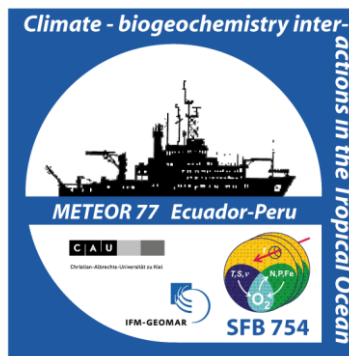


## Short Report

### METEOR Cruise No. 77 Leg 1

Talcahuano (Chile) –Callao (Peru): 22. 10. – 21. 11. 2008



## Climate- Biogeochemistry interactions in the tropical ocean of the SE-American oxygen minimum zone

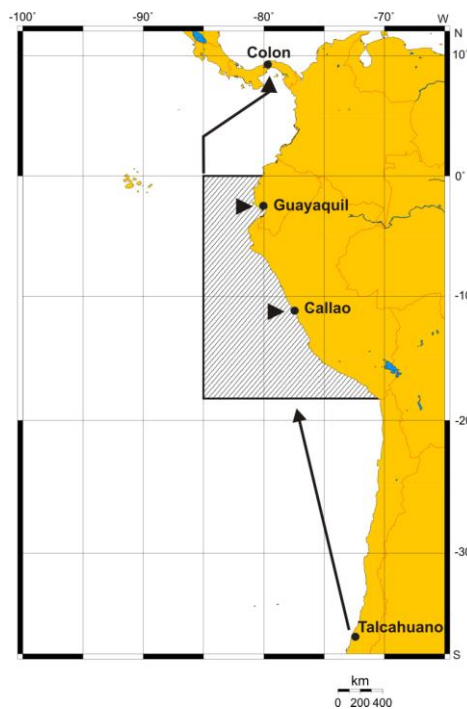
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## 1. Objectives of the cruise

A research cruise with the German research vessel METEOR to the south-eastern tropical Pacific was carried out for the period end of October 2008 to mid of February 2009. Main research topic is the investigation of the oxygen minimum zone (OMZ) in the coastal upwelling areas off Peru and to a lesser extend off Ecuador. The research is carried out in the context of the new Sonderforschungsbereich 754 at the University of Kiel, "Climate – Biogeochemistry Interactions in the Tropical Ocean" which started in 2008 and is funded by the German Research Council (DFG).



**Fig. 1:** Cruise METEOR 77 (28.10.2008 – 18.02.2009) : Overview of the total working areas and harbours .

The major objective of M77 leg 1 was the investigation of the sediment and sediment bordering water body ("benthic boundary layer" in the Peruvian oxygen minimum zone). Investigations comprised the in situ measurements of turnover and fluxes of nitrogen compounds, nutrients, trace metals, phosphate and iron across the sediment-water interface at variable oxygen concentrations of the bottom water of the shelf and upper continental slope, typical in a depths gradient from about 100m to 1200m. In parallel to these measurements of the natural environment, the effects of variable oxygen availability (thresholds) in the bottom water on N-speciation and release of nutrients were determined by additional in situ experiments. Further major activities of leg 1 comprised biological investigations of benthic bacterial and foraminiferal communities, the geochemistry of OMZ sediments as well as paleoceanographic and paleoclimatologic studies.

Major goal was to determine and quantify the effect of different oxygen/redox regimes on the speciation and in situ magnitude of nitrogen fluxes ( $\text{N}_2$ ,  $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{NH}_4^+$ )  $\text{Fe}^{2+}$ ,  $\text{PO}_4^{3-}$ ,  $\text{O}_2$ , and  $\text{SO}_4^{2-}$  across the sediment water interface underlying an extended oxygen minimum zone. Key issues were:

- Determination of natural fluxes of nitrogen species, trace metals as well as sulfate, oxygen, Fe and phosphate across the sediment water interface at selected shelf to upper slope transects across the oxygen minimum zone with different oxygen conditions using state of the art benthic observatories (lander technology).
- Regional estimates of the sink function of the benthic boundary layer for fixed N.

## 2. Working Program

Biogeochemical investigations on M77-1 comprised water column sediment and sediment pore water sampling to analyze key chemical species, whose chemical behavior and distribution are altered via oxygen mediated redox changes, most notably the key nutrients (fixed) nitrogen, phosphate, and iron. Specifically, we aimed to track the fate of dissolved iron and phosphate in the water column, to quantify the release of dissolved iron and phosphate from sediments, and to improve our understanding of their coupling to carbon, nitrogen, sulphur, and manganese cycles. The major goal of the biogeochemistry group was to determine and quantify the effect of bottom water oxygenation on the magnitude of  $\text{O}_2$ , N ( $\text{N}_2$ ,  $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{NH}_4^+$ ),  $\text{Fe}^{2+}$ ,  $\text{PO}_4^{3-}$ , Si, and  $\text{SO}_4^{2-}$  fluxes across the sediment water interface underlying an extended oxygen minimum zone.

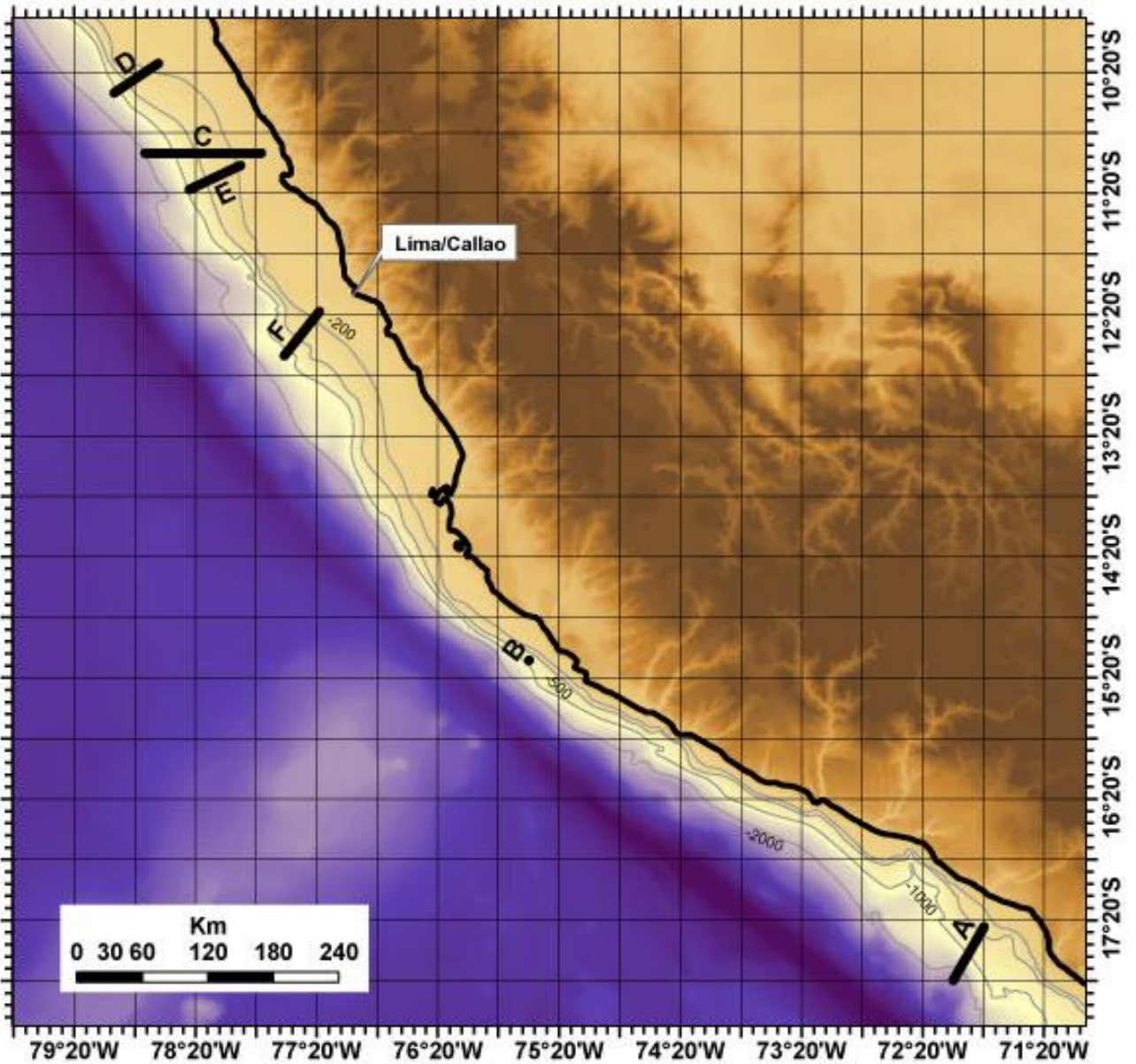
Investigations of the water column and sediments were conducted at a number of stations along transects across the oxygen minimum zone covering a depth range of 80 –1 200 m (Fig. 2).

Gear employments:

- Seafloor imaging with swath bathymetry and Parasound surveys,
- Water column surveys with CTD/Rosette water sampler,
- Ocean floor imaging with Ocean Floor Observation System transects (OFOS),
- Sediment sampling with gravity corer,
- Sediment sampling with TV-multi corer,
- Lander deployment a newly developed in situ pore water sampler,
- Lander deployments for in situ flux measurements and experiments, BIGO lander,
- Lander deployments for sediment x/y/z-micro-electrode profiler.

### 3. Working area

Station work of M77 leg 1 was exclusively performed in the Peruvian EEZ (Fig. 2). Five shelf to slope transects (transect A, C, D, E, F) and one single station (area B) were investigated.



**Fig. 2:** Working areas of cruise M77 leg: Five shelf to upper slope transects (transect lines A, C, D, E, F) and one single Station (B).

#### 4. Participants METEOR 77 Leg 1, scientific party

<b>Name</b>	<b>Expertise</b>	<b>Institution</b>
1. Pfannkuche, Olaf	<i>Chief Scientist</i>	IFM-GEOMAR
2. Bahr, André	<i>Paleoceanography</i>	IFM-GEOMAR
3. Bannert, Bernhard	<i>Video Technician</i>	IFM-GEOMAR
4. Boeschen, Tepke	<i>Paleoceanography</i>	IFM-GEOMAR
5. Camilli, Richard	<i>Scientist</i>	WHOI
6. Cherednichenko, Sergiy	<i>Engineer</i>	IFM-GEOMAR
7. Croot, Peter	<i>Geochemistry</i>	IFM-GEOMAR
8. Dibbern, Meike	<i>Laboratory Technician</i>	IFM-GEOMAR
9. Domeyer, Bettina	<i>Laboratory Technician</i>	IFM-GEOMAR
10. dos Santos Ferreira, Christian	<i>Technician</i>	IFM-GEOMAR
11. Ebbinghaus, Renate	<i>Laboratory Technician</i>	IFM-GEOMAR
12. Enriquez, Edgardo	<i>Benthosfauna</i>	IMARPE
13. Glock, Nicolaas	<i>Geochemistry</i>	IFM-GEOMAR
14. Graco, Michelle	<i>Biogeochemistry</i>	IMARPE
15. Hensen, Christian	<i>Geochemistry</i>	IFM-GEOMAR
16. Hommer, Julia	<i>Microbiology</i>	IFM-GEOMAR
17. Karas, Cyrus	<i>Paleoceanography</i>	IFM-GEOMAR
18. Kriwanek, Sonja	<i>Technician</i>	IFM-GEOMAR
19. Liebetrau, Volker	<i>Geochemistry</i>	IFM-GEOMAR
20. Mallon, Jürgen	<i>Paleoceanography</i>	IFM-GEOMAR
21. Mosch, Thomas	<i>Biogeochemistry</i>	IFM-GEOMAR
22. Nürnberg, Dirk	<i>Paleoceanography</i>	IFM-GEOMAR
23. Petersen, Asmus	<i>Technician</i>	IFM-GEOMAR
24. Pfannkuche, Björn	<i>Technician</i>	IFM-GEOMAR
25. Queisser, Wolfgang	<i>Technician</i>	IFM-GEOMAR
26. Scholz, Florian	<i>Geochemistry</i>	IFM-GEOMAR
27. Sommer, Stefan	<i>Biogeochemistry</i>	IFM-GEOMAR
28. Truscheit, Torsten	<i>Meteorology</i>	DWD
29. Türk, Matthias	<i>Engineer</i>	IFM-GEOMAR
30. Voigt, Silke	<i>Paleoceanography</i>	IFM-GEOMAR

## **5. Participating Institutions**

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## 6. Narrative

Wednesday, 22-10-08

Due to a delay in the ship yard inspections the M77-1 scientific party which arrived on the 20-10-08 could board METEOR only after a stay in a hotel on the morning of the 22-10-08. Until 15:00h we loaded our equipment from five containers on the pier. Four Containers were taken onboard and were unloaded by the scientists. It was also planned to refuel the ship on the same day and to leave the port lately the next morning but due to the weather situation the bunker vessel from Valparaiso was rescheduled for the afternoon of the 23-10-08.

Thursday, 23-10-08

We left the shipyard in the morning of the 23-10-08 at 08.12h and anchored in the Bay of Talcahuano to await the bunker vessel which arrived at 16:00h. After refuelling followed by custom and immigration clearance we finally left Talcahuano roadstead at 23:30h with a delay of two days. We steamed north along the Chilean coast heading to our first area of investigation at 18°S in the Peruvian EEZ.

Friday, 24-10-08

We continued our progress along the Chilean coast which was supported by tailwinds and currents.

Saturday, 25-10-08

We further advanced to the north.

Sunday, 26-10-08

Our voyage to the first station continued.

Monday, 27-10-08

We continued our passage to the first working station. We passed into the Peruvian EEZ at 18:35h and reached our first station in 17°50'S/072°05'W at 21:30h where we started station work with a CTD/RO cast at 2000m water depth (Stat. 386).

Tuesday, 28-10-08

During the night until noon we surveyed an upslope transect (**Transect A**, Fig. 2) with multi-beam EM120 /EM710 and Parasound from 2000m to about 130m water depth with CTD/casts near the 1000m 800m 500m 300m and 200m depth contour (Stat. 387-95). In the afternoon we took 3 multi-corer samples in down slope direction at the 300m- and 500m-Stations (Stat. 396-398). In the later evening an OFOS transect at 120m water depth was carried out (Stat399).

Wednesday, 29-10-08

We continued our OFOS investigations around the 300m and 500m depth lines during the night (Stat. 400-01). We then steamed to the 2000m-Station for another CTD/RO cast (Stat. 402). Our activities were then centered at the 300m-Station where we took two multi-corer samples and deployed a BIGO-T lander (Stat. 403-05). The afternoon and evening was

dedicated to further multi-corer sampling at the 500m-, 700m-and 1000m-Stations (Stat. 406-410).

Thursday, 30-10-08

Multi-coring was continued at 2000m during the night followed by another CTD/RO cast (Stat. 411-412). During the day we performed gravity corer sampling along the depth transect from 2100m to 300m at five sites (Stat. 413-418) with variable success gaining core lengths between 6m and less than 1m. In the evening we retrieved the BIGO-T lander (Stat. 419) and left transect A in northern direction to  $15^{\circ} 11,4'S/075^{\circ} 34,8'W$ .

Friday, 31-10-08

We reached the  $15^{\circ}N$ -Station (**Site B**, Fig. 2) in the afternoon and took a series of samples at the 500m contour comprising of two MULTI-CORER, one gravity corer and one CTD/RO cast (Stat. 420-23). Afterwards we left for  $11^{\circ}S$  to investigate a new depth transect. It was originally planned to investigate a transect in the vicinity of  $12^{\circ}S$  but the course of the 5miles coastal zone which limited our research area expands too far out due to some islands. In consequence we could not investigate water depths beyond 150m. Therefore we shifted our area of investigation to  $11^{\circ}S$  where we could sample a water depth up to 80m.

Saturday, 01-11-08

We arrived at our first station in  $11'S/078^{\circ}30'W$  at 21:00h (**Transect C**, Fig. 1) and started station work with a CTD/RO cast at 950m water depth (Stat. 424). This was followed by an upslope transect with multi-beam EM120 /EM710 and Parasound from Station 424 to about 85m water depth on the shelf interrupted by CTD/RO casts near the 700m, 800m, 500m, 300m, 200m, 15 0m and 85m depth contour (Stat. 425-36).

Sunday, 02-11-08

The multi-beam/Parasound- and CTD-survey line ended at 11:00h. Afterwards we turned  $180^{\circ}$  and steamed back down slope on another multi-beam/Parasound survey line slightly shifted to the South (Stat. 437). This transect was extended to water deeper than 1200m. At the end point of this track line we took a CTD/RO (Stat. 438) afterwards we drove another multi-beam/Parasound survey line slightly shifted to the North back up slope to 950m depth (Stat. 439) where we took a multi-corer sample (Stat. 440).

Monday, 03-11-08

During the night we made three CTD/RO casts with the in situ mass spectrophotometer built into the supporting frame of the rosette to measure di-nitrogen content in the benthic boundary layer water (Stat. 441-444). In the morning we shifted position to the 950m-station and took multi-corer samples (Stat. 445-448). We continued the multi-corer series upslope at 325m depth (Stat. 449-50). Afterwards we deployed a BIGO-Lander (Stat. 451). We then continued our up slope passage to the shallowest station in 85m to make a CTD/RO cast (Stat. 452). After the release of the first rosette water bottle the command unit of the CTD failed and the station had to be abandoned. Afterwards we drove our first OFOS-survey line down slope heading  $270^{\circ}W$  (Stat 453).

Tuesday, 04-11-08



We continued with another OFOS starting at 200m during the night (Stat. 454). Unfortunately we had to abandon the station since the flash of the digital photo camera failed. Therefore we changed to multi-corer sampling and took three samples by 475m (Stat. 455-57) and two samples by 730m (Stat. 458-59) as well as a further sample by 1200m (Stat. 460). In the afternoon we enlarged our multi-beam survey to the West and drove another transect down slope to the 2000m depth contour (Stat. 461). With this survey transect C was extended to more than 40nm covering a depth range from 85m to 2000m. A multi-corer sample at 2000m followed (Stat. 462). Afterwards we steamed back up slope to retrieve the BIGO Lander deployed the day before at 325m (Stat. 464). During the evening we changed gear to OFOS and started with a survey line at 325m (Stat. 465).

Wednesday, 05-11-08

During the night we continued with OFOS surveys at 400m and 600m (Stat. 466-67). The morning started with a CTD/RO cast at 150m (Stat. 468) followed by two multi-corer casts (Stat. 469-70). The afternoon was dedicated again to multi-corer sampling at 325m (Stat. 471-73). The BIGO Lander and the PROFI Lander were deployed in the evening at 725m (Stat. 474-475). Afterwards we started with a CTD/RO survey with the in situ mass-spectrometer attached to the gear at 400m (Stat. 476)

Thursday, 06-11-08

During the night we continued with CTD/RO survey at 300m, 200 and 100m (Stat. 477-79). The morning started with another CTD/RO cast at 300m (Stat. 480) followed by two multi-corer casts at 370m (Stat. 481-82). Afterwards we steamed down slope for three multi-corer casts at 725m (Stat. 483-85). We then retrieved the PROFI lander (Stat. 486) which was moored in a distance of three cables. We changed position again to 600m and took two more multi-corer samples (Stat. 487-88). Afterwards we returned to 725m to retrieve the BIGO Lander (Stat. 489). During the evening we changed to OFOS and started with a survey line at 500m (Stat. 490).

Friday, 07-11-08

During the night we continued the OFOS survey in down slope direction with survey tracks at 700m and 1000m (Stat. 491-92). In the morning we shifted from coaxial cable to wire to perform a series of gravity corer casts which started in deep water at 2020m (Stat. 493-94) and was continued up slope at 1200m (Stat. 495-96) and at 925m (Stat. 497). During the evening until early morning next day we undertook CTD/RO casts at 150m, 250m, 500m and 1000m (Stat. 498-501).

Saturday, 08-11-08

We continued our gravity corer sampling program in the early morning until the evening starting again at 925m (Stat. 502) afterwards we worked up slope at 700m, 500m, 300m and 150m (Stat. 503-12). In the evening we started a multi-beam/Parasound survey to enlarge the mapping of our investigation area to North and South of the 11°S-transect line (Sta. 513).

Sunday, 09-11-08

We continued the multi-beam/Parasound survey (Stat. 513) during the night until mid morning. We then steamed to the 600m contour where we deployed a BIGO-T lander (Stat.

514) which was followed by a CTD/RO cast two cables north of the lander position (Stat. 515). A series of multiple corers was taken up slope between 600m and 195m (Stat. 516-522).

Monday, 10-11-08

During the night we drove a series of OFOS transects at 480m, 340m and 200m (Stat. 523-526). This was followed during the day by the deployment of a BIGO lander by 395m (Stat. 526) and a lander with a micro electrode profiles (PROFI) by 990m (Stat. 527). After wards we retrieved the BIGO-T- lander deployed the day before (Stat. 528). We then left transect C and steamed about 40 nm to the North to start a new transect line.

Tuesday, 11-11-08

During the night and morning we mapped the new **transect line D** between 1100m and 150m with three multi-beam/Parasound transects in both in up slope and down slope direction (Stat. 529-531). At the shallowest part we made a CTD/RO cast and took two multi-corer samples (Stat. 532-34). We then steamed back to the transect C to retrieve the BIGO lander and Profiler deployed the day before (Stat. 535-36).

Wednesday, 12-11-08

We continued with OFOS-surveys at transect C during the night at 300m 200m and 100m (Stat. 537-39). We continued with multi-corer sampling in the shallowest region at 78m (Stat. 540-43). Afterwards we steamed to the 300m contour to deploy another BIGO-T lander (Stat. 544). We then moved further down slope and made three CTD/RO casts at 500m and 1000m (Stat. 545-47). In the evening we deployed a BIGO lander and took a multi-corer sample at 1000m (Stat. 548-49).

Thursday, 13-11-08

We returned to transect D and drove a series of OFOS transects during the night at 140m, 320m and 700m (Stat.550-552). This was followed during the morning by two multi-corer samples and two CTD/RO casts at 300m (Stat 553-56). During the afternoon we steamed back to transect C to retrieve the BIGO T and PROFI lander (Stat. 558-559).

Friday, 14-11-08

During the night three multiple-corer samples were taken around 450m (Stat. 559-561) followed by two OFOS survey lines around 300m and 500m (Stat. 562-63). During the day we continued with multi-corer sampling at 550m and 650m (Stat. 564-65). In the evening we deployed a BIGO-T lander by 300m and a PROFI lander by 765m (Stat. 566-67). We then drove up slope and deployed a BIGO lander by 85m (Stat. 568) followed by a CTD/RO cast at 185m (Stat. 569).

Saturday, 15-11-08

During the night we added a further multibeam/Parasound transect line enlarging our mapped area of transect C (Sta. 570). We continued with OFOS surveys at 635m and 400m (Stat. 571-72). During the day we worked around the 300m contour where we took two multi-corer samples (Stat. 573-74), made a CTD/RO cast (Stat. 575) and retrieved the BIGO-T

lander (Stat. 576). Afterwards we steamed to the shallowest position and retrieved the BIGO lander (Stat. 577).

Sunday, 16-11-08

The whole night was dedicated again to OFOS surveys at 200m, 500m and 600m depth (Stat. 578-80). Afterwards we switched to multiple corer sampling during the morning (Stat. 581-84). During the afternoon we retrieved the PROFI lander (Stat. 585) and deployed a BIGO-T lander at 316m depth (Stat. 586). Two multi-corer casts were performed at 200m Stat. (Stat. 587-588). Afterwards we changed position to a new transect line (**transect E**) where we continued multi-corer sampling by 500m (Stat. 589-90)

Monday, 17-11-08

Two OFOS surveys were driven at transect E during the night at 720m and 960m (Stat. 591-92). A series of five CTD/RO casts between 900m and 500m followed (Stat. 593-97). We returned to transect C to retrieve the BIGO-T lander (Stat. 598). Afterwards we returned to transect E and took two more CTD/RO samples (Stat. 599-600) and made four multi-corer casts on the mid slope (Stat. 601-04). Afterward we left transect E and steamed south to 12°32'S to start a new transect line (**transect F**).

Tuesday, 18-11-08

We started station work at transect F with two multi-beam/Parasound profiles in up slope and down slope direction (Stat. 605-606). During the day we took two multi-corer samples by 580m (Stat. 607-608), a CTD/RO cast by 300m (Stat. 609) and two more multi-corer casts by 400m (Stat. 610-611). An OFOS survey followed at 620m (Stat. 612).

Wednesday, 19-11-08

An additional multi-beam/Parasound profile was driven during the night to enlarge the sea floor mapping of transect F (Stat. 613). During the day we took a series of multi-corer samples and o CTD/RO casts along the transect line between 250m and 1085m (Stat. 614-23).

Thursday 20-11-08

During the night and morning we drove four OFOS transects at 700m 440m 250m and 160m (Stat. 624-27). Afterwards we continued with CTD/RO casts at 20m, 400m 600m 800m and 1000m (Stat. 628-32). With Station 632 we finished station work of M77 leg 1 in the afternoon.

Friday 21-11-08

During the night we steamed towards Callao where we docked in the morning around 08:00h. With the departure of the scientific crew in the afternoon Meteor cruise 77 leg 1 ended.

## 7. Station list

### Gear acronyms in the Station list

MB/PS	Multi beam/Parasound echosoudners
CTD/RO	CTD-Rosette water sampler
GC	gravity corer
MUC	TV multi-corer
OFOS	Ocean floor observation system
BIGO	Biogeochemistry laboratory-lander
BIGO-P	BIGO + pore water sampler
BIGO-T	BIGO +mass spec
PROFI	Lander + micro electrode profiler







Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
437	MB/PS 12	02.11.	11°0,011'	77°48,62'	16:22	100								
438	CTD/RO 16	03.11.	11°0,688'	78°35,025'	00:59	1261								
439	MB/PS 13	03.11.	11°0,780'	78°35,065'	02:22	1270								
440	MUC 14	03.11.	10°39,96'	78°30,05'	03:44	928	11°0,01'	10°39,05'	03:44	928				
441	CTD/RO 17	03.11.	11°0,00'	78°27,44'	05:23	797								
442	CTD/RO 18	03.11.	11°0,00'	78°26,290'	07:00	746								
443	CTD/RO 19	03.11.	11°0,00'	78°25,550'	08:26	695								
444	CTD/RO 20	03.11.	11°0,00'	78°24,65'	09:55	645								
445	MUC 15	03.11.	10°59,98'	78°30,02'	12:23	928	10°59,997'	78°30,022'	12:52	928				
446	MUC 16	03.11.	11°0,44'	78°30,06'	13:50	932	11°0,02'	78°30,06'	14:17	932				
447	MUC 17	03.11.	10°59,99'	78°30,48'	15:05	928	11°0,03'	78°30,03'	15:30	935				
448	MUC 18	03.11.	10°59,97'	78°30,04'	16:16	926	10°59,97'	78°30,05'	16:36	928				
449	MUC 19	03.11.	11°0,00'	78°09,97'	19:28	315	11°0,01'	78°09,97'	19:41	319				
450	MUC 20	03.11.	10°59,98'	78°10,04'	20:25	319	10°59,99'	78°10,00'	20:35	315				
451	BIGO 1	03.11.	11°00,00'	78°09,84'	23:28	319	11°00,00'	78°09,92'	23:41	315				
452	CTD/RO 21	04.11.	11°00,04'	77°98,18'	02:26	90,9								
453	OFOS 4	04.11.	11°00,00'	77°47,97'	03:11	90	11°00,00'	77°47,97'	03:17	83	11°00,00'	77°48,43'	04:48	92



Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
454	OFOS 5	04.11.	11°00,00'	78°01,00'	06:12	189	11°00,00'	78°01,04'	06:20	192	11°00,00'	78°01,92'	07:46	202
455	MUC 21	04.11.	11°00,01'	78°19,24'	11:30	465	11°00,00'	78°19,23'	11:48	466				
456	MUC 22	04.11.	11°00,01'	78°19,23'	12:30	465	11°00,013'	78°19,234'	12:50	465				
457	MUC 23	04.11.	11°,00,05'	78°19,26'	13:19	467	11°00,02'	78°19,24'	13:32	467				
458	MUC 24	04.11.	11°00,12'	78°25,59'	14:43	698	11°00,05'	78°25,64'	15:01	700,5				
459	MUC 25	04.11.	11°00,02'	78°25,6'	15:40	698	11°00,03'	78°25,60'	16:00	697				
460	MUC 26	04.11.	11°00,01'	78°35,16'	17:24	1245	11°00,01'	78°35,11'	17:56	1242				
461	MB/PS 14	04.11.	11°00,03'	78°35,3'	18:36	1259								
462	MUC 27	04.11.	10°59,999'	78°44,7'	20:17	2020	10°59,97'	78°44,76'	21:05	2025				
463	CTD/RO 22	04.11.	11°00,008'	78°44,864'	22:24	2030,5								
464	Lander	05.11.	10°59,79'	78°10,01'	03:37	318,1								
465	OFOS 6	05.11.	11°00,093'	78°09,452'	04:27	310	11°00,094'	78°9,450'	04:39	309	10°59,983'	78°10,042'	05:41	317
466	OFOS 7	05.11.	11°00,005'	78°14,785'	06:31	385	10°59,966'	78°14,883'	06:50	386	10°59,990'	78°16,012'	09:17	407
467	OFOS 8	05.11.	10°59,986'	78°22,989'	10:22	575	10°59,966'	78°23,027'	10:41	575	10°59,990'	78°24,511'	12:43	673
468	CTD/RO 23	05.11.	11°00,047'	77°56,645	15:50	145,5								
469	MUC 28	05.11.	11°00,06'	77°56,6'	16:28	145	11°00,03'	77°56,58'	16:37	145				
470	MUC 29	05.11.	11°00,00'	77°56,61'	17:08	143	11°00,02'	77°56,60'	17:16	145				

Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
471	MUC 30	05.11.	11°00,007'	78°9,938'	18:47	316,5	11°0,00'	78°9,924'	18:59	320				
472	MUC 31	05.11.	11°00,02'	78°9,96'	19:35	320	11°00,01'	78°9,96'	19:46	318				
473	MUC 32	05.11.	11°0,03'	78°9,95'	20:25	316	11°0,01'	78°9,94'	20:35	317				
474	BIGO 2	05.11.	11°0,01'	78°25,48'	22:35	693	11°0,01'	78°25,55'	23:03	695				
475	PROFI 1	05.11.	11°0,01'	78°25,91'	01:25	723	11°0,02'	78°25,98'	01:56	727				
476	CTD/RO 24	06.11.	11°0,1'	78°15,20'	03:52	391,7								
477	CTD/RO 25	06.11.	11°0,02'	78°8,457'	05:51	302								
478	CTD/RO 26	06.11.	10°59,997'	78°1,572'	0,3194	198								
479	CTD/RO 27	06.11.	11°	77°49,22'	09:46	92								
480	CTD/RO 28	06.11.	11°00,003'	78°08,415'	12:18	297,2								
481	MUC 33	06.11.	11°0,01'	78°14,15'	13:53	376	11°0,00'	78°14,19'	14:04	376				
482	MUC 34	06.11.	11°0,02'	78°14,17'	14:51	375	11°0,01'	78°14,17'	14:51	375				
483	MUC 35	06.11.	10°59,71'	78°25,98'	16:20	723	10°59,78'	78°25,78'	16:48	721				
484	MUC 36	06.11.	10°59,74'	78°25,98'	17:32	720	10°59,74'	78°25,96'	17:52	722				
485	MUC 37	06.11.	10°59,75'	78°25,98'	18:31	721	10°59,74'	78°25,96'	18:51	720				
486	PROFI 2	06.11.	10°59,76'	78°26'	19:30	721,3								
487	MUC 38	06.11.	11°00,00'	78°23,17'	20:27	579	11°00,00'	78°23,17'	20:42	579				

Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
488	MUC 39	06.11.	11°00,02'	78°23,18'	21:27	580	11°00,02'	78°23,17'	21:45	579				
489	BIGO 2	06.11.	11°00,29'	78°25,71'	23:40									
490	OFOS 9	07.11.	11°	78°19,9'	00:40	483	10°59,98'	78°19,98'	01:00	485	10°59,97'	78°23,01'	06:12	577
491	OFOS 10	07.11.	11°	78°24,35'	07:11	628	10°59,97'	78°24,35'	07:38	627	10°59,99'	78°21,521'	10:14	755
492	OFOS 11	07.11.	11°	78°31,015'	11:21	988	10°59,99'	78°31,04'	11:48	990	11°	78°31,57	12:22	1022
493	GC 8	07.11.	10°59,97'	78°44,79'	14:44	2020	11°00,01'	78°44,81'	15:06	2025				
494	GC 9	07.11.	11°0,025'	78°44,80'	16:25	2020	11°0,01'	78°44,81'	16:42	2024				
495	GC 10	07.11.	10°59,96'	78°34,44'	18:35	1195	11°0,01'	78°34,39'	19:00	1194				
496	GC 11	07.11.	11°0,01'	78°34,39'	20:02	1192	11°0,01'	78°34,38'	20:25	1197				
497	GC 12	07.11.	11°0,01'	78°30,05'	20:54	932,5	11°0,01'	78°30,05'	21:58	930				
498	CTD/RO 29	08.11.	11°0,030'	77°55,997'	01:54	138,8								
499	CTD/RO 30	08.11.	11°0,02'	78°5,29'	03:49	249								
500	CTD/RO 31	08.11.	11°0,01'	78°20,21'	05:46	487,6								
501	CTD/RO 32	08.11.	11°	78°31'	08:52	988								
502	GC 13	08.11.	11°0,01'	78°30,05'	11:09	929	11°	78°30,05'	11:29	930				
503	GC 14	08.11.	11°	78°25,65'	12:49	698,4	11°	78°25,65'	13:01	697,5				
504	GC 15	08.11.	11°0,01'	78°25,67'	13:43	699,2	11°0,01'	78°25,65'	14:02	700				

Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
505	GC 16	08.11.	11°0,01'	78°25,66'	14:38	700,6	11°0,004'	78°25,652'	14:55	698,9				
506	GC 17	08.11.	11°	78°21,14'	16:04	520	11°	78°21,13'	16:14	522,7				
507	GC 18	08.11.	11°0,03'	78°21,13'	17:03	520	11°0,01'	78°21,13'	17:13	522,2				
508	GC 19	08.11.	11°0,03'	78°14,19'	18:29	376	11°0,03'	78°14,19'	18:35	379				
509	GC 20	08.11.	11°0,03'	78°17,18'	0,8056	379	11°0,04'	78°14,17'	0,8104	397				
510	GC 21	08.11.	11°0,02'	78°13,31'	20:06	365,7	11°0,023'	78°13,314'	20:16	365	11°0,024'	78°13,317'	20:18	365
511	GC 22	08.11.	11°0,05'	77°56,61'	22:19	144	11°0,05'	77°56,61'	22:23	146				
512	GC 23	08.11.	11°0,05'	77°56,61'	22:48	143,5	11°0,05'	77°56,61'	22:55	144				
513	MB/PS 15	08.11.	10°99,74'	77°92,44'	23:55	138,9								
514	BIGO-T 2	09.11.	10°59,99'	78°23,54'	17:46	592	11°0,002'	78°23,548'	18:15	594,2				
515	CTD/RO 33	09.11.	10°59,813'	78°23,547'	19:08	595,6								
516	MUC 40	09.11.	10°59'	78°21'	20:43	513	11°	78°20'	21:29	511,6				
517	MUC 41	09.11.	11°0,1'	78°20,92'	22:23	510	11°	78°20,91'	22:54	511				
518	MUC 42	10.11.	11°0,01'	78°16,3'	01:03	411,6	11°0,01'	78°16,3'	01:16	412				
519	MUC 43	10.11.	11°0,01'	78°16,28'	01:54	410	11°0,01'	78°16,29'	02:04	410				
520	MUC 44	10.11.	11°0,02'	78°1,87'	03:53	196	11°0,01'	78°1,87'	04:00	195				
521	MUC 45	10.11.	11°	78°1,86'	04:27	195	11°0,01'	78°1,86'	04:35	195				

Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
522	MUC 46	10.11.	11°0,02'	78°1,88'	05:03	198	11°0,02'	78°1,88'	05:10	195				
523	OFOS 12	10.11.	11°	78°20'	07:05	481	11°	78°20'	07:25	482	11°	78°18,9'	08:55	461
524	OFOS 13	10.11.	11°	78°11,5'	10:10	340	11°	78°11,485'	10:26	340	11°	78°10,61'	11:27	329
525	OFOS 14	10.11.	11°	78°2,5'	12:40	202	11°	78°2,5'	12:55	206	11°	78°2,29'	13:11	200
526	BIGO 3	10.11.	11°	78°15,27'	18:32	395,9	11°0,022'	78°15,27'	18:47	397,3				
527	PROFI 2	10.11.	11°	78°30,98'	0,8813	990,4	11°	78°30,981'	0,9111	999,8				
528	BIGO-T 2	10.11.	10°59,81'	78°23,62'	23:29	594								
529	MB/PS 15	11.11.	10°30,07'	79°0,12'	04:03	1091								
530	MB/PS 16	11.11.	10°15,90'	78°38,98'	08:30	143								
531	MB/PS 17	11.11.	10°29,84'	79°0,49'	12:42	1100								
532	CTD/RO 34	11.11.	10°15,94'	78°38,67'	17:25	143								
533	MUC 47	11.11.	10°16'	78°38,9'	18:30	140	10°16'	78°38,9'	18:35	142,5				
534	MUC 48	11.11.	10°15,9'	78°38,8'	19:11	140	10°15,8'	78°38,8'	19:18	140				
535	BIGO 3	12.11.	10°59,85'	78°15,38'	00:10	396,4								
536	PROFI 2	12.11.	10°59,95'	78°31,1'	02:40	1061								
537	OFOS 15	12.11.	11°	78°10,76'	05:15	332	11°	78°10,77'	05:30	332	11°	78°9,83'	06:51	317
538	OFOS 16	12.11.	11°	78°2,36'	08:00	202	11°	78°02,35'	08:11	202	11°	78°1,83'	08:56	196



Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
556	CTD/RO 39	13.11.	10°25,547'	78°53,247'	15:43	314,9								
557	BIGO-T 3	13.11.	11°	78°09,15'	22:10	306								
558	BIGO 4	14.11.	10°59,85'	78°31,4'	00:56	1016								
559	MUC 56	14.11.	11°0,02'	78°18,02'	03:24	446	11°0,03'	78°17,97'	03:36	444				
560	MUC 57	14.11.	11°0,04'	78°17,98'	04:05	445	11°0,01'	78°17,97'	04:17	445				
561	MUC 58	14.11.	11°0,01'	78°17,94'	04:45	445	11°0,02'	78°17,96'	04:58	445				
562	OFOS 21	14.11.	11°10'	78°06,97'	07:00	327	11°10,02'	78°06,99'	09:12	331	11°09,54'	78°06,2'	10:14	313
563	OFOS 22	14.11.	11°14,96'	78°16,53'	11:47	550	11°14,95'	78°16,51'	12:09	551	11°14,63'	78°15,77'	13:06	530
564	MUC 59	14.11.	11°14,6'	78°15,8'	14:39	526	11°14,5'	78°15,7'	14:55	527				
565	MUC 60	14.11.	11°7,99'	78°21,41'	16:20	650	11°8'	78°21,4'	16:39	640				
566	BIGO-T 4	14.11.	11°	78°9,12'	19:05	306	11°	78°9,13'	19:17	309				
567	PROFI 3	14.11.	10°59,99'	78°26,58'	21:22	765	11°	78°26,52'	21:55	765,0				
568	BIGO 5	15.11.	11°	77°47,72'	02:05	82	11°0,02'	77°47,72'	02:14	85				
569	CTD/RO 40	15.11.	11°6,491'	77°58,201'	03:59	184,5								
570	MB/PS 18	15.11.	11°6'	77°58'	04:50	188								
571	OFOS 23	15.11.	11°16,18'	78°18,72'	10:25	635	11°16,2'	78°18,73'	10:48	634,0	11°15,183'	78°16,91'	13:02	564
572	OFOS 24	15.11.	11°12,76'	78°11,51'	14:15	407	11°12,78'	78°11,45'	14:33	403	11°12,61'	78°11,1'	15:04	398

Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
573	MUC 61	15.11.	11°9,8'	78°5,5'	16:22	304	11°9,9'	78°5,5'	16:32	309				
574	MUC 62	15.11.	11°10,02'	78°5,54'	17:05	305	11°1'	78°5,53'	17:13	303				
575	CTD/RO 41	15.11.	10°59,77'	78°9,19'	20:06	303,9								
576	BIGO-T 4 Re.	15.11.	10°59,96'	78°09,26'	21:30	314								
577	BIGO 5	16.11.	10°59,82'	77°47,72'	01:04									
578	OFOS 25	16.11.	11°7,01'	77°59,4'	02:46	205	11°7,02'	77°59,35'	02:56	197	11°06,54'	77°58,32'	04:20	184
579	OFOS 26	16.11.	11°14,47'	78°14,86'	06:20	502	11°14,47'	78°14,86'	06:37	501	11°14,05'	78°13,96'	08:02	473
580	OFOS 27	16.11.	11°16,75'	78°19,75'	09:13	680	11°16,75'	78°19,75'	09:41	682	11°16,17'	78°18,67'	11:01	633
581	MUC 63	16.11.	11°11,2'	78°8,15'	12:48	352	11°11,2'	78°8,12'	12:57	351				
582	MUC 64	16.11.	11°9,7'	78°4,93'	13:51	299	11°9,69'	78°4,88'	14:01	291				
583	MUC 65	16.11.	11°6,856'	78°3,11'	14:51	250	11°6,86'	78°3,06'	15:00	248				
584	MUC 66	16.11.	11°7'	77°59,3'	15:52	200	11°7'	77°59,3'	16:00	198				
585	PROFI 3	16.11.	10°59,91'	78°26,62'	19:30	765								
586	BIGO-T 5	16.11.	10°59,99'	78°9,4'	22:05	315	11°	78°9,4'	22:19	316				
587	MUC 67	16.11.	11°0,01'	78°1,87'	23:17	205	11°	78°1,85'	23:34	203				
588	MUC 68	17.11.	11°	78°1,86	00:01	198	11°0,01'	78°1,86	00:08	204				
589	MUC 69	17.11.	11°14,27'	78°14,66'	02:37	495	11°14,29'	78°14,62'	02:51	494				





Station No.	Gear No.	Date 2008	Position		Time [UTC]	Depth [m]	Position at bottom		Time [UTC]	Depth [m]	Position off bottom		Time [UTC]	Depth [m]
			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]			Lat. [°S]	Long. [°W]		
607	MUC 75	18.11.	12°32,5'	77°30,5'	16:29	583	12°32,5'	77°30,5'	16:45	584				
608	MUC 76	18.11.	12°32,55'	77°30,47'	17:02	584	12°32,53'	77°30,49'	17:36	584				
609	CTD/RO 49	18.11.	12°25,81'	77°24,9'	19:06	294								
610	MUC 77	18.11.	12°29,5'	77°27'	20:40	418	12°29,5'	77°27'	20:51	418				
611	MUC 78	18.11.	12:29,47'	77°27,96'	21:18	417	12°29,45'	77°27,95'	21:46	418				
612	OFOS 30	18.11.	12°33,07'	77°30,64'	22:39	620	12°33,2'	77°30,62'	23:03	622	12°31,28'	77°29,15'	01:48	487
613	MB/PS 21	19.11.	12°32,12'	77°30,14'	02:30	558								
614	MUC 79	19.11.	12°25,6'	77°24,8'	14:37	290	12°25,6'	77°24,8'	14:43	290				
615	MUC 80	19.11.	12°25,58'	77°24,86'	15:13	290	12°25,56'	77°24,83'	15:21	289				
616	MUC 81	19.11.	12°22,69'	77°29,06'	18:46	302	12°22,69'	77°29,05'	18:55	302				
617	MUC 82	19.11.	12°22,69'	77°29,05'	19:21	302	12°22,71'	77°29,05'	19:30	303				
618	CTD/RO 50	19.11.	12°18,628'	77°19,157'	20:59	149								
619	MUC 83	19.11.	12°18,6'	77°19,2'	21:30	151	12°18,6'	77°19,1'	21:37	152				
620	MUC 84	19.11.	12°18,62'	77°19,2'	22:08	150	12°18,62'	77°19,2'	22:13	150				
621	MUC 85	20.11.	12°32,75'	77°34,75'	00:25	820	12°32,757'	77°34,757'	00:56	823,1				
622	MUC 86	20.11.	12°32,74'	77°34,73'	01:35	819	12°32,75'	77°34,74'	01:57	819				
623	MUC 87	20.11.	12°38,16'	77°34,58'	03:03	1085	12°38,18'	77°34,59'	03:32	1085				

