The fourth and last week of the expedition HYPOX was dedicated to closing the gaps in the sampling scheme of our two working areas on the Ukrainian shelf before returning to Istanbul. On Monday May 3rd we dedicated the first dive to a rendezvous of the two mobile underwater instruments MOVE (the benthic crawler) and the manned submersible JAGO. During 4 and 5 May we deployed moorings, MOVE and JAGO at the intermediate depth zones. On May 6th we carried out two last short dives of JAGO in the morning, to sample a permanently anoxic zone at 400m depth as another reference site, and to record the vertical distribution of mega- and macroplankton associated with the chemocline. In the evening of the 6th MAy, the last MOVE deployment is scheduled as a revisit of the 100m station with the main mission of taking photographs of active benthic fauna at the permanently oxic reference site. The very last task of this mission is the retrieval of the three oceanographic moorings, starting at the break of the new day May 7th. The very last station of the mission MSM15/1 is the deployment of “NEMO” floats to monitor temperature, salinity and oxygen for a period of 2-3 years.

We arrive early in the morning of the 8th May in Istanbul and were able to finish the container packing and the cleaning of the ship within a few hours, as the next science crew was waiting to board the MERIAN. All scientists of MSM15/1 embarked the same day and returned to their home institutions after a highly successful expedition.

Acknowledgements

We thank Captain and crew of the MERIAN expedition MSM15/1 for their excellent support of our work at sea. Also, we thank the JAGO, MOVE and MEDUSA teams for the excellent dives essential for fulfilling the goals of the cruise. The MERIAN ship time was provided by the Deutsche Forschungsgemeinschaft. Financial support for the HYPOX project was provided though the EU 7th FP.

List of participants

	Name	Function	Institute
1.	Antje Boetius	Chief scientist	AWI
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3.	Anna Lichtschlag	in situ biogeochemistry	MPI
4.	Axel Nordhausen	Coring and instruments	MPI
5.	Jan Fischer	O2 sensors	MPI
6.	Rafael Stiens	Coring and instruments	MPI
7.	Gerdhard Jessen	Microbiology	MPI
8.	Erika Weiz	Microbiology	MPI
9.	Moritz Holtappels	Nutrients	MPI
10.	Ryan North	Noble gasses	EAWAG
11.	Sebastian Albrecht	CTD, Parasound	FIELAX
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14.	Maksim Gulin	Biology	IBSS
15.	Sofia Mazlumyan	Biology	IBSS
16.	Gabi Klockether	Nutrients	MPI
17.	Yudi Nurul Ishan	Nutrients	MPI
18.	Gaute Lavik	Nutrients	MPI
19.	Umut Ulgen	Palaeoproxies	ITU
20.	Dursun Acar	Palaeoproxies	ITU
21.	Zeynep Erdem	Palaeoproxies	ITU
22.	Jean Francois Rolin	Profiler	IFREMER
23.	Serge Le Reste	Profiler	IFREMER

Austausch wiss./tech. Crew Port Eregli, 19.04.

16.	Giuditta Marinaro	MEDUSA	INGV
17.	Nadia Lo Bue	MEDUSA	INGV
18.	Flavio Furlan	MEDUSA	TECNOMARE

Austausch wiss./tech. Crew Sevastopol, 23.04.

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17.	Jörn Patrick Meyer	in situ biogeochemistry	MPI
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20.	Jürgen Schauer	JAGO	IFM GEOMAR
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22.	Christoph Waldmann	MOVE	MARUM
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Station list MSM15-1 (as deposited in PANGAEA)

Station Name	Date	Time	Latitude (N)	Longitude (E)	Depth (m)	Sampling Gear
MSM15/178-2	12.4.10	17:00	41° 20.97'	29° 13.50'	82	CTD/rosette
MSM15/179-1	12.4.10	18:04	41° 22.78'	29° 15.18'	93	CTD/rosette
MSM15/180-1	12.4.10	19:18	41° 24.38'	29° 16.67'	265	CTD/rosette
MSM15/181-1	12.4.10	21:03	41° 25.48'	29° 17.79'	542	CTD/rosette
MSM15/182-1	12.4.10	22:20	41° 25.48'	29° 17.79'	540	Freifall Pump CTD
MSM15/183-1	13.4.10	1:35	41° 27.30'	29° 21.29'	992	CTD/rosette
MSM15/184-1	13.4.10	3:15	41° 29.80'	29° 25.89'	1258	CTD/rosette
MSM15/185-1	13.4.10	4:46	41° 31.99'	29° 30.00'	1092	CTD/rosette
MSM15/186-1	13.4.10	6:27	41° 27.99'	29° 29.02'	585	CTD/rosette
MSM15/187-1	13.4.10	8:15	41° 24.49'	29° 23.48'	646	CTD/rosette
MSM15/188-1	13.4.10	10:25	41° 28.49'	29° 17.02'	529	CTD/rosette
MSM15/189-1	13.4.10	11:55	41° 31.99'	29° 16.00'	748	CTD/rosette
MSM15/190-1	13.4.10	13:06	41° 30.13'	29° 16.32'	301	CTD/rosette
MSM15/191-1	13.4.10	13:46	41° 30.15'	29° 16.34'	307	Television multicorer
MSM15/192-1	13.4.10	14:26	41° 30.14'	29° 16.34'	306	ITU Corer
MSM15/193-1	13.4.10	14:48	41° 30.14'	29° 16.34'	310	ITU Corer
MSM15/194-1	13.4.10	15:05	41° 30.14'	29° 16.34'	309	EAWAG Corer
MSM15/195-1	13.4.10	15:31	41° 30.14'	29° 16.34'	306	EAWAG Corer
MSM15/196-1	13.4.10	16:17	41° 30.16'	29° 16.37'	311	Television multicorer
MSM15/197-1	13.4.10	17:21	41° 29.97'	29° 16.16'	260	CTD/rosette
MSM15/198-1	13.4.10	17:58	41° 29.98'	29° 16.17'	262	Television multicorer
MSM15/199-1	13.4.10	18:22	41° 29.98'	29° 16.17'	264	ITU Corer
MSM15/200-1	13.4.10	18:38	41° 29.98'	29° 16.17'	262	ITU Corer
MSM15/201-1	13.4.10	18:51	41° 29.98'	29° 16.17'	263	ITU Corer
MSM15/202-1	13.4.10	19:48	41° 29.94'	29° 16.13'	253	Television multicorer
MSM15/203-1	13.4.10	20:10	41° 29.94'	29° 16.13'	252	ITU Corer
MSM15/204-1	13.4.10	20:24	41° 29.94'	29° 16.13'	252	ITU Corer
MSM15/205-1	13.4.10	21:26	41° 29.81'	29° 15.99'	221	CTD/rosette
MSM15/206-1	13.4.10	21:49	41° 29.81'	29° 15.99'	223	ITU Corer
MSM15/207-1	13.4.10	22:10	41° 29.81'	29° 15.99'	221	ITU Corer
MSM15/208-1	13.4.10	22:28	41° 29.81'	29° 15.99'	221	ITU Corer
MSM15/209-1	13.4.10	22:46	41° 29.82'	29° 15.99'	223	ITU Corer
MSM15/210-1	14.4.10	1:40	41° 22.74'	29° 37.97'	551	CTD/rosette
MSM15/211-1	14.4.10	2:54	41° 24.00'	29° 34.49'	483	CTD/rosette
MSM15/212-1	14.4.10	4:14	41° 23.82'	29° 30.00'	476	CTD/rosette
MSM15/213-1	14.4.10	5:52	41° 23.58'	29° 22.83'	510	CTD/rosette
MSM15/214-1	14.4.10	7:24	41° 25.46'	29° 17.91'	523	CTD/rosette
MSM15/215-1	14.4.10	8:39	41° 30.14'	29° 16.33'	297	Television multicorer
MSM15/216-1	14.4.10	9:16	41° 30.14'	29° 16.33'	300	Television multicorer
MSM15/217-1	14.4.10	10:49	41° 31.73'	29° 9.99'	479	CTD/rosette
MSM15/218-1	14.4.10	12:20	41° 35.99'	29° 1.77'	373	CTD/rosette
MSM15/219-1	14.4.10	13:37	41° 37.84'	29° 1.90'	645	CTD/rosette
MSM15/220-1	14.4.10	16:28	41° 37.84'	29° 1.90'	649	Freifall Pump CTD
MSM15/221-1	14.4.10	17:52	41° 37.85'	29° 1.90'	647	CTD/rosette

MSM15/223-1	14.4.10	21:37	41° 29.59'	29° 15.74'	197	CTD/rosette
MSM15/224-1	14.4.10	22:10	41° 29.59'	29° 15.74'	200	Television multicorer
MSM15/225-1	14.4.10	22:37	41° 29.59'	29° 15.74'	200	ITU Corer
MSM15/226-1	14.4.10	22:53	41° 29.59'	29° 15.74'	198	ITU Corer
MSM15/227-1	14.4.10	23:42	41° 29.08'	29° 15.23'	172	CTD/rosette
MSM15/228-1	15.4.10	0:04	41° 29.08'	29° 15.23'	174	Television multicorer
MSM15/229-1	15.4.10	0:54	41° 29.08'	29° 15.24'	173	ITU Corer
MSM15/230-1	15.4.10	1:07	41° 29.08'	29° 15.24'	172	ITU Corer
MSM15/231-1	15.4.10	1:27	41° 29.08'	29° 15.24'	172	Box corer
MSM15/232-1	15.4.10	2:02	41° 28.97'	29° 15.12'	159	CTD/rosette
MSM15/233-1	15.4.10	2:17	41° 28.97'	29° 15.12'	160	Box corer
MSM15/234-1	15.4.10	2:39	41° 28.97'	29° 15.12'	159	Gravity corer
MSM15/235-1	15.4.10	3:40	41° 28.97'	29° 15.12'	159	Television multicorer
MSM15/236-1	15.4.10	3:59	41° 28.97'	29° 15.13'	160	ITU Corer
MSM15/237-1	15.4.10	4:12	41° 28.97'	29° 15.13'	159	EAWAG Corer
MSM15/238-1	15.4.10	4:24	41° 28.97'	29° 15.13'	160	EAWAG Corer
MSM15/239-1	15.4.10	4:36	41° 28.97'	29° 15.13'	160	EAWAG Corer
MSM15/240-1	15.4.10	4:54	41° 28.97'	29° 15.13'	160	ITU Corer
MSM15/241-1	15.4.10	5:20	41° 28.97'	29° 15.13'	159	EAWAG Corer
MSM15/242-1	15.4.10	6:37	41° 28.92'	29° 15.06'	152	CTD/rosette
MSM15/243-1	15.4.10	6:54	41° 28.92'	29° 15.06'	152	Television multicorer
MSM15/244-1	15.4.10	7:12	41° 28.92'	29° 15.06'	152	ITU Corer
MSM15/245-1	15.4.10	7:20	41° 28.92'	29° 15.06'	153	ITU Corer
MSM15/246-1	15.4.10	7:48	41° 28.92'	29° 15.06'	152	Box corer
MSM15/247-1	15.4.10	8:19	41° 28.92'	29° 15.06'	153	Box corer
MSM15/248-1	15.4.10	11:15	41° 20.99'	29° 2.37'	81	CTD/rosette
MSM15/249-1	15.4.10	12:34	41° 21.00'	29° 5.53'	82	CTD/rosette
MSM15/250-1	15.4.10	13:07	41° 21.01'	29° 6.23'	82	CTD/rosette
MSM15/251-1	15.4.10	13:54	41° 21.01'	29° 9.71'	76	CTD/rosette
MSM15/252-1	15.4.10	15:37	41° 21.00'	29° 20.93'	90	CTD/rosette
MSM15/253-1	15.4.10	17:06	41° 21.01'	29° 30.11'	94	CTD/rosette
MSM15/255-1	15.4.10	19:40	41° 27.31'	29° 21.30'	977	CTD/rosette
MSM15/256-1	15.4.10	21:18	41° 25.50'	29° 17.78'	549	CTD/rosette
MSM15/257-1	15.4.10	22:44	41° 23.58'	29° 22.85'	488	CTD/rosette
MSM15/259-1	16.4.10	0:26	41° 29.08'	29° 15.24'	172	Box corer
MSM15/260-1	16.4.10	0:53	41° 28.96'	29° 15.13'	159	Box corer
MSM15/261-1	16.4.10	1:50	41° 30.12'	29° 16.33'	294	Television multicorer
MSM15/262-1	16.4.10	2:29	41° 30.13'	29° 16.34'	296	Television multicorer
MSM15/263-1	16.4.10	3:09	41° 29.92'	29° 16.12'	248	Television multicorer
MSM15/264-1	16.4.10	4:22	41° 28.91'	29° 15.07'	150	Television multicorer
MSM15/265-1	16.4.10	5:58	41° 25.89'	29° 18.60'	661	CTD/rosette
MSM15/266-1	16.4.10	6:31	41° 25.88'	29° 18.63'	641	Provor Float
MSM15/268-1	16.4.10	9:07	41° 25.45'	29° 28.17'	243	CTD/rosette
MSM15/270-1	16.4.10	11:30	41° 31.97'	29° 30.07'	1063	CTD/rosette
MSM15/271-1	16.4.10	12:28	41° 31.98'	29° 30.01'	1068	Freifall Pump CTD
MSM15/272-1	16.4.10	15:19	41° 31.99'	29° 30.01'	1067	CTD/rosette
MSM15/274-1	16.4.10	18:23	41° 28.79'	29° 14.89'	136	CTD/rosette
MSM15/275-1	16.4.10	18:53	41° 28.78'	29° 14.91'	134	Television multicorer
MSM15/276-1	16.4.10	19:08	41° 28.77'	29° 14.90'	136	ITU Corer
MSM15/277-1	16.4.10	19:16	41° 28.77'	29° 14.90'	135	ITU Corer

MSM15/278-1	16.4.10	19:50	41° 28.77'	29° 14.90'	132	Box corer
MSM15/279-1	16.4.10	20:11	41° 28.77'	29° 14.90'	131	Box corer
MSM15/280-1	16.4.10	20:55	41° 28.53'	29° 14.62'	116	CTD/rosette
MSM15/281-1	16.4.10	21:13	41° 28.53'	29° 14.62'	116	Box corer
MSM15/282-1	16.4.10	21:35	41° 28.54'	29° 14.62'	117	Box corer
MSM15/283-1	16.4.10	22:29	41° 28.54'	29° 14.63'	117	Television multicorer
MSM15/284-1	16.4.10	23:49	41° 25.22'	29° 11.28'	97	CTD/rosette
MSM15/285-1	17.4.10	0:05	41° 25.21'	29° 11.29'	97	Television multicorer
MSM15/286-1	17.4.10	0:47	41° 25.22'	29° 11.29'	96	Television multicorer
MSM15/287-1	17.4.10	1:02	41° 25.23'	29° 11.30'	96	ITU Corer
MSM15/288-1	17.4.10	1:13	41° 25.23'	29° 11.30'	96	EAWAG Corer
MSM15/289-1	17.4.10	1:23	41° 25.22'	29° 11.29'	97	EAWAG Corer
MSM15/290-1	17.4.10	1:34	41° 25.22'	29° 11.29'	97	EAWAG Corer
MSM15/291-1	17.4.10	2:06	41° 25.22'	29° 11.29'	97	Gravity corer
MSM15/292-1	17.4.10	2:32	41° 25.22'	29° 11.29'	96	EAWAG Corer
MSM15/293-1	17.4.10	2:48	41° 25.22'	29° 11.29'	97	Box corer
MSM15/294-1	17.4.10	3:11	41° 25.22'	29° 11.29'	96	Box corer
MSM15/295-1	17.4.10	4:12	41° 22.31'	29° 8.33'	82	CTD/rosette
MSM15/296-1	17.4.10	4:21	41° 22.31'	29° 8.32'	83	Box corer
MSM15/297-1	17.4.10	4:40	41° 22.31'	29° 8.32'	82	Box corer
MSM15/298-1	17.4.10	5:23	41° 22.31'	29° 8.32'	82	Television multicorer
MSM15/299-1	17.4.10	5:36	41° 22.31'	29° 8.32'	82	ITU Corer
MSM15/300-1	17.4.10	5:42	41° 22.31'	29° 8.32'	82	ITU Corer
MSM15/301-1	17.4.10	6:36	41° 24.53'	29° 10.56'	93	CTD/rosette
MSM15/302-1	17.4.10	6:49	41° 24.53'	29° 10.56'	93	Television multicorer
MSM15/303-1	17.4.10	7:02	41° 24.53'	29° 10.56'	91	ITU Corer
MSM15/304-1	17.4.10	7:09	41° 24.53'	29° 10.56'	92	ITU Corer
MSM15/305-1	17.4.10	9:31	41° 30.25'	29° 16.44'	334	Television multicorer
MSM15/307-1	17.4.10	17:42	41° 28.91'	29° 15.06'	153	CTD/rosette
MSM15/308-1	17.4.10	18:22	41° 28.91'	29° 15.06'	151	Benthic Boundary Layer Profiler
MSM15/309-1	17.4.10	21:20	41° 24.11'	29° 16.43'	146	CTD/rosette
MSM15/310-1	17.4.10	21:52	41° 24.11'	29° 16.43'	147	Benthic Boundary Layer Profiler
MSM15/311-1	18.4.10	1:54	41° 34.78'	29° 3.45'	307	ITU Corer
MSM15/312-1	18.4.10	2:07	41° 34.78'	29° 3.45'	307	ITU Corer
MSM15/313-1	18.4.10	2:43	41° 32.97'	29° 3.41'	117	ITU Corer
MSM15/314-1	18.4.10	2:53	41° 32.97'	29° 3.41'	117	ITU Corer
MSM15/315-1	18.4.10	3:37	41° 34.40'	29° 3.46'	188	CTD/rosette
MSM15/316-1	18.4.10	3:51	41° 34.40'	29° 3.46'	188	ITU Corer
MSM15/317-1	18.4.10	4:13	41° 34.40'	29° 3.46'	188	ITU Corer
MSM15/318-1	18.4.10	5:13	41° 31.19'	29° 3.42'	97	CTD/rosette
MSM15/319-1	18.4.10	5:26	41° 31.20'	29° 3.42'	102	ITU Corer
MSM15/320-1	18.4.10	5:42	41° 31.20'	29° 3.42'	99	Gravity corer
MSM15/321-1	18.4.10	6:47	41° 25.36'	29° 3.27'	83	ITU Corer
MSM15/322-1	18.4.10	6:53	41° 25.36'	29° 3.27'	82	ITU Corer
MSM15/323-1	18.4.10	7:59	41° 23.28'	29° 12.26'	88	ITU Corer
MSM15/324-1	18.4.10	8:10	41° 23.28'	29° 12.26'	88	Gravity corer
MSM15/325-1	18.4.10	8:31	41° 23.28'	29° 12.26'	87	Gravity corer
MSM15/328-1	18.4.10	10:17	41° 24.40'	29° 16.69'	258	CTD/rosette
MSM15/329-1	18.4.10	11:42	41° 24.40'	29° 16.69'	263	Freifall Pump CTD
MSM15/330-1	18.4.10	12:48	41° 24.40'	29° 16.69'	234	CTD/rosette
MSM15/331-2	18.4.10	16:05	41° 25.59'	29° 28.77'	443	CTD/rosette

MSM15/332-1	18.4.10	17:47	41° 29.94'	29° 16.11'	253	Television multicorer
MSM15/333-1	18.4.10	18:51	41° 29.63'	29° 15.80'	200	Television multicorer
MSM15/335-1	18.4.10	19:56	41° 25.49'	29° 17.79'	603	CTD/rosette
MSM15/336-1	18.4.10	21:36	41° 25.29'	29° 32.63'	624	CTD/rosette
MSM15/337-1	20.4.10	7:39	44° 46.21'	31° 58.02'	364	CTD/rosette
MSM15/339-1	20.4.10	9:50	44° 46.61'	31° 58.43'	207	Medusa
MSM15/340-1	20.4.10	14:07	44° 47.55'	31° 56.90'	112	CTD/rosette
MSM15/341-1	20.4.10	15:04	44° 46.60'	31° 58.43'	208	CTD/rosette
MSM15/342-1	20.4.10	15:59	44° 46.42'	31° 59.79'	256	CTD/rosette
MSM15/343-1	20.4.10	16:48	44° 46.42'	31° 59.79'	257	Medusa
MSM15/344-1	20.4.10	20:40	44° 47.57'	31° 57.31'	117	CTD/rosette
MSM15/346-1	21.4.10	5:15	44° 47.44'	31° 57.40'	124	Box corer
MSM15/347-1	21.4.10	5:37	44° 47.44'	31° 57.40'	124	Box corer
MSM15/348-1	21.4.10	6:02	44° 47.29'	31° 57.69'	146	Box corer
MSM15/349-1	21.4.10	6:21	44° 47.29'	31° 57.69'	145	Box corer
MSM15/350-1	21.4.10	6:54	44° 47.09'	31° 58.04'	161	Box corer
MSM15/351-1	21.4.10	7:13	44° 47.09'	31° 58.04'	161	Box corer
MSM15/352-1	21.4.10	8:09	44° 46.99'	31° 58.60'	182	CTD/rosette
MSM15/353-1	21.4.10	8:52	44° 46.99'	31° 58.60'	181	Medusa
MSM15/354-1	21.4.10	15:19	44° 49.12'	32° 1.23'	169	CTD/rosette
MSM15/355-1	21.4.10	15:59	44° 49.46'	32° 0.53'	120	CTD/rosette
MSM15/356-1	21.4.10	16:28	44° 49.47'	32° 0.53'	121	Medusa
MSM15/358-1	22.4.10	6:26	44° 49.31'	32° 0.88'	138	CTD/rosette
MSM15/359-1	22.4.10	7:02	44° 49.31'	32° 0.88'	138	Medusa
MSM15/360-1	22.4.10	11:45	44° 47.22'	31° 57.58'	142	CTD/rosette
MSM15/361-1	22.4.10	12:28	44° 48.74'	31° 55.32'	83	Box corer
MSM15/362-1	22.4.10	12:44	44° 48.74'	31° 55.32'	83	Box corer
MSM15/363-1	22.4.10	14:04	44° 48.60'	32° 0.10'	150	Mooring (short time deployment)
MSM15/364-1	22.4.10	15:02	44° 48.70'	31° 59.97'	142	Mooring (short time deployment)
MSM15/365-1	22.4.10	15:44	44° 48.88'	31° 59.80'	134	Mooring (short time deployment)
MSM15/366-1	22.4.10	17:02	44° 46.51'	31° 59.58'	225	CTD/rosette
MSM15/367-2	22.4.10	20:01	44° 46.51'	31° 59.36'	214	Medusa
MSM15/368-1	24.4.10	20:35	44° 34.01'	32° 42.40'	396	CTD/rosette
MSM15/370-1	24.4.10	23:06	44° 37.12'	32° 53.68'	162	CTD/rosette
MSM15/372-1	25.4.10	8:53	44° 37.14'	32° 53.49'		JAGO Underwater Craft
MSM15/373-1	25.4.10	15:19	44° 33.99'	32° 42.39'	398	MUFO
MSM15/374-1	25.4.10	17:42	44° 37.27'	32° 54.31'		JAGO Underwater Craft
MSM15/375-1	25.4.10	21:30	44° 37.46'	32° 54.90'	156	MOVE
MSM15/377-1	26.4.10	10:34	44° 37.55'	32° 54.98'	156	Television multicorer
MSM15/378-1	26.4.10	11:28	44° 37.53'	32° 54.98'	155	Television multicorer
MSM15/379-1	26.4.10	12:33	44° 37.55'	32° 54.97'	155	Television multicorer
MSM15/380-1	26.4.10	14:00	44° 37.65'	32° 54.51'	156	Benthic Boundary Layer Profiler
MSM15/381-1	26.4.10	14:49	44° 37.62'	32° 54.72'	156	Multi Fibre Optics Sensor
MSM15/382-1	26.4.10	15:58	44° 37.73'	32° 54.91'	157	CTD/rosette
MSM15/384-1	26.4.10	17:37	44° 37.77'	32° 55.19'	153	Eddy
MSM15/385-1	26.4.10	18:52	44° 37.65'	32° 55.08'	154	bottom water sampler
MSM15/386-1	26.4.10	20:22	44° 37.58'	32° 54.97'	156	MOVE
MSM15/392-1	27.4.10	11:03	44° 37.12'	32° 53.40'	166	CTD/rosette

MSM15/393-1	27.4.10	12:01	44° 37.08'	32° 53.48'	164	Television multicorer
MSM15/394-1	27.4.10	13:37	44° 36.00'	32° 50.19'	194	JAGO Underwater Craft
MSM15/395-1	27.4.10	17:49	44° 35.82'	32° 49.15'	206	CTD/rosette
MSM15/396-1	27.4.10	18:35	44° 36.09'	32° 50.19'	194	CTD/rosette
MSM15/397-1	27.4.10	19:55	44° 37.55'	32° 55.11'	155	MOVE
MSM15/399-1	28.4.10	9:55	44° 37.34'	32° 54.72'	156	chamber lander
MSM15/400-1	28.4.10	10:34	44° 37.31'	32° 55.07'	156	Multi Fibre Optics Sensor
MSM15/401-1	28.4.10	11:24	44° 37.45'	32° 55.29'	155	Benthic Boundary Layer Profiler Mooring
MSM15/402-1	28.4.10	11:59	44° 37.46'	32° 55.05'	155	Eddy Mooring
MSM15/403-1	28.4.10	12:47	44° 37.57'	32° 55.00'	155	CTD/rosette
MSM15/404-1	28.4.10	13:15	44° 37.57'	32° 55.00'	156	bottom water sampler
MSM15/405-1	28.4.10	14:24	44° 37.23'	32° 54.59'	157	JAGO Underwater Craft
MSM15/406-1	28.4.10	19:15	44° 37.19'	32° 54.72'	156	MOVE
MSM15/411-1	29.4.10	4:20	44° 39.66'	33° 2.97'	128	CTD/rosette
MSM15/412-1	29.4.10	5:25	44° 39.72'	33° 2.99'	128	JAGO Underwater Craft
MSM15/413-1	29.4.10	8:46	44° 39.84'	33° 3.63'	126	CTD/rosette
MSM15/414-1	29.4.10	9:25	44° 40.24'	33° 5.02'	123	CTD/rosette
MSM15/415-1	29.4.10	10:07	44° 40.70'	33° 6.68'	118	CTD/rosette
MSM15/416-1	29.4.10	11:35	44° 37.25'	32° 54.74'	155	JAGO Underwater Craft
MSM15/421-1	30.4.10	11:37	44° 48.73'	31° 55.31'	84	Television multicorer
MSM15/422-1	30.4.10	12:30	44° 47.45'	31° 57.38'	124	Television multicorer
MSM15/423-1	30.4.10	13:03	44° 47.45'	31° 57.38'	124	Television multicorer
MSM15/424-1	30.4.10	13:35	44° 47.29'	31° 57.70'	148	Television multicorer
MSM15/425-1	30.4.10	14:03	44° 47.09'	31° 58.05'	163	Television multicorer
MSM15/426-1	30.4.10	14:49	44° 46.87'	31° 58.50'	175	Television multicorer
MSM15/427-1	30.4.10	15:26	44° 46.60'	31° 58.44'	213	CTD/rosette
MSM15/428-1	30.4.10	15:51	44° 46.60'	31° 58.44'	213	Television multicorer
MSM15/429-1	30.4.10	16:43	44° 48.59'	32° 0.09'	149	CTD/rosette
MSM15/430-1	30.4.10	21:33	44° 37.30'	32° 54.75'	156	CTD/rosette
MSM15/431-1	30.4.10	22:28	44° 37.30'	32° 54.75'	155	Mooring (short time deployment)
MSM15/432-1	30.4.10	23:41	44° 39.04'	33° 0.14'	137	CTD/rosette
MSM15/433-1	30.4.10	23:53	44° 39.04'	33° 0.15'	137	Mooring (short time deployment)
MSM15/434-1	1.5.10	0:51	44° 38.93'	32° 59.98'	137	chamber lander
MSM15/435-1	1.5.10	1:36	44° 38.84'	33° 0.18'	140	Eddy
MSM15/436-1	1.5.10	2:09	44° 38.72'	33° 0.06'	138	Benthic Boundary Layer Profiler
MSM15/437-1	1.5.10	2:55	44° 38.68'	33° 0.26'	137	Multi Fibre Optics Sensor
MSM15/438-1	1.5.10	3:45	44° 38.53'	33° 0.08'	138	CTD/rosette
MSM15/439-1	1.5.10	4:08	44° 38.53'	33° 0.08'	139	bottom water sampler
MSM15/439-2	1.5.10	4:52	44° 38.53'	33° 0.08'	137	bottom water sampler
MSM15/440-1	1.5.10	6:26	44° 40.82'	33° 6.43'	119	JAGO Underwater Craft
MSM15/442-1	1.5.10	10:59	44° 49.50'	33° 9.59'	105	CTD/rosette
MSM15/443-1	1.5.10	11:07	44° 49.50'	33° 9.59'	106	Mooring (short time

						deployment)
MSM15/444-1	1.5.10	12:09	44° 49.32'	33° 9.46'	104	JAGO Underwater Craft
MSM15/447-1	1.5.10	19:18	44° 35.84'	32° 49.02'	207	Television multicorer
MSM15/448-1	1.5.10	19:50	44° 35.84'	32° 49.03'	207	Television multicorer
MSM15/449-1	1.5.10	20:19	44° 35.85'	32° 49.03'	207	Television multicorer
MSM15/453-1	2.5.10	0:22	44° 38.91'	32° 59.97'	138	CTD/rosette
MSM15/454-1	2.5.10	0:52	44° 38.91'	32° 59.97'	139	bottom water sampler
MSM15/455-1	2.5.10	2:05	44° 38.92'	32° 59.97'	137	MOVE
MSM15/456-1	2.5.10	8:35	44° 38.92'	32° 59.97'	138	JAGO Underwater Craft
MSM15/457-1	2.5.10	11:43	44° 37.53'	32° 54.79'	154	CTD/rosette
MSM15/458-1	2.5.10	13:06	44° 40.49'	33° 5.53'	120	Television multicorer
MSM15/459-1	2.5.10	13:24	44° 40.48'	33° 5.53'	120	Television multicorer
MSM15/460-1	2.5.10	14:26	44° 38.87'	32° 59.94'	138	JAGO Underwater Craft
MSM15/462-1	2.5.10	19:29	44° 49.45'	33° 9.26'	105	Television multicorer
MSM15/463-1	2.5.10	19:55	44° 49.45'	33° 9.26'	104	Television multicorer
MSM15/464-1	2.5.10	20:24	44° 49.45'	33° 9.26'	104	Television multicorer
MSM15/465-1	2.5.10	20:42	44° 49.43'	33° 9.25'	104	EAWAG Corer
MSM15/466-1	2.5.10	20:53	44° 49.43'	33° 9.25'	105	EAWAG Corer
MSM15/467-1	2.5.10	21:03	44° 49.43'	33° 9.25'	106	EAWAG Corer
MSM15/468-1	2.5.10	21:15	44° 49.43'	33° 9.25'	105	EAWAG Corer
MSM15/469-1	2.5.10	21:42	44° 49.46'	33° 9.67'	106	chamber lander
MSM15/470-1	2.5.10	22:15	44° 49.49'	33° 9.31'	104	Eddy
MSM15/471-1	2.5.10	22:49	44° 49.37'	33° 9.16'	106	Benthic Boundary Layer Profiler
MSM15/472-1	2.5.10	23:29	44° 49.25'	33° 9.64'	106	Multi Fibre Optics Sensor
MSM15/473-1	3.5.10	0:16	44° 49.43'	33° 9.66'	103	CTD/rosette
MSM15/474-1	3.5.10	0:38	44° 49.43'	33° 9.66'	103	bottom water sampler
MSM15/476-1	3.5.10	6:36	44° 49.26'	33° 9.32'	107	MOVE
MSM15/477-1	3.5.10	5:59	44° 49.26'	33° 9.32'	105	JAGO Underwater Craft
MSM15/482-1	3.5.10	12:16	44° 49.07'	33° 9.53'		JAGO Underwater Craft
MSM15/484-1	3.5.10	17:53	44° 49.49'	33° 9.32'	104	MOVE
MSM15/486-1	4.5.10	6:59	44° 39.00'	33° 0.96'	134	JAGO Underwater Craft
MSM15/487-1	4.5.10	9:51	44° 38.78'	33° 0.25'	136	Television multicorer
MSM15/488-1	4.5.10	10:15	44° 38.79'	33° 0.26'	136	Television multicorer
MSM15/489-1	4.5.10	10:40	44° 38.79'	33° 0.25'	138	Television multicorer
MSM15/490-1	4.5.10	11:27	44° 38.79'	33° 0.27'	138	Box corer
MSM15/491-1	4.5.10	12:29	44° 37.49'	32° 54.75'	155	Box corer
MSM15/492-1	4.5.10	12:58	44° 37.49'	32° 54.75'	985	JAGO Underwater Craft
MSM15/493-1	4.5.10	15:59	44° 37.66'	32° 54.85'	154	CTD/rosette
MSM15/494-1	4.5.10	16:37	44° 37.41'	32° 55.02'	156	EAWAG Corer
MSM15/495-1	4.5.10	16:48	44° 37.41'	32° 55.01'	156	EAWAG Corer
MSM15/496-1	4.5.10	16:59	44° 37.41'	32° 55.01'	157	EAWAG Corer
MSM15/497-1	4.5.10	17:09	44° 37.41'	32° 55.02'	156	EAWAG Corer
MSM15/498-1	4.5.10	18:08	44° 37.43'	32° 54.84'	155	MOVE

MSM15/499-1	5.5.10	0:11	44° 38.80'	33° 0.26'	140	chamber lander
MSM15/500-1	5.5.10	0:41	44° 38.67'	33° 0.10'	137	Eddy
MSM15/501-1	5.5.10	1:10	44° 38.51'	33° 0.21'	138	Benthic Boundary Layer Profiler
MSM15/502-1	5.5.10	1:46	44° 38.33'	33° 0.14'	138	Multi Fibre Optics Sensor
MSM15/503-1	5.5.10	2:31	44° 38.26'	33° 0.46'	137	CTD/rosette
MSM15/504-1	5.5.10	2:56	44° 38.26'	33° 0.46'	137	bottom water sampler
MSM15/505-1	5.5.10	4:36	44° 36.38'	32° 52.72'	171	Box corer
MSM15/506-1	5.5.10	5:28	44° 36.38'	32° 52.72'	171	Television multicorer
MSM15/507-1	5.5.10	5:59	44° 36.38'	32° 52.72'	170	JAGO Underwater Craft
MSM15/512-1	5.5.10	12:38	44° 37.39'	32° 56.21'	150	JAGO Underwater Craft
MSM15/513-1	5.5.10	15:20	44° 37.87'	32° 57.22'	147	Television multicorer
MSM15/514-1	5.5.10	15:57	44° 37.87'	32° 57.22'	147	Box corer
MSM15/515-1	5.5.10	17:02	44° 36.33'	32° 52.68'	172	CTD/rosette
MSM15/516-1	5.5.10	17:47	44° 35.74'	32° 49.25'	206	Box corer
MSM15/517-1	5.5.10	18:04	44° 35.74'	32° 49.25'	206	EAWAG Corer
MSM15/518-1	5.5.10	18:14	44° 35.74'	32° 49.25'	206	EAWAG Corer
MSM15/519-1	5.5.10	18:25	44° 35.74'	32° 49.25'	206	EAWAG Corer
MSM15/520-1	5.5.10	18:35	44° 35.74'	32° 49.25'	206	EAWAG Corer
MSM15/521-1	5.5.10	20:03	44° 35.74'	32° 49.25'	206	MOVE
MSM15/522-1	6.5.10	0:47	44° 35.92'	32° 49.89'	199	chamber lander
MSM15/523-1	6.5.10	1:18	44° 35.60'	32° 49.92'	201	Benthic Boundary Layer Profiler
MSM15/524-1	6.5.10	2:25	44° 35.39'	32° 50.18'	196	MUFO
MSM15/525-1	6.5.10	3:31	44° 35.04'	32° 50.49'	195	CTD/rosette
MSM15/526-1	6.5.10	4:14	44° 35.04'	32° 50.49'	195	bottom water sampler
MSM15/527-1	6.5.10	5:50	44° 33.56'	32° 44.24'	363	JAGO Underwater Craft
MSM15/528-1	6.5.10	9:01	44° 35.73'	32° 49.23'	206	Television multicorer
MSM15/529-1	6.5.10	9:55	44° 35.29'	32° 49.48'	211	JAGO Underwater Craft
MSM15/530-1	6.5.10	12:11	44° 35.09'	32° 49.10'	208	CTD/rosette
MSM15/533-1	6.5.10	15:40	44° 38.56'	33° 0.07'	137	Box corer
MSM15/534-1	6.5.10	18:21	44° 49.43'	33° 9.46'	104	Box corer
MSM15/535-1	6.5.10	19:21	44° 49.43'	33° 9.43'	104	MOVE
MSM15/536-1	7.5.10	1:18	44° 49.42'	33° 9.42'	106	CTD/rosette
MSM15/538-1	7.5.10	3:11	44° 39.14'	33° 0.03'	137	CTD/rosette
MSM15/540-1	7.5.10	4:46	44° 37.35'	32° 54.60'	155	CTD/rosette
MSM15/542-1	7.5.10	8:17	44° 10.00'	32° 30.01'		ARGO Float
MSM15/543-1	7.5.10	9:54	44° 0.02'	32° 4.92'		ARGO Float