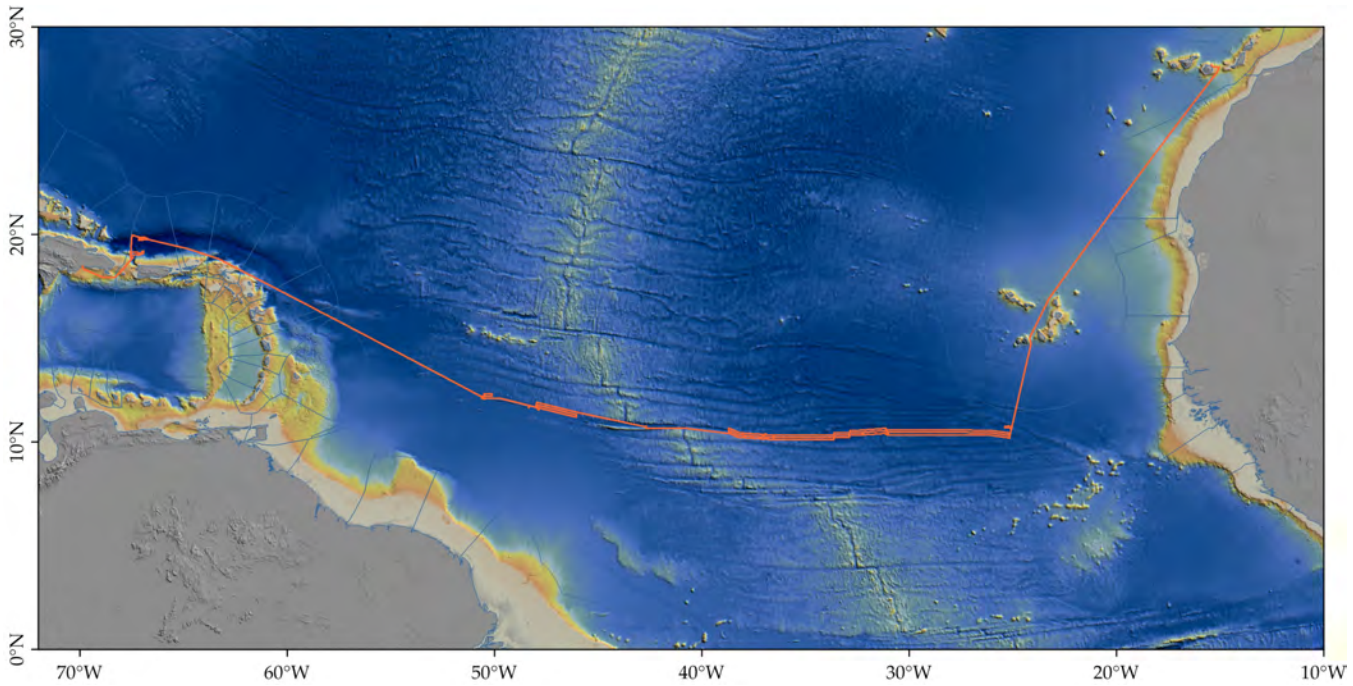
Prof. Dr. Colin Devey
Geomar - Helmholtz Centre for Ocean Science, Kiel
Wischhofstr. 1-3
D-24148 Kiel
Germany
Tel: +49 431 600 2257
Fax: +49 431 600 2924
email: cdevey@geomar.de

Short Cruise Report
R.V. "Sonne" Cruise SO-237

Las Palmas - Santo Domingo
14.12.2014 - 26.01.2015
Chief Scientist: Colin Devey
Captain: Oliver Meyer



Objectives

The abyssal seafloor makes up > 60% of our planet´s surface, it is nevertheless largely unexplored. We know very little about how the processes which created it have varied through time, about life on the deep seafloor or about how the hydrosphere, biosphere and lithosphere interact over this vast area. In the Atlantic, transform faults and fracture zones characterize most of the seafloor bathymetry and the volcanic and tectonic process which create and modify the crust can be deduced from their bathymetric signature. During the cruise SO-237 we surveyed and sampled the entire length of one of the major offsets of the Mid-Atlantic Ridge, the Vema Fracture Zone, looking at a history of plate creation and modification over 120Ma. Variations in benthic communities along this transect will be investigated using samples recovered from corers and towed gear as well as detailed photographic mapping of the benthic megafauna using AUV. The results will be used to test the hypothesis that the Mid-Atlantic Ridge serves as a barrier limiting benthic species distribution in the abyssal basins on both sides of the ridge. The Puerto Rico Trench is much deeper than the surrounding abyssal West Atlantic and so we also took samples there to determine whether the biodiversity of its hadal meio-, macro-, and megabenthic fauna differs from that of the abyssal Atlantic due to isolation of the trench. The cruise yielded important information for the Transregio proposal "Maturing oceanic plates: Earth's hidden reactors" and has provided the first high-resolution bathymetric survey along an entire fracture zone trace and one of the world's best surveyed seafloor features.

Cruise Narrative

The brand new research vessel "Sonne" left Las Palmas for her maiden scientific voyage on 14th December 2014 for a 4-day transit to the working area south of the Cape Verde islands. On Thursday 18.12.14 we left the Cape Verde EEZ and the first scientific data were collected with the ship´s multibeam echo-sounder. The seafloor sampling began on Friday 19.12.14 with successful deployments of the sediment gravity core, the multi-corer and the epibenthos sled. In parallel the deep-diving autonomous underwater vehicle ABYSS was deployed to map the seafloor in high resolution. Following a successful dredge haul in the night from Saturday 20.12.14 to 21.12.14, Sonne then began the first long mapping transect with over 4 days of multibeam measurements, providing the first-ever seafloor maps of the crust between 25° and 31°W along the Vema Fracture Zone. In the afternoon of 25.12.14 the AUV was again deployed, followed by the usual sequence of 3 Multi-corers, a gravity core, two epibenthos-sled deployments and a dredge. The return of the AUV on 27.12. with evidence of an Eh-anomaly 80m above the seafloor led us to carry out one extra gravity core at the position. There then followed the second large mapping block, covering the region 31° - 37°W. On 01.01.15 at 15:00 the first station work at 37°W began with biological sampling as the wind was too strong (Beaufort 7) to deploy the AUV. Following three successful MUC deployments the weather had improved to such an extent that we were able to deploy the AUV for its first photographic mission - this returned 9000 pictures after a 16 hour dive, showing large clumps of sunken Sargassum algae on the seafloor at 5300m.

The following epibenthos sleds also contained large amounts of sargassum debris. There then followed a long mapping transit towards the active transform fault region, which we arrived at in the early morning of 06.01.15. During this mapping transit we deployed two APEX floats at 38 and 42°W. Upon arrival in the transform region, preparations began for extensive AUV diving with the deployment of two LBL transponders. During the calibration phase for these transponders the weather worsened significantly and the first AUV deployment in the region where Cannat et al. (1991) found evidence of seafloor clam beds had to be delayed. We completed 6 MUC deployments (3 empty, probably as a result of the poor weather conditions), two EBS, two gravity corers (one empty) and a CTD tow-yo whilst waiting for an improvement in the weather. When this had not materialized by 08.01.15 we continued the mapping transit westward, releasing two more YPEX floats at 45° and 48°W.

The first station on the west of the spreading axis was reached on 11.01.15. The AUV was deployed to map an area of seafloor for the filming of a subsequent EBS deployment. During the AUV dive the EBS was deployed for its first haul. This deployment led to the sled becoming stuck on the bottom, after several hours maneouvring the sled was freed and came to the surface full of round Mn-nodules. A second deployment returned benthic fauna and Mn-crusts. Due to difficulties with the first EBS haul the AUV photo-mapping did not see the EBS trace but did return with 8500 pictures of the seafloor. Three MUC deployments were successful, as was a gravity corer. The dredge had no bites and returned empty. Late on 12.01.15 we continued the mapping westward and arrived at the second station west of the spreading axis on 13.01.15 in the early evening. Due to shortage of time (caused by the sampling problems during bad weather at the spreading axis) it was decided to only perform EBS and MUC sediment sampling and to try to make a photo-survey of the EBS track using the AUV. This was all successfully achieved and on 15.01.15 we began the 82 hour transit to the Puerto Rico trough at full speed. Details of all sampling areas along the Vema Fracture Zone are shown in Figures 1 & 2.

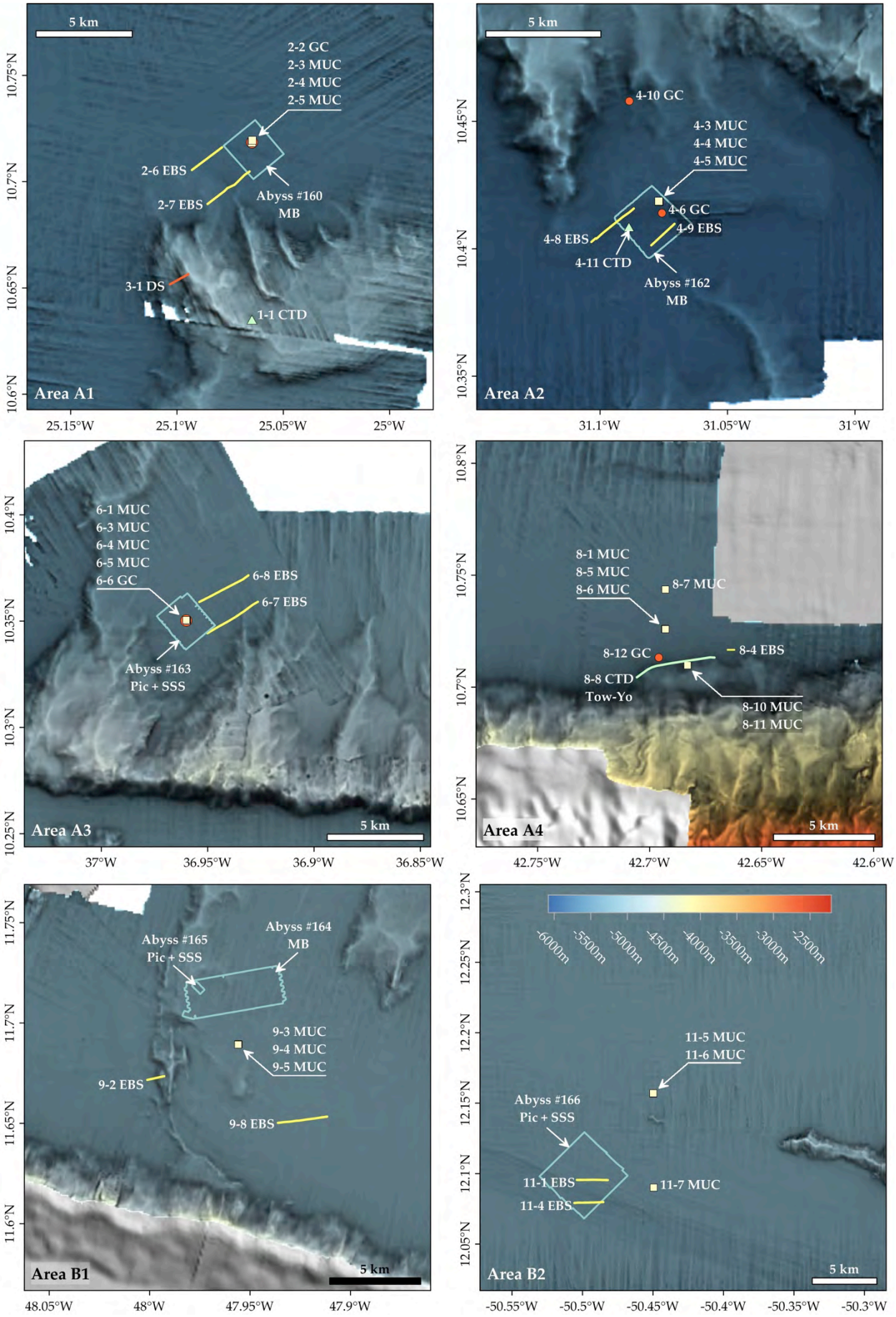


Figure 1: Maps of the areas of biological sampling and AUV deployment.

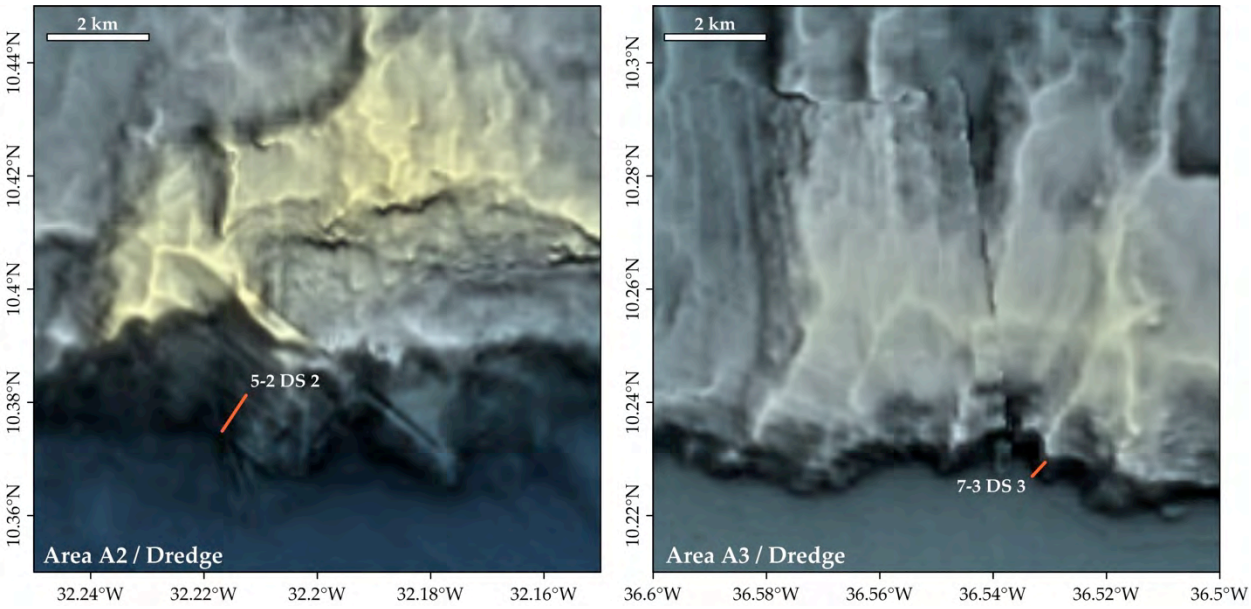


Figure 2: Maps of the dredge stations conducted away from the biological sampling spots.

This transit occurred with no major incidents, we arrived on station for the first MUC deployment in 8350m water depth at 20:00 on 18.01.15. At 8290m wire length (60m above bottom) problems with a pulley in the wire system (bolts in the axle had worked loose and broken) meant the station had to be abandoned and the MUC returned to deck at 0,3 m/s (7,5 hours!). The problem was solved within 3 hours by the engineers and the MUC was attempted once more. After 6 hours waiting, it returned empty. Another attempt was similarly fruitless but did return evidence for a very soft and sticky bottom sediment, which we were then able to sample with a subsequent MUC lowered extremely slowly into the sediment. We were able to recover 3 full MUCs then at this station and also deployed the EBS twice at depths of around 8350m, on the first deployment using the full working length of cable available on the ship (11.000m). During this deployment it became clear that the friction winch was at the limit of its lifting capacity and that it began to stall at around 100kN. For this reason, in consultation with the Captain and Chief Engineer, it was decided not to risk dredging at these depths as almost no tension at the seafloor would be available. The second deep station in the Puerto Rico Trough was completed on the evening of 23.01.15 and the ship moved to shallower water (ca. 5000m) for MUC and EBS deployments. These were completed at 15:00 on 25.01.15 at which time the ship began an 17-hour transit to Santo Domingo. The ship tied up in Santo Domingo on 26.01.15 at 08:00.

Acknowledgements

We thank Capt. Meyer and his crew for the excellent support during the SO-237 cruise - it was as always a real pleasure to work with them. The cruise was financed through BMBF grant 03G0237A to A. Brandt (travel, transport, consumables) and through internal funds of Geomar (AUV-costs). The help of the German Embassies in Washington (Frau Weiss) and Santo Domingo

(Frau Weber) with acquiring permission to work in the Puerto Rico Trench is gratefully acknowledged.

Cruise Participants

Name	Discipline	Institution
Devey, Colin, Prof. Dr.	Marine Geology / Chief Scientist	GEOMAR
Arndt, Hartmut, Prof. Dr.	Marine Microbiology	U. Köln
Augustin, Nico, Dr.	Marine Geology/Bathymetry	GEOMAR
Bober, Simon	Macrofauna	U. HH
Borges, Valeska	Meiofauna	U. HH
Brandt, Angelika, Prof. Dr.	Meiofauna	U. HH
Brenke, Nils, Dr.	EBS Technics	U. HH
Brix-Elsig, Saskia, Dr.	Macrofauna/Isopoda	DZMB, HH
Elsner, Nikolaus	Macrofauna/Isopoda	U. HH
Frutos, Inmaculada, Dr.	Macrofauna/Isopoda	U. HH
Guggolz, Theresa	Macrofauna/Polychaeta	U. HH
Heitland, Nele	Macrofauna/Isopoda	U. HH
Jeuck, Alexandra	Protists/Nanoflagellates	U. Köln
Klischies, Meike	Marine Geology/Bathymetry	GEOMAR
Köhler, Janna	Oceanography	U. HB
Lejzerovicz, Franck	Protists/Foraminifera	U. Geneva
Lins, Lidia	Nematodes	U. Ghent
Linse, Katrin	Macrofauna/Mollusca	BAS
Malytina, Marina	Macrofauna/Isopoda	IBM
Metz, Dirk	Marine Geology/Bathymetry	Oxon
Minzlaff, Ulrike	Macrofauna/Biochemistry	U. HH
Praußе, Dennis	Microbiology	U. Köln
Palgan, Dominik	Marine Geology/Petrology	GEOMAR
Riehl, Torben	Macrofauna/Isopoda	U. HH
Rothenbeck, Marcel	AUV-Leitung	GEOMAR
Schmidt, Christina	Meiofauna	DZMB, WHV
Schmidt, Christopher	Marine Geology/Pore waters	GEOMAR
Schoenle, Alexandra	Protists/Nanoflagellates	U. Köln
Schultze, Gudrun	Biology Team	PTJ
Schwabe, Enrico	Macrofauna/Mollusca	ZSM Munich
Springer, Tanya	Biology/Data management	U. HH
Steinführer, Anja	AUV-Navigation	GEOMAR
Triebe, Lars	AUV-Technik	GEOMAR
Voltski, Ivan	Protists/Foraminifera	U. Geneva
Walter, Thomas	Öffentlichkeitsarbeit	U. HH.
Wenzlaff, Emanuel	AUV-Technik	GEOMAR
Yeo, Isobel	Marine Geology/Bathymetry	GEOMAR
Zinnkann, Ann-Christine	Macrofauna/Biochemistry	U. HH
Zoeller, Khalhela	Marine Geology/Petrology	U. Ottawa

GEOMAR: Helmholtz Centre for Ocean Research, Kiel, Germany

U. HH: Universität Hamburg, Centrum für Naturkunde, Zoologisches Museum Hamburg.

U. HB:	Institute of Environmental Physics, University of Bremen, Germany
BAS:	British Antarctic Survey, Cambridge, UK
U. Ottawa:	University of Ottawa, Canada
Oxon:	Department of Earth Sciences, University of Oxford, UK
PTJ:	Projektträger Jülich, Warnemünde, Germany
ZSM Munich:	Zoologische Stattssammlung München, Munich, Germany
U. Köln:	Institute of Zoology, University of Cologne, Germany
U. Geneva:	Department of Genetics and Evolution, University of Geneva,Switzerland
DZMB WHV:	Deutsches Zentrum für Meeresbiologie, Wilhelmshaven
DZMB HH:	Deutsches Zentrum für Meeresbiologie, Hamburg
U. Ghent:	Marine Biology Department, University of Ghent, Belgium
IMB:	A.V. Zhirmunsky Institute of Marine Biology FEB RAS, Vladivostok, Russia

Station List

Stat. No.	Date	Time UTC	Latitude	Longitude	Depth [m]	Wire Length [m]	Device	Action
			* *Posidonia position*					
1-1	18.12.14	19:56	10°38.06' N	25°03.88' W	4790	4750	CTD + MAPR	Soundvelocity profile
2-1	19.12.14	8:49	10°43.25' N	25°03.88' W	5461	-	AUV	Launch Dive 160
2-2	19.12.14	11:15	10°43.11' N	25°03.88' W	5507	5535	GC + MAPR	On/Off bottom
	19.12.14	11:32	10°43.118' N	25°03.893' W	-	-	Algae	Sampling at sea surface
2-3	19.12.14	15:08	10°43.112' N	25°03.886' W	5498	5561	MUC + MAPR	On/Off bottom
2-4	19.12.14	19:43	10°43.108' N	25°03.888' W	5517	5559	MUC	On/Off bottom
2-5	20.12.14	4:34	10°43.17' N	25°03.88' W	5518	5553	MUC	On/Off bottom
2-6	20.12.14	11:09	*10°42.330' N	*25°05.580' W	5520	8204	EBS	On bottom
2-6	20.12.14	12:18	*10°42.969' N	*25°04.728' W	5520	6568	EBS	Off bottom
2-7	20.12.14	19:50	*10°41.370' N	*25°05.137' W	5514	8200	EBS	On bottom
2-7	20.12.14	21:20	*10°42.287' N	*25°03.952' W	5510	5725	EBS	Off bottom
3-1	21.12.14	3:30	10°39.00' N	25°05.60' W	5144	5195	DS	On bottom
3-1	21.12.14	5:25	10°39.60' N	25°05.30' W	4879	4871	DS	Off bottom
4-1	25.12.14	21:38	10°27.70' N	31°01.60' W	5672	-	AUV	Launch Dive 161
4-2	25.12.14	21:52	10°27.82' N	31°01.64' W	5637	200	Plankton-Net	On depth
4-3	26.12.14	3:06	10°25.11' N	31°04.61' W	5771	5809	MUC	On/Off bottom
4-4	26.12.14	7:24	10°25.12' N	31°04.62' W	5759	5813	MUC + MAPR	On/Off bottom
4-5	26.12.14	11:39	10°25.12' N	31°04.62' W	5767	5814	MUC	On/Off bottom
	26.12.14	12:16	10°25.114' N	31°4.617' W	-	-	Algae	Sampling at sea surface
4-6	26.12.14	17:31	10°24.84' N	31°04.54' W	5805	5857	GC	On/Off bottom
4-7	26.12.14	20:34	10°24.76' N	31°04.53' W	5808	-	AUV	Launch Dive 162
4-8	27.12.14	1:24	*10°24.161' N	*31°06.205' W	5735	8200	EBS	On bottom
4-8	27.12.14	2:46	*10°24.950' N	*31°05.204' W	5725	6080	EBS	Off bottom
4-9	27.12.14	8:33	*10°24.082' N	*31°04.795' W	5735	8200	EBS	On bottom
4-9	27.12.14	10:52	*10°24.589' N	*31°04.247' W	5733	6050	EBS	Off bottom
	28.12.14	16:58	10°24.481' N	31°5.318' W	-	-	Algae	Sampling at sea surface
4-10	28.12.14	17:52	10°27.48' N	31°05.31' W	5814	5857	GC + MAPR	On/Off bottom
4-11	28.12.14	20:11	10°24.48' N	31°05.32' W	5820	300	CTD	Casting Depth of 300 m
5-1	29.12.14	6:15	10°22.515' N	32°12.987' N	5455	5584,3	DS	On bottom
5-1	29.12.14	9:30	10°22.874' N	32°12.755' N	5004	4967	DS	Off bottom
6-1	01.01.15	19:25	10°21.01' N	36°57.58' W	5138	5178	MUC	On/Off bottom
6-2	01.01.15	21:20	10°20.998' N	36°57.616' W	5136	-	AUV	Launch Dive 163
6-3	01.01.15	23:37	10°21.03' N	36°57.59' W	5138	5180	MUC + MAPR	On/Off bottom
6-4	02.01.15	3:30	10°21.03' N	36°57.61' W	5134	5182	MUC + MAPR	On/Off bottom
6-5	02.01.15	7:09	10°21.03' N	36°57.61' W	5137	5178	MUC + MAPR	On/Off bottom
6-6	02.01.15	10:48	10°21.02' N	36°57.60' W	5135	5177	GC + MAPR	On/Off bottom
6-7	02.01.15	17:49	*10°20.659' N	*36°57.010' W	5085	7500	EBS	On bottom
6-7	02.01.15	19:15	*10°21.547' N	*36°55.585' W	5079	5600	EBS	Off bottom
6-8	02.01.15	2:12	*10°21.542' N	*36°57.236' W	5119	7100	EBS	On bottom

6-8	02.01.15	3:20	*10°22.293' N	*36°55.852' W	5127	5400	EBS	Off bottom
7-1	03.01.15	13:17	10°13.62' N	36°31.96' W	5063	5102	DS	On bottom
	03.01.15	14:54	10°14.161' N	36°31.615' W	-	-	Algae	Sampling at sea surface
7-1	03.01.15	15:50	10°13.763' N	36°31.81' W	4760	4490	DS	Off bottom
8-1	06.01.15	05:04	10° 43.60' N	42° 40.99' W	5184	-	AUV	Transponder 1 to water
8-1	06.01.15	05:54	10° 43.58' N	42° 41.92' W	5183	-	AUV	Transponder 2 to water
8-2	06.01.15	8:08	10°43.56' N	42°41.59' W	5183	5239	MUC	On/Off bottom
8-3	06.01.15	11:38	10°43.56' N	42°41.59' W	5182	200	Plankton-Net	At depth
8-4	06.01.15	19:01	10°43.00' N	42°39.91' W	5176	7500	EBS	On bottom
8-4	06.01.15	20:18	10°43.00' N	42°39.73' W	5178	5450	EBS	Off bottom
8-5	06.01.15	0:50	10°43.55' N	42°41.59' W	5183	5243	MUC + MAPR	
8-6	07.01.15	4:37	10°43.54' N	42°41.58' W	5180	5200	MUC	
8-7	07.01.15	8:40	10°44.62' N	42°41.58' W	5185	5226	MUC	
8-8	07.01.15	14:35	*10°42.263' N	*42°42.343' W	5110	5100	CTD + MAPR	Tow-Yo-Start
8-8	07.01.15	20:22	*10°42.792' N	*42°40.264' W	5170	5160	CTD + MAPR	Tow-Yo-End
8-9	08.01.15	0:35	10°43.67' N	42°41.75' W	5141	5206	GC + MAPR	On/Off bottom
8-10	08.01.15	7:10	10°42.58' N	42°40.99' W	5117	5167	MUC	On/Off bottom
8-11	08.01.15	10:49	10°42.59' N	42°40.99' W	5122	5162	MUC	On/Off bottom
8-12	08.01.15	15:13	10°42.79' N	42°41.76' W	5176	5213	GC + MAPR	On/Off bottom
	08.01.15	19:10	10°42.645' N	42°41.893' W	-	-	Algae	Sampling at sea surface
9-1	11.01.15	6:23	11°42.58' N	47°59.07' W	4974	-	AUV	Launch Dive 164
9-2	11.01.15	10:38	*11°40.299' N	*48°00.071' W	4995	7100	EBS	On bottom
9-2	11.01.15	14:45	*11°40.410' N	*47°59.565' W	4986	4870	EBS	Off bottom
9-3	11.01.15	19:34	11°41.37' N	47°57.36' W	4996	5051	MUC + MAPR	On/Off bottom
9-4	11.01.15	0:31	11°41.36' N	47°57.34' W	5000	5050	MUC + MAPR	On/Off bottom
	12.01.15	00:51	11°41.357' N	47°57.334' W	-	-	Algae	Sampling at sea surface
9-5	12.01.15	4:23	11°41.35' N	47°57.36' W	4997	5017	MUC	On/Off bottom
9-6	12.01.15	7:14	11°42.58' N	47°59.07' W	4977	-	AUV	Launch Dive 165
9-7	12.01.15	11:17	11°32.00' N	47°51.64' W	4941	4955	GC + MAPR	On/Off bottom
9-8	12.01.15	17:33	*11°39.014' N	*47°56.168' W	5004	5460	EBS	On bottom
9-8	12.01.15	19:29	*11°39.201' N	*47°54.697' W	5001	5260	EBS	Off bottom
10-1	13.01.15	3:49	11°39.96' N	48°20.89' W	4236	4307	DS	On bottom
10-1	13.01.15	6:10	11°40.44' N	48°19.56' W	3625	3625	DS	Off bottom
11-1	14.01.15	00:00	*12°05.732' N	*50°30.239' W	5093	5721	EBS	On bottom
11-1	14.01.15	10:34	*12°05.727' N	*50°28.922' W	5088	5400	EBS	Off bottom
11-2	14.01.15	11:47	12°05.80' N	50°27.96' W	-	-	Plankton-Net	In Water
11-2	14.01.15	12:23	12°05.92' N	50°28.01' W	-	-	Plankton-Net	On deck
11-3	14.01.15	13:57	12°05.99' N	50°28.4' W	5093	-	AUV	Launch Dive 166
11-4	14.01.15	17:27	*12°04.753' N	*50°30.348' W	5130	5770	EBS	On bottom
11-4	14.01.15	19:03	*12°04.791' N	*50°29.114' W	5108	5460	EBS	Off bottom
11-5	14.01.15	23:19	12°05.40' N	50°26.98' W	5091	5145	MUC	On/Off bottom
11-6	15.01.15	3:03	12°05.42' N	50°26.98' W	5090	5115	MUC	On/Off bottom
11-7	15.01.15	6:38	12°05.40' N	50°26.97' W	5090	5142	MUC	On/Off bottom
	19.01.15	00:54	19°43.400' N	67°8.010' W	-	-	Algae	Sampling at sea surface
12-1	19.01.15	17:15	19°46.01' N	66°49.99' W	8346	8414	MUC + MAPR	On/Off bottom

12-2	19.01.15	23:36	19°46.02' N	66°49.00' W	8337	8428	MUC	On/Off bottom
12-3	20.01.15	6:13	19°46.01' N	66°50.00' W	8336	8404	MUC	On/Off bottom
12-4	20.01.15	12:14	19°50.20' N	66°50.30' W	8323	8404	GC	On/Off bottom
12-5	20.01.15	20:40	19°49.50' N	66°50.97' W	8339	8964	EBS	On bottom
12-5	20.01.15	22:54	19°46.85' N	66°49.99' W	8338	8845	EBS	Off bottom
12-6	21.01.15	07:19	19°48.49' N	66°45.44' W	8340	9470	EBS	On bottom
12-6	21.01.15	08:19	19°48.60' N	66°45.12' W	8336	9208	EBS	Off bottom
12-7	21.01.15	15:58	19° 46.00' N	66° 49.99' W	8338	8407	MUC	On/Off bottom
12-8	21.01.15	21:49	19° 46.00' N	66° 49.99' W	8340	8421	MUC	On/Off bottom
12-9	22.01.15	00:56	19° 46.01' N	66° 49.99' W	8338	200	Plancton-Net	At depth
12-10	22.01.15	05:02	19° 48.81' N	66° 58.39' W	8317	8403	GC	On/Off bottom
13-1	22.01.15	11:57	19°43.809' N	67°09.284' W	8352	8430	MUC	On/Off bottom
13-2	22.01.15	17:56	19°43.812' N	67°09.284' W	8350	8430	MUC	On/Off bottom
13-3	22.01.15	23:26	19°43.817' N	67°09.285' W	8350	8428	MUC	On/Off bottom
13-4	23.01.15	06:47	19°46.73' N	67°06.21' W	8329	9261	EBS	On bottom
13-4	23.01.15	08:07	19°47,13' N	67°05.79' W	8316	9050	EBS	Off bottom
13-5	23.01.15	15:49	19°49.85' N	67°02.91' W	8082	9157	EBS	On bottom
13-5	23.01.15	16:52	19°50.14' N	67°02.60' W	8043	8853	EBS	Off bottom
13-6	23.01.15	23:45	19°48.63' N	66°58.43' W	8322	8399	GC	On/Off bottom
14-1	24.01.15	18:42	*19°00.760' N	*67°10.219' W	4552	5111	EBS	On bottom
14-1	24.01.15	19:55	*19°01.373' N	*67°09.776' W	4552	5156	EBS	Off bottom
14-2	25.01.15	0:34	*19°03.044' N	*67°08.650' W	4930	5490	EBS	On bottom
14-2	25.01.15	1:57	*19°03.877' N	*67°08.100' W	4925	5181	EBS	Off bottom
14-3	25.01.15	6:11	19°04.68' N	67°07.77' W	4925	4996	MUC	On/Off bottom
14-4	25.01.15	9:38	19°04.66' N	67°07.75' W	4925	4969	MUC	On/Off bottom
14-5	25.01.15	13:00	19°04.66' N	67°07.76' W	4925	4992	MUC	On/Off bottom

EBS - Epibenthos-Sled
MUC - Multicorer
GC - Gravity Corer (5m)
MAPR - Miniature Autonomous Plume Recorders
AUV - Autonomous Underwater Vehicle (ABYSS, Geomar)
DS - Chain bag dredge