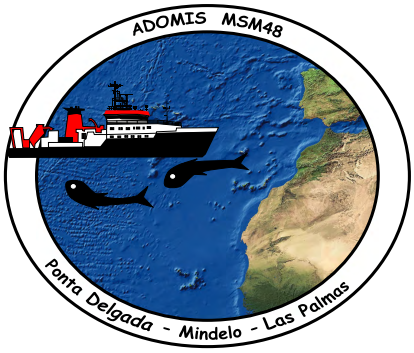
Dr. Karin Zonneveld

MARUM Center for marine environmental Sciences
Leobener Straße
D-28359 Bremen
Germany

Tel.: +49 421 218 65797
Fax: +49 421 218 9865974
email: kzonneveld@marum.de



Short Cruise Report
Maria S. Merian MSM 48

Ponta Delgada – Las Palmas
02.11.2015 – 25.11.2015
Chief Scientist: Karin Zonneveld
Captain: Ralf Schmidt

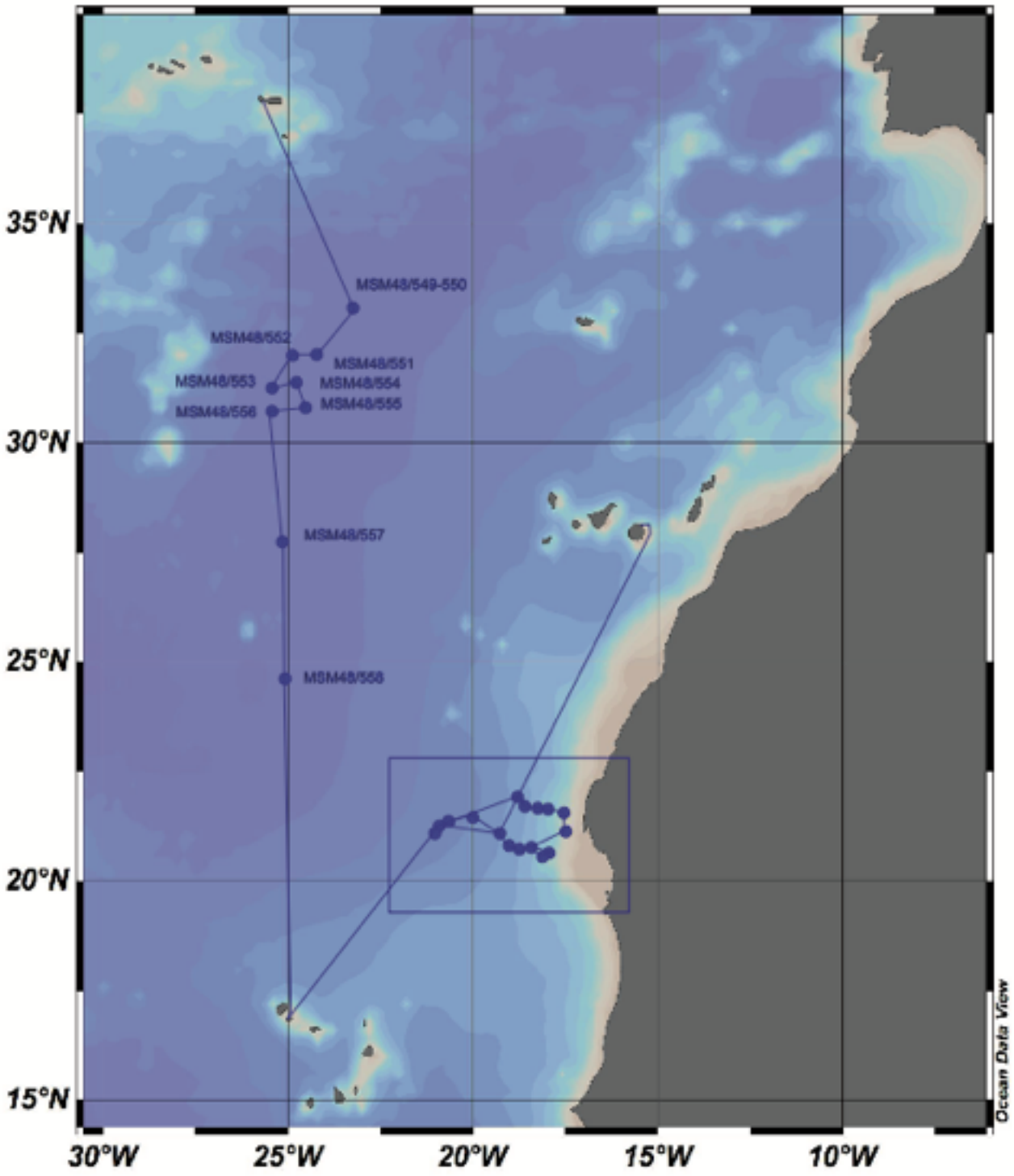


Figure 1. Map depicting cruise track and station positions.

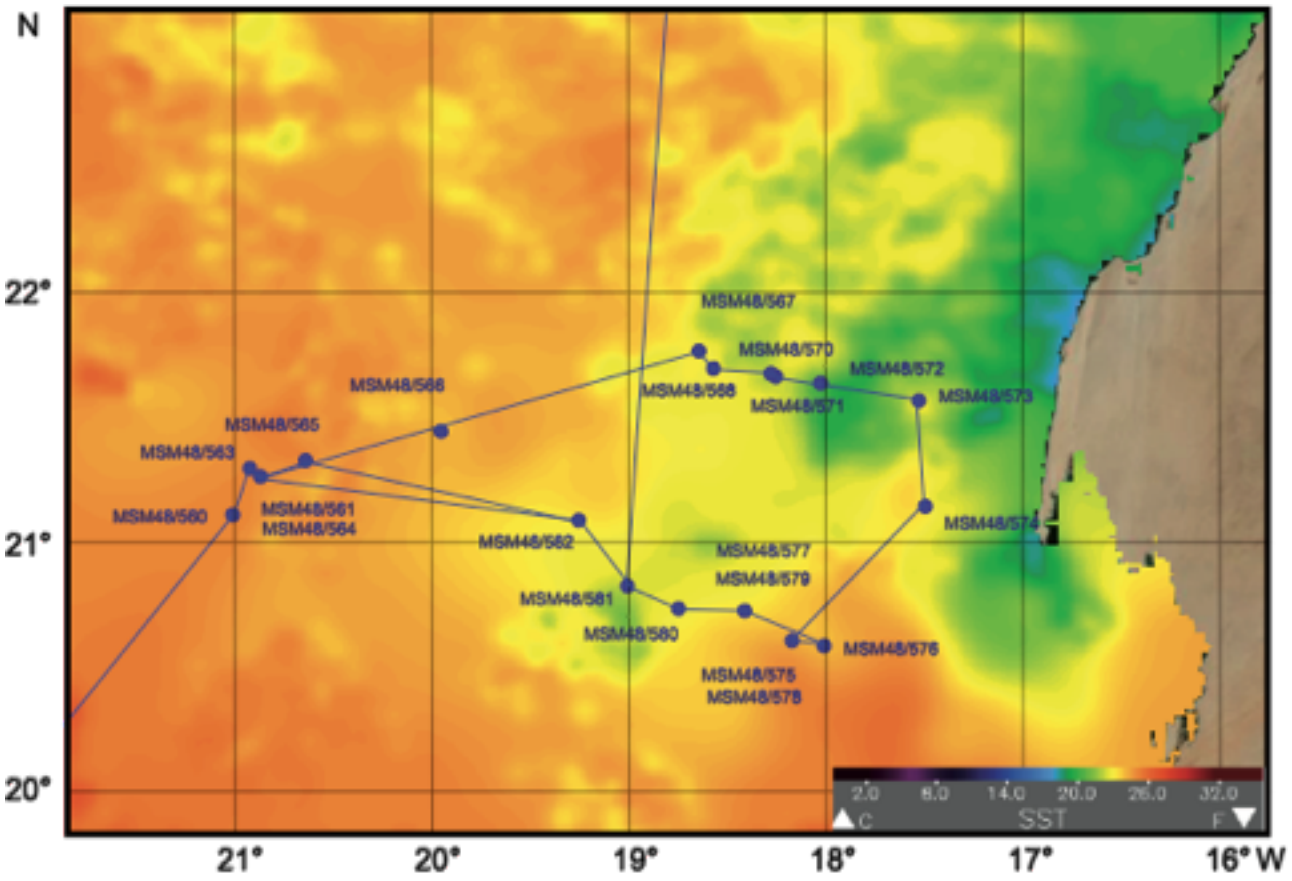


Figure 2. Map depicting satellite derived sea surface temperatures at 17. November 2015, cruise track and station positions. SST graph derived from http://podaac-tools.jpl.nasa.gov.

Objectives

The scientific activities of cruise MSM 48 focussed on several aspects of the carbon cycle namely the process of bioproduction in the upper water column and the relocation and degradation of organic matter during the settling process, at the sediment water interface and in downcode sediments. The cruise bundled the scientific questions of five different research programs which are currently carried out at the University of Bremen, the Center for Marine Environmental Sciences (MARUM-Bremen) and the Royal Netherlands Institute of Sea Research (NIOZ). These research programs excellently compliment each other and have a strong common need for samples and data from the region off NW Africa and the Madeira Abyssal Plain. The following main objectives were addressed:

1. Determine the rate and characterize the composition of terrestrial dust input, which is a major fertilizer, in the ocean.
2. Characterize the composition and growth of the pelagic microbial, archaeal, coccolithophorid and cyst producing dinoflagellate community compositions in relationship to environmental conditions.
3. Determine the winter-season assemblage composition and vertical habitat structuring of planktonic foraminifera along upper water environmental gradients and collect specimens of rare species to investigate the genetic fingerprinting of the group.
4. Characterize the transport and selective degradation of particular organic matter of known origin (dinoflagellate cysts and microbial communities) in the water column in relationship to different oxygen concentrations and the presence of nepheloid layers.
5. Determine growth rates of benthic microbial communities and turnover rates of microbial lipids in marine sediments in relation to different oxygen gradients.
6. Determine the species-specific degradation rates of dinoflagellate cysts in relationship to differential oxygen concentrations in the upper sediments.

Research activities were carried out on the continental margin off Cape Blanc (NW Africa) and the Madeira Abyssal Plain.
The region off NW Africa is one of the world's most productive regions due to the presence of year-round upwelling und terrestrial dust input that fertilizes the ocean with nutrient and trace elements such as iron and phosphorus. A considerable part of the biomass produced in the photic zone sinks to the deep sea in the form of aggregates, fecal pellets and marine snow. Particles are transported both vertically and laterally, the latter can occur in nepheloid layers which position and extent varies through time.
The Madeira Abyssal Plain is an unique sedimentary system characterized by the frequent deposition of turbidite sediments that originate from the high productivity regions of the northwest African continental shelf. The sediments are deposited as nearly perfectly mixed layers on the abyssal plain at a depth of about 5420 m. Being re-exposed to well ventilated bottom-waters, bottom-water oxygen penetrated the sediments and created a downward migrating oxidation front. Deposition of a new turbidite stops oxygen diffusion and a so-called fossil oxidation front remains. The penetration of oxygen into the turbidites resulted in the destruction of organic matter originally present in the oxidized part of the turbidites whereas the unoxidized parts remained virtually unaffected. Comparing the compositional differences over the fossilized oxidation front between the oxidized and unoxidized parts of the turbidites provides the unique situation to obtain insight into the effect of aerobic degradation in natural settings.

Results of the cruise will lead to a better understanding of the processes that influence upper water bioproductivity, transport and preservation of organic matter particles in the water column and degradation and preservation of organic matter in ocean sediments.

Narrative

During the night of 1 and 2 November the majority of the scientific party of cruise MSM48 arrived in Ponta Delgada and boarded the RV Maria S. Merian after several hours of delay. The scientific crew consisted of geologists, sedimentologists, organic-geochemists, micropalaeontologists, nannoplankton researchers and palynologists that are hosted at the Geoscience department of the University of Bremen, MARUM Center for marine environmental Sciences in Bremen, AWI, Alfred-Wegener-Institute Bremerhaven, and NIOZ, Royal Netherlands Institute of Sea Research (Texel, The Netherlands).

The RV Maria S. Merian left port in the early morning of 2th November to head south-east into the direction to the Madeira Abyssal plain. After a transit of 24 hours the first station was reached at the southern edge of the Azores Front and the northern edge of the Madeira Abyssal plain. Station work was started by collecting plankton samples from the upper 700m of the water column with a multinet, characterization of the physical characteristics of the water column with a CTD/Rosette system and by collecting sediment samples from the ocean floor at a depth of 5396m with a Multicoring device. Although these sediments were deposited way below the carbon compensation depth where the large majority of biogenic carbonates are being dissolved, the sediments contained a rich assemblage of calcareous microfossils including planktonic and benthic foraminifera, coccolithophorids and calcareous dinoflagellates. The sediments consisted of very fine clay minerals and had a vey high water content. Station work at the first station was finished after collecting suspended microbial particles from the water column at subsurface and from 5000m depths.

In the following days from the 4th to 9th of November, three west-east transects located in the northern, middle and southern part of the Madeira Abyssal Plain were studied. In focus was the collection of downcore material with a gravity coring system. The sediments deposited at a depth of 5420m, consist of a series of sapropels that have a volcanic origin or consist of calcareous or organc-rich particles. Our special interest became the organic rich sapropels that were deposited as nearly perfectly mixed layers. The upper parts of these sapropels have been oxidized by downward diffusing oxygen. Comparison of the organic-geochemical, microbial, palynological and chemical difference between the reduced and oxidized parts of the sapropels provides information about the character, rate and effects of aerobic degradation processes in natural settings as well as the biological entities of the degraders. We notably focused on the collection of an undisturbed oxidation front in the uppermost sapropel (the so-called a-sapropel) where the downward moving oxidation front is still active. Furthermore we were highly interested in collection of the so-called f-sapropel that is positioned at 7m below the ocean floor. This sapropel is especially suited for our research activities as the oxidation front moved downward to a position way below the bioturbation zone before the process was stopped by deposition of the e-sapropel leaving a fossil oxidation front imprinted in the sediments.
The coring program was extremely successful with a maximal harvest of cores on all stations varying from 9 – 11m in length. Opening and line-scanning of the cores on board revealed that we were able to collect the f-sapropel in all collected cores and an undisturbed oxidation front of the a-sapropel in the large majority of the cores. The upper a-turbidite that contains the still active oxidation front, has been collected by Multi-coring on all stations as well.
Apart from the coring program the water column was sampled and characterized along a north south gradient. First the watercolumn characteristics were determined through the deployment of the ships-own CTD system. Successively planktonic foraminifera were collected at selected depth intervals in the upper 700m of the water column with a multinet followed by simultaneous collection of particulate organic matter at selected water depths with three in-situ pump systems. The characterization and water column-sampling program was continued southward at the 10th and 11th of November as the ship headed south into the direction of the Cape Verden Islands.

In the late evening of the 11th of November a transit towards Mindelo (Cape Verden Islands) was started. The harbor of this city was reached in the early morning of the 13th of November. After a few hours in port where our scientific team was extended with three dutch scientists from the Royal Netherlands institute of sea research, the RV Maria S. Merian left port at 14:00 to take a north-eastward course into the direction of the coastal upwelling area off Cape Blanc (NW Africa).

After a transit of 28 hours the RV Maria S. Merian reached the station positioned in the vicinity of

the dust-buoy “Carmen”. This buoy is positioned 217 seemiles off Cape Blanc. In this region the north-east passate winds can transport large amounts of dust that have an origin in the Sahara Desert. This dust contains large amounts of nutrients and trace elements that form important fertilizers of the upper ocean. It influences both biological as well as sedimentological processes. Carmen has collected atmospheric dust over a one-year period in intervals that are similar to those of the MARUM sediment trap series “CB” that collects the downward flux of particles at water depths of about 1000m and 3000m since 1988, as such being the world-wide longest sediment trap time series.
During the night of 14/15 November the water column in the vicinity of Carmen was characterized and sampled. The good weather allowed that in the morning of 15 November a start could be made by the collection of the buoy. After successful connection of cables at both sides of the buoy, she could be moved by the RV Maria S. Merian to her anchor position. There she was lifted on deck, de-coupled from her ground-bound cable and replace by a floating dummy. Successively the upper part of the buoy, the so called “tower” which contained the actual dust collectors, could be detached and transported into the hangar where servicing started immediately. The next day the dust collecting system was cleaned, and repaired where needed. In the mean time a start was made with the next research program that focused on the upwelling area of the Cape-Blanc region. Here samples and data were collected along two onshore-offshore transects that cover gradients of upper water bioproductivity and bottom water oxygen concentrations.
At the 16th of November a start was made by investigating the water column characteristics of the most offshore positions of both transects with the CTD/Rosette system. Focus lied on the localization of nepheloid layers in the water column as well as the mapping of the extension and location of the oxygen minimum zone.
On the 17th of November the Maria S. Merian returned to the anchor position of buoy Carmen. After the servicing of the dust collector had finished in the early afternoon, the tower was replaced on the buoy. Now the dummy could be replaced by the cleaned and repaired Carmen. In the early evening a successful return of the buoy to her sampling position could be achieved and course was set to the most offshore station at the northern transect.

In the following three days (18th to 20th November) research activities were carried out along the northern onshore-offshore transect. Did the research activities in the Madeira Abyssal Plain region concentrated on the study of fossil oxidation sedimentary fronts in downcore sediments, the focus in the Cape Blanc area was to study the active oxidation fronts in upper sediments and the transport and preservation of organic matter in the water column in relationship to the presence of nepheloid layers and different ambient oxygen concentrations. For this physical characteristics of the water column, the position and extension of the nepheloid layers were characterized by the CTD system. Simultaneously the Rosette system was used to collected water across oxygen gradients for oxygen, carbon and nitrogen isotopic analyses as well as to determine the composition and/or concentration of dissolved organic carbon, trace elements, the coccolithophorid and the microbial community. At every station, particulate organic particles and the microbial community as well as the palynological assemblage were sampled with in-situ pump systems from the prominently present nepheloid layers that could be localized at subsurface, intermediate and near bottom depths. Furthermore surface sediments were sampled with the multicoring device. Direct after recovery of the sediments, the upper sedimentary pore-water oxygen concentration was measured using a clark-type oxygen microsensor system. In the 19th of November the first deployment of a floating sediment could be realized, This trap collected the particle flux over a time period of 24 hours at depths of 50m, 100m and 400m. The trap could successfully be recovered in the evening of the 20th of November. Similar research activities continued at the southern transect on 21th and 22th of November. On this transect it was possible to deploy the floating sediment trap at two locations, one at the edge of an active upwelling cell, the second at the most distal position of the southern transect. Research activities of this second part of the cruise were again extremely successful with a near-maximal recovery of data and material of all deployed devices. Research activities ended in the morning of 23th of November by collecting the floating trap, after which the transit towards Las Palmas was started. The RV. Maria S. Merian entered this port in the early morning of 25 November.

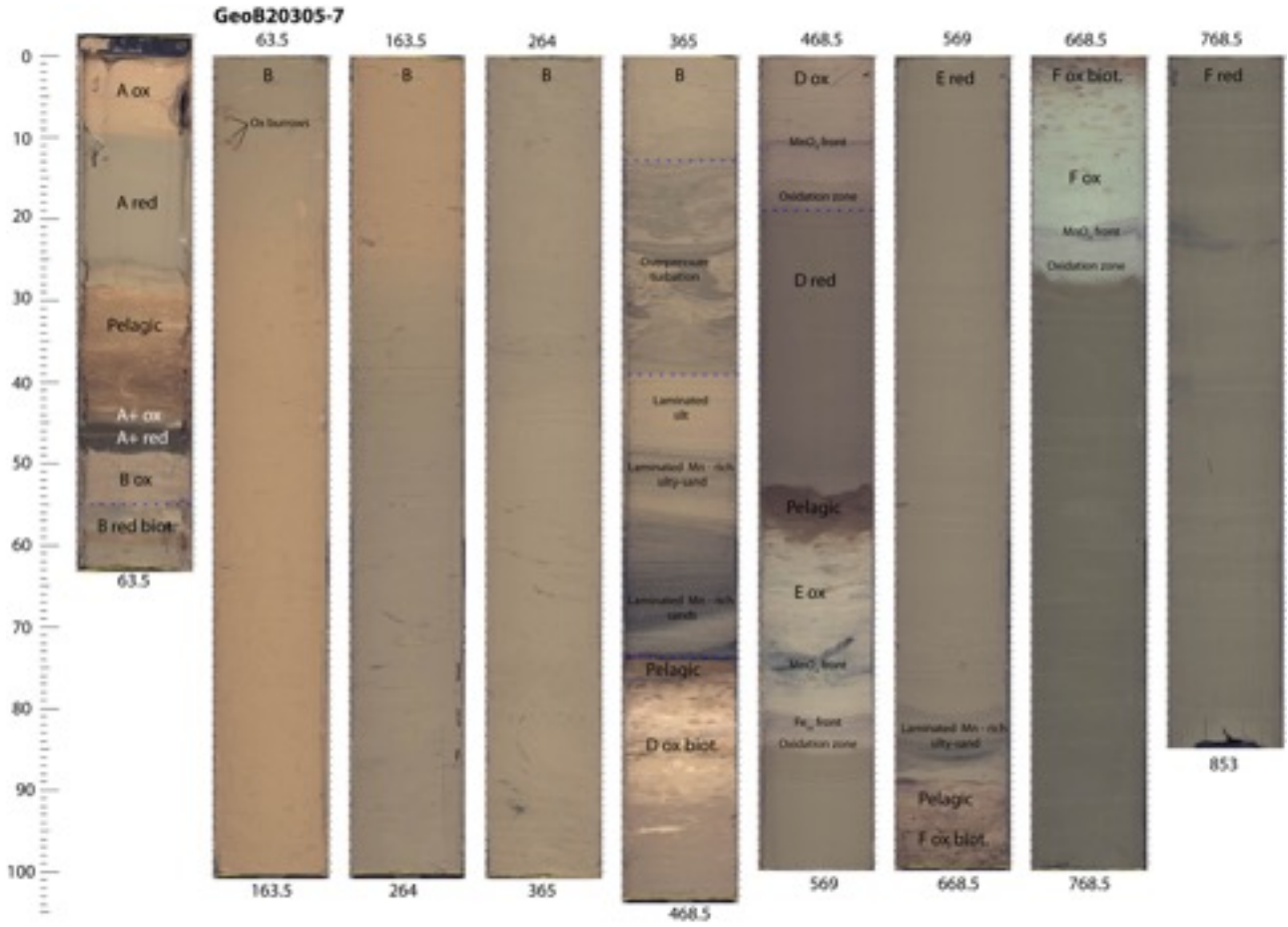


Figure 3. Composite line-scan of Sediment core GeoB 20305-7 (Northern Madeira Abyssal plain). A-F represent the different turbiditic deposits. Ox = oxidized part, red=reduced parts.

Figure 4. RV. Maria S. Merian transports buoy “Carmen” towards her anchor point.

Acknowledgements

The scientific crew of cruise MSM48 thanks Captain Schmidt and his crew for their great flexibility, their technical assistance and by creating an very pleasant working atmosphere that substantially contributed to the success of this cruise. We also appreciate the support by the Leitstelle Deutsche Forschungsschiffe at the University of Hamburg. The expedition was funded by the Deutsche Forschungsgemeinschaft.

Teilnehmerliste

Name	Discipline	Institution
Karin Zonneveld	Chief Scientist	MARUM
Mario Albert	Palynology/Sedimentology	MARUM
Barbara Donner	Micropalaeontology	MARUM
Friederike Ebersbach	Organic Geochemistry	MARUM
Carmen Friese	Sedimentology	MARUM
Daniel Gray	Palynology	MARUM
Catarina Guerreiro	Nannaoplankton	Univ. Bremen
Marco Klann	Marine Geology/logistics	MARUM
Bob Koster	Sedimentology	NIOZ
Birgit Lübben	Micropalaeontology/Palaecoenography	MARUM
Mara Maeke	Micropalaeontology/Palaecoenography	MARUM
Fiona Rochholz	Micropalaeontology/Palaecoenography	MARUM
Annegret Rüßbult	Palynology	MARUM
Lóránd Silye	Micropalaeontology/Palaecoenography	MARUM
Jan-Beerend Stuut	Sedimentology	NIOZ
Finn Schwentner	Micropaleontology	MARUM
Gerard Versteegh	Organic Geochemistry	AWI
Yvo Witte	Sedimentology	NIOZ
Weichao Wu	Organic Geochemistry	MARUM

Station list MSM 48

Station Ship No.	Station GeoB No.	Date	Device	Time [UTC] seafloor / maximum wire length	Latitude [N]	Longitude [W]	Water depth [m]
549-1	20301-1	03.11.15	MN	11:20	33°04.997'	23°15.984'	5397
549-2	20301-2	03.11.15	MUC	14:37	33°04.970'	23°15.985'	5396
550-1	20301-3	03.11.15	CTD	17:26	33°04.729'	23°17.139'	5398
550-2	20301-4	03.11.15	ISP	21:30	33°04.727	23°17.138'	5397
551-1	20302-1	04.11.15	SL	10:15	32°02.486'	24°12.052'	5421
551-2	20302-2	04.11.15	SL	13:40	32°02.487'	24°12.052'	5418
551-3	20302-3	04.11.15	SL	16:42	32°02.916'	24°12.057'	5423
551-4	20302-4	03.11.15	Dust	14:45	32°04.9713'	23°15.988'	
551	20302-4	04.11.15	Dust	14:30	32°02.486'	24°12.051'	
552-1	20303-1	04.11.15	CTD	22:40	32°01.929'	24°51.207'	5421
552-2	20303-2	05.11.15	ISP	02:00	32°01911'	24°51.214'	5421
552-3	20303-3	05.11.15	MN	08:44	32°01916'	24°51.227	5418
552-4	20303-4	05.11.15	MN	10:08	32°01917'	24°51.221'	5420
552-5	20303-5	05.11.15	MUC	11:36	32°01916'	24°51.225'	5420
552-6	20303-6	05.11.15	SL	14:57	32°01956'	24°51.193'	5419
552-7	20303-7	05.11.15	SL	17:58	32°01957'	24°51.193'	5427
552-8	20303-8	05.11.15	SL	21:00	32°01961'	24°51.197'	5418
552	20303-9	04.11.15	Dust	14:45	32°02.487'	24°12.049'	
552	20303-9	05.11.15	Dust	14:30	32°01.955	24°51.194	
553-1	20304-1	06.11.15	CTD	03:12	31°16.719'	25°23.316'	5423
553-2	20304-2	06.11.15	ISP	04:45	31°16.712'	25°23.316'	5425
553-3	20304-3	06.11.15	MN	08:15	31°16.712'	25°23.319'	5421
553-4	20304-4	06.11.15	MN	09:48	31°16.711'	25°23.318'	5420
553-5	20304-5	06.11.15	MUC	10:10	31°16.712'	25°23.317'	5422
553-6	20304-6	06.11.15	SL	13:18	31°16.713'	25°23.317'	5425
553-7	20304-7	06.11.15	SL	16:21	31°16.712'	25°23.316'	5425
553-8	20304-8	06.11.15	SL	19:16	31°16.711'	25°23.316'	5423
553	20304-9	05.11.15	Dust	14:45	32°01.959'	24°51.193'	
553	20304-9	06.11.15	Dust	14:39	31!16.712'	25°23.317'	
554-1	20305-1	07.11.15	CTD	00:32	31°22.339'	24°45.202'	5425
554-2	20305-2	07.11.15	ISP	03:30	31°22.336'	24°45.211'	5422
554-3	20305-3	07.11.15	MN	10:30	31°22.336'	24°45.212'	5424
554-4	20305-4	07.11.15	MN	12:05	31°22.336'	24°45.210'	5420
554-5	20305-5	07.11.15	MUC	13:31	31°32.334'	24°45210'	5422
554-6	20305-6	07.11.15	SL	16:32	31°22.224'	24°45211'	5422
554-6	20305-7	07.11.15	SL	19:30	31°22.333'	24°45.211'	5421
554-8	20305-8	07.11.15	SL	22:25	31°22.331'	24°45.214	5421
554	20305-9	06.11.15	Dust	14:45	31°16.713'	24°51193'	
554	20305-9	07.11.15	Dust	14:30	31°16.711'	24°25.233'	
555-1	20306-1	08.11.15	CTD	02:43	30°47.426'	24°30560'	5420
555-2	20306-2	08.11.15	ISP	06:10	30°47.434'	24°30.568	5420
555-3	20306-3	08.11.15	MN	12:55	30°47.437'	24°30.571'	5422
555-4	20306-4	08.11.15	MN	14:15	30°47.440'	24°30.604'	5426
555-5	20306-5	08.11.15	MUC	15:45	30°47.460'	24°30.667'	5420
555-6	20306-6	08.11.15	SL	19:02	30°47.421'	24°30.741	5421
555-7	20306-7	08.11.15	SL	21:38	30°47.404'	24°30.741	5419
555-8	20306-8	09.11.15	SL	00:42	30°47.405'	24°30.740	5421
555	20306-9	07.11.15	Dust	14:45	31°22.333'	24°45.209'	
555	20306-9	08.11.15	Dust	05:15	30°47.433'	24°30.567'	
556-1	20307-1	09.11.15	MUC	07:44	30°44.203'	25°22.517'	5421
556-2	20307-2	09.11.15	SL	10:43	30°44.204'	25°22.525'	5420
556-3	20307-3	09.11.15	SL	13:40	30°44.202'	25°22.520'	5420
556-4	20307-4	09.11.15	SL	16:33	30°44.204'	25°22.527'	5421
556	20307-5	08.11.15	Dust	16:15	30°47.459'	24°30.666'	
556	20307-5	09.11.15	Dust	16:00	30°44.204'	25°22.527'	
557-1	20308-1	10.11.15	CTD	09:04	27°44.285'	25°09482'	5253
557-2	20308-2	10.11.15	ISP	00:00	27°44.284'	25°09.483'	5251
557-3	20308-3	10.11.15	MN	13:05	27°44.287'	25°09.484'	5252
557-4	20308-4	10.11.15	MN	14:20	27°44.429'	25°09.494'	5253
557-5	20308-5	10.11.15	MUC	15:47	27°44.446'	25°09.490'	5254
557	20308-6	09.11.15	Dust	16:15	30°44.203'	25°22.524'	
557	20308-6	10.11.15	Dust	16:00	27°44.447'	25°09.490'	
558-1	20308-1	11.11.1015	CTd	09:00	24°36.481'	25°03.835'	5243
558-2	20309-2	11.11.1015	ISP	10:00	24°36.487'	25°03.836'	5244
558-3	20309-3	11.11.1015	MN	13:00	24°36.489'	25°03.836'	5244
558-4	20309-4	11.11.1015	MN	14:23	24°36.821'	25°03.785'	5241
558-5	20309-5	11.11.1015	MUC	15:45	24°36.850'	25°03.780'	5240
558-6	20309-6	11.11.1015	MUC	18:40	24°36.850'	25°03.781'	5241
558	20309-7	10.11.1015	Dust	16:15	27°44.446'	25°09.491'	
558	20309-7	11.11.1015	Dust	16:00	24°36.852'	25°03.781'	

558	20309-8	11.11.1015	Dust	16:15	24°36.851'	25°03.781'	
558	20309-8	12.11.1015	Dust	13:36	20°45.436'	24°56.994'	
560-1	20310-1	14.11.15	MN	18:15	21°12.706'	21°00.194'	4223
560-1	20310-2	14.11.15	MN	19:29	21°12.706'	21°00.192'	4222
560-1	20310-3	14.11.15	CTD	20:20	21°13.608'	20°59.935'	4233
560-1	20310-4	14.11.15	ISP	23:00	21°13.682'	20°59.934'	4235
560	20310-5	14.11.15	Dust	10:00	20°06.582'	22°02.653'	
560	20310-5	14.11.15	Dust	20:00	21°12.705'	21°00.193'	
561	20311-1	15.11.15	Buoy Carmen	08:00	21°16.05'	20°55.59'	4217
561	20311-2	14.11.15	Dust	20:15	21°13.547'	20°59.969'	
561	20311-2	15.11.15	Dust	15:45	21°16.203'	20°53.168'	
562	20312-1	16.11.15	CTD	00:43	21°05.122'	19°15.565'	3395
563-1	20313-1	16.11.15	CTD	08:55	21°15.770	20°52.338'	4191
563-2	20313-2	16.11.15	CTD	10:46	21°15.770	20°52.338'	4191
563-3	20313-3	16.11.15	CTD	12:37	21°15.770	20°52.338'	4191
564	20314-1	16:11.15	Buoy Carmen	16:14	21°16,08'	20°55.56'	4214
565-1	20315-1	16.11.15	CTD	17:49	21°19.623'	20°38.507'	4133
566-1	20316-1	16.11.15	CTD	22:10	21°27.122'	19°56.927'	3943
566	20316-2	15.11.15	Dust	16:00	21°16.007'	20°49.787'	
566	20316-2	16.11.15	Dust	15:45	21°16.265'	20°55.427'	
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567-2	20317-2	17.11.15	FT	10:30	21°40.28'	18°33.82'	2930
567-3	20317-3	17.11.15	ISP	11:00	21°42.035'	18°34.091'	2930
567-4	20317-4	17.11.15	MN	16:35	21°42.034'	18°34.089'	2931
567-5	20317-5	17.11.15	MN	18:05	21°42.035'	18°34.091'	2937
567-6	20317-6	17.11.15	MUC	19:21	21°42.037'	18°34.075'	2939
567	2017-7	16.11.15	Dust	16:00	21°42.032'	18°.34.089'	
567	2017-7	17.11.15	Dust	15:45	21°40.486'	18°16.847'	
568-1	20318-1	17.11.15	CTD	22:09	21°40.345'	18°15.181'	2340
568-2	20328-2	18.11.15	ISP	00:01	21°40.343'	18°15.181'	2338
568-3	20318-3	18.11.15	ISP	03:45	21°40352'	18°15.183'	2342
568-4	20318-4	18.11.15	MN	08:00	21°40.349'	18°15.187'	2338
568-5	20318-5	18.11.15	MUC	10:26	21°40.350'	18°15.190'	2339
567-2	20319-1	18.11.15	FT	13:15	21°46.099'	18°38.487'	3024
569-1	20320-5	18.11.15	MN	15:56	21°40.487'	18°16.266'	2387
570-1	20321-1	18.11.15	CTD	17:42	21°37.985'	18°01.598'	1442
570-2	20321-2	18.11.15	MN	18:34	21°37.986'	18°01.599'	1439
570-3	20321-3	18.11.15	MN	18:54	21°37-984'	18°01.598'	1437
571-1	20321-4	18.11.15	CTD	20:30	21°37.255'	18°02.339'	1471
571-2	20321-5	18.11.15	ISP	22:00	21°37.251'	18°02.339'	1472
571-3	20321-6	19.11.15	ISP	01:30	21°37.255'	18°02.339'	1473
571-4	20321-7	19.11.15	MUC	03:45	21°37.252'	18°02.339'	1472
571-5	20321-8	19.11.15	SL	05:58	21°37.254'	18°02.341'	1472
571	20321-9	17.11.15	Dust	16:00	21°42.032'	18°34.099'	
571	20321-9	18.11.15	Dust	18:15	21°40.486'	18.16.847'	
572-1	20322-1	19.11.15	CTD	08:13	21°36.219'	17°48.224'	845
572-2	20322-2	19.11.15	MUC	09:00	21°36.214'	17°48.223'	844
573-1	20323-1	19.11.15	CTD	11:12	21°34.151'	17°31.537'	496
573-2	20323-2	19.11.15	MUC	11:40	21°34.161'	17°31.530'	495
574-1	20324-1	19.11.15	CTD	14:32	21°08.536'	17°29.397'	111
574-2	20324-2	19.11.15	CTD	14:58	21°08.537'	17°29.396'	111
574-3	20324-3	19.11.15	MUC	15:22	21°08.535'	17°29.396'	111
574	20324-4	18.11.15	Dust	16:00	21°40.493'	18°16.270'	
574	20324-4	19.11.15	Dust	18:15	20°46.950'	17°56.229'	
575-1	20325-1	19.11.15	CTD	20:51	20°36.234'	18°10.093'	1044
575-2	20325-2	19.11.15	ISP	22:00	20°36.233'	18°10.095'	1043
575-2	20325-3	20.11.15	ISP	01:00	20°36.252'	18°10.107'	1044
574-2	20325-4*	19.11.15	FT	19:50	20°36.280'	18°12.70'	
576-1	20326-1	20.11.15	CTD	05:50	20°35.035'	18°00.221'	780
576-2	20326-2	20.11.15	ISP	06:30	20°35.161'	18°00.277'	781
576-3	20326-3	20.11.15	MN	10:19	20°35.047'	18°00.218'	791
576-4	20326-4	20.11.15	MUC	11:00	20°35.042'	18°00.217'	780
577	20327-1	20.11.15	MUC	14:00	20°43.421'	18°23.305'	1624
577	20327-2	20.11.15	SL	15:12	20°43.421'	18°24.309'	1622

578-1	20328-1	20.11.15	MN	17:19	20°36.268'	18°10.212'	1045
578-2	20328-2	20.11.15	FT	18:42	20°42.27'	18°18.61'	
578-3	20328-3	20.11.15	MUC	20:42	20°36.219'	18°10.066'	1044
579-1	20329-1	20.11.15	CTD	22:44	20°43.428'	18°24.299'	1621
579-2	20329-2	21.11.15	ISP	00:45	20°43.403'	18°24.288'	1621
579-3	20329-3	21.11.15	ISP	03:45	20°43.431'	18°24.335'	1622
580-1	20330-1	21.11.15	CTD	08:18	20°44.097'	18°44.096'	2778
580-2	20330-2	21.11.15	ISP	10:30	20°44.111'	18°44.096'	2778
580-3	20330-3	21.11.15	MN	14:56	20°44.457'	18°44.266'	2782
580-4	20330-4	21.11.15	MN	16:10	20°44.589'	18°44.437'	2782
580-5	20330-5	21.11.15	MUC	16:43	20°44.433'	18°44.278'	2784
580	20330-6	19.11.15	Dust	18:20	20°46.285'	17°57.153'	
580	20330-6	21.11.15	Dust	09:03	20°.44.093	18°44.052'	
581-1	20331-1	21.11.15	FT	19:57	20°49.53'	19°00.227'	3201
581-2	20331-2	21.11.15	CTD	20:59	20°49.483'	19°00.062'	3200
581-3	20331-3	21.11.15	ISP	23:15	20°49.484'	19°00.061'	3199
581-4	20331-4	22.11.15	ISP	02:45	20°49.482'	19°00.061'	3200
581-5	20331-5	22.11.15	MUC	07:47	20°49.479'	19°00.045'	3199
581-6	20331-6	22.11.15	SL	09:49	20°49.486'	19°00.046'	3200
581-7	20331-7	22.11.15	MN	11:50	20°.49.75'	19°00.776'	3199
581-8	20331-8	22.11.15	MN	13:15	20°48.992'	19°01.065'	3206
581	20331-9	21.11.15	Dust	09:15	20°44.09'	18°44.054'	
581	20331-9	21.11.15	Dust	21:01	20°49'482'	19°00.062'	
581	20331-10	21.11.15	Dust	21:15	20°49.482'	19°00.061'	
581	20331-10	22.11.15	Dust	09:00	20°49.484'	19°00.045'	
582-1	20332-1	22.11.15	MN	15:27	21°05.103'	19°15.566'	3390
582-2	20332-2	22.11.15	MN	16:52	21°05.138'	19°15.816'	3404
582-3	20332-3	22.11.15	MUC	17:50	21°05.141'	19°15.836'	3405
582-4	30332-4	22.11.15	CTD	21:03	21°05.913'	19°15.073'	3378
582-5	30332-5	23.11.15	ISP	22:15	21°05.906'	19°15.075'	3382
582	30332-6	22.11.15	Dust	09:13	21°49.483'	19°00.050'	
582	20332-6	22.11.15	Dust	20:58	21°05.908'	19°15.073'	