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Short Cruise Report

MERIAN MSM13-3

“HOMER”



Limassol - Limassol

25.10.2009 – 18.11.2009

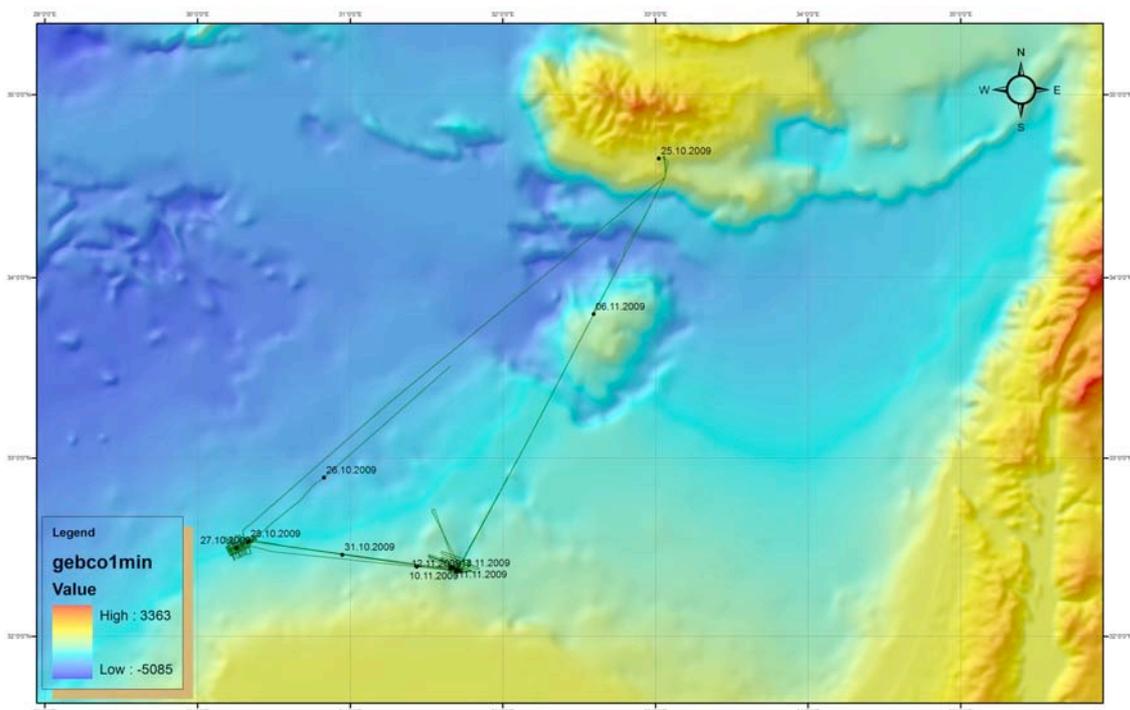
Chief Scientist: Antje Boetius

Captain: Karl Friedhelm von Staa

Objectives

The cruise leg MSM13/3 investigated chemosynthetic ecosystems of the deep Eastern Mediterranean. At fluid escape structures in water depths of 1000- 2000 m energy rich chemical substances such as sulfur and hydrocarbon compounds are available to fuel rich and abundant microbial life and diverse chemosynthetic ecosystems. The main objectives of leg MSM13/3 were 1) to obtain a quantitative insight in element cycling and export at different types of fluid seeps in the Eastern Mediterranean and 2) to understand the relation and interaction between fluid seepage and seep biodiversity and community distribution. Another special type of chemosynthetic ecosystem investigated during MSM 13/3 were large wood falls which had been deployed at both sites 3 and 2 years ago and which were now re-sampled to get a better understanding of temporal succession of wood degrading communities. The main technology used for these objectives were the ROV QUEST4000 (MARUM) with its diverse payloads operated by the MPI Bremen, allowing targeted, coupled videographic, biogeochemical and ecological investigations, as well as the online heat flux corer of IFM Geomar. We used these tools in a combination to quantify physical, biogeochemical and ecological processes in chemosynthetic ecosystems, and to study the link between the deep-water geosphere and biosphere in the Eastern Mediterranean. Two working areas had been selected: The “East Delta” in the eastern Nile fan province, at 32°22’N, 31°42’E with comparably young mud volcanoes with fluid seepage; and the “Central Delta” at 32°38’N, 29°55’E, with a high density of pockmarks harbouring carbonate chimneys and pavements as well as patchy colonies of chemosynthetic organisms. In addition, various experiments and devices deployed during M70/2 in 2006 were recovered during MSM13/3. The expedition contributed to the EC’s 7th FP HERMIONE, the GDRE DIWOOD and ESF EUROCORES project CHEMECO, as well as to the goals of the research center MARUM (Geosphere- Biosphere Research).

Fig. 1 Trackplot of MSM13-3



Narrative

Expedition HOMER (MSM13/3) started with a reception on board RV Maria S. Merian, which for the first time berthed at the New Lemesos Port of Cyprus. Representatives of the German Embassy in Nikosia, Cypriot researchers, port authorities, and representatives of a number of maritime institutions met on board the MERIAN to inform each other of the goals of the research expedition MSM13 and of the role of Cyprus in EU oceanography programs. After two days of installing the ROV QUEST for the first time on board MERIAN, and after unpacking 8 containers, we left Limassol in the morning of Sunday 25 October towards our first target area, the “Central Delta” with its vast carbonate pavements and abundant pockmarks on the Nile Deep Sea Fan.

We reached the first study site in the morning of the 26 October and immediately began our work with the calibration of the Posidonia navigation system. For our studies aiming at small scale habitat structures, it is essential that we can deploy and relocate instruments and experiments with a precision of less than 10 m at the seafloor in a depth of > 1000 m, which is still a technological and methodological challenge. This time we could profit a lot from MERIAN's excellent positioning and station keeping abilities. A first test dive was started in the afternoon of the 26th October, this was the 236th dive of the ROV QUEST. We were able to deploy our deep-sea elevator and to unpack it with the ROV at the seafloor, we placed a larval colonization experiment, and we relocated some of the markers of the METEOR M70 expedition. The first short three dives between the 27 and 30 October were dedicated to the sampling of three biological colonization experiments at a water depth of 1700 m. In different distances from the central chemosynthetic ecosystem, we had deployed large wood logs in 2006, which were almost completely degraded by specialized wood boring animals three years later. It is an old theory that chemosynthetic organisms can use sunken woods as stepping stones for their dispersal, and our experiments clearly show that some mussels use this strange habitat to get their energy from sulfur, even at > 100m distance from the next seep, in a normal pelagic setting. Coming back now for the third time to these experiments has allowed us to record a fascinating succession of the diverse life forms settling on the wood, and also different biogeochemical phases in the life of the chemosynthetic ecosystem and our sunken wood experiments.

On 1st November we carried out Dive 241 which was dedicated to in situ biogeochemical measurements to investigate changes in the geological and chemical drivers of chemosynthetic ecosystems in the second target area, a deep water mud volcano. We have studied this area already during the METEOR expedition M70/2 BIONIL in 2006. Coming back to the same chemosynthetic habitats three years later, we were totally surprised to find the previously rather fauna-impooverished central area populated by a rich world of bacteria, fish, crabs, worms and bivalves, along with several different signs of a declining activity in mud volcanism. The heat flux transects carried out by the team from IfM GEOMAR showed strongly decreased temperature gradients in the underlying seabed compared to 2006. The 2nd November was spent with heat flux and multibeam transects, as wind and waves were too high for deploying QUEST. We were looking for evidence of flares and bottom structures indicative of geological activity. Already in the evening of the 3rd November we could carry out a short dive 242. Unfortunately, the ROV sonar system

broke, and we decided to get a replacement delivered to Limassol, This was already possible on the 5-6 November, after dive 243, during which we explored other chemosynthetic habitats on the flanks of the mud volcano. At a lateral mudflow visited already in 2006 during the BIONIL expedition, we detected new rivers of mud, a replacement of the mat forming bacteria by others, and the immense growth of giant tubeworms, which had developed from two small colonies to a large population surrounding the mud flows. Dive 245 with a functional sonar started in the morning of 7 November, followed by gravity core sampling to analyze the geochemical composition of the subsurface fluids in the center of the mud volcano. Dive 246 was dedicated to the mapping of flares and associated emissions from the seafloor, as well as for carrying out more biogeochemical measurements. Unfortunately, it turned out that the cable of the ROV was severely damaged and needed a major repair. With three long dives between 10-14 November, we were able to complete a relevant part of the program foreseen for the last week of our mission. Dive 247 was dedicated to the sampling of colonization experiments three years after deploying our sunken wood deployments, and also to flare mapping in the southwestern flank of the mud volcano. Specifically, we measured benthic respiration rates close to and away from the colonization experiments, to see if the community that has established on the woods has an impact on the seafloor community, for example by spreading wood chips due to sloppy feeding. During Dive 248, we focused on sampling for the biodiversity experiment for the EU project HERMIONE, and further flare mapping in the vicinity. Interestingly, many of the flares mapped with the ship's Parasound and the ROV's sonar system are directly associated with carbonate towers extending from the seafloor, or with small black holes in the seafloor. Dive 249 aimed at the quantification of hydrocarbon emission from the seafloor, and further sampling for the biodiversity experiment. In between the dives, we carried out numerous TV MUC transects to learn more about the macroscale distribution of habitats, especially the relation between backscatter maps, carbonate cements and chemosynthetic life. In addition, another heat lance survey was completed on positions already probed in 2006 to learn more about temporal change, as well as many Parasound tracks and some gravity coring.

The last dive D251 of leg MSM13/3 took place on Monday, 16 November. It explored a new area at 1700 m water depth, which is characterized by a fully calcified seafloor, with several strong fluid vents. Below and between thick carbonate crusts we found large biomasses of chemosynthetic tubeworms, sometimes also associated with blackish reduced sediments. From 16-17 November we finished the scientific program with Parasound and multibeam measurements before steaming back to Limassol in the afternoon of 17 November.

Acknowledgements

We thank Captain and crew of the MERIAN expedition MSM13/3 for their excellent support of our work at sea. Also, we thank the ROV QUEST team for the excellent dives and the tireless efforts in repairing the ROV cable. Many thanks go to the German Embassy in Nicosia and to the MERIAN coordination office (Leitstelle) for their help with the reception, permissions and the harbor logistics. The ship time was provided by the Deutsche Forschungsgemeinschaft. Financial support for the different projects carried out during the cruise was provided through the EU- and ESF Projects HERMIONE and EURODEEP, as well as by the research institutes involved. We gratefully acknowledge this support.

List of participants

Name	Function	Institute
1. Boetius, Antje	Fahrtleiter / Chief Scientist	AWI
2. Wenzhöfer, Frank	In situ Instruments	MPI
3. Pop Ristova, Petra	In situ Instruments	MPI
4. Schüssler, Gabriele	Biogeochemistry	MPI
5. Beier, Viola	Biogeochemistry/Microbiology	MPI
6. Sahling, Heiko	Biology	MARUM
7. Römer, Miriam	Gas flux	MARUM
8. Bienhold, Christina	Wood experiments	MPI
9. Borowski, Christian	Wood experiments	MPI
10. Feseker, Tom	Heat flow	IFM GEOMAR
11. Wetzel, Gero	Heat flow	IFM GEOMAR
12. Wintersteller, Paul	GIS, Geophysics	MARUM
13. Asendorf, Volker	Shuttle	MPI
14. Ratmeyer, Volker	ROV	MARUM
15. Viehweger, Marc	ROV	MPI
16. Düsmann, Ralf	ROV	MARUM
17. Hüttich, Daniel	ROV	MARUM
18. Zarrouk, Marcel	ROV	MARUM
19. Franke, Philipp	ROV	MARUM
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21. Schmidt, Werner	ROV	MARUM

Institutes

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Stationsliste

Station	Date	Time	PositionLat	PositionLon	Depth[m]	Gear
MSM13/893-1	26.10.09	4:37	32° 32.01' N	30° 21.16' E	1661	Schallprofilsonde
MSM13/894-1	26.10.09	10:11	32° 32.0339' N	30° 21.1691' E	1696	Elevator
MSM13/895-1	26.10.09	16:50	32° 31.99' N	30° 21.13' E	0	ROV Dive 236
MSM13/896-1	26.10.09	21:52	32° 32.33' N	30° 21.32' E	0	Heat Flow
MSM13/897-1	26.10.09	23:24	32° 30.18' N	30° 15.73' E	0	Multibeam,Parasound
MSM13/898-1	27.10.09	6:15	32° 32.0370' N	30° 21.1670' E	0	Elevator
MSM13/899-1	27.10.09	11:50	32° 32.04' N	30° 21.18' E	0	ROV Dive 237
MSM13/900-1	27.10.09	22:30	32° 32.32' N	30° 20.40' E	1710	Heat Flow
MSM13/901-1	28.10.09	0:37	32° 30.08' N	30° 15.85' E	0	Multibeam,Parasound
MSM13/902-1	28.10.09	7:07	32° 32.0350' N	30° 21.1716' E	0	Elevator
MSM13/903-1	28.10.09	11:24	32° 32.06' N	30° 21.08' E	0	ROV Dive 238
MSM13/904-1	28.10.09	15:38	32° 34.16' N	30° 22.48' E	1786	Multibeam,Parasound
MSM13/904-1	28.10.09	17:18	32° 30.17' N	30° 11.74' E	1745	Multibeam,Parasound
MSM13/905-1	29.10.09	4:46	32° 21.9061' N	31° 42.9961' E	0	Heat Flow
MSM13/906-1	29.10.09	5:25	32° 21.94' N	31° 42.93' E	0	Heat Flow
MSM13/907-1	29.10.09	7:59	32° 21.96' N	31° 42.85' E	1142	Multibeam,Parasound
MSM13/908-1	29.10.09	14:31	32° 22.20' N	31° 42.66' E	0	TV Multicorer
MSM13/909-1	29.10.09	19:12	32° 22.1171' N	31° 42.7160' E	1128	Heat Flow
MSM13/910-1	29.10.09	19:43	32° 22.1349' N	31° 42.6941' E	1124	Heat Flow
MSM13/911-1	29.10.09	20:05	32° 22.1501' N	31° 42.6719' E	1122	Heat Flow
MSM13/912-1	29.10.09	20:26	32° 22.1620' N	31° 42.6580' E	1127	Heat Flow
MSM13/913-1	29.10.09	21:29	32° 22.1759' N	31° 42.6340' E	1120	Heat Flow
MSM13/914-1	29.10.09	21:48	32° 22.1870' N	31° 42.6209' E	1123	Heat Flow
MSM13/915-1	29.10.09	22:09	32° 22.1990' N	31° 42.6039' E	1125	Heat Flow
MSM13/916-1	29.10.09	22:30	32° 22.2241' N	31° 42.5740' E	1129	Heat Flow
MSM13/917-1	29.10.09	23:28	32° 22.2519' N	31° 42.5389' E	1137	Heat Flow
MSM13/918-1	30.10.09	7:25	32° 32.07' N	30° 20.96' E	0	ROV Dive 239
MSM13/919-1	31.10.09	3:58	32° 21.9530' N	31° 42.9371' E	1173	Heat Flow
MSM13/920-1	31.10.09	4:33	32° 22.0019' N	31° 42.8729' E	1146	Heat Flow
MSM13/921-1	31.10.09	4:58	32° 22.0339' N	31° 42.8309' E	1139	Heat Flow
MSM13/922-1	31.10.09	5:23	32° 22.0609' N	31° 42.7910' E	0	Heat Flow
MSM13/923-1	31.10.09	5:48	32° 22.0939' N	31° 42.7469' E	1446	Heat Flow
MSM13/924-1	31.10.09	8:10	32° 22.2820' N	31° 42.4959' E	1141	Heat Flow
MSM13/925-1	31.10.09	8:33	32° 22.3060' N	31° 42.4629' E	1140	Heat Flow
MSM13/926-1	31.10.09	9:05	32° 22.3421' N	31° 42.4160' E	1146	Heat Flow
MSM13/927-1	31.10.09	9:29	32° 22.3761' N	31° 42.3709' E	1150	Heat Flow
MSM13/928-1	31.10.09	20:51	32° 22.18' N	31° 42.56' E	0	Elevator
MSM13/929-1	31.10.09	13:30	32° 22.20' N	31° 42.63' E	1123	ROV Dive 240
MSM13/930-1	31.10.09	23:14	32° 22.4140' N	31° 42.3160' E	1162	Heat Flow
MSM13/930-2	31.10.09	23:46	32° 22.4501' N	31° 42.2671' E	1156	Heat Flow
MSM13/930-3	1.11.09	0:11	32° 22.4890' N	31° 42.2140' E	1167	Heat Flow
MSM13/930-4	1.11.09	1:09	32° 22.2171' N	31° 42.7830' E	1132	Heat Flow
MSM13/930-5	1.11.09	1:28	32° 22.2109' N	31° 42.7531' E	1131	Heat Flow
MSM13/930-6	1.11.09	1:47	32° 22.2029' N	31° 42.7330' E	1129	Heat Flow
MSM13/930-7	1.11.09	2:51	32° 22.1679' N	31° 42.6420' E	1122	Heat Flow
MSM13/931-1	1.11.09	3:48	32° 21.87' N	31° 42.92' E	0	Multibeam,Parasound
MSM13/932-1	1.11.09	8:53	32° 22.2081' N	31° 42.6539' E	0	Elevator
MSM13/933-1	1.11.09	10:23	32° 22.19' N	31° 42.62' E	0	ROV Dive 241
MSM13/934-1	1.11.09	22:03	32° 22.1939' N	31° 42.7100' E	1110	Heat Flow
MSM13/934-2	1.11.09	22:32	32° 22.1831' N	31° 42.6840' E	1060	Heat Flow
MSM13/934-3	1.11.09	22:50	32° 22.1731' N	31° 42.6640' E	1040	Heat Flow
MSM13/934-4	1.11.09	23:58	32° 22.1650' N	31° 42.6469' E	1107	Heat Flow
MSM13/934-5	2.11.09	0:16	32° 22.1609' N	31° 42.6310' E	1108	Heat Flow
MSM13/934-6	2.11.09	0:34	32° 22.1540' N	31° 42.6080' E	1109	Heat Flow
MSM13/934-7	2.11.09	1:01	32° 22.1450' N	31° 42.5879' E	1111	Heat Flow
MSM13/934-8	2.11.09	1:20	32° 22.1369' N	31° 42.5670' E	1112	Heat Flow
MSM13/934-9	2.11.09	1:33	32° 22.1369' N	31° 42.5670' E	1112	Heat Flow
MSM13/935-1	2.11.09	3:09	32° 23.71' N	31° 39.26' E	1023	Multibeam,Parasound

MSM13/936-1	3.11.09	9:11	32° 22.16' N	31° 42.65' E	1122	TV Multicorer
MSM13/937-1	3.11.09	15:31	32° 22.17' N	31° 42.63' E	0	ROV Dive 242
MSM13/938-1	3.11.09	22:28	32° 22.1359' N	31° 42.5379' E	1130	Heat Flow
MSM13/938-2	3.11.09	22:52	32° 22.1341' N	31° 42.5379' E	1131	Heat Flow
MSM13/938-3	3.11.09	23:17	32° 22.1259' N	31° 42.5170' E	1132	Heat Flow
MSM13/938-4	3.11.09	23:45	32° 22.1150' N	31° 42.4879' E	1140	Heat Flow
MSM13/938-5	4.11.09	1:03	32° 22.0939' N	31° 42.4310' E	1139	Heat Flow
MSM13/938-6	4.11.09	1:33	32° 22.0700' N	31° 42.3590' E	1161	Heat Flow
MSM13/938-7	4.11.09	2:06	32° 22.0360' N	31° 42.2789' E	1151	Heat Flow
MSM13/938-8	4.11.09	2:16	32° 22.0339' N	31° 42.2750' E	1152	Heat Flow
MSM13/938-9	4.11.09	2:24	32° 22.0470' N	31° 42.2750' E	1151	Heat Flow
MSM13/938-10	4.11.09	4:39	32° 22.3880' N	31° 41.7640' E	1187	Heat Flow
MSM13/938-10	4.11.09	4:44	32° 22.3900' N	31° 41.7650' E	1187	Heat Flow
MSM13/940-1	4.11.09	11:36	32° 22.01' N	31° 42.21' E	1150	ROV Dive 243
MSM13/941-1	4.11.09	20:50	32° 22.1380' N	31° 42.5369' E	1130	Gravity corer
MSM13/942-1	4.11.09	22:12	32° 22.33' N	31° 42.26' E	1158	Multibeam,Parasound
MSM13/943-1	5.11.09	4:37	32° 22.0390' N	31° 42.2369' E	1191	Elevator
MSM13/944-1	5.11.09	6:54	32° 22.06' N	31° 42.21' E	1147	ROV Dive 244
MSM13/945-1	6.11.09	22:41	32° 23.05' N	31° 42.45' E	0	Multibeam,Parasound
MSM13/946-1	7.11.09	6:22	32° 22.0421' N	31° 42.2459' E	1156	Elevator
MSM13/947-1	7.11.09	9:19	32° 22.05' N	31° 42.24' E	1154	ROV Dive 245
MSM13/948-1	7.11.09	20:50	32° 22.41' N	31° 41.72' E	1188	TV Multicorer
MSM13/949-1	8.11.09	2:05	32° 22.07' N	31° 41.91' E	1175	Multibeam,Parasound
MSM13/950-1	8.11.09	6:57	32° 22.1741' N	31° 42.6271' E	1122	Gravity corer
MSM13/951-1	8.11.09	8:27	32° 22.1751' N	31° 42.6271' E	1122	Gravity corer
MSM13/952-1	8.11.09	10:53	32° 22.0480' N	31° 42.2470' E	1152	Elevator
MSM13/953-1	8.11.09	12:10	32° 22.00' N	31° 42.24' E	1150	ROV Dive 246
MSM13/954-1	8.11.09	22:20	32° 21.89' N	31° 42.10' E	0	Parasound
MSM13/955-1	9.11.09	3:03	32° 23.65' N	31° 39.94' E	1001	Multibeam,Parasound
MSM13/956-1	9.11.09	12:43	32° 22.4560' N	31° 41.7220' E	1184	Gravity corer
MSM13/957-1	9.11.09	14:08	32° 22.4540' N	31° 41.7060' E	1186	Gravity corer
MSM13/958-1	9.11.09	15:29	32° 22.4540' N	31° 41.7060' E	1185	Gravity corer
MSM13/959-1	9.11.09	19:26	32° 22.30' N	31° 41.96' E	1176	TV Multicorer
MSM13/960-1	9.11.09	23:06	32° 22.57' N	31° 44.12' E	1271	Multibeam,Parasound
MSM13/961-1	10.11.09	6:35	32° 22.0350' N	31° 42.2310' E	1151	Elevator
MSM13/962-1	10.11.09	9:17	32° 22.03' N	31° 42.22' E	1151	ROV Dive 247
MSM13/963-1	11.11.09	3:40	32° 22.45' N	31° 41.75' E	1186	TV Multicorer
MSM13/964-1	11.11.09	4:27	32° 21.90' N	31° 42.14' E	1194	Multibeam,Parasound
MSM13/965-1	11.11.09	9:20	32° 22.1491' N	31° 42.7180' E	0	Heat Flow
MSM13/965-2	11.11.09	9:50	32° 22.1189' N	31° 42.6531' E	0	Heat Flow
MSM13/965-3	11.11.09	10:07	32° 22.1290' N	31° 42.6511' E	0	Heat Flow
MSM13/965-4	11.11.09	10:24	32° 22.1380' N	31° 42.6400' E	0	Heat Flow
MSM13/965-5	11.11.09	10:39	32° 22.1429' N	31° 42.6350' E	0	Heat Flow
MSM13/965-6	11.11.09	11:12	32° 22.1210' N	31° 42.5611' E	0	Heat Flow
MSM13/965-7	11.11.09	11:49	32° 22.0589' N	31° 42.4219' E	0	Heat Flow
MSM13/965-8	11.11.09	12:49	32° 22.0571' N	31° 42.6350' E	0	Heat Flow
MSM13/966-1	11.11.09	14:41	32° 22.20' N	31° 42.70' E	1127	TV Multicorer
MSM13/967-1	11.11.09	19:12	32° 22.0460' N	31° 42.2490' E	1149	Elevator
MSM13/968-1	11.11.09	20:53	32° 22.04' N	31° 42.25' E	1149	ROV Dive 248
MSM13/969-1	12.11.09	12:09	32° 21.99' N	31° 41.98' E	1183	TV Multicorer
MSM13/970-1	12.11.09	20:58	32° 22.2040' N	31° 42.6540' E	0	Elevator
MSM13/971-1	13.11.09	0:16	32° 22.20' N	31° 42.64' E	0	ROV Dive 249
MSM13/972-1	14.11.09	1:33	32° 32.0775' N	30° 21.3862' E	1695	Wood experiment
MSM13/973-1	14.11.09	2:34	32° 32.64' N	30° 23.23' E	1714	Multibeam,Parasound
MSM13/974-1	14.11.09	8:37	32° 30.04' N	30° 15.70' E	1687	TV Multicorer
MSM13/975-1	14.11.09	17:56	32° 32.0370' N	30° 21.2200' E	0	Elevator
MSM13/976-1	14.11.09	19:56	32° 32.07' N	30° 21.17' E	0	ROV Dive 250
MSM13/977-1	15.11.09	11:55	32° 30.0580' N	30° 15.6130' E	1690	Gravity corer
MSM13/978-1	15.11.09	13:54	32° 29.44' N	30° 15.36' E	1676	TV Multicorer
MSM13/979-1	15.11.09	22:36	32° 30.16' N	30° 11.31' E	1753	Multibeam,Parasound

MSM13/980-1	16.11.09	8:05	32° 30.05' N	30° 15.58' E	0	ROV Dive 251
MSM13/981-1	16.11.09	19:43	32° 31.83' N	30° 11.30' E	1794	Multibeam,Parasound