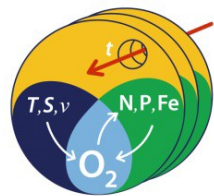


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**SFB 754**



## Short Cruise Report RV METEOR M137

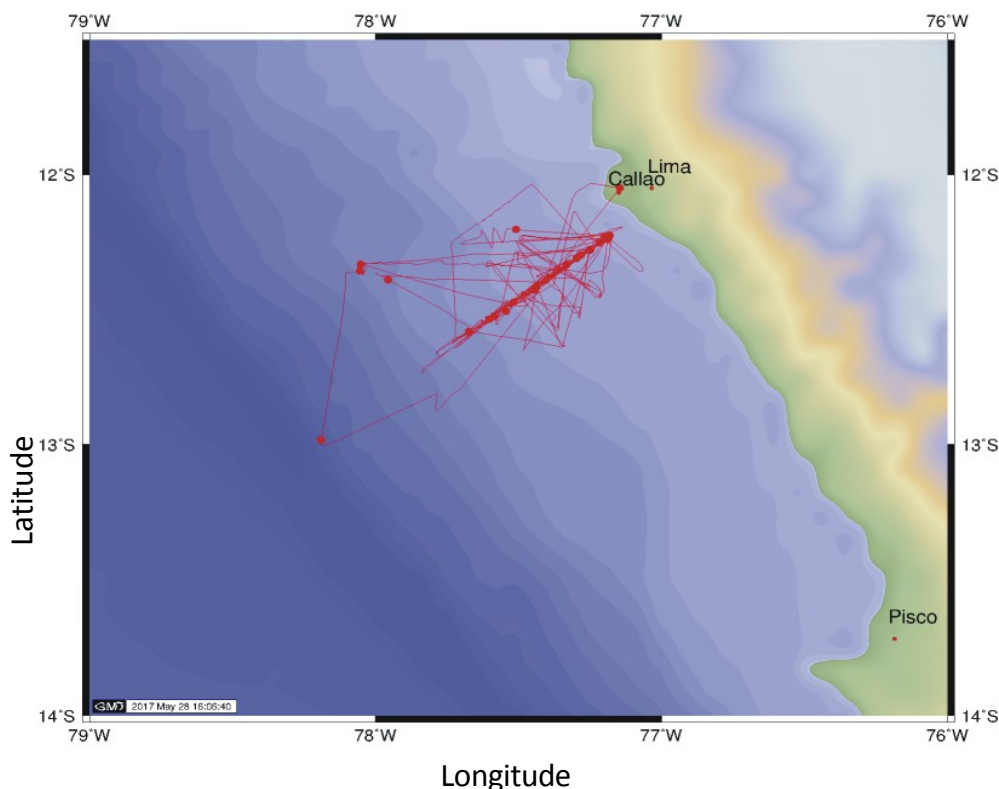
Callao (Peru) - Callao (Peru)

06.05.2017 – 29.05.2017

**Project: Collaborative Research Centre 754 “Climate -  
Biogeochemistry Interactions in the Tropical Ocean”**

Chief Scientist: Stefan Sommer

Captain: Rainer Hammacher



**FS METEOR**

**Cruise M137**

Callao - Callao

06.05.2017 - 29.05.2017



**Ship track during Meteor cruise M137 off Peru**

## Objectives

The magnitude, timing and pathways of nutrient and trace metal release from oxygen minimum zone (OMZ) sediments as well as their fate in the water column is of utmost importance for the pelagic nutrient budget and consequently impacts the ongoing expansion of OMZs. The major aims and questions addressed during the METEOR cruise M137, which was conducted within the framework of the Kiel collaborative research center SFB 754 (Climate – Biogeochemistry Interactions in the Tropical Ocean), were the following:

- a. To experimentally elucidate the magnitude and pathways of benthic nutrient fluxes (N, P, Fe, other trace metals) in response to the sustained availability of bottom water  $\text{NO}_3^-$  and  $\text{O}_2$ . The results will be linked to time series of  $\text{O}_2$ ,  $\text{NO}_3^-$ , and  $\text{NO}_2^-$  in order to allow for a better up-scaling and predictive capability of the benthic-pelagic coupling in the Peruvian OMZ at seasonal and inter-annual time scales.
- b. To what extent are benthic N, P and S fluxes coupled and controlled by filamentous sulfide oxidizing bacteria *Beggiatoa* and *Thioploca* as well as by denitrifying foraminifera? This involves the determination of the turnover of the internal  $\text{NO}_3^-/\text{NO}_2^-$  pools in foraminifera and filamentous sulfur bacteria in response to changing bottom water levels of electron acceptors. It will be determined to what extent foraminifera and sulfur bacteria compete for  $\text{NO}_3^-$  and  $\text{NO}_2^-$  resulting into the prevalence of fixed N loss versus recycling. It further encompasses genetic studies of foraminifera as well as studies about the phosphate pools in both groups.
- c. Another important goal of the ex situ and in situ experiment series was to determine the timing and magnitude of sulfidic events after stepwise depletion of  $\text{O}_2$ ,  $\text{NO}_3^-$  and  $\text{NO}_2^-$  in the bottom water. These studies encompass the determination of the capacity of bacteria and foraminifera to survive conditions of bottom water depleted in  $\text{O}_2$ ,  $\text{NO}_3^-$  and  $\text{NO}_2^-$ .
- d. To quantify benthic and pelagic cycling of nutrients and trace metals in the OMZ by budgeting physical fluxes of solutes including turbulent-, lateral-diffusive- and advective fluxes in the water column combined with benthic flux measurements during austral winter. The measurement program focused on quantifying diapycnal solute fluxes due to turbulent mixing in the water column and particularly in the bottom boundary layer. The findings will be compared to the results from the M92 cruise in austral summer to assess the impact of seasonal changes in stratification on the generation of non-linear internal waves. Observations of the large-scale boundary circulation and water column nutrient and trace metal distributions will allow the quantification of advective nutrient and trace metal fluxes.
- e. The water-column measurement program additionally focused on lateral-diffusive fluxes of nutrients and trace metals by mesoscale eddies and their role in the nutrient budget. Eddies may transport nutrients, trace metals as well as significant amounts of particulate organic matter offshore.

## Narrative

At the 4<sup>th</sup> of May 14 scientists arrived in the evening hours on board of RV METEOR. Participants from IMARPE (Instituto del Mar del Perú, Peru) and UCLA (University of California, Los Angeles, USA) arrived at the 5. May, whereas the remaining participants were already on board from the previous cruise M136. The harbour time was used to establish the laboratories or to maintain gears that were used during the previous M136 cruise. At the 4. May the German ambassador J. Ranau and collaborators as well as representatives from the Peruvian military visited RV METEOR. We conducted a tour around the ship and introduced the visitors into our scientific research and instruments. The visit was very nice and all were very interested. At the following day pupils of the German-Peruvian School Beata Imelda in Chosica visited RV METEOR. At the late afternoon, we conducted a small workshop with 11 scientists from IMARPE to discuss first results from the METEOR cruise M136.

At Saturday (6. May) at about 09:00 the RV METEOR left Callao during good weather conditions. After a short transit of only about 4 hours, we started with the station work along the depth transect at 12°S. On board was a very diverse team of 29 scientists from 6 different institutions, covering different disciplines including physical-, chemical, biogeochemical oceanography as well as microbiology and ecology, which reflects the interdisciplinary structure of the Kiel collaborative research centre (SFB754). Despite this short transit, the laboratories and scientific gears were ready for deployment allowing to immediately start with the regular station work. Since the working area was well known from the previous cruises M92 and M136 a pre-site survey was not required. The depth- transect at 12°S includes 10 main stations in water depths of about 74 to 1000 m but extends to almost 6000 m for water column investigations. Due to the formation of an eddy, which was observed during the previous cruise a small zonal transect at 12°13.44'S encompassing water depths from 200 down to 1200 m was included into the working program.

During the day-time we typically deployed the in-situ pumps (ISP), the Multiple Corer (MUC) and the two BIGO-type lander (BIGO I and II, **Biogeochemical Observatory**) for in situ flux measurements and in situ experiments. During natural flux measurements, the exchange of nutrients, oxygen and DIC inside the two benthic chambers, which were mounted into each lander were measured for time periods of about 32 hours. During experiments the flux chambers were manipulated by adding <sup>15</sup>N-nitrate solutions to ambient or increased nitrate levels in the enclosed bottom water. During one experiment (BIGO-I-6) at about 80 m water depth <sup>15</sup>N-nitrate as well as oxygen was added.

Ex situ experiments on board of the RV METEOR investigating the N and P turnover of foraminifera and sulfur bacteria represented another major activity of this research cruise. Five scientists from the University of Kiel and GEOMAR were specifically dedicated to the investigation of the single celled foraminifera, which in high densities populate the sediment surface of the Peruvian oxygen minimum zone. The investigation of denitrification rates of single species, incubation of the entire sediment system as well as sampling for latter genomic, transcriptomic and morphological analyses were the focus of these studies. One scientist from the Leibniz-Institut für Ostseeforschung, Warnemünde in collaboration with GEOMAR was dedicated to the investigate phosphate turnover in filamentous sulfur bacteria.

At night, we typically deployed the CTD water sampler rosette (CTD) for physical and

nutrient measurements, a specifically designed CTD water sampler for trace metal measurements (TM-CTD) and a microstructure probe (MSS) for turbulence measurements. We further deployed and took care of the Gliders for autonomous and continuous measurements of physical parameters, currents, oxygen as well as nitrate. During the entire cruise, the shipboard ADCP was used for current measurements. During transits between stations the Fish and a Rapid Cast System was deployed. The two small-sized lander SML and POZ were used to continuously record currents and physical parameters during the METEOR cruises M136 and M137 in water depths of 74 and 128 m. These landers were recovered at the 25<sup>th</sup> of May. This working schedule was continued until the end of the cruise and we are glad that we fully achieved our planned program and we hope that our data base is sufficient to address all planned scientific aims after final analyses and synthesis.

During most days, the weather was calm with south-easterly winds in the range of 3 to 4 Bft with a swell of about 2m allowing for smooth operations off the different gears. Only during mid-May weather conditions changed due to a strong low, which formed off Chile resulting in high swell of 4 m. Towards the end of the cruise wind force was between 5 and 6 Bft and swell was up to 3.5 m. However, these weather conditions didn't affect station work. Just two days prior to the end of the cruise we had a problem with the Trace Metal winch and we recommended for the next cruise to solve this problem. At the 28. May the gear and scientific instrumentation was packed and all laboratories were cleaned. At the 29<sup>th</sup> RV METEOR headed towards the harbor of Callao and most scientists disembarked for their flights back to Germany. A small group of scientists stayed on board to take care of the container shipping, which due to customs was very much delayed.

### **Acknowledgements**

We thank Captain Rainer Hammacher, the officers and the entire crew of RV METEOR for their excellent support. They created a very professional working environment and contributed a lot to the success of this cruise. The friendly atmosphere aboard is greatly acknowledged. We thank the Peruvian Ministerio De La Producción for its support and the allowance to conduct research in Peruvian waters and we very much would like to acknowledge the support of the German Ministry of Foreign Affairs. We would also like to express our gratitude to the Leitstelle METEOR/MERIAN for its valuable support. The ship time of RV METEOR was provided by the Deutsche Forschungsgemeinschaft. The collaborative research centre 754 "Climate – Biogeochemistry Interactions in the Tropical Ocean" is funded by the German Research Council, DFG.

## Participants

	<b>Name</b>	<b>Discipline</b>	<b>Institution</b>
1.	Sommer, Stefan	PI, Lander, Geochemistry	GEOMAR
2.	Beck, Antje	Lander	GEOMAR
3.	Türk, Matthias	Lander Electronics	GEOMAR
4.	Petersen, Asmus	Mechanics	GEOMAR
5.	Clemens, David	PhD Stud. N-Cycle, Lander	GEOMAR
6.	Braasch, Johanna	Stud. Assist. Lander	GEOMAR
7.	Domeyer, Bettina	Geochemistry	GEOMAR
8.	Schüßler, Gabriele	Geochemistry	GEOMAR
9.	Dale, Andrew	Geochemistry	GEOMAR
10.	Plaß, Anna	PhD Stud. Fe-Cycle	GEOMAR
11.	Utecht, Christine	Geochemistry	GEOMAR
12.	Meier, Karl	Stud. Assist. Geochemistry	GEOMAR
13.	Karen Mareike Paul	Stud. Assist. Geochemistry	GEOMAR
14.	Dengler, Marcus	Physical Oceanography	GEOMAR
15.	Müller, Mario	Physical Oceanography	GEOMAR
16.	Lüdke, Jan	Physical Oceanography	GEOMAR
17.	Thomsen, Sören	Physical Oceanography	GEOMAR
18.	Dagan, Tal	Foraminifera	GEOMAR
19.	Roy, Alexandra-Sophie	Foraminifera	CAU
20.	Weißbach, Julia	Foraminifera	CAU
21.	Wein, Tanita	PhD Stud. Foraminifera	CAU
22.	Glock, Nico	Foraminifera	CAU
23.	Achterberg, Eric	Trace Metal Geochemistry	GEOMAR
24.	Mutzberg, Andre	Trace Metal Geochemistry	GEOMAR
25.	Treude, Tina	Sulfur Geochemistry	UCLA
26.	Gasser, Beat	Radiotracer	IAEA
27.	Langer, Simon	Microbiology, Sulfur	IOW
28.	Chuquival, Dennis S.	Foraminifera	IMARPE
29.	Bernabe, Wilson J. C.	Carbon Cycle	IMARPE
30.	Rohleder, Christian	Bordwetterwarte	DWD

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## Station List M137

Station #	Date	Time (UTC)	Gear #	Latitude	Longitude	Depth (m)	Remarks
M137 - 594	06.05.17	17:29	CTD 01	12°23.30'S	77°24.27'W	244	
M137 - 595	06.05.17	18:45	TV-MUC 011	12°23.29'S	77°24.27'W	246	
M137 - 596	06.05.17	19:14	MSS 01	12°23.34'S	77°24.29'W	244	
M137 - 597	06.05.17	21:24	BIGO-II-1	12°23.36'S	77°24.276'W	244	deployment
M137 - 598	06.05.17	23:35	CTD 02	12°15.125'S	77°12.931'W	108	
M137 - 599	07.05.17	00:44	MSS 02	12°15.219'S	77°18.000'W	107	
M137 - 600	07.05.17	02:11	CTD 03	12°16.716'S	77°14.993'W	130	
M137 - 601	07.05.17	03:09	MSS 03	12°16.896'S	77°15.206'W	128	
M137 - 602	07.05.17	04:30	RAP CST 01	12°28.959'S	77°32.032'W	131.2	end of transect
M137 - 603	07.05.17	06:55	MSS 04	12°30.387'S	77°34.838'W	682	
M137 - 604	07.05.17	08:02	CTD 04	12°31.486'S	77°35.002'W	757	
M137 - 605	07.05.17	13:12	CTD 05	12°23.298'S	77°25.282'W	243	
M137 - 606	07.05.17	13:30	MUC 02	12°23.299'S	77°24.282'W	244	
M137 - 607	07.05.17	14:14	MUC 03	12°23.297'S	77°24.283'W	245	
M137 - 608	07.05.17	14:53	MUC 04	12°23.257'S	77°24.282'W	244	
M137 - 609	07.05.17	15:38	MUC 05	12°23.323'S	77°24.293'W	243	2nd worked
M137 - 610	07.05.17	16:00	RAP CST 02	12°12.889'S	77°10.642'W	244	end/mid transect 74m
M137 - 611	07.05.17	18:22	MSS 05	12°12.932'S	77°10.649'W	69	
M137 - 612	07.05.17	19:04	CTD 06	12°13.490'S	77°10.782'W	74.5	
M137 - 613	07.05.17	20:12	TM CTD 68	12° 13.48' S	77° 10.81' W	76.4	
M137 - 614	07.05.17	21:47	BIGO-I-1	12°13.514'S	77°10.787'W	74	deployment
M137 - 615	07.05.17	22:16	FISH	12° 13.21' S	77° 11.22' W	74.4	
M137 - 616	07.05.17	22:34	MSS 06	12°13.052'S	77°11.796'W	77	
M137 - 617	07.05.17	23:39	CTD 07	12°14.296'S	77°11.954'W	90	
M137 - 618	08.05.17	00:07	RAP CST 03	12°14.296'S	77°11.954'W	94.2	start / end of transect
M137 - 619	08.05.17	02:00	MSS 07	12°13.820'S	77°29.152'W	170	
M137 - 620	08.05.17	03:21	CTD 08	12°15.699'S	77°29.529'W	181	
M137 - 621	08.05.17	03:50	RAP CST 04	12°15.099'S	77°29.529'W	181	start transect coast
M137 - 622	08.05.17	06:19	MSS 08	12°26.01'S	77°12.63'W	166	
M137 - 623	08.05.17	07:15	CTD 09	12°27.152'S	77°12.611'W	179	
M137 - 624	08.05.17	09:04	MSS 09	12°20.341'S	77°21.669'W	183	
M137 - 625	08.05.17	09:59	CTD 10	12°21.150'S	77°21.754'W	190	
M137 - 626	08.05.17	13:05	BIGO-II-1	12° 23.20' S	77° 24.24' W	241.1	recovery
M137 - 627	08.05.17	14:30	ISP 01	12° 23.53' S	77° 24.47' W	250.5	
M137 - 628	08.05.17	20:27	RAP CST 05	12°22.577'S	77°56.584'W	253	
M137 - 629	08.05.17	21:22		12° 21.86' S	77° 59.80' W	1826.8	
M137 - 630	08.05.17	22:04	TM CTD 69	12°21.84'S	77°59.86'W	1840	
M137 - 631	09.05.17	02:01	MSS 10	12°33.748'S	77°40.507'W	1000	
M137 - 632	09.05.17	03:11	CTD 11	12°35.432'S	77°40.539'W	1020	
M137 - 633	09.05.17	05:43	MSS 11	12°28.140'S	77°32.299'W	523	
M137 - 634	09.05.17	06:52	CTD 12	12°29.13'S	77°32.98'W	526.7	

Station #	Date	Time # (UTC)	Gear	Latitude	Longitude	Depth (m) Remarks
M137 - 635	09.05.17	:10	MSS 12	12°20.51'S	77°21.23'W	.5
M137 - 636	09.05.17	:36	CTD 13	12°20.76'S	77°21.32'W	.1
M137 - 637	09.05.17	13 :00	BIGO-I-1	12°13.38'S	77°10.70'W	72.8 recovery
M137 - 638	09.05.17	13 :54	TM CTD 70	12°13.495'S	77°10.785'W	74
M137 - 639	09.05.17	14 :30	ISP 02	12°13.46'S	77°10.75'W	74
M137 - 640	09.05.17	18 :55	MUC 06	12°16.677'S	77°14.993'W	128
M137 - 641	09.05.17	19 :45	MUC 07	12°16.676'S	77°14.994'W	.4
M137 - 642	09.05.17	22:13	BIGO-II-2	12°14.888'S	77°12.699'W	102 deployment
M137 - 643	09.05.17	23:09	MSS 13	12°17.325'S	77°17.652'W	136
M137 - 644	10.05.17	:32	CTD 14	12°19.220'S	77°17.877'W	148
M137 - 645	10.05.17	01:58	MSS 14	12°23.705'S	77°25.951'W	280
M137 - 646	10.05.17	03:01	CTD 15	12°24.895'S	77°26.257'W	300
M137 - 647	10.05.17	:26	MSS 15	12°28'80'S	77°32.19'W	489
M137 - 648	10.05.17	05:27	CTD 16	12°29.635'S	77°32.86'W	.7
M137 - 649	10.05.17	:57	MSS 16	12°26.22'S	77°28.95'W	.1
M137 - 650	10.05.17	:15	CTD 17	12°27.15'S	77°29.50'W	.9
M137 - 651	10.05.17	13 :08	MUC 08	12°18.709'S	77°17.796'W	144
M137 - 652	10.05.17	17 :30	ISP 03	12°23.380'S	77°24.135'W	244
M137 - 653	10.05.17	18 :27	TM CTD 71	12° 23.35' S	77° 24.20' W	.6
M137 - 654	10.05.17	19 :37	MUC 09	12°23.351'S	77°24.251'W	244
M137 - 655	10.05.17	:22	CTD 18	12°23.275'S	77°24.358'W	244
M137 - 656	10.05.17	23:00	BIGO-I-2	12°16.798'S	77°14.989'W	.4 deployment
M137 - 657	10.05.17	23:34	CTD 19	12°16.708'S	77°14.960'W	128
M137 - 658	11.05.17	:37	MSS 17	12°18.567'S	77°19.868'W	156
M137 - 659	11.05.17	01:56	CTD 20	12°20.170'S	77°19.910'W	170
M137 - 660	11.05.17	03:45	MSS 18	12°32.563'S	77°21.511'W	378
M137 - 661	11.05.17	:45	CTD 21	12°33.846'S	77°21.610'W	417
M137 - 662	11.05.17	:51	MSS 19	12°26.90'S	77°29.29'W	381
M137 - 663	11.05.17	07:33	CTD 22	12°26.98'S	77°29.54'W	401
M137 - 664	11.05.17	:20	CTD 23	12°26.87'S	77°36.48'W	446
M137 - 665	11.05.17	:49	MSS 20	12°29.90'S	77°36.49'W	447
M137 - 666	11.05.17	13 :21	BIGO-II-2	12°14.78' S	77°12.59' W	.5 recovery
M137 - 667	11.05.17	14 :33	MUC 10	12°16.821'S	77°15.012'W	128
M137 - 668	11.05.17	15 :08	MUC 11	12°16.845'S	77°15.021'W	129
M137 - 669	11.05.17	19 :00	ISP 04	12°23.50'S	77°23.96'W	244
M137 - 670	11.05.17	23:22	MUC 12	12°31.358'S	77°34.997'W	752
M137 - 671	12.05.17	01:15	TM CTD 72	12°36.573'W	77°43.051'W	1070
M137 - 672	12.05.17	:23	CTD 24	12°15.016'S	77°43.999'W	1400
M137 - 673	12.05.17	05:32	CTD 25	12°12.03'S	77°39.98'W	1019
M137 - 674	12.05.17	:32	CTD 26	12°11.06'S	77°38.63'W	707
M137 - 675	12.05.17	07:27	CTD 27	12°10.07'S	77°37.30'W	337
M137 - 676	12.05.17	:16	CTD 28	12°09.03'S	77°35.75'W	197
M137 - 677	12.05.17	:06	CTD 29	12°07.52'S	77°33.92'W	165

Station #	Date	Time # (UTC)	Gear	Latitude	Longitude	Depth (m) Remarks
M137 - 678	12.05.17	09:53	CTD 30	12°06.02'S	77°31.98'W	154
M137 - 679	12.05.17	10:20	RAP CST 06	12°06.09'S	77°31.91'W	154 software problems
M137 - 680	12.05.17	13 :15	BIGO-I-2	12°16'372'S	77°14.952'W	128 recovery
M137 - 681	12.05.17	17 :36	MUC 13	12°13.507'S	77°10.774'W	74.2
M137 - 682	12.05.17	18 :04	MUC14	12°13.497'S	77°10.787'W	75
M137 - 683	12.05.17	19 :38	CTD 31	12°16'784'S	77°14.982'W	127
M137 - 684	12.05.17	22:31	BIGO-II-3	12°24.90'S	77°26.29'W	302 deployment
M137 - 685	13.05.17	:20	TM CTD 73	12°39.50'S	77°47.03'W	1446
M137 - 686	13.05.17	03:15	MSS 21	12°39.489'S	77°47.128'W	1451
M137 - 687	13.05.17	:30	CTD 32	12°39.492'S	77°47.103'W	1446
M137 - 688	13.05.17	:25	MSS 22	12°36.59'S	77°43.34'W	1076
M137 - 689	13.05.17	07:16	CTD 33	12°37'16'S	77°43.60'W	1121
M137 - 690	13.05.17	:15	MSS 23	12°32.51'S	77°37.42'W	919
M137 - 691	13.05.17	10:03	CTD 34	12°33.44'S	77°37.76'W	955
M137 - 692	13.05.17	13 :20	MUC 15	12°21.504'S	77°21.699'W	194
M137 - 693	13.05.17	14 :05	MUC 16	12°21.499'S	77°21.702'W	195
M137 - 694	13.05.17	18 :00	ISP 5	12°16.78'S	77°14.98'W	128
M137 - 695	13.05.17	18 :42	MUC 17	12°16.780'S	77°14.979'W	130
M137 - 696	13.05.17	21 :08	BIGO-I-3	12°21.506'S	77°21.706'W	193 deployment
M137 - 697	13.05.17	22:20	CTD 35	12°16.759'S	77°14.964'W	127
M137 - 698	13.05.17	22:39	RAP CT 07	12°16.86'S	77°15.01'W	128
M137 - 699	14.05.17	03:15	TM CTD 74	12°43.03'S	77°50.03'W	2060
M137 - 700	14.05.17	:46	MSS 24	12°43.13'S	77°50.07'W	2058
M137 - 701	14.05.17	05:39	CTD 36	12°44.00'S	77°50.10'W	2135
M137 - 702	14.05.17	13 :01	BIGO-II-3	12° 24.84' S	77° 26.23' W	318 recovery
M137 - 703	14.05.17	15 :00	ISP 06	12°27.21'S	77°21.59'W	408
M137 - 704	14.05.17	19 :19	MUC 18	12°29.280'S	77°32.267'W	507 empty
M137 - 705	14.05.17	:23	MUC 19	12°28.923'S	77°31.684'W	476 empty
M137 - 706	14.05.17	21 :00	RAP CST 08	12°28.59'S	77°32.24'W	491
M137 - 707	15.05.17	:00	CTD 37	12°19.950'S	78°03.144'W	1967
M137 - 708	15.05.17	:50	TM CTD 75	12°19.95'S	78°03.06'W	1966
M137 - 709	15.05.17	:18	MSS 25	12°20.06'S	78°03.35'W	1990
M137 - 710	15.05.17	03:55	CTD 38	12°19.981'S	77°58.019'W	1718
M137 - 711	15.05.17	05:18	CTD 39	12°20.022'S	77°52.011'W	1582
M137 - 712	15.05.17	07:09	CTD 40	12°19.56'S	77°45.88'W	1398
M137 - 713	15.05.17	:31	CTD 41	12°20.02'S	77°39.96'W	1048
M137 - 714	15.05.17	:36	CTD 42	12°20.01'S	77°36.93'W	463
M137 - 715	15.05.17	10:23	CTD 43	12°20.02'S	77°33.92'W	374
M137 - 716	15.05.17	11 :30	CTD 44	12°20.05'S	77°27.88'W	239
M137 - 717	15.05.17	13 :37	BIGO-I-3	12°21.486'S	77°21.714'W	195 recovery
M137 - 718	15.05.17	14 :05	MUC 20	12°21.488'S	77°21.707'W	195
M137 - 719	15.05.17	16 :00	ISP 07	12°13.44'S	77°10.79'W	74
M137 - 720	15.05.17	19 :15	MUC 21	12°13.47'S	77°10.787'W	75



Station #	Date	Time # (UTC)	Gear	Latitude	Longitude	Depth (m)	Remarks
M137 - 721	15.05.17	19:35	MUC 22	12°13.470'S	77°10.797'W	75	
M137 - 722	15.05.17	:14	CTD 45	12°13.295'S	77°10.826'W	74	
M137 - 723	15.05.17	:45	MSS 26	12°13.053'S	77°10.591'W	70	
M137 - 724	15.05.17	21 :55	CTD TM 76	12°13.45'S	77°10.83'W	74	
M137 - 725	15.05.17	22:20	CTD 46	12°13.535'S	77°10.801'W	75.2	
M137 - 726	15.05.17	22:59	MSS 27	12°13.01'S	77°11.64'W	75	
M137 - 727	16.05.17	:11	CTD 47	12°14.235'S	77°11.865'W	88	
M137 - 728	16.05.17	:23	MSS 28	12°13.754'S	77°29.714'W	170	
M137 - 729	16.05.17	03:15	CTD 48	12°15.099'S	77°29.606	182	
M137 - 730	16.05.17	:43	MSS 29	12°20.13'S	77°21.76'W	.6	
M137 - 731	16.05.17	05:33	CTD 49	12°21.36'S	77°21.68'W	.6	
M137 - 732	16.05.17	07:15	MSS 30	12°26.06'S	77°12.95'W	.1	
M137 - 733	16.05.17	07:55	CTD 50	12°26.82'S	77°12.93'W	.6	
M137 - 734	16.05.17	13 :20	MUC 23	12°37.787'S	77°21.352'W	.6	
M137 - 735	16.05.17	14 :23	MUC 24	12°38.143'S	77°20.740'W	4 .1	
M137 - 736	16.05.17	16 :21	ISP 08	12°27.243'S	77°29.243'W	400	
M137 - 737	16.05.17	18 :38	CTD 51	12°27.243'S	77°29.243'W	400	
M137 - 738	16.05.17	19 :45	TM CTD 77	12°27.24'S	77°29.24'W	397	
M137 - 739	16.05.17	21 :52	BIGO-II-4	12°21.501'S	77°21.708'W	190	deployment
M137 - 740	16.05.17	23:00	MSS 31	12°18.832'S	77°19.159'W	154	
M137 - 741	17.05.17	01:07	CTD 52	12°20.235'S	77°19.902'W	172	
M137 - 742	17.05.17	:44	MSS 32	12°32.482'S	77°21.570'W	409	
M137 - 743	17.05.17	03:45	CTD 53	12°33.892'S	77°21.584'W	418	
M137 - 744	17.05.17	05:39	MSS 33	12°26.25'S	77°29.39'W	384	
M137 - 745	17.05.17	:22	CTD 54	12°26.97'S	77°29.58'W	404	
M137 - 746	17.05.17	:12	MSS 34	12°19.07'S	77°35.97'W	422	
M137 - 747	17.05.17	:11	CTD 55	12°19.56'S	77°36.07'W	4 .5	
M137 - 748	17.05.17	13 :04	MUC 25	12°21.582'S	77°21.763'W	.7	
M137 - 749	17.05.17	15 :00	cancelled				drifting
M137 - 750	17.05.17	16 :00	ISP 09	12°22.59'S	77°26.15'W	262	
M137 - 751	17.05.17	19 :00	MUC 26	12°23.999'S	77°24.277'W	244	
M137 - 752	17.05.17	19 :58	CTD 56	12°22.597'S	77°26.157'W	261	
M137 - 753	17.05.17	21 :12	RAP CST 09	12° 20.26' S	77° 21.73' W	182	
M137 - 754	17.05.17	23:00	BIGO-I-4	12°13.504'S	77°10.799'W	75	deployment
M137 - 755	18.05.17	13 :21	BIGO-II-4	12°21.479'S	77°21.877'W	194	recovery
M137 - 756	18.05.17	14 :34	MUC 27	12°23.249'S	77°24.269'W	242	
M137 - 757	18.05.17	17 :00	ISP 10	12°31.25'S	77°34.88'W	734	
M137 - 758	18.05.17	:36	TM CTD 78	12°31.34'S	77°35.05'W	750	
M137 - 759	18.05.17	21 :31	CTD 57	12°31.384'S	77°35.196'W	764	
M137 - 760	18.05.17	22:13	MSS 35	12°31.567'S	77°35.126'W	789	
M137 - 761	18.05.17	23:48	CTD 58	12°31.373'S	77°35.045'W	756	
M137 - 762	19.05.17	01:27	MSS 36	12°28.167'S	77°32.104'W	478	
M137 - 763	19.05.17	:29	CTD 59	12°29.899'S	77°32.867'W	547	

Station #	Date	Time # (UTC)	Gear	Latitude	Longitude	Depth (m)	Remarks
M137 - 764	19.05.17	04:25	MSS 37	12°23.53'S	77°25.57'W	266	
M137 - 765	19.05.17	05:38	CTD 60	12°24.81'S	77°26.10'W	298	
M137 - 766	19.05.17	:48	MSS 38	12°22.21'S	77°23.66'W	297	
M137 - 767	19.05.17	07:37	CTD 61	12°23.02'S	77°23.89'W	232	
M137 - 768	19.05.17	:12	CTD 62	12°18.72'S	77°17.73'W	144	
M137 - 769	19.05.17	:30	MSS 39	12°18.92'S	77°17.67'W	144	cancelled. high swell
M137 - 770	19.05.17	13 :13	BIGO-I-4	12°13.564'S	77°10.703'W	75	recovery
M137 - 771	19.05.17	14 :40	MUC 27	12°16.731'S	77°14.947'W	.6	
M137 - 772	19.05.17	16 :04	MUC 28	12°21.573'S	77°21.738'W	195	
M137 - 773	19.05.17	16 :35	MUC 29	12°24.540'S	77°21.633'W	195	
M137 - 774	19.05.17	17 :00	MUC 30	12°21.55'S	77°21.60'W	194	
M137 - 775	19.05.17	17 :57	MUC 31	12°23.286'S	77°24.276'W	243	
M137 - 776	19.05.17	19 :10	MUC 32	12°24.898'S	77°26.293'W	303	
M137 - 777	19.05.17	22:13	BIGO-II-5	12°16.96'S	77°14.984'W	.6	deployment
M137 - 778	19.05.17	22:37	MSS 40	12°16.66'S	77°15.008'W	130	
M137 - 779	19.05.17	23:58	CTD 63	12°16.737'S	77°14.938'W	128	
M137 - 780	20.05.17	01:02	MSS 41	12°14.39'S	77°12.40'W	92	
M137 - 781	20.05.17	:41	CTD 64	12°15.087'S	77°12.866'W	106	
M137 - 782	20.05.17	:33	MSS 42	12°13.068'S	77°10.482'W	68	
M137 - 783	20.05.17	:59	CTD 65	12°13.51'S	77°10.78'W	75.8	
M137 - 784	20.05.17	:44	MSS 43	12°17.83'S	77°17.36'W	.7	
M137 - 785	20.05.17	07:45	CTD 66	12°18.68'S	77°17.77'W	143	
M137 - 786	20.05.17	10 :07	RAP CST 10	12° 28.11' S	77° 29.15' W	4 .9	
M137 - 787	20.05.17	13 :04	MUC 33	12°14.80'S	77°12.70'W	.4	
M137 - 788	20.05.17	15 :50	MUC 34	12°27.195'S	77°29.296'W	.6	
M137 - 789	20.05.17	:38	ISP 11	12°32.875'S	77°34.769'W	824	
M137 - 790	20.05.17	21 :13	CTD 67	12°33.158'S	77°34.651'W	838	
M137 - 791	20.05.17	23:43	BIGO-I-5	12°24.91'S	77°26.29'W	302	deployment
M137 - 792	21.05.17	01:50	TM CTD 79	12°30.99'S	77°34.57'W	750	
M137 - 793	21.05.17	:37	MSS 44	12°17.115'S	77°30.346'W	225	
M137 - 794	21.05.17	05:43	CTD 68	12°18.57'S	77°30.18'W	.4	
M137 - 795	21.05.17	07:11	MSS 45	12°22.38'S	77°23.90'W	222	
M137 - 796	21.05.17	:01	CTD 69	12°23.23'S	77°24.08'W	234	
M137 - 797	21.05.17	:50	CTD 70	12°31.01'S	77°17.35'W	284	
M137 - 798	21.05.17	10 :24	MSS 46	12°31.14'S	77°17.37'W	.9	
M137 - 799	21.05.17	13 :17	BIGO-II-5	12°16.814'S	77°14.952'W	130	recovery
M137 - 800	21.05.17	16 :42	MUC 35	12°38.153'S	77°20.728'W	503	no sediment
M137 - 801	21.05.17	17 :45	MUC 36	12°38.142'S	77°20.415'W	496	
M137 - 802	21.05.17	:00	ISP 12	12°34.81'S	77°40.33'W	980	
M137 - 803	21.05.17	23:44	TM CTD 80	12°34.81'S	77°40.33'W	972	
M137 - 804	22.05.17	:46	CTD 71	12°34.992'S	77°40.395'W	982	
M137 - 805	22.05.17	01:43	MSS 47	12°35.108'S	77°40.455'W	991	
M137 - 806	22.05.17	:59	CTD 72	12°34.911'S	77°40.318'W	977	

Station #	Date	Time # (UTC)	Gear	Latitude	Longitude	Depth (m)	Remarks
M137 - 807	22.05.17	04:22	MSS 48	12°36.64'S	77°43.76'W	1086	
M137 - 808	22.05.17	05:16	CTD 73	12°37.47'S	77°43.67'W	1150	
M137 - 809	22.05.17	07:27	CTD 74	12°32.43'S	77°37.88'W	105	
M137 - 810	22.05.17	08:00	MSS 49	12°28.03'S	77°31.54'W	406	
M137 - 811	22.05.17	08:54	CTD 75	12°28.70'S	77°31.67'W	501	
M137 - 812	22.05.17	13:14	BIGO-I-5	12°24.980'S	77°26.244'W	305	recovery
M137 - 813	22.05.17	14:28	MUC 37	12°23.294'S	77°24.271'W	102	
M137 - 814	22.05.17	17:00	ISP 13	12°34.91'S	77°40.35'W	980	
M137 - 815	22.05.17	18:08	CTD 76	12°34.910'S	77°40.350'W	966	
M137 - 816	22.05.17	21:09	RAP CST 11	12° 34.91' S	77° 40.27' W	904	
M137 - 817	23.05.17	07:55	BIGO-II-6	12°13.49'S	77°10.78'W	74.8	blind deployment
M137 - 818	23.05.17	08:21	MSS 50	12°20.409'W	77°04.093'W	101	
M137 - 819	23.05.17	08:30	CTD 77	12°21.254'S	77°03.820'W	106	
M137 - 820	23.05.17	09:17	MSS 51	12°14.25'S	77°12.23'W	92.2	
M137 - 821	23.05.17	10:14	CTD 78	12°14.99'S	77°12.77'W	102	
M137 - 822	23.05.17	10:41	CTD 79	12°08.19'S	77°18.33'W	102	
M137 - 823	23.05.17	11:17	MSS 52	12°08.20'S	77°18.32'W	105	
M137 - 824	23.05.17	11:08	TM CTD 81	12°21.50'S	77°21.71'W	102	
M137 - 825	23.05.17	13:08	MUC 38	12°21.51'S	77°21.72'W	193	2nd try successful
M137 - 826	23.05.17	14:41	MUC 39	12°24.903'S	77°26.280'W	301	
M137 - 827	23.05.17	15:16	MUC 40	12°24.903'S	77°26.256'W	302	
M137 - 828	23.05.17	17:11	Glider IFM03	12°39.03'S	77°28.86'W	893	
M137 - 829	23.05.17	18:02	RPD CST 12	12°37.65'S	77°28.01'W	108	
M137 - 830	23.05.17	21:47	BIGO-I-6	12°13.544'S	77°10.678'W	75.4	blind deployment
M137 - 831	23.05.17	22:10	RPD CST 13	12°13.58'S	77°10.93'W	76	
M137 - 832	24.05.17	07:17	MSS 53	12°12.20'S	77°32.55'W	183	
M137 - 833	24.05.17	08:03	MSS 54	12°11.890'S	77°35.231'W	237	
M137 - 834	24.05.17	07:06	MSS 55	12°12.53'S	77°37.73'W	101	
M137 - 835	24.05.17	08:45	TM CTD 82	12°15.30'S	77°42.06'W	1234.5	
M137 - 836	24.05.17	13:16	BIGO-II-6	12°13.606'S	77°10.917'W	75	recovery
M137 - 837	24.05.17	13:00	ISP 14	12°13.608'S	77°10.96'W	76.7	
M137 - 838	24.05.17	17:06	MUC 41	12°13.473'S	77°10.855'W	75	
M137 - 839	24.05.17	17:55	MUC 42	12°13.475'S	77°10.846'W	75	
M137 - 840	24.05.17	19:35	MUC 43	12°18.695'S	77°17.786'W	144	
M137 - 841	24.05.17	19:35	MUC 44	12°17.011'S	77°14.704'W	130	
M137 - 842	24.05.17	21:46	CTD 80	12°13.600'S	77°10.912'W	75	
M137 - 843	24.05.17	22:24	MSS 56	12°13.605'S	77°10.922'W	69	
M137 - 844	24.05.17	23:55	CTD 81	12°14.377'S	77°11.203'W	85	
M137 - 845	25.05.17	01:22	MSS 57	12°25.959'S	77°12.056'W	163	
M137 - 846	25.05.17	02:36	CTD 82	12°27.316'S	77°12.941'W	182	
M137 - 847	25.05.17	03:06	MSS 58	12°20.498'S	77°20.596'W	176	
M137 - 848	25.05.17	05:11	CTD 83	12°21.25'S	77°21.39'W	105	
M137 - 849	25.05.17	07:00	MSS 59	12°14.25'S	77°29.11'W	106	

Station #	Date	Time # (UTC)	Gear	Latitude	Longitude	Depth (m) Remarks
M137 - 850	25.05.17	07:39	CTD 84	12°14.68'S	77°29.41'W	.6
M137 - 851	25.05.17	:10	RAP CST 14	12°14.94'S	77°28.86'W	.3
M137 - 852	25.05.17	:35	MSS 60	12°13.346'S	77°11.323'W	77
M137 - 853	25.05.17	10 :31	CTD 85	12°13.94'S	77°11.66'W	83.6
M137 - 854	25.05.17	13 :17	BIGO-I-6	12°13.560'S	77°10.710'W	76 recovery
M137 - 855	25.05.17	14 :12	SLM	12°13.52'S	77°10.79'S	76.3 recovery from M136
M137 - 856	25.05.17	16 :25	MUC 45	12°23.316'S	77°24.280'W	244
M137 - 857	25.05.17	18 :04	POZ Lander	12°16.50'S	77°15.02'W	.1 recovery from M136
M137 - 858	25.05.17	:50	MUC 46	12°27.203	77°29.506'W	410
M137 - 859	25.05.17	11 :45	TM CTD 83	12°28.977'S	77°31.074'W	501
M137 - 860	25.05.17	22:36	MSS 61	12°28.977'S	77°31.074'W	460
M137 - 861	25.05.17	23:48	CTD 86	12°28.380'S	77°31.020'W	491
M137 - 862	26.05.17	:56	MSS 62	12°25.976'S	77°29.036'W	370
M137 - 863	26.05.17	01:44	CTD 87	12°26.848'S	77°29.488'W	397
M137 - 864	26.05.17	03:44	MSS 63	12°29.696'S	77°16.908'W	255
M137 - 865	26.05.17	:26	CTD 88	12°30.629'S	77°17.278'W	275
M137 - 866	26.05.17	:09	MSS 64	12°22.38'S	77°23.89'W	: .2
M137 - 867	26.05.17	:47	CTD 89	12°23.07'S	77°24.08'W	: .3
M137 - 868	26.05.17	:19	MSS 65	12°17.00'S	77°29.91'W	.1
M137 - 869	26.05.17	:50	CTD 90	12°17.74'S	77°30.07'W	: .4
M137 - 870	26.05.17	11 :18	MUC 47	12°16.685'S	77°14.989'W	.4
M137 - 871	26.05.17	11 :46	RAP CST 15	12° 16.73' S	77° 15.06' W	.1
M137 - 872	26.05.17	17 :25	Glider IFM09	12°20.00'S	78°03.00'W	1965 deployment
M137 - 873	26.05.17	18 :11	CTD 91	12°20.66'S	78°02.23'W	1937
M137 - 874	26.05.17	19 :27	TM CTD 84	12°20.78'S	78°01.88'W	1911
M137 - 875	27.05.17	11 :11	TM CTD 85	12°58.88'S	78°11.30'W	4990
M137 - 876	27.05.17	16 :14	CTD 92	12°58.90'S	78°11.33'W	5097
M137 - 877	28.05.17	14 :57	Glider IFM13	12°51.92'S	77°47.36'W	2251 recovery
M137 - 878	28.05.17	19 :35	Glider IFM07	12°35.48'S	77°15.58'W	1021 deployment

#### Abbreviations of the different gears/Measured parameters

##### *Watercolumn*

**CTD:** (CTD water sampling rosette): Physical properties, nutrients **TM CTD:** (Trace Metal CTD water sampling rosette): Trace metals **Glider:** Physical properties, turbulence, O<sub>2</sub>, Nitrate

**ISP:** radiotracer and sulphur geochemistry

**MSS:** (Microstructure profiling system): Physical properties and turbulence

**RAP CST:** (Rapid Cast): Physical properties

**Fish:** (Device for the continuous sampling of surface waters)

##### *Benthos*

**BIGO-I. BIGO-II:** (Biogeochemical Observatory, lander): Geochemistry, Microbiology, Foraminifera

**MUC:** (Multiple corer video-guided): Geochemistry, Microbiology, Foraminifera

**SLM:** (Satellite lander MOLAB): ADCP current measurements

**POZ Lander:** (Physical Oceanography Lander): ADCP current measurements