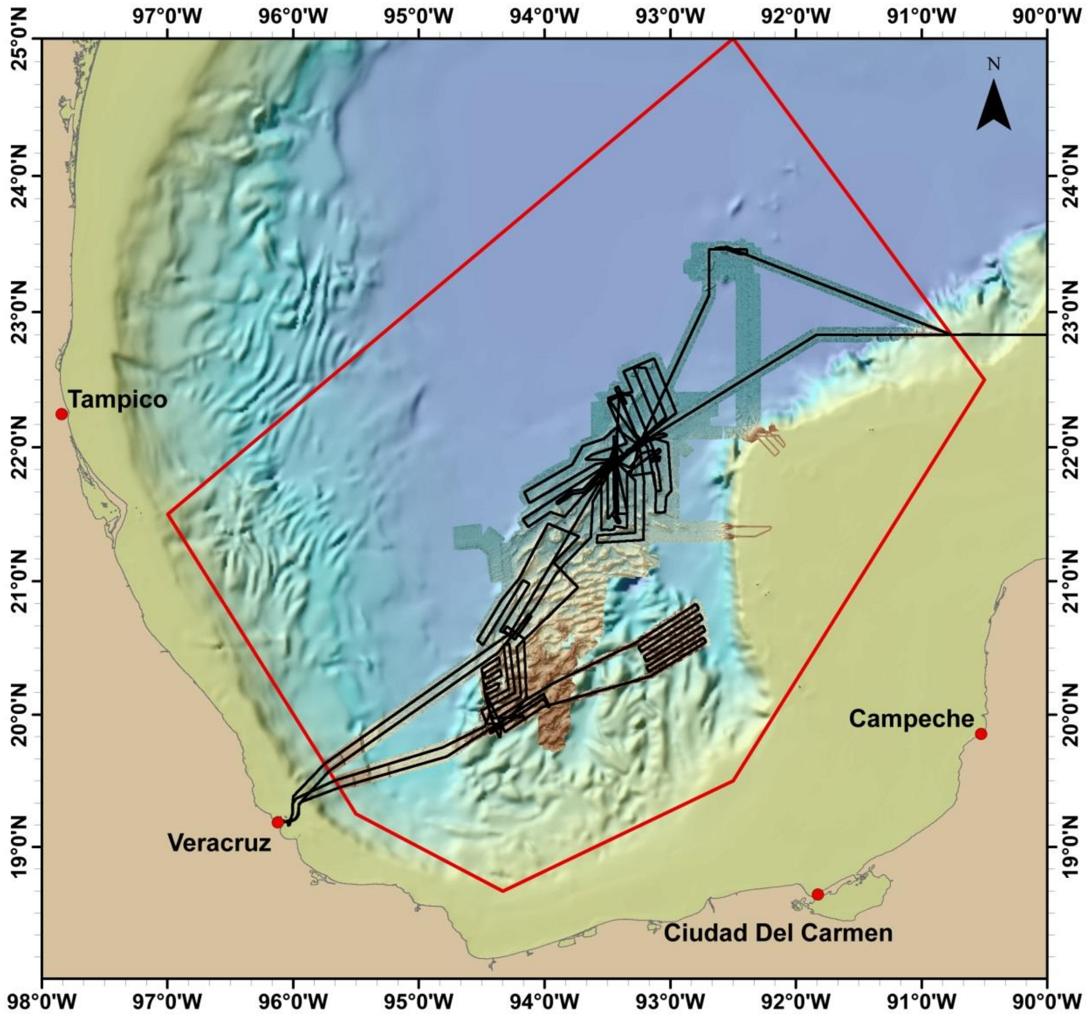
Dr. Heiko Sahling
Prof. Dr. Gerhard Bohrmann
MARUM – Center for Marine Environmental Sciences
Klagenfurter Str.
28359 Bremen – GERMANY
Tel. +49 421-218-65050
Email: hsahling@marum.de
gbohrmann@marum.de

Short Cruise Report
R/V METEOR – M114
Kingston – Veracruz – Kingston
February 12 – March 28, 2015

Chief Scientist:
Heiko Sahling (Leg 1)
Gerhard Bohrmann (Leg 2)
Captain:
Michael Schneider (Leg 1)
Rainer Hammacher (Leg 2)



Objectives

Heavy oil and gas bubbles are emitted from the 1200 to 3400 m deep seafloor in the hydrocarbon province Campeche Knolls of the southern Gulf of Mexico. The viscous heavy oil flows across the seafloor, loses volatile compounds, solidifies, and is converted to asphalt with time. Due to the fact that the heavy oil remains at the seafloor, these sites are natural laboratories to study the impact of oil on deep-sea ecosystems, and the time scales of oil and asphalt degradation. The goal was to study the extent of oil emissions and asphalt deposits using modern technology like AUV SEAL and ROV Quest. The research cruise focused on studying natural hydrocarbon seeps in the southern Gulf of Mexico. The cruise was split in two legs. The first leg focuses on finding and mapping of oil seeps at the seafloor using sidescan sonar and AUV technology. The main objective was to identify sites with asphalt deposits that are then studied in detail during the second leg, which concentrates on samples and measurements taken with the ROV Quest.

Cruise Narrative

Research vessel METEOR left the port of Kingston, Jamaica on the **12 February** 2015 at 09:00 local time, in calm and sunny weather. All participants of the expedition arrived safely at the ship, even though some had some difficulties caused by a strike, last-minute receipt of travel documents, or a formality-loaded way from the airport to the ship. The mobilization of equipment during the port call was accomplished fast, as only two containers of the autonomous underwater vehicle AUV SEAL 5000 had to be shifted from the forecastle to the working deck and scientific goods had to be unloaded from two additional containers.

After only three days of transit assisted by tail wind and favorable current, we entered the research area on **Sunday 15 February** 2015 at 11:40 local time. Upon arrival in the working area, a CTD was conducted to obtain sound velocity profiles needed for optimal performance of the ship-mounted hydroacoustic equipment. Water samples collected during this hydrocast also shed light on the methane concentration and aerobic turnover rates at a site not influenced by hydrocarbon seepage. On **Monday, 16 Feb. 2015**, we found hydroacoustic evidence for hydrocarbon emissions in the water column by crossing of the first knoll in the main working area (Knoll 2201), using the multibeam echosounder EM 122. At Chapopote Knoll an AUV SEAL 5000 m deployment was planned, but subsequently canceled due to unfavorable sea state. A hydrocast revealed elevated methane concentrations only close to the seafloor at the seep site. As the sea state remained unchanged during the day, preventing the deployment of the AUV, the deep-towed side-scan sonar DTS-1 was deployed. For this towed system, a new 8000-m long coaxial cable was specifically installed on the winch prior to the cruise. The extent of seep-influenced seafloor areas was mapped at the summit of three knolls with the DTS until the morning of **Tuesday, 17 Feb. 2015**. Subsequently, the AUV (Dive 67) was deployed at a favorable sea state. However, due to strong water currents, a first attempt to reach the seafloor was abandoned by the vehicle and it rose to the sea surface. After some modification in the mission plan that was radio transmitted to the vehicle while at the sea surface, the AUV conducted the dive to the maximum water depth of 3090 m. During this dive the bathymetry, backscatter and flare distribution was mapped along four profiles in the area of the main asphalt fields at Chapopote Knoll. Due to increasing wind speeds of Bft 6-7, everyone involved was relieved upon the safe recovery of the vehicle.

The high wind speeds, in combination with strong water currents perpendicular to it, presented challenges to the CTD deployment that were overcome by allowing the ship to slowly drift with the CTD through the flares. Due to the strong wind, the planned DTS deployment was delayed to the morning of **Wednesday, 18 Feb. 2015**. Unfortunately, an electrical short circuit required the recovery of the system just upon deployment at very rough sea state; again, everyone involved was relieved after safe recovery. As an alternative scientific program, multibeam mapping and CTD casts were conducted. The wind speed decreased and so the DTS was deployed **Thursday, 19 Feb. 2015**, but electrical problems with the umbilical again caused a delay of four hours. The subsequent successful deployment lasted until noon **Saturday, 21 Feb. 2015**. During that time the mapping previously conducted during DTS-1 was extended and, in addition, the summit area of an additional knoll was mapped. At all four knolls the seafloor revealed evidence for extensive hydrocarbon seepage indicating that this process is ubiquitous in the region. A hydrocast station ended that day and allowed us to celebrate the retirement of Master Michael Schneider. After about 28 years at sea and five years as master of the R/V METEOR, Michael will disembark in Veracruz.

On **Sunday, 22 February,** the wind and waves slowly began to decrease. The team was to start AUV Dive 68 as soon as it was possible safely to launch the vehicle. The AUV dived to the summit area of Knoll 2201- By noontime of the following day, the AUV was recovered under calm sea conditions. The good weather continued and we were able to deploy AUV Dive No. 69 during the night of **Thursday, 24 February**, after completing some additional ship-based multi-beam investigations. The next hill explored (Knoll 2223), is characterized by strong gas emissions in the water column. The dive successfully covered the essential parts of the hill, but the dive had to be interrupted in the morning because of a technical failure in the device. While we were above the hill, clearly visible oil came to the water surface and formed a well definable oil slick. The rubber boat was rapidly mobilized for taking samples from the oil-bearing water. Further ship-based hydroacoustic measurements were completed. That evening the last AUV mission at *Chapopote* asphalt volcano was performed. AUV Dive No. 70 successfully ended on **Wednesday, 25 February** with high quality data.

The track into Veracruz was used for a detailed investigation of gas emission sites and bathymetry with the ship operating at a slower speed. On the morning of **Thursday, 26 February** we reached Veracruz as scheduled, but had to stand by until 10:30 a.m., to dock at Pier No. 6 in the port basin. This was a change from the plan to dock at Pier No. 1 as previously advised that occurred because of time delay required for the considerable formalities in this Mexican harbor. As is usual during port stays, busy loading and unloading work took place in Veracruz. However, the severe formalism in this Mexican port created extra complications. Both AUV containers were unloaded and sent back home. The four new ROV-containers had to be unpacked together with two additional containers from Germany with material and devices. At the same time we had an exchange of about half of the scientists and the ship's crew. Happily, the port stay in Veracruz gave us the opportunity on Friday **27 February** to hold a press conference on board, organized by the German Honorary Consul in Veracruz, Mrs. Erika Rempening, together with the German Embassy**.** It was attended by 18 journalists, cameramen, and photographers. This led to extensive favorable reporting in all media. Mr. Werner Schaich, as German Embassy representative, arrived with a small delegation from Mexico City. We were very happy to welcome them. During the subsequent reception with invited guests from Veracruz, we were able to present the ship to high-ranking representatives from all sectors of public life. Again, we thank Honorary Consul Mrs. Erika Rempening for her outstanding support.

On **Saturday 28 February** we were pleasantly surprised by a visit from 30 cadets and their teachers from two nautical schools in Mexico. After all these mutually enjoyable exchanges, R/V METEOR left the port of Veracruz on **Sunday 1 March** in order to start the second part of expedition M114 in the Gulf of Mexico. During the fourth week of our expedition we focused on scientific work in the southern part of Campeche Bay in water depths of around 1,200-1,900 m. Transit times and night-time hours have been employed to make further measurements of topography and backscatter intensity of the seafloor, as well as continued searching for locations of gas emission. In the southern part of the Campeche Bay, particularly elongated ridge structures dominate – built during millions of years by thick salt layers in the underground, as well as by a special tectonic of salt diapirism when sediments are buried above the salt. From seismic records taken during expedition M67/2 nine years ago in this area, we know that the salt has ascended through the sedimentary strata and quite close to the seafloor in some of the diapir features – in some case it may be exposed at the seafloor. So far, salt glaciers and salt lakes are unknown in the southern Gulf. Based on a combination of high backscatter from the seafloor with the detection of flares in the water column, we could forecast with a high rate of accuracy the precise locations of active seeps. For instance we were able to identify new seep locations by means of former survey during the two TV-sled operations, performed on **Monday, 2 March** and **Tuesday, 3 March** at deep sea hills 1955 and 2036. The characteristic formations of carbonates, asphalt layers and, most importantly, the occurrence of chemosynthetic communities were reliable indicators of active seepage or seepage in the recent past.

On **Wednesday, 4 March** and **Thursday, 5 March** we were able to document new discoveries at the seafloor during the first dives of this expedition (No. 351 and 352) and successfully collected samples. Our ROV-team was debilitated by some cases of flu at the beginning of the week, but the middle of the week they could perform a complete dive again. The dive area was a ridge which had been classified as Knoll 1955, as per usual definition of deep sea knolls here in southern Gulf according to the highest point of the elevated structure at 19 degrees and 55 minutes of geographic latitude. We had very good results from the dives so that we from now on will call this structure UNAM-Ridge in order to point out the peculiarity of this ridge. UNAM is the abbreviation for „Universidad Nacional Autónoma de **México, the university of our Mexican cooperating partners in Mexico City.**

On **Thursday, 5 March** we had to finish Dive 352 prematurely at 4 p.m. in order to take shelter from some bad weather which had been forecast by our weather technicians on board during the past three days. The weather front approached from north, and the skies turned dark very fast. Within half an hour the wind turned from east to northwest, and its speed increased from 10 to more than 40 knots, with squalls up to 58 knots. Because the waves also increased from 1m to 5m in the western part of Campeche Bay, we relocated our work program to the eastern sector. However, there also the waves were up to 3-4m height on Friday. Therefore, we had to stop our equipment deployments devices. On **Sunday, 7 March** after the swell had decreased a bit, we were only able to complete two survey profiles with the TV-sled at the seafloor. We examined areas of high backscatter from the seafloor – namely at the flank of a knoll showing significant morphologic sign of slope slumping and strange glacier-like flow structures. These visual inspections of the seafloor were quite unspectacular. However, the subsequent gravity core in an area with much higher acoustic backscatter intensities revealed an unexpected bull's eye: At a depth of 1m in the sediment a layer of crystalline gypsum stopped the 6m long gravity core penetration. The big gypsum crystals we recovered from the end of the core not only explain the high backscatter signals from the seafloor, but also show the proximity to the salt stock, and its contact with sea water explains why those gypsum crystals stayed behind.

The fifth week of our expedition was characterized by numerous dive activities with ROV QUEST, mainly at the asphalt volcanoes which had been mapped in detail by AUV during the first part of the cruise. But before this work could take place, we had to collect an airfreight consignment in Veracruz on **Monday, 9 March**, which unfortunately did not clear through Mexican customs before METEOR's departure on 1 March. This airfreight was very important for the further progress of our expedition and we could not continue without this equipment. At this opportunity, we were also able to receive some additional chemicals and spare parts for a camera from Florida which had arrived late, as well as some replacement medical supplies for the ship's hospital. The transfer of these materials from a small boat to RV METEOR outside of Veracruz harbor went exactly as scheduled. After this transfer, RV METEOR proceeded northwards on the selected survey tracks, and on **Tuesday, 10 March**, we dived at Chapopote Asphalt Volcano (Dive 354). Extensive asphalts on the deep sea floor of Campeche Bay were first discovered during a SONNE expedition in 2003 at this same knoll. We named the knoll *Chapopote,* which is the Aztec word for tar or asphalt. In 2006, we were able to investigate the asphalts at Chapopote and their different weathering stages in more detail with RV METEOR and ROV-QUEST. The freshest asphalts were concentrated on the main field at the southeastern crater rim. The most exciting question before the dive was this: How much will the asphalt of the main field at the seafloor have changed during nine years? Reaching the asphalt field with ROV-QUEST again in 2015, we were surprised as we recognized more or less identical asphalt structures in the video records. Three of the markers placed at the seafloor in 2006 were found almost immediately.

After recording some video transects, the ROV navigated to the so-called "elevator," which had been deployed early in the morning from the ship. Several sampling containers and measuring instruments, which could not be put on ROV-QUEST, had been transported to the seafloor and thus were available for *in situ*-research work. We then moved to a location discovered in 2006 for intensive sampling of gas bubble emissions, gas hydrate-outcrops, and various chemosynthetic fauna. We deployed a video time-lapse camera that was able to monitor a gas bubble flow for three days. Analysis of size and emission rates of the bubbles in HD video will allow a quantification of the bubbling gas volume during this time and will give us important data on the geochemical flow rates. Using our gas bubble sampler we also collected the escaping gas bubbles as they rose from the seafloor and brought them back to the surface in the gas-tight pressure tank. In the lab, the chemical composition of the captured gas was measured. The gas samples taken during the cruise so far are thermogenic hydrocarbons. However, this will be further characterized by carbon isotopic analysis back in the laboratory onshore.

Dive 355 on **Wednesday, 11 March**, at Knoll 2201 investigated the crater area of a different asphalt volcano for the first time. A TV-sled profile performed the night before gave us important hints for the dive. Unlike Chapopote, this asphalt volcano featured many small-scale emissions of viscous oil, which sometimes generated bizarre, whip-like structures attached to the seafloor. These tubes, sometime clustered within patches of tube worms, are coated with a white bio-film and slowly release black oil drops from their upper ends. Investigations of the collected sample material will give us more information about their formation and how they relate to asphalt volcanism.

Unfortunately the bad weather forecast for Wednesday arrived on schedule; so instead of an additional ROV dive, we took several gravity cores at Chapopote. Asphalts and sediments were collected along with liquid oil. The remaining three days of the week we were able to complete daily dives (Dives 360, 361, and 362) under good weather conditions – the dives brought fascinating insight and familiarized us with the asphalt-associated processes. On **Sunday, 15 March** we dived for the first time on Knoll 2223, which will be named "Tsanyao Yang Knoll" in honor of our dear colleague Prof. Tsanyao Yang of National Taiwan University in Taipei, who had tragically passed away last week. Six dives were completed with ROV QUEST within seven days of the following week --each with more than 8 hours of time on the bottom. Three asphalt volcanoes, in 2,900 to 3,400m water depth, were the target areas. Chapopote was investigated most intensively on **Monday 16 March** and **Friday 20 March**. After a good preliminary reconnaissance of the main field of asphalt releases, we visually mapped an area of about 70 x 50m with the ROV's Prosilica camera (oriented downwards). This allowed us to register all relevant asphalt flows in a very-high-resolution photo-mosaic. The chronology of asphalt production of different ages can be reconstructed better in a complete mosaic than in single images. A second focus was on the sampling of asphalt deposits of variable ages with push cores, nets and directed sampling by the ROV-manipulator. Numerous biological samples were also collected. In addition to tubeworms, we sampled mussels, sponges and also mobile benthic animals in traps which our Mexican colleagues had brought. A special focus was on sampling some *Bathymodiolus*-mussels; these will be investigated more in detail by our MPI colleagues with incubation experiments and other microbiological methods. These mussels are known to have symbiotic sulfur- and/or methane-oxidizing bacteria. There are also indications of additional symbionts, which possibly can use higher hydrocarbons for energy source. Such higher hydrocarbons are clearly plentiful at Chapopote asphalt volcano. During the dive on Monday at Chapopote the ROV developed a kink in its umbilical cable. ROV QUEST was safely recovered, but the cable had to be cut and re-terminated—a lengthy job. Therefore, the following day (**Tuesday, 17 March**) was used for taking six gravity cores from selected locations at Chapopote and Knoll 2223 asphalt volcanoes. The deepest asphalt volcano was Tsanyao Yang Knoll where we operated on **Thursday, 19 March** in a depth between 3,360 and 3,390m. Also in this case the micro-bathymetry and backscatter intensities of our AUV-map led us accurately to the emission sites of gas and asphalt at the seafloor.

Very large fields of tubeworms were encountered on several occasions, often associated with gas hydrate outcrops. The tubeworms were as numerous as a dense bamboo forest in places and it was sometimes impossible to see the limits of the field from the ROV cameras. By flying with ROV QUEST in transects across the tubeworm fields and photo mosaicking at the same time, we were able to confirm continuous tubeworm aggregations of several hundred square meters. These are some of the largest tubeworm fields yet seen in the Gulf of Mexico. Investigation of the gas hydrate outcrops by means of the HD-camera revealed a special highlight when we found the ice worm, *Hessioceaca methanicola*. This animal was previously known only from northern Gulf of Mexico at depths of about 1,200m or less. It is a polychaete worm, which lives in a network of interconnected burrows in massive gas hydrate. These ice worms appeared right at home in front of our HD-camera, in a water depth of 3,380m and burrowing into a bubbly white gas hydrate.

On **Sunday 22 March** the last of our 14 dives on METEOR cruise 114 brought us again to asphalt volcano 2201 whose asphalt formation showed the highest variety of forms diversity and dimension. In total, with five ROV dives, three TV-sled profiles and seven gravity cores, we spent the most station time of all knolls at this asphalt volcano. This focus was motivated by the fantastic micro-bathymetry map, showing curious hill and depression structures, that was recorded during the first leg of the cruise by MARUM-AUV SEAL5000. Thanks to our dives and TV-sled operations we now understand better the features seen in that map. It was also possible to delineate many of the surface features. By means of this map, we can estimate realistic asphalt quantities for the first time. Beneath wide-spread surfaces of smooth asphalt, which correspond to past emissions of heavy oil, many small-scale oil emissions can be observed. Over time, the accumulated emissions combine to cover the seafloor like stacks of pancakes. Bright bacterial mats accumulating on the fresh asphalt are constantly grazed by deep-sea shrimp, crabs and sea cucumbers, but seem regularly to recover for to be just as constantly renewed by fresh growth over a long time. Bacterial mats which existed nine years ago at Chapopote can still be found at the exact same locations. They show that the release of volatile asphalt components is a very slow process during the process of ageing.

Because of the many scientific results from Knoll 2201, we decided to also name this structure. After a voting among the scientists, the name “Mictlan Asphalt Volcano” was chosen. *Mictlan* is the Aztec word for underworld, a region with unknown animals and fabulous creatures—very fitting considering the strange asphalt structures found on this deep-sea hill. Saturday night, **21 to 22 March**, METEOR had departed Campeche Bay for additional sampling. We sailed 100 nautical miles northwards into the central basin of the Gulf with water depths around 3,750 m where the well-known Sigsbee Knolls rise above the absolutely flat deep-sea plain as individual hills. On Monday, 23 March, we performed a TV-sled profile at Challenger Knoll. This deep-sea hill became well-known because it was a drill site during the first cruise of the famous deep-sea drill ship GLOMAR CHALLENGER in 1968. At the time, the formation of knolls by salt diapirism had not yet been confirmed; when they had drilled into the salt stock at 140m sediment depth the cores came up soaked with oil. The oil occurrence was spectacular at that time because it was the first discovery in such a great water depth. Furthermore, they realized for the first time the high risk of drilling into such a cap rock—which might have been hazardous if it had higher gas pressures. The then newly-inaugurated Deep Sea Drilling Program was controversial right at its beginning.

After we had detected acoustic gas emissions in the water column at the western side of Challenger Knoll, the TV-sled confirmed the existence of seeps. A gravity core at the knoll flank showed a 3-fold increase of salt content in the pore water. This is a clear sign of salt-rich waters ascending from the salt stock to the sediments – in this case the salt is probably in only a few meters under the sediment surface. Further observations took us to the eastern edge of our working area by **Tuesday, 24 March** at 09:50 a.m. There we concluded the collection work of this cruise. A four-days-transit brought us to Kingston, Jamaica, where we reached the port on **Saturday, 28 March** at 09:00 a.m. R/V METEOR cruise M114 finished here.

Acknowledgements

We would like to thank Captain Michael Schneider and Captain Rainer Hammacher and theirs expert crew for their outstanding support of our research. Special thanks also to the ROV-Team who had performed 14 dives at 5 asphalt volcanoes with ROV QUEST 4000 m. We thank the many other people whose contributions also helped to make this cruise possible: Control Station German Research Vessels in Hamburg, shipping company Reederei Briese, German Foreign Ministry in Belin, German Embassy in Mexico City, Honorary Consul in Veracruz, Mrs. Erika Rempening, the MARUM logistics group and administrators, as well as our Mexican and US colleagues.

Cruise participants

Name	Discipline	Affiliation	Leg
Ahrlich, Frauke	AUV	MARUM	1
Bohrmann, Gerhard	Chief scientist (Leg 2)	GeoB	2
Borowski, Christian	Symbionts	MPI	2
Breitzke, Monika	Multibeam/Parasound	GeoB	1
Buchheister, Stephanie	Pore water and gases	GeoB	1 & 2
Büttner, Hauke	ROV	MARUM	2
Ferreira, Christian	Multibeam	GeoB	1
Gaytán Caballero, Adriana	Biology	UNAM	1 & 2
Geprägs, Patrizia	OA-ICOS	MARUM	1 & 2
Groeneveld, Jan-Derk	Multibeam/Parsasound	GeoB	1 & 2
Hsu, Chieh-Wie	TV-sled, EM122/Parasound	GeoB	1 & 2
Jiménez Guadarrama, Elvira	Biology	UNAM	1
Klar, Steffen	ROV	MARUM	2
Klauke, Ingo	Sidescan sonar DTS	GEOMAR	1
Klüber, Sven	ROV payload	MARUM	2
Leymann, Tom	AUV	MARUM	1
Loher, Markus	Mapping, sediments	MARUM	1 & 2
Mai, Hoang Anh	ROV	MARUM	2
Mau, Susan	Methane oxidation rates	GeoB	1
MacDonald, Ian	Visual observation	???	2
Marcon, Yann	Mosaicking	AWI	2
Meinecke, Gerrit	AUV	MARUM	1
Melcher, Anne-Christin	Water column work	GeoB	1
Morales Dominguez, Esmeralda	Biology	UNAM	2
Raeke, Andreas	Weather technician	DWD	2
Rehage, Ralf	ROV	MARUM	2
Renken, Jens	AUV	MARUM	1
Reuter, Michael	ROV	MARUM	2
Rohleder, Christian	Weather technician	DWD	2
Römer, Miriam	GIS/Flare imaging	GeoB	2
Rubin, Maxim	symbionts	MPI	2
Sahling, Heiko	Chief scientist (Leg 1)	GeoB	1 & 2
Schade, Tobias	ROV	MARUM	2
Schubotz, Florence	Microbiology	MARUM	2

Seiter, Christian	ROV	MARUM	2
Smerzka, Daniel	Carbonates	EZ	1 & 2
Spiessecke, Ulli	AUV	MARUM	1
Torres, Marta	Geochemistry	COAS	1
Vittori, Vincent	AUV	MARUM	1
Von Neuhoff, Stephanie	media	MARUM	2
Von Wahl, Till	AUV	MARUM	1
Wegener, Gunter	Microbiology	HGF-MPG	2
Wiebe, Monika	Protocoll	GeoB	1 & 2
Wintersteller, Paul	Maps	GeoB	1
Zarrouk, Marcel	ROV	MARUM	2
Zwicker, Jennifer	Hydroacoustics	GeoB	1

GEOMAR – Leibniz Institute for Marine Sciences, Kiel, Germany
GeoB – Department of Geosciences at the University Bremen, Germany
MARUM – Center for Marine Environmental Sciences, Bremen, Germany
MPI – Max-Planck Institute for marine Mircobiology, Bremen, Germany
HGF-MPG – Group of for Deep Sea Ecology and Technology at the Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
UNAM - Universidad National Autonoma de Mexico, Mexico City, Mexico
FSU - Florida State University, Tallahassee, USA.
EZ - Erdwissenschaftliches Zentrum – University Vienna, Austria
DWD Deutscher Wetterdienst, Hamburg, Germany

List of Stations

Date	St.	Instrument	GeoB	Location	Time (UTC)		Latitude	Longitude	Water
2015	No.		St. No.		Begin	End	N	W	depth (m)
15.-26.02.	55-1	HS	-	Southern Gulf of Mexico	17:40	10:15	22°49.998	90°47.271	853
15.-16.02.	56-1	CTD-1	19301-1	Background	21:05	00:04	22°49.795	91°30.802	3749
16.02.	57-1	CTD-2	19302-1	Chapopote Knoll (2155)	15:24	19:20	21°53.953	93°26.173	2910
16.-17.02.	58-1	DTS-1	19303-1	2155/2146/2139	23:09	11:42	21°59.706	93°26.137	3285
17.-18.02.	59-1	AUV-67	19304-1	Chapopote Knoll (2155)	15:16	01:55	21°54.587	93°27.509	2951
18.02.	60-1	CTD-3-1	19305-1	Chapopote Knoll (2155)	02:34	03:20	21°54.073	93°26.193	2905
18.02.	60-2	CTD-3-2	19305-2	Chapopote Knoll (2155)	03:47	06:42	21°53.923	93°25.473	2906
18.02.	61-1	DTS-2	-	Knoll 2124	14:18	15:15	21°23.383	93°26.753	3109
19.02.	62-1	CTD-4	19306-1	Chapopote Knoll (2155)	06:15	09:41	21°53.951	93°25.141	3062
19.02.	63-1	DTS-3	-	Knoll 2128	12:59	13:21	21°31.074	93°27.058	3185
19.-21.02.	64-1	DTS-4	19307-1	2155/2146/2139/2201	17:15	16:23	21°32.457	93°26.527	3479
21.02.	65-1	CTD-5	19308-1	Mictlan Knoll (2201)	18:04	20:51	22°01.523	93°14.865	3080
22.-23.02.	66-1	CTD-6	19309-1	Tsanyao Yang Knoll (2223)	20:45	00:58	22°23.636	93°24.381	3310
23.02.	67-1	AUV-68	19310-1	Mictlan Knoll (2201)	04:15	16:56	22°01.972	93°14.756	3102
24.02.	68-1	AUV-69	19311-1	Tsanyao Yang Knoll (2223)	04:39	14:10	22°23.821	93°24.584	3322
25.02.	69-1	AUV-70	19312-1	Chapopote Knoll (2155)	02:20	13:20	21°54.636	93°27.240	3023
25.02.	70-1	XSV-1	19313-1	Knoll 2036	21:24	21:32	20°40.585	94°13.912	2628
02.03.	71-1	TVS-1	19314-1	UNAM Ridge (1955)	12:30	18:14	19°56.117	94°20.501	1298
03.03.	72-1	TVS-2	19315-1	Knoll 2036	06:00	11:08	20°36.201	94°17.153	1891
03.03.	73-1	MIC-1	19316-1	Knoll 2036	11:21	12:36	20°36.174	94°17.170	1885
04.-05.03.	74-1	ROV-351	19317-1	UNAM Ridge (1955)	16:55	02:18	19°55.829	94°21.014	1198
05.03.	75-1	ROV-352	19318-1	UNAM Ridge (1955)	16:04	21:58	19°55.840	94°20.503	1285
07.03.	76-1	TVS-3	19319-1	Knoll 2009	17:50	20:47	20°00.895	94°14.077	1306
07.-	77-1	TVS-4	19320-1	Knoll 2009	21:25	00:25	19°59.797	94°14.828	1414

08.03.									
08.03.	78-1	GC-1	19321-1	Knoll 2009	01:28	02:45	19°58.823	94°10.592	1859
08.-09.03.	79-1	ROV-353	19322-1	Knoll 2000	16:17	02:48	20°01.134	94°26.177	1844
09.03.	80-1	GC-2	19323-1	Knoll 2000	03:11	04:39	20°01.115	94°26.258	1861
10.03.	81-1	Lift-1	19324-1	Chapopote Knoll (2155)	12:20		21°53.944	93°26.169	2886
10.-11.03.	82-1	ROV-354	19325-1	Chapopote Knoll (2155)	16:58	03:53	21°53.939	93°26.242	2920
11.03.	83-1	TVS-5	19326-1	Mictlan Knoll (2201)	05:49	13:21	22°01.503	93°14.735	3089
11.-12.03.	84-1	ROV-355	19327-1	Mictlan Knoll (2201)	14:43	03:20	22°01.322	93°15.009	3141
12.03.	85-1	TVS-6	19328-1	Mictlan Knoll (2201)	04:26	06:00	22°01.700	93°14.972	3096
12.03.	86-1	GC-3	19329-1	Mictlan Knoll (2201)	15:30	17:35	22°01.399	93°15.018	3125
12.03.	87-1	GC-4	19330-1	Mictlan Knoll (2201)	17:55	20:08	22°01.339	93°15.250	3125
12.03.	88-1	GC-5	19331-1	Mictlan Knoll (2201)	20:38	23:03	22°01.354	93°14.809	3092
12.-13.03.	89-1	GC-6	19332-1	Mictlan Knoll (2201)	23:28	01:37	22°01.102	93°15.316	3134
13.-14.03.	90-1	ROV-356	19333-1	Chapopote Knoll (2155)	14:14	03:24	21°53.926	93°26.267	2918
14.03.	91-1	GC-7	19334-1	Chapopote Knoll (2155)	04:00	05:47	21°53.962	93°26.208	2905
14.03.	92-1	TVS-7	19335-1	Chapopote Knoll (2155)	06:16	10:33	21°53.758	93°25.942	2949
14.03.	81-1	Lift-1	19324-2	Chapopote Knoll (2155)		13:30	21°53.944	93°26.169	2886
14.-15.03.	93-1	ROV-357	19336-1	Mictlan Knoll (2201)	15:55	03:40	22°01.349	93°14.937	3142
15.03.	94-1	ROV-358	19337-1	Tsanyao Yang Knoll (2223)	14:09	22:53	22°23.608	93°24.232	3366
16.03.	95-1	TVS-8	19338-1	Chapopote Knoll (2155)	01:49	10:24	21°54.125	93°25.950	2934
16.03.	96-1	GC-8	19339-1	Chapopote Knoll (2155)	11:23	13:11	21°53.951	93°26.210	2905
16.-17.03.	97-1	ROV-359	19340-1	Chapopote Knoll (2155)	14:41	02:28	21°53.938	93°26.220	2919
17.03.	98-1	TVS-9	19341-1	Mictlan Knoll (2201)	04:10	13:00	22°01.777	93°15.156	3110
17.03.	99-1	GC-9	19342-1	Mictlan Knoll (2201)	13:10	15:08	22°01.070	93°15.147	3137
17.03.	100-1	GC-10	19343-1	Mictlan Knoll (2201)	15:52	17:42	22°01.475	93°14.795	3070
17.03.	101-1	GC-11	19344-1	Mictlan Knoll (2201)	18:09	20:16	22°01.501	93°14.761	3085
17.03.	102-1	GC-12	19345-1	Chapopote Knoll (2155)	21:36	23:31	21°53.964	93°26.226	2905
18.-19.03.	103-1	ROV-360	19346-1	Mictlan Knoll (2201)	14:09	03:39	22°01.470	93°14.810	3096
19.03.	104-1	TVS-10	19347-1	Mictlan Knoll (2201)	04:02	11:09	22°01.530	93°14.845	3094
19.-20.03.	105-1	ROV-361	19348-1	Tsanyao Yang Knoll (2223)	14:04	03:34	22°23.549	93°24.353	3386
20.03.	106-1	GC-13	19349-1	Tsanyao Yang Knoll (2223)	03:58	06:05	22°23.571	93°24.339	3347
20.03.	107-1	TVS-11	19350-1	Tsanyao Yang Knoll (2223)	07:35	10:44	22°23.715	93°24.224	3322
20.-21.03.	108-1	ROV-362	19351-1	Chapopote Knoll (2155)	14:07	02:27	21°53.965	93°26.231	2918
21.-22.03.	109-1	ROV-363	19352-1	Mictlan Knoll (2201)	14:47	03:24	22°01.321	93°14.765	3088
22.-23.03.	110-1	ROV-364	19353-1	Mictlan Knoll (2201)	14:26	02:44	22°01.430	93°14.903	3133
23.03.	111-1	CTD-7	19354-1	Mictlan Knoll (2201)	03:03	05:23	22°01.452	93°14.720	3081
23.-24.03.	112-1	TVS-12	19355-1	Challenger Knoll	18:45	02:46	23°28.444	92°35.274	3549
24.03.	113-1	GC-14	19356-1	Challenger Knoll	03:44	06:07	23°28.590	92°32.588	3738

AUV = Autonomous underwater vehicle: 4 dives
ROV = Remotely Operated Vehicle: 14 dives
GC = Gravity cores: 14 stations
TV-sled: 12 deployments
CTD: 7 CTD/hydrocast stations
MIC = Minicorer: 1 station
XPT: 1 deployment
Mapping with Parasound and EM122: 3575 nm