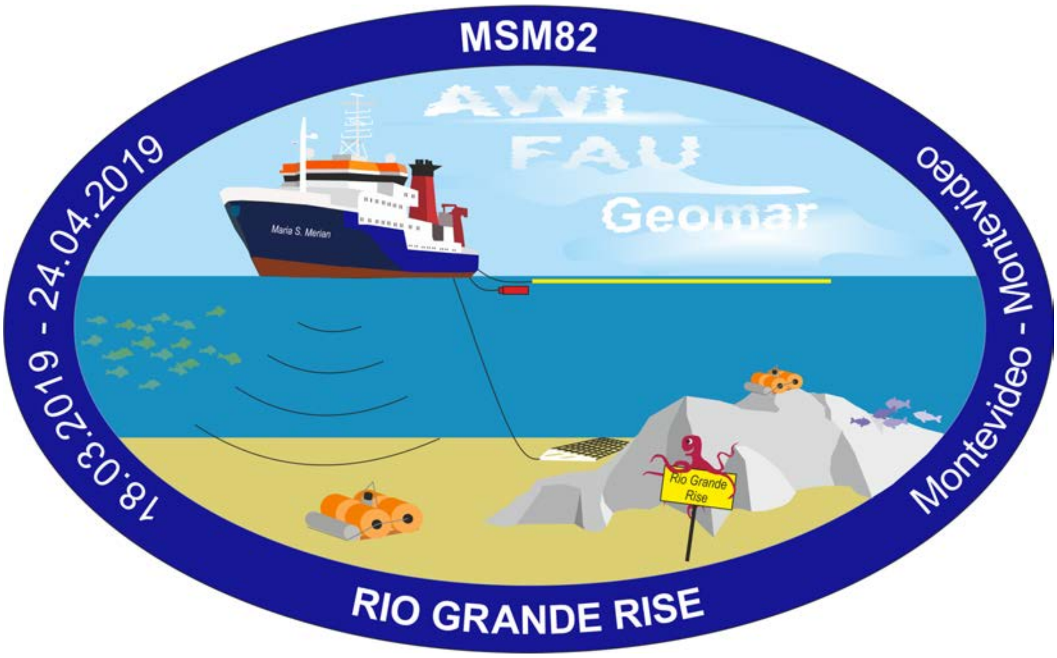
MARIA S. MERIAN-Berichte

The Rio Grande Rise and Jean Charcot Seamount Chain - microcontinents or the trail of the Tristan-Gough hotspot?

Cruise No. MSM 82

18 March 2019 – 24 April 2019,
Montevideo (Uruguay) – Montevideo (Uruguay)
RIOGRANDE



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1 Cruise Summary

1.1 Summary in English

Rio Grande Rise: microcontinent, mantle plume, or both?

The origin of the Rio Grande Rise (RGR) is debated. It could represent a continental sliver, or a large igneous province that was emplaced in the late Cretaceous after the opening of the South Atlantic Ocean. The interplay between the RGR and the nearby Jean Charcot Seamount Chain (JCSC) is also not understood. Cruise MSM82 dredge sampled rocks from the JCSC and the RGR and measured two seismic refraction profiles across the RGR where it is bisected by a long rift graben. A range of geophysical data were also collected during much of the expedition, including magnetics, gravity, bathymetry (Kongsberg EM 122), sub-bottom profiling (ATLAS PARASOUND DS P70) and ADCP data. The combination of geochronological, geochemical and geophysical information will provide a unique window on the relation between mantle plumes, continental fragments and the evolution of large igneous provinces.

1.2 Zusammenfassung

Rio Grande Rise: ein Mikrokontinent, Ergebnis eines Mantel-Plumes oder beides?

Die Entstehung des Rio Grande Rise (RGR) wird kontrovers diskutiert. Es könnte sich um ein Kontinentalfragment oder aber um eine Large Igneous Province handeln, deren Platznahme nach der Öffnung des Südatlantiks in der Oberkreidezeit erfolgte. Der Zusammenhang zwischen dem RGR und der angrenzenden Jean Charcot Seamount Chain (JCSC) ist ebenfalls nicht klar. Während der Ausfahrt MSM82 wurden mittels Dredge Gesteinsproben von der JCSC und dem RGR gesammelt. Zwei refraktionsseismische Profile wurden über das RGR und den das RGR teilenden Rift-Graben gemessen. Ein Bündel verschiedener geophysikalischer Daten wurde während der meisten Zeit der Expedition gesammelt, darunter Bathymetrie (Kongsberg EM 122), Sedimentecholotdaten (ATLAS PARASOUND DS P70), Gravimetrie, Magnetik, und ADCP-Daten. Die Kombination von geochemischen, geochronologischen und geophysikalischen Informationen soll einen außergewöhnlichen Einblick in den Zusammenhang zwischen Mantel-Plumes, Kontinentalfragmenten und der Entwicklung von Large Igneous Provinces ermöglichen.

2 Participants

2.1 Principal Investigators

Name	Institution
Dr. Haase, Karsten, Prof.	FAU
Dr. O'Connor, John	FAU
Dr. Jokat, Wilfried, Prof.	AWI
Dr. Geissler, Wolfram	AWI
Dr. Hoernle, Kaj, Prof.	GEOMAR

2.2 Scientific Party

Name	Discipline	Institution
Dr. Geissler, Wolfram	Geophysics / Chief Scientist	AWI
Dr. Krumm, Stefan	Petrology / Co-Chief Scientist	FAU
Dr. Geldmacher, Jörg	Petrology	GEOMAR
Dr. O'Connor, John	Petrology	FAU
Dr. Altenbernd, Tabea	Geophysics	AWI
Dr. Homrighausen, Stephan	Petrology	GEOMAR
Dr. Hackspacher, Peter, Prof.	Petrology	UNESP
Dr. Funck, Thomas	Geophysics	GEUS
Kirk, Henning	Geophysics	AWI
Pfeiffer, Adalbert	Geophysics	AWI
Geils, Jonah	Hydroacoustics	AWI
Mossad, Abdelrahman	Hydroacoustics / Geophysics	AWI
Unger-Moreno, Katharina Anna	Hydroacoustics / Petrology	AWI
Schlager, Ursula	Geophysics	AWI
Lehmann, Carsten	Geophysics	AWI
Korsch, Karsten	Geophysics	AWI
Hättig, Katrin	Geophysics	AWI
Nöbel, Kristina	Petrology	FAU
Hoyer, Patrick	Petrology	FAU
Falkenberg, Jan	Petrology	FAU
Shearing, Jennifer	Marine Mammal Observer	Seiche
Purdon, Jean	Marine Mammal Observer	Seiche

Fig. 2.1 Group photograph of the Scientific Party. Photo credit: Jörg Walter.

2.3 Participating Institutions

AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Bremerhaven
FAU	GeoZentrum Nordbayern, Friedrich-Alexander-Universität Erlangen-Nürnberg
GEOMAR	Helmholtz-Zentrum für Ozeanforschung Kiel
UNESP	Department of Petrology and Metalogeny, Institut of Geocience and Exact Sciences, São Paulo State University- UNESP, São Paulo, Brazil
GEUS	Geological Survey of Denmark and Greenland, Copenhagen, Denmark
Seiche	Seiche Environmental Limited, Holsworthy, Devon/UK

2.4 Crew

Name	**Rank**
Schmidt, Ralf	Kapitän / Master
Peters, Ralf	Chief Mate
Schilling, Sandra	1st Officer
Kruse, Marius	2nd Officer
Ogrodnik, Thomas	Chief Engineer
Boy, Manfred	2nd Engineer
Schwieger, Philipp	3rd Engineer
Dr. Staak, Ludwig	Ship’s doctor
Walter, Jörg	Electronics
Maggiulli, Michael	System Operator
Beyer, Thomas	Electrician
Friesenborg, Helmut	Fitter
Sauer, Jürgen	Motorman
Fröhlich, Mike	1st Cook
Preuss, Georg	2nd Cook
Kluge, Sylvia	Stewardess
Vredenborg, Enno	Bosun
Nebe, Tom	Ship’s Mechanic
Bischek, Olaf	Ship’s Mechanic
Siefken, Tobias	Ship’s Mechanic
Altmann, Detlef	Ship’s Mechanic
Schrapel, Andreas	Ship’s Mechanic
Meyer, Felix	Ship’s Mechanic
Plink, Sebastian	Ship’s Mechanic

3 Research Program

3.1 Description of the Work Area

Our study area consists of three areas as follows (Fig. 3.1).

The western Rio Grande Rise

The Rio Grande Rise is an aseismic ridge with a mean water depth of 4 km, rising to about 2 km below sea level (Gamboa and Rabinowitz, 1984) (Fig. 4). It is considered to be entirely volcanic in origin having formed together with the Walvis Ridge while the Tristan-Gough plume-hotspot was located on or near the Mid-Atlantic spreading ridge (O'Connor and Duncan, 1990). Gamboa and Rabinowitz (1984) divided the Rio Grande Rise into western (WRGR) and eastern (ERGR) sections. The WRGR is a large elliptical bulge with a mean depth of about 2 km with numerous seamounts that formed on crust located near magnetic anomaly C-34 (83 Ma) (Mohriak et al., 2010). According to Ussami et al. (2012), the isostatic analysis by Bulot et al. (1984) using the admittance function technique, shows that the compensation of the volcanic loads in the RGR is local (Airy isostasy), consistent with formation on or near a spreading ridge.

DSDP Leg 72 Site 516F drilled tholeiitic basaltic lavas on the WRGR platform which have recently been re-dated using modern $^{40}Ar/^{39}Ar$ methods to 80-87 Ma (Rohde et al., 2013; O'Connor and Jokat, 2015) suggesting that the Rio Grande Rise plateau formed close to a spreading center (Gamboa and Rabinowitz, 1984; O'Connor and Duncan, 1990; Mohriak et al., 2010; Ussami et al., 2012). A widespread volcano-tectonic event subsequently affected this region during the Eocene and parts of the plateau were uplifted above sea level creating several short-lived volcanic islands (Gamboa and Rabinowitz, 1984; Mohriak et al., 2010), which were later submerged as the plateau subsided. Some of the guyots constructed on the plateau are only 600-700 m below sea level. Samples dredged from a small seamount close to Site 516F are composed of alkalic basalt (Fodor et al., 1977), one of which (RC 11-2DR P5) yielded an $^{40}Ar/^{39}Ar$ age of 46 Ma (Rohde et al., 2013).

Paleogeographic reconstructions for C34 (83 Ma) show that the WRGR is coeval with the older part of the Walvis Ridge implying a common origin (O'Connor and Duncan, 1990; Ussami et al., 2012). Incompatible trace element ratios and isotope signatures for lavas drilled from the WRGR (DSDP Site 516F) and WR (DSDP Site 525) are similar. These lavas have different compositions to lavas from present day Tristan da Cunha but are similar to the high-Ti Paraná continental flood basalt tholeiites (Ussami et al., 2012). Some authors argue that the 'EM-1' or Dupal geochemical signature results from a contribution from ancient recycled subducted pelagic sediments, which might have been stored in the mantle for more than 2 Ga (e.g. Weaver, 1991; Chauvel et al., 1992; Eisele et al., 2002). If so, then the Dupal Anomaly is likely to have a deep-mantle origin (Gibson et al., 2005; Class and le Roex, 2006). Others have argued that delamination or thermal erosion of subcontinental lithospheric material (SCLM) during rifting has contaminated the upper mantle in the South Atlantic, and that the Dupal Anomaly is thus relatively 'young' and restricted to the upper mantle (Hawkesworth et al., 1986; Regelous et al., 2010).

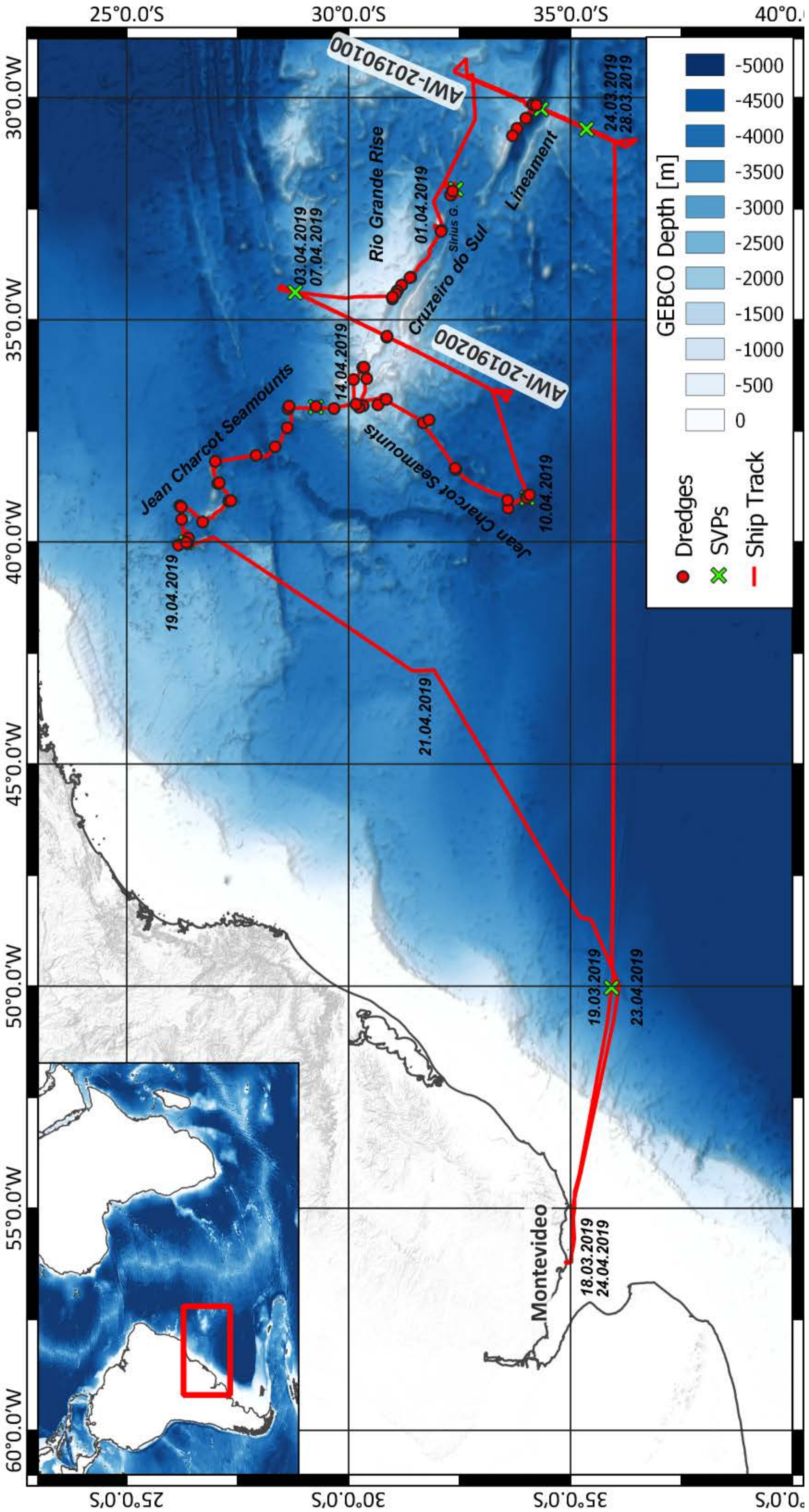

Fig. 3.1 Track chart of *MARIA S. MERIAN* Cruise MSM82. Bathymetry (GEBCO, 2014).

Cruzeiro do Sul Lineament (CDSL)

Both the WRGR and ERGR are cut by a roughly 1000 km-long series of NW–SE-trending troughs that are about 10-20 km wide, 1 km deep, and filled with sediments (Mohriak et al., 2010). Seamounts are also located along these troughs, that might be the result of extensional stresses in the Middle Eocene (Baker, 1983; Rhode et al., 2013; Mohriak et al., 2010). The Cabo Frio High might be the landward continuation of the CDSL troughs/rift zone (Souza et al., 1993), especially as it is also marked by Eocene volcanism (Mohriak et al., 2010). The CDSL might therefore to be a tectono-magmatic lineament/event related to a shear zone that affected both continental and oceanic lithosphere (Souza et al., 1993; Szatmari and Mohriak, 1995), possibly triggered by major plate reorganization(s) in the Palaeogene and Neogene (Mohriak et al., 2010). At its western end, the CDSL cuts that WRGR where it is characterised by a strong negative Bouguer anomaly consistent with less dense continental crust.

Jean Charcot Seamount Chain

Satellite altimetry maps (Sandwell and Smith, 2009) reveal that the JCSC is roughly 1000 km long, extending southeastward for about 500 km from the Brazilian continental margin as far as the western side of the WRGR, where it bends sharply and continues to the south for another 500 km. The only other continuous seamount chain with such a sharp bend is the ~50 Ma classic bend in Hawaiian-Emperor seamount chain (HEB). It is still not clear if the HEB bend is due to changes in Pacific plate motion and/or mantle convection (Tarduno et al., 2003; Steinberger et al., 2004; Sharp and Clague, 2006; Whittaker et al., 2007; Tarduno et al., 2009; Wessel and Kroenke 2009).

The Jean Charcot Chain remains completely unsampled, and so the age and composition of these volcanoes are unknown. However, the northern section of the Jean Charcot Chain has the same NW-SE trend as seamount chains extending from Brazil (Bahia and Pernambuco) reflecting the NW absolute motion of the South American plate during the Cretaceous (e.g., O'Connor and Duncan, 1990; Bryant and Cherkis, 1995). On the other hand, if the Jean Charcot Chain is young then it should have the same E-W trend as younger seamount chains in the South Atlantic such as the Martin Vas chain reflecting the eastward absolute motion of the South American plate (e.g., O'Connor and Duncan, 1990). The JCSC bend is located on the RGR in an area associated with a widespread Eocene volcano-tectonic event when parts of the plateau were uplifted above sea level (Gamboa and Rabinowitz, 1984). Samples dredged from a small seamount in the area, close to Site 516, are composed of alkalic basalt (Fodor et al., 1977), one of which (RC 11- 2DR P5) yielded the 46 Ma $^{40}Ar/^{39}Ar$ age reported in Rohde et al. (2013).

3.2 Aims of the Cruise

Significant doubts have arisen about a mantle plume origin for the RGR because of recent evidence that it is a fragment of Gondwanaland (Roberto Ventura Santos, Geological Survey of Brazil, personal communication) and the discovery of continental fragments in hotspot trails in the Indian Ocean (Torsvik et al., 2013). In 2012 and 2013, Japanese and Brazilian researchers using Japan's research ship Yokosuka and its manned submersible Shinkai 6500 recovered samples of granite, gneiss and silica-rich metamorphic rocks. The expedition also found an outcrop of granite 100 m^2 at a depth of roughly 1000 meters together with a large expanse of quartz sand (Roberto Ventura, personal communication). The size of the granite slab, the thick alteration crust on the granite slab, and the presence of quartz sand, unknown on the seafloor, indicates that it is highly unlikely to be ballast jettisoned from a ship. Based on fossils found in the nearby seabed the area appears to have been above sea level until about 50 Ma, during which time the sand deposit formed by beach erosion. The plateau then became submerged over a period spanning several million years (Roberto Ventura, personal communication). The extent of the mass deficiency under the RGR indicated by the negative Bouguer gravity shown in Figure 5, implies that much of the WRGR is underlain by continental crust (Mohriak et al., 2010) that was captured by the oceanic lithosphere during rifting of South America from Africa.

However, assuming that the Rio Grande Rise is exclusively the result of microcontinent formation this cannot explain the overlying/adjacent 1000 km-long bending Jean Charcot seamount chain, which seems to be a classic hotspot trail produced by a long-lived mantle plume. Our results will be important for identifying suitable drill sites in a future IODP proposal to drill the RGR. In summary, we will use gravity and seismic measurements combined with geochemical, geochronological and thermochronological data to address the following questions and hypotheses:

1. **Is the Rio Grande Rise a microcontinent or a hotspot track or both?**

Seismic experiments across the RGR and Cruzeiro do Sul Lineament (CdSL) will provide constraints on the following questions/problems:

- Determine areas of continental and oceanic crust and of transition zones between different crustal domains by comparing seismic velocity–depth functions with known crustal structures,
- How does the continental/oceanic crust (geometry, structure) of the RGR terminate against true oceanic crust?
- How does the crustal structure change across the CdSL?
- Has the CdSL been significantly modified by magmatic intrusions?
- How does the crustal thickness of the RGR compare to the WR?
- Is the CdSL an old continental-style rift graben or was it caused by major plate reorganization(s) in the Paleogene and Neogene?
- Do changes in the velocity-depth functions correlate with geochemical and age variations across the RGR?

Geochemistry and geochronology of rock samples from the RGR and along the CdSL will address the following:

- Does the distribution of oceanic and continental crust across the RGR correlate with variations in velocity-depth functions?
- Is there evidence that a mantle plume influenced microcontinent formation at the time of rifting?
- Is the RGR oceanic crust similar in age and composition to the WR?
- Did the RGR oceanic crust form in multiple stages from different mantle sources?
- Was there a chemical evolution with time in sampled oceanic crust?
- Is the oceanic crust from an enriched (plume) or a depleted (spreading axis) source?
- What can age and geochemical information tell us about the evolution of mantle source composition, upper mantle temperature and the effects of lithosphere thickness?

- Does the DUPAL isotopic signature decrease with increasing distance from the Brazilian margin suggesting that it is from the sub-continental lithospheric mantle (SCLM)?

2. **Is the Jean Charcot Seamount Chain a hotspot trail?**

Seismic experiments across the Jean Charcot Seamount Chain (JCSC) will help address the following questions and hypotheses:

- Did the JCSC chain form where lines of weakness in the lithosphere channeled (buoyant plume) melts to the plate surface?
- Does the mantle source (plume) responsible for the JCSC influence significantly the surrounding lithosphere implying a vigorous mantle plume?

Geochemistry, geochronology and thermochronology of rock samples will address questions and objectives as follows:

- Is the JCSC an age progressive hotspot trail?
- Does the JCSC record the (absolute) motion of the South American plate?
- Do along chain volcanic propagation rates (plate motion) vary significantly?
- Is the JCSC, especially the seemingly sharp bend, synchronous with one or more stages of RGR formation.
- Specifically, does Eocene volcanism on the RGR correlate with the timing of JCSC bend and a change in plate-plume relative motion?
- Is the bend in the JCSC associated with a change in South American and African plate motion?
- How does the age and composition of the JCSC compare to RGR-WR.
- Does the JCSC, together with the WR, provide important new information constraining plate-plume relative motion in the South Atlantic?
- What does geochemical variation with time tell us about the evolution of mantle source composition, upper mantle temperature and the effects of lithosphere thickness?
- Does the DUPAL isotopic signature decrease with increasing distance from the Brazilian margin suggesting that it is from the sub continental lithospheric mantle (SCLM)?

3.2 Agenda of the Cruise

Deep Seismic sounding experiments

The seismic experiments will provide constraints on the distribution and thickness of continental and oceanic crust and its possible role in the formation of the RGR, CdSL and JCSC. The deeper structure of the CdSL is of particular interest because it is so unusual for an oceanic plateau. If the RGR is a microcontinent, the CdSL might represent a rift graben, which formed during the opening of the South Atlantic and the rotation of the RGR into its current position. We propose investigating these structures at three locations:

1. The seismic line to the west was planned to cross the JCSC close to the Brazilian continental margin. We expect to find thick oceanic crust in areas influenced by a mantle plume. Otherwise, we should find normal oceanic crust, which might vary across the fracture zone crossed by the seismic line. This line was planned to be rather short (only 20 OBS with a spacing of 15 km).

2. The middle line is the longest seismic line with a total 30 OBS spaced 18 km apart and crosses the RGR, CdSL and the northern end of the JCSC. It will allow us to determine why the RGR exhibits such a pronounced Bouguer Anomaly. Furthermore, the data will show whether (1) the CdSL has modified the deeper crust, (2) the area consists of extended continental crust and (3) how strongly it has been modified by plume-related magmatic intrusions and rifting. Changes in the composition of precisely dated dredge samples (RGR, CdSL and JCSC) will be correlated with variations in the underlying basement structure indicated by changes in the velocity-depth functions.
3. A third profile to the east crosses the SE end of the CdSL where it transects the less elevated part of the ERGR. The eastern part of the CdSL seems to be a pronounced rift graben, the nature and origin of which is completely unknown. The seismic data and rock sampling will reveal whether it is part of a continental rift zone or oceanic crust modified by unknown tectonic processes. Thus, it is important that the line includes areas north and south of the CdSL so that differences or similarities between the different domains can be determined. A spacing of the 25 OBS 15 km apart along this line is a compromise between the expectation of relative homogenous crust (oceanic/extended continental crust) and the maximum operating time for the vessel (35 days).

High-resolution bathymetry
High-resolution bathymetric maps are available from the Hydrographic Division of the Brazilian navy (Leplac program) for our working areas along the CdSL and JCS. We intend to fill in any gaps in existing maps using the bathymetric data collected during transit, seismic profiling and while searching for suitable dredging locations. In particular, we intend to map portions of the apparent rift structures of the RGR during transiting between the dredge stations in order to better understand their tectonic formation and guide the dredge sampling. We will also use Parasound sediment echosounder information to avoid dredging in sediment covered areas.

Rock sampling, geochemistry, geo- and thermochronology
We will dredge volcanic basement and sedimentary rock from JCSC and the side-walls of the CdSL (Fig. 7). We expect that the JC seamounts will be good dredging targets because they are probably volcanic structures with steep flanks with little to no sediment cover. Continental and oceanic rocks CdSL have been dredged from the western end of the CdSL (Santos et al., 2019). We will, therefore, sample the eastern end of the CdSL where it cross cuts the WRGR. Tectonic movements apparently caused the steep rift-like structures in the RGR and these are ideally suited for dredge sampling of the deeper levels of the RGR. Participants from the FAU and GEOMAR have extensive experience in dredging old seamounts and aseismic ridges. Thus, we are confident that sampling using chain sack dredges represents the most efficient way of recovering sample from the RGR and JCSC best suited to geochemical and chronological analyses.

Biology
An expert in deep-sea faunas was originally planned to be on board to identify and preserve and biological specimens that may be recovered by dredging.

4 Narrative of the Cruise

When the *MARIA S. MERIAN* finished the successful expedition MSM81 to the Falkland Plateau in Montevideo most members of the MSM82 scientific party had already arrived in Montevideo. As all formalities in the port had already been completed we could go onboard in the morning. We were hoping to start with our preparation work early. Unfortunately, our first day in port did not continue as expected because the wind became so strong that the containers could not be delivered to the vessel as planned. All the containers arrived finally at the pier or were already loaded on deck by the following morning. It was important for us to start installing the gravity meters on schedule. These instruments for measuring the gravity of the Earth must be heated before any measurements can be taken. Sunday morning (17.3.), all members of the scientific party embarked on the vessel. We could use the last day in port to continue preparing the scientific instruments and laboratories. In the morning there was an introduction lecture about life and work at sea, and in the afternoon we could finally make the tie measurements for the gravity meter.

Monday morning (18.3.) *MARIA S. MERIAN* set sail at 8:30 am as planned for the Rio Grande Rise. It would take another four days to reach our first working area. Even though the weather was pretty nice as we left Montevideo and the waves in the estuary of the Rio de la Plata were small, there was strong wind and a rough sea state when we reached the open Atlantic. Luckily, the weather became better during the course of the first week and eventually we all got used to life and work at sea. We used the long transit time to continue preparing for our measurements. In particular, the ocean bottom seismometers (OBS) had to be assembled and tested. The testing of the release units, essential for recovering the instruments and recorded data from the seafloor, took place as soon as we left Uruguay on Tuesday (19.3.) at 35° 56' S 050° 02' W. After a successful test we started all underway measurements and instruments such as multibeam swath bathymetry, sediment echo sounder, gravity meter, and current meters (ADCP). In addition, we carried out the first magnetic measurements that will allow us to determine the age of the oceanic crust. Heading eastward along 36° S we arrived at our first OBS deployment station at 36° 00' S 031° 00' W in the morning of Saturday (23.3.). Deploying a 450 km long profile of 27 OBS, spaced 8 NM apart, took until the early Tuesday morning (26.3.). After we had deployed 16 of the OBS the petrology group started the first of eight dredge hauls on Sunday (24.3.) and finished the last one around noon on Monday (25.3.). The first dredge haul was unexpectedly successful. It was carried out at approximately 34° 09' S 030° 09' W on the steep wall of the graben bisecting the Rio Grande Rise. The steep northern flank exposes rocks at depths that normally can only be reached by expensive deep drilling. Good weather conditions and a favorable wind direction resulted in seven successful dredge hauls. Only one haul came up empty.

The second week was dedicated to the first seismic refraction profile. Starting Monday afternoon (25.3.) and continuing until Tuesday early morning (26.3.) the remaining eleven ocean bottom seismometers were deployed along the first seismic profile. At about 6 am we started to deploy the streamer, a 3000 m long cable with 240 hydrophones. Since it was not clear if, or how well, the streamer would function we used some time reserved for contingencies to test some of its sections and modules. Unfortunately, the test was not successful so we decided to deploy the airguns and start with the seismic measurements. The first airgun was put into operation only after we were given the “Go” from the marine mammal observers from Seiche Environmental

Limited. No whales or other marine mammals were observed close to the vessel. We started the seismic profile Tuesday (26.3.) at 12:00 am at 32° 23' S 029° 25' W. The airguns were operated at a pressure of 200 bar. We also deployed the towed magnetometer along the profile. Unfortunately, we could only record data with the streamer sporadically. Further testing indicated that most probably the tow cable of the streamer - the lead in - was causing the malfunction. As we were not able to solve that issue on board we will have to rely solely on the OBS data.

After two days without a break we arrived at the end of the first seismic profile at 36° 15' S 031° 06' W shortly after lunch on Thursday (28.3.). The magnetometer, airguns and streamer were recovered without any problems. We started then to recover the OBS beginning at the southwest end of the profile. The last of the 27 OBS surfaced and was successfully recovered early on Saturday morning (30.3.).

Next, we started our transit towards the second working area in the central Rio Grande Rise. On the way we measured with the towed magnetometer and all other onboard measurement systems, such as the swath multibeam echo sounder and sediment echo sounder. We made two stops at nearby seamounts.

One was already named Sirius Guyot so we provisionally named the other Jokat seamount. During the first dredge haul Sunday morning (31.3.) on Jokat seamount (32° 18' S 032° 12' W) the dredge became stuck. But it was freed and recovered successfully thanks to the master and the crew. The dredge was empty, with the exception of some sediments. The dredge also became stuck during the second attempt but it was again freed and recovered a large sample that turned out, unfortunately, to be carbonate material rather than the expected basalt or maybe plutonic rock

At the start of week three we arrived at Sirius Guyot (32° 06' S 032° 59' W), an impressively large seamount located to the southeast of the central Rio Grande Rise. Because of its location we assumed that its formation is closely related to the evolution of the deep graben structure. Therefore, we aimed to dredge samples from its flanks but because of easterly winds we had to search for a suitably steep slope in the bathymetry data. Unfortunately, we were not successful this time because the dredge became stuck during both hauls and had to be freed by the ship’s officers. When it was clear that the dredges did not contain any rock samples we decided not to try again and to continue on our way to the northwest. During the course of Monday (1.4.) and Tuesday (2.4.) we planned to dredge more samples from the flanks of the deep graben in the central Rio Grande Rise. During our transit across the northern flank of the graben we mapped the seafloor to look for a suitably steep slope we could dredge in an eastward direction. Unfortunately, the wind continued to blow from an easterly direction with 4 to 5 Bft. Northeasterly winds would have been better for dredging. The success rate of the individual dredge hauls has varied but as of Tuesday (2.4.) evening the petrologists had sampled a few good rocks from the graben at approximately 31° 12' S 034° 13' W.

Wednesday morning (3.4.) we arrived at the northern end of the second seismic refraction profile. On our way we mapped the seafloor and measured magnetic data. Before we deployed the first OBS we again measured the water sound velocity to calibrate the multibeam swath echo sounder to establish the water conditions in our new study area.

Deployments of the OBS, spaced 10 NM apart, proceeded quickly. But suddenly there was an interruption. Close to the eighth deployment position, some unknown obstacle was observed right in front of the vessel. On reaching the obstacle, it became clear that it was an old buoy from a harbor. This obstacle could have represented a serious danger especially at night, because we might have collided with it during our measurement along the profile. The master decided to return to the buoy after we had deployed the eight OBS. In the meantime, the buoy had drifted slightly southwards, but more or less along our track. Therefore, the decision was made to flag the obstacle. Within minutes, a daughter buoy was manufactured in the deck workshop. It was equipped with a flag, a radio beacon and a flashlight, all the things that we normally use to identify the OBS when they surface. Our hope is to identify the buoy easily in case it is still close to our track during seismic profiling. Around the buoy we observed different kinds of fish. Even if the buoy represents just a piece of garbage, it is like a little oasis in the wide ocean.

Thursday at noon (4.4.) we deployed the last of the 30 OBS. We moved some miles further south to reach the start point of the seismic profile and started to deploy the airguns. Our marine mammal observers were already on watch taking care that no whales or other marine mammals would be too close to the vessel when we started our measurements. Indeed, they observed a sperm whale, but a long way from the vessel. After all our preparations were finished and we were sure that no marine mammals were close to the vessel we could start with the seismic measurements in the late afternoon. The profile runs from 33° 35' S 036° 47' W to 28° 29' S 034° 14' W and is about 600 km long.

The weather conditions were fine over the course of the third week, with the exception of the unfavorable wind directions during the dredge operations at the start of the week. So, on Friday (5.4.) our marine mammal observers were able to spot a female together with a young fin whale crossing our track a long way from the vessel. Due to problems with the pressure hoses we could operate the airguns at a pressure of only 170-180 bar. However, everything went well, and we have been able to measure without any interruptions. We finished measuring the second profile on Sunday afternoon (7.4.) and started to recover the OBS.

The fourth week started with dredging in the western part of the graben structure where it is crossed by the seismic profile. The forecast of bad weather and high swell forced us to make only a short stop for dredging. We decided to continue with the recovery of the remaining OBS. Luckily all the OBS's were recovered by Tuesday evening (9.4.) without any problems or damage even though the weather and sea state was bad due to a low-pressure system crossing our track.

We continued to the southwest and started sampling southern end of the Jean Charcot Seamount Chain on Wednesday (10.4.). Attempts to dredge two seamounts (at 34° 00' S 038° 59' W and 33° 36' S 039° 15' W) were unsuccessful due to unfavorable wind and wave direction and because the seamounts are small and eroded so offering few steep slopes suitable for dredging. Although weather conditions had become better by Thursday (11.4.) dredging a third seamount at 32° 24' S 038° 21' W also proved unsuccessful. Fortunately, on Friday (12.4.) we were very successful in sampling the first large seamount we encountered at 31° 41' S 037° 19' W, located just south of the RGR. During longer transits between the seamounts we again collected magnetic data.

Saturday (13.4.) we tried to sample two shallow seamounts on the western Rio Grande Rise (30° 40' S 036° 55' W and 30° 19' S 036° 56' W). We mapped for long distances along their flanks searching for suitable sites for dredging depending on the wind and swell directions. But we recovered no volcanic or plutonic rocks. During Sunday (14.4.) we returned for the last time to the deep graben structure and recovered samples along its southern and northern flanks (30° 24' S 036° 20' W and 30° 21' S 036° 04' W). During the night and Monday morning we returned to one of the seamounts on the western Rio Grande Rise at 30° 10' S 036° 54' W but the dredge became stuck yet again and we recovered only carbonate crust.

By the beginning of the fifth week it was time to make a final decision about the third planned seismic refraction profile. With only 5 working days left before we had to start the transit back to Montevideo and the experience of many unsuccessful dredge hauls we decided to cancel the seismic profile and invest all remaining time into sampling the crucially important unsampled part of the Jean Charcot Seamount Chain.

While this was a difficult decision it was made somewhat easier by the knowledge that since Klingelhoefer et al. (2015) have published results from a nearby seismic refraction study. Thus, we can use this published information in our interpretation about the nature of the Jean Charcot Seamount Chain.

The sampling of the Jean Charcot Seamount Chain north of the Rio Grande Rise and the western end of the graben proved to be just as challenging as before. We had to map and find suitable steep slopes with wind and swell directions often severely limiting our options. We were successful at some seamounts, and failed at others (empty dredges or only carbonate crusts). But overall, we recovered a fascinating and scientifically very important collection of rocks distributed along the seamount chain and graben. Weather conditions varied over the course of the week, but were generally good. We encountered a southwesterly swell almost all time during the cruise.

We finished dredging between Friday and Saturday (19./20.4.) on the large seamount at the northwestern end of the seamount chain, not far from the Brazilian Economic Zone (EEZ). After three unsuccessful hauls we recovered a large piece of basalt. Before heading back to Montevideo, we measured the water sound velocity using a mobile XSV probe. Afterwards we deployed the towed magnetometer and set sail southward staying outside the Brazilian EEZ in order to continue with the underway measurements and magnetic profiling. Magnetic measurements finished Monday (22.4.) at noon. Underway measurements (multibeam bathymetry, sediment echo sounder, gravity, ADCP) continued until Monday evening, shortly before we reached the Uruguayan EEZ. Weather conditions were fine during our transit. The transit time was used to pack almost all the scientific freight and samples and stow the containers before we reached the port.

We reached the port of Montevideo Wednesday morning (24.4.) at 8:30 am. Shortly afterwards we measured gravity at the tie stations in the harbor. The last of the scientific equipment was stowed into the containers. By the evening all members of the scientific party had left the vessel marking the end of MSM82.

5 Preliminary Results

5.1 Underway Hydroacoustics

(J. Geils, K. Unger Moreno, A. Mosaad)

5.1.1 Bathymetry

(J. Geils [1], K. Unger Moreno [1])

[1]AWI

During cruise MSM82 bathymetric data were measured with the hull-mounted MBES Kongsberg EM122. Data acquisition started on the 19th of March and continued until 22nd of April 2019. Only minor acquisition pauses took place during station work, OBS release and OBS recovery. The main focus of the cruise was dredging and acquiring refraction seismic profiles. Thus, it was essential to provide swath maps for planning the exact position of the OBSs and dredge stations.

System Overview

The full ocean depth MBES Kongsberg EM122 uses frequencies from 11.25 to 12.6 kHz, depending on the measuring sector, to map the seafloor. The transmitting and receiving units are aligned in mills cross configuration with transducer chains of 8 m length each. With these frequencies and the size of the EM122 transducers the *MARIA S. MERIAN* achieves a vertical resolution of 10 to 40 cm (theoretically) and a horizontal resolution of 2° x 2° per beam. For one ping the system calculates 864 depth values. A Kongsberg Seapath system provides time, position and motion data and sends it directly to the processing unit of the echosounder. The EM122 is able to compensate for ship movements of 10° pitch and yaw and 15° roll. Depending on the weather conditions, ships speed and water depth the maximum opening angle of 150° was reduced to 130° or 120° to ensure outer beam data quality. The EM122 was operated with the Kongsberg Seafloor Information System (SIS).

The shallow water MBES Kongsberg EM712 is also installed on *MARIA S. MERIAN* but was not used during the expedition due to the overall deep-water depths of the working area.

Sound Velocity Measurements

Sound Velocity Profiles (SVPs) are required to calibrate the EM122 for different areas. Otherwise the exact ray path of individual beams can't be calculated. During MSM82 four methods were used to establish the SVPs. To save time during transit to the working area we applied synthetic SVPs from the WorldOceanAtlas 2013. Once we reached the area of interest SVPs were measured with the Sea-Bird Electronics Inc. SBE 911plus CTD. This probe calculates empirically the sound velocity from the Conductivity (salinity), Temperature and Depth. We also used the AML Applied Microsystems SV PlusX sound velocity profiler. The benefit of this device is the direct measurement of the sound velocity of water with a small pinger. As the ship had to stop for a CTD or AML anyway, both systems were used simultaneously by attaching AML to the wire of the CTD. The AML SVP was then applied to SIS, whereas the CTD data, with the benefit of many other measured parameters like oxygen, was just stored for databases such as PANGAEA. Conducting both measurements concurrently proved to be very handy because on one occasion there was an issue with the AML flash and several times the CTD depth sensor was error-prone. To save more time during cruise MSM82 we used also the single-use Lockheed-Martin Sippican XSV w. This probe is launched from the aft of the vessel and gives online sound velocity information while falling through the water column. This measurement was conducted at a ship speed of 2 to 5 kn.

Table 5.1 lists the SVP stations during MSM82 and Figure 5.1 shows the measured SVPs.

Table 5.1 MSM82 Sound Velocity Stations. 1: Attached to releaser test. 2: Failed due to flash disk error (max. depth 280 m). 3: Problems with deck unit (max. depth 1300 m).

BATHYMETRY STATION	OFFICIAL MSM82 STATION	DATE	UTC	LONGITUDE	LATITUDE	STATION TYPE	APPLIED IN SIS	APPLIED IN HIPS
SVP01[1]	MSM82_1-1	2019-03-19	15:31	-50.035280	-35.925185	AML	v	v
SVP02	X	2019-03-20	06:00	-48.445700	-35.871829	WOA13	v	v
SVP03	X	2019-03-21	05:00	-43.176467	-35.967179	WOA13	v	v
SVP04	X	2019-03-22	04:30	-36.088786	-35.993008	WOA13	v	v
SVP05	MSM82_4-1	2019-03-23	12:20	-30.707000	-35.359167	CTD	v	v
SVP06[2]	MSM82_4-1	2019-03-23	12:20	-30.707000	-35.359167	AML	x	x
SVP07	MSM82_5-1	2019-03-23	22:15	-30.256333	-34.337667	CTD	v	x
SVP08	MSM82_5-1	2019-03-23	22:15	-30.256333	-34.337667	AML	v	v
SVP09	X	2019-03-26	03:45	-29.652750	-32.929947	WOA13	v	v
SVP10	MSM82_18-1	2019-03-31	19:30	-32.060966	-32.416768	XSV	v	v
SVP11	MSM82_31-1	2019-04-03	07:00	-34.381934	-28.795448	CTD	x	x
SVP12	MSM82_31-1	2019-04-03	07:00	-34.381934	-28.795448	AML	v	v
SVP13	MSM82_39-1	2019-04-10	20:45	-39.011498	-34.023543	CTD	x	x
SVP14	MSM82_39-1	2019-04-10	20:45	-39.011498	-34.023543	AML	v	v
SVP15	X	2019-04-13	07:50	-37.243506	-30.593911	WOA13	v	v
SVP16[3]	MSM82_61-1	2019-04-15	15:12	-36.962975	-29.262804	CTD	x	x
SVP17	MSM82_61-1	2019-04-15	15:12	-36.962975	-29.262804	AML	v	v
SVP18	MSM82_81-1	2019-04-20	04:19	-40.011348	-26.342700	XSV	v	v

Data Management and Processing

The raw bathymetric data was initially stored on the operator's computer and then mirrored to the public_wiss server on board *MARIA S. MERIAN* and afterwards mirrored again to the processing computer. At this point the processing flow in CARIS HIPS and SIPS starts. The data was sound velocity corrected with the CARIS algorithm and the navigational data merged with the across track sounding position to get geographical coordinates for each sounding. Then the files were cleaned of outliers in the swath editor and further inspected in the 3D subset editor.

After gridding and export of the data the processed grids were imported to QGIS. Map production and station planning could then begin.

The software SoundSpeedManager (SSM) was used to handle the different SVPs by smoothing and cleaned them for outliers. CTD, AML and XSV profiles were mainly conducted down to 2500 m and extended to the seafloor using data from the WorldOceanAtlas 2013. All profiles were then extended linearly down to 12000 m, which is compulsory for SIS. Finally, the profiles were exported as .asvp files for SIS, stored as .csv files and merged as .svp for CARIS sound velocity correction.

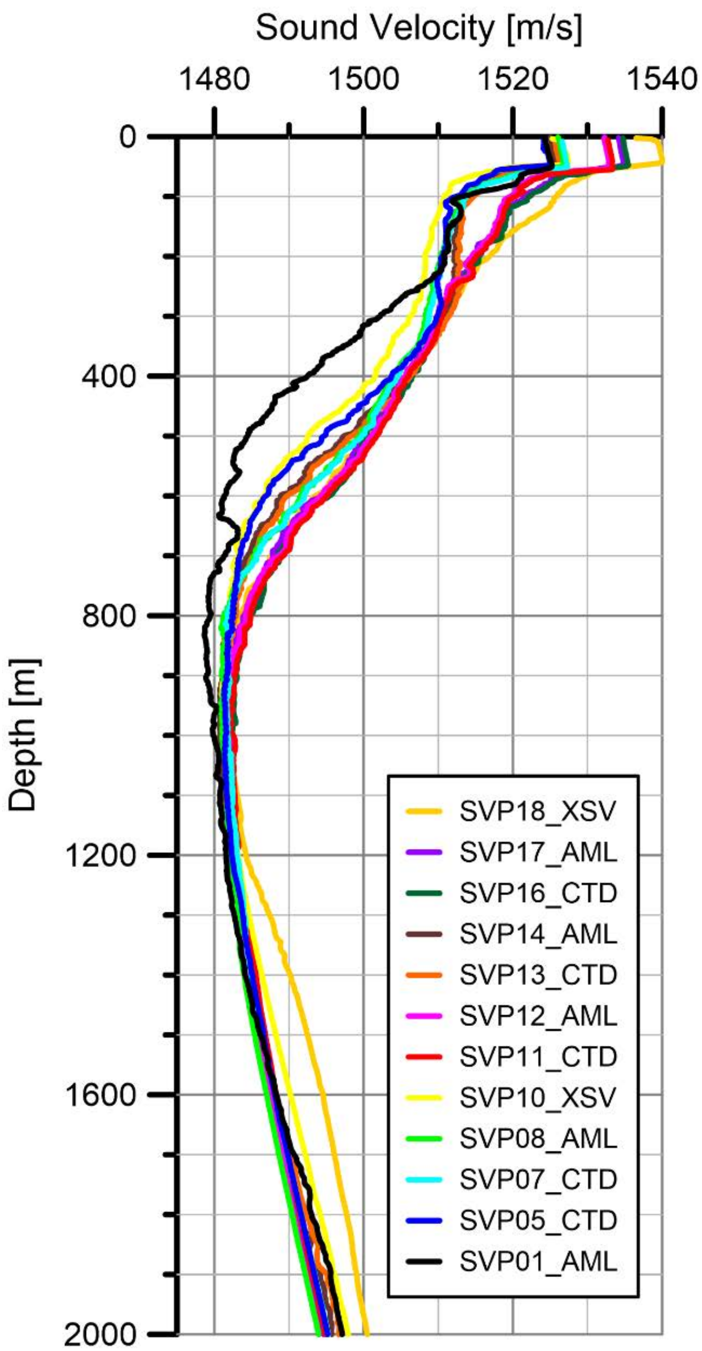

Figure 5.1 Measured Sound Velocity Profiles during MSM82.

Preliminary Results

During MSM82 the seafloor was mapped with the help of the EM122 along a track of 10,300 km representing an area of about 130,000 km². An overview of the acquired bathymetry and the SVPs in the working area is given in Figure 5.2.

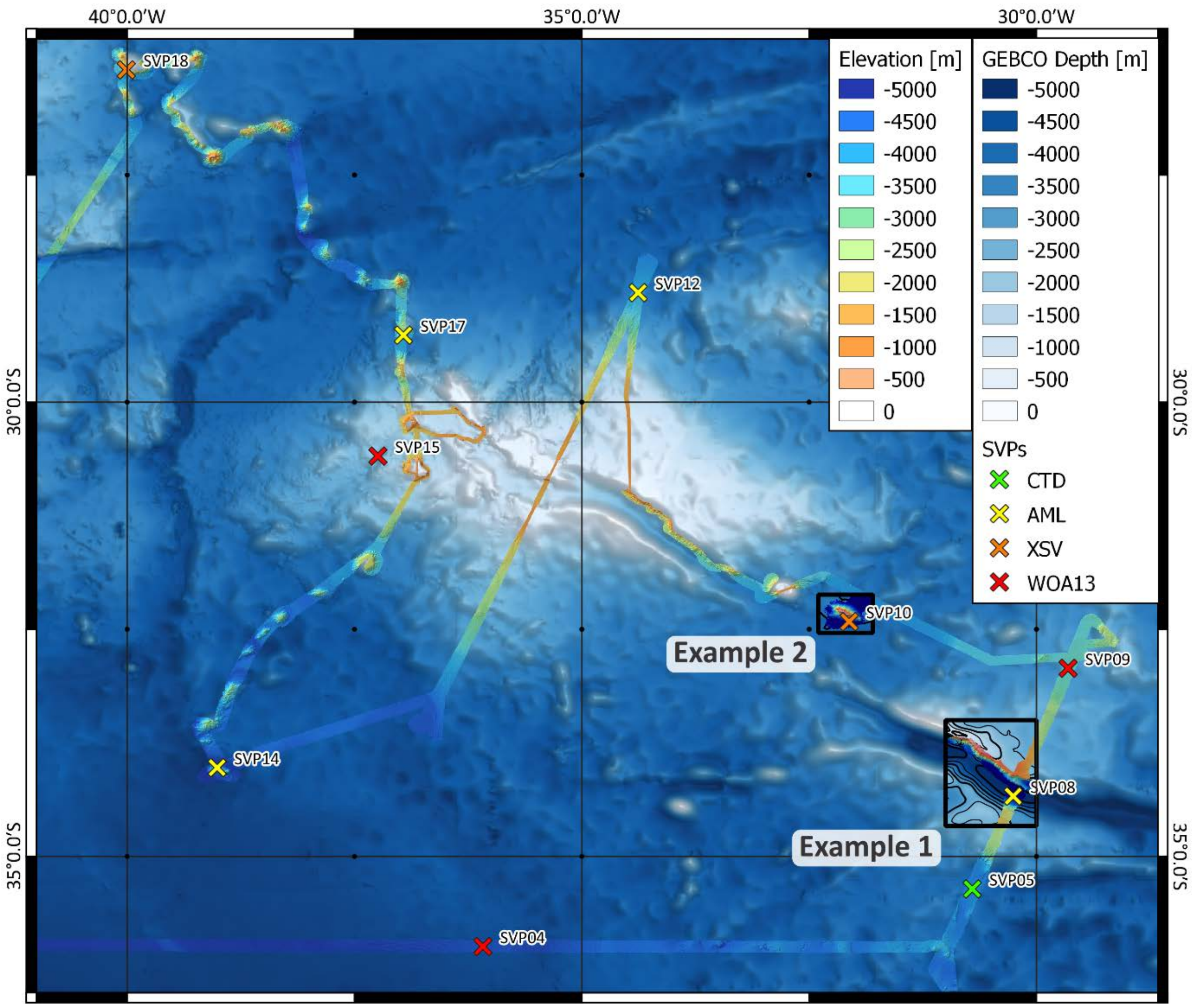

Figure 5.2 Overview of the acquired bathymetry and the SVPs in the area of the Rio Grande Rise.

Example 1

Figure 5.3 shows a partly mapped flank of the southeastern Cruzeiro do Sul Lineament feature. Over a distance of about 10 km the water depth decreases from 5250 m to 1250 m. The maximum slope is up to 66°. The continuous slope in the western part is remarkable whereas the eastern slope is divided into two steps.

Example 2

Figure 5.4 shows Jokat Seamount (preliminary name). This structure is 47 km long and 27 km wide and an overall area of about 1115 km² a. The slope is up to 41° and the maximum relief is approximately 2600 m with the highest point is at a water depth of 1658 m.

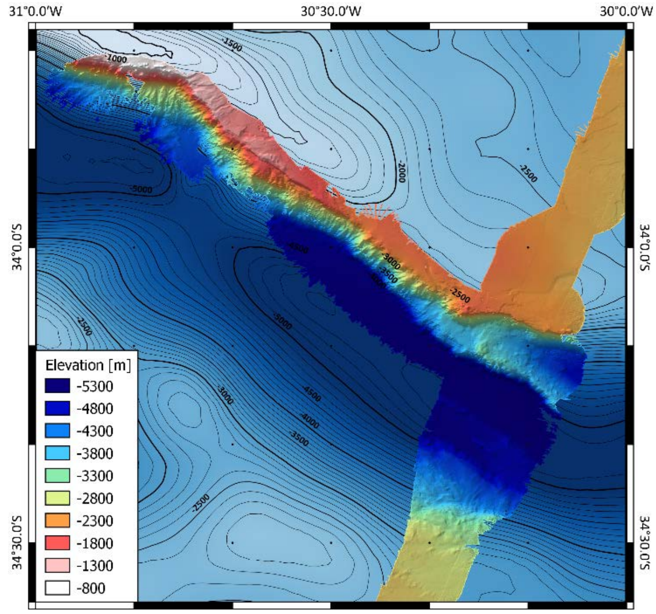

Figure 5.3 This figure shows a part of the northern flank of the southeastern Cruzeiro do Sul Lineament.

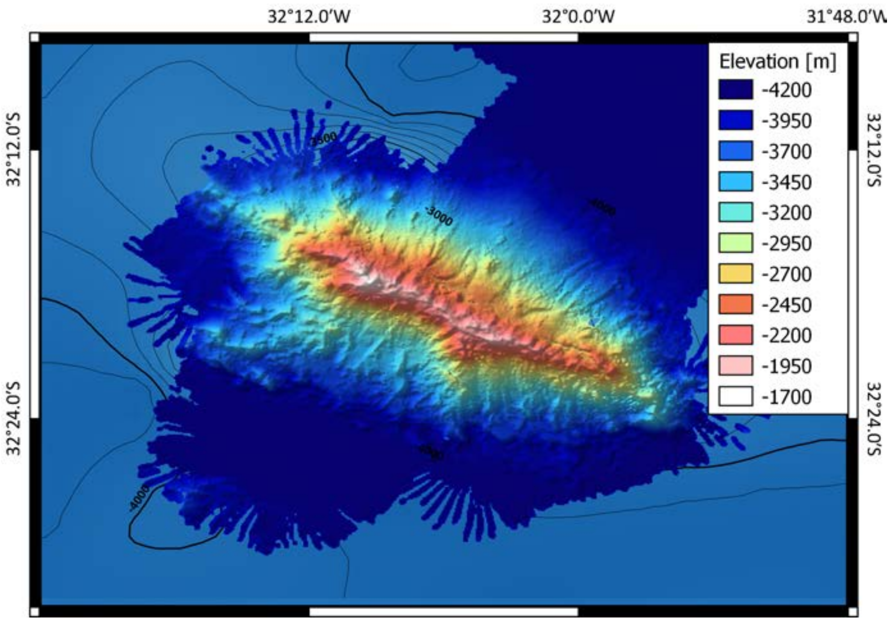

Figure 5.4 A map of the Jokat Seamount (preliminary name).

5.1.2 Sediment Echo-Sounding

(A. Mosaad [1], K. Unger Moreno [1])

[1]AWI

The hull-mounted ATLAS PARASOUND sub bottom profiler has been operated during the MSM82 cruise for ocean floor and one time for water column imaging. Generally, areas with outcropping acoustic basement or soft sediment cover were imaged. Real time PARASOUND data was used to avoid dredging at sediment covered slopes. Recording stopped during dredging operations and OBS deployments and recoveries.

Technical details

The parametric echo sounder system PARASOUND DS3 (P70) was developed by TELEDYNE ATLAS HYDROGRAPHIC GmbH. The PARASOUND system generates two primary frequencies, where the lower frequency is selectable between 18 and 23.5 kHz transmitting in a narrow beam of 4.5° at high power. As a result of Parametric Effect, two secondary frequencies are then generated where the secondary low Frequency (SLF) is the difference (e.g. 4 kHz) and the Secondary high frequency (SHF), e.g. 40 kHz is the sum of the primaries. The generated SLF then travels within the emission cone of the primary high-frequency waves with a sub ocean floor penetration of up to 200m. The echo sounder has a limitation in imaging slopes with inclination of more than 4° as the energy then gets reflected away from the mounted transducers. The acquisition software package consists of Teledyne ATLAS HYDROMAP SERVER, ATLAS HYDROMAP CONTROL and ATLAS PARASTORE.

Data Acquisition and Management

The echo-sounder data were acquired from 19th of March, 23:51 UTC to the 24th of April 2019, 03:59 UTC where the PARASOUND was switched off after reaching the 200-mile zone with sounding breaks during dredging, OBS deployments and recoveries, as well as in areas with very steep slopes where the system limitations prevented clear imaging of the ocean floor. The echo sounder was also switched off during sound velocity profiling and OBS releaser tests. The PARASOUND system has been used to generate a SLF signal of 4 kHz, the PHF was set to 19.8 kHz. The PHF signal commonly serves for the water depth determination as a system depth source to help acquiring the SLF in quasi-equidistant mode since the length of reception mode is limited and Depending on the water depth, the system calculates a resulting time interval between pulses that roughly equals the desired time interval and secures that pulses are transmitted only at times at which no sediment data is received preventing loss of data.

The system was operated mainly in quasi-equidistant pulse mode for shallow areas where single pulse mode was applied with 140 Volt transmission voltage avoiding overcharging the capacitors since after going with full power capacitors were overcharged at (07:18 UTC) 20-03-2019. Incoming data were stored in ASD-, SEGY- and PS3-files. PS3 data were converted to SEGY files using a processing tool (written by Hanno Keil, University of Bremen) then imported into IHS Kingdom® for visualization and quality control

Data Examples and Preliminary Results

Sub bottom SLF profiles collected during MSM82 show different SLF echo- types controlled by the rugged acoustic basement and the presence of hard and soft sediments. First facies type is characterized by overlapping hyperbolae varying in vertex elevations, Fig. a) shows some deeper parallel internal reflectors in parts, (Damuth and Hayes 1977) have identified similar echo Type (Type IIIA) being returned from exposed basement of Mid-Atlantic ridge and Rio Grande Rise. It is observed in data collected along seismic refraction profiles 20190100 and 20190200 and at the Jean Charcot Seamounts (Fig. 5.5).

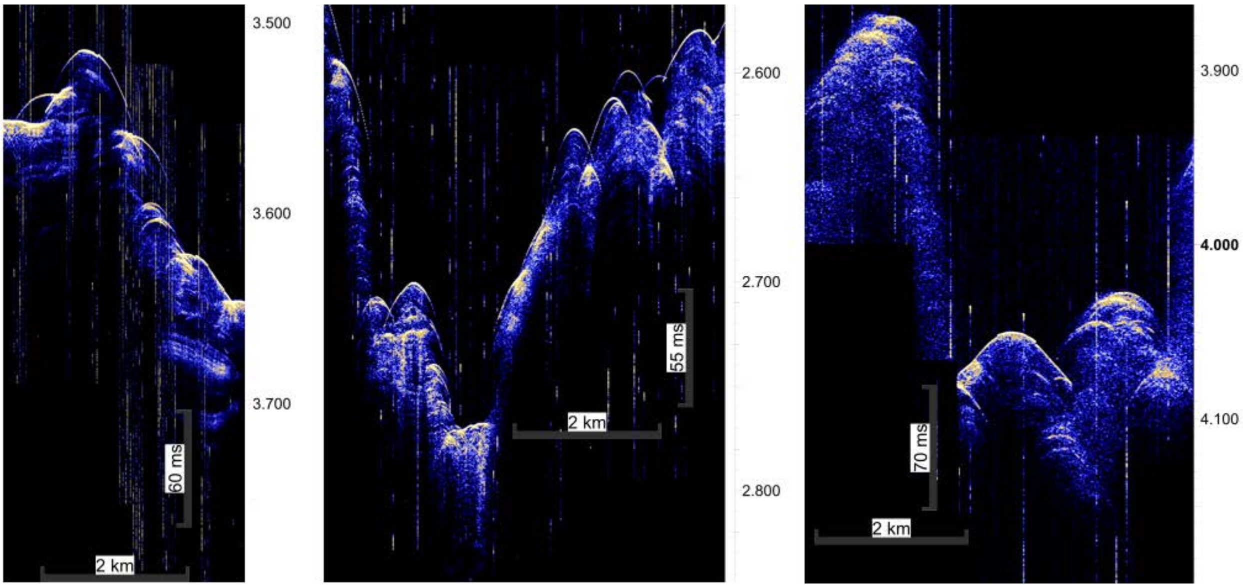

Figure 5.5 Three Examples of sub-bottom profilers of a), b) and c) taken from OBS Profile 20190100, OBS Profile 20190200 and Jean Charcot Seamounts. (Data example type I). Vertical scale – two-way travel time in seconds.

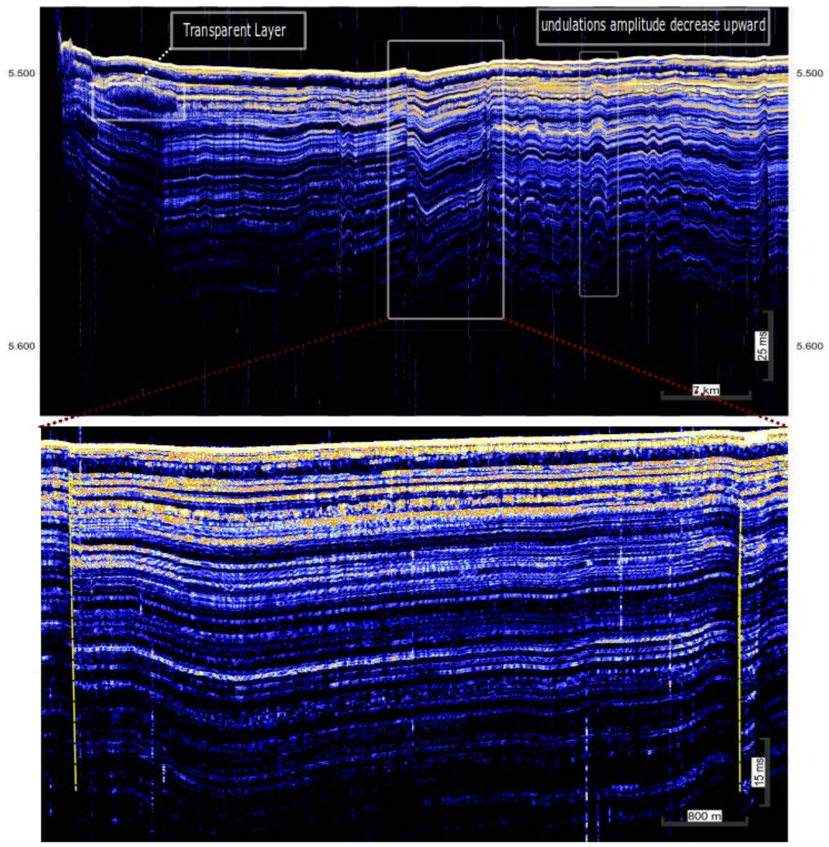

Figure 5.6 SLF profile near the Sirius Guyot showing sub-bottom penetration of up to 80 m. showing parallel continuous reflectors. (Data example type II). Vertical scale – two-way travel time in seconds.

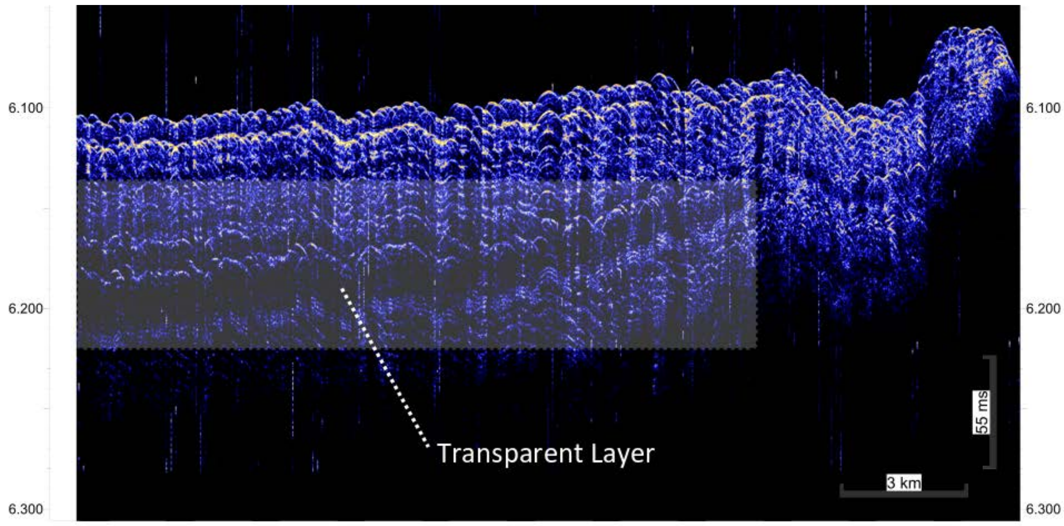

Figure 5.6 SLF profile imaged south WRGR on the transit to the JC seamounts (Data example type III). Vertical scale – two-way travel time in seconds.

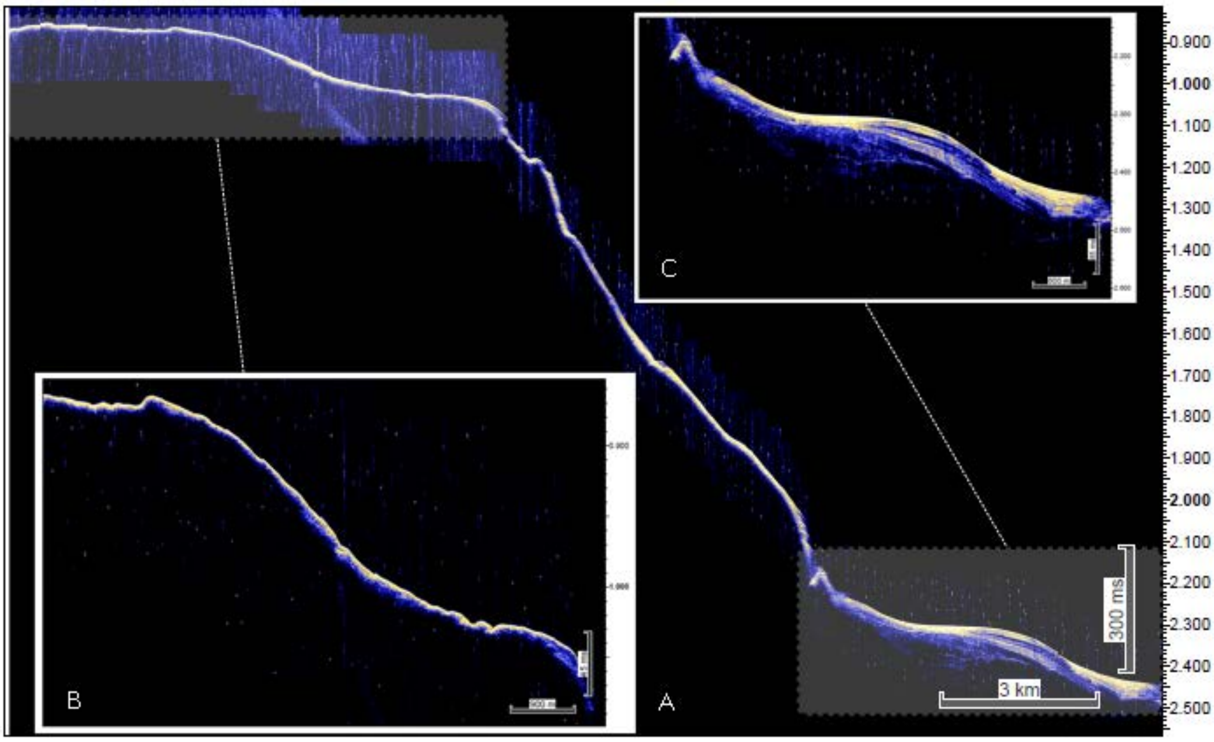

Figure 5.7 SLF profile imaging the top and flank a of central Jean Charcot seamount dredged earlier by Brazilian researchers). Vertical scale – two-way travel time in seconds.

Sharp continuous parallel reflectors of ~80 m thick sediment packages were imaged near the Sirius Guyot at the central Rio Grande Rise showing sediment packages with undulations that have more amplitude downward (Fig 5.6 top), profiling of sediment echoes shows faulting of these packages as well (Fig 5.6 bottom).

Another imaged echo type with overlapping hyperbolae conformable with sub-bottom reflectors (Fig. 5.6) was earlier identified by (Damuth and Hayes, 1977) as type (IIIB). Where in this example such characterized echo is also part of some undulations and interrupted by a transparent layer.

An example where the SLF data were used to avoid dredging at sediment covered slopes. Fig 5.7A shows an overview of the seamount, Fig. 5.7B shows the upper slope of the seamount with prolonged bottom echoes with no sub-bottom reflectors with some parts of discontinuous hyperbolae echoes, with going down the slope the hyperbolae echoes get more continuous. Fig. 5.7C shows clear sharp prolonged echoes with sub-bottom reflectors.

The PHF can be used to image gas bubbles, so along with the hull-mounted MBES Kongsberg EM122 was used to cover an area of potential gas emissions at the northern central Rio Grande Rise. No gas features were observed in this area, however, shortly after some bubble streams were imaged with spacing of a few kilometers. Echogram (Fig. 5.8) shows the gas emissions recorded using the PHF profile.

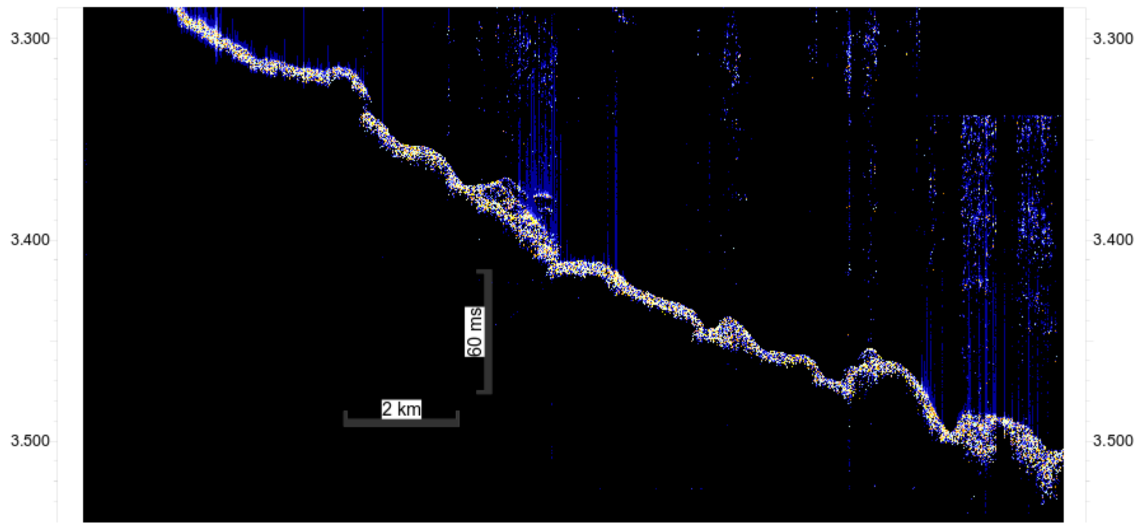

Figure 5.8 PHF profile imaging echoes of gas bubbles directly above seafloor. Vertical scale – two-way travel time in seconds.

5.2 Petrological Sampling

(J. Geldmacher [1], P. Hackspacher [2], S. Homrighausen [1], P. Hoyer [3], S. Krumm [3], J. O'Connor [3]

[1]GEOMAR

[2]UNESP

[3]FAU

5.2.1 Methods

Dredging and Site Selection

Rock sampling on MSM82 was carried out using rectangular chain sack dredges. A dredge is a steel frame with teeth at the upper opening and a chain bag at the end in which rock samples are collected as the dredge is pulled over geological structures of interest. The most effective way to recover rock samples is to dredge steep slopes on seamounts or in the graben. The ship, however, can only dredge along tracks that face into the oncoming wind and waves. So sometimes we could not dredge the optimum slopes, which reduced the chances of obtaining a large number of samples or any samples at all.

Figure 5.9 A successful chain dredge haul is on its way onboard. Photo credit: Jan Falkenberg.

In order to dredge the ship stops over the deepest part of the selected dredge track and the dredge is lowered down to the sea floor. The ship is then driven slowly towards the endpoint of the track and only as much cable as needed is payed to keep the dredge stationary on the seafloor so as to avoid getting it tangled. Once the ship is at the end position, the dredge is pulled toward the ship and finally brought onboard.

Dredge station areas were chosen on the basis of a number of existing datasets such as " GEBCO_2014 Grid, version 20150318", http://www.gebco.net) or multi-beam bathymetry recorded on former cruises (e.g., Leplac Brazilian Navy) and published data, maps, and profiles. The final selection of dredge sites was made based on detailed multi-beam surveys carried out at each site before dredging.

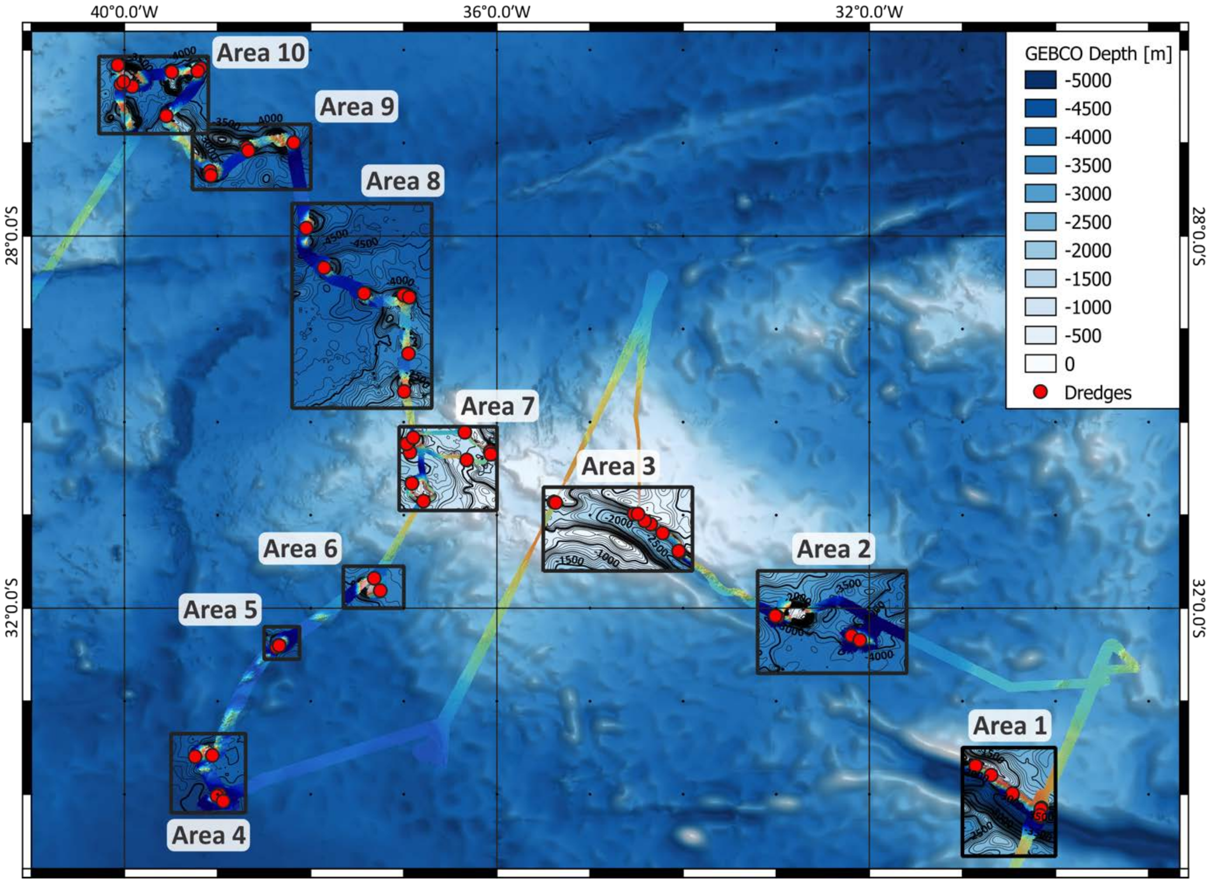

Figure 5.10 Overview map showing the MSM82 working areas and dredge stations.

Shipboard Procedure

The samples were sorted into various rock types and sawn into two pieces in order to classify them visually and gauge their degree of alteration. Similar looking rocks were grouped, and the best samples were selected for further investigation onshore. Outer crusts were removed with the rock saw and the least altered parts cut into small pieces to be used in the preparation of thin sections, isotopic age determinations, and major, trace element and isotopic geochemical analyses. Finally, the samples were described, photographed again, packed and labeled.

Tab. 5.2 Dredge station summary.

Date	Station	Dredge	Location	total volume	Rec. DR	Rock summary	on bottom lat °S	on bottom long °W	off bottom lat °S	off bottom long °W	water depth (m) begin	water depth (m) end	Volcanic rock	Sediment rock
24.03.19	MSM82_6-1	6-DR	Eastern RGR, rift valley, upper part of northern rift slope	half full	1	volcanic rock, Mn-crust	34°08.82	30°09.09	34°08.65	30°08.90	3252	2944	1	
24.03.19	MSM82_7-1	7-DR	Eastern RGR, rift valley, lower part of northern rift slope	1/4 full	1	basalt columne, several smaller rocks	34°09.57	30°09.49	34°09.31	30°09.22	3800	3674		
24.03.19	MSM82_8-1	8-DR	Eastern RGR, rift valley, northern slope of finger-like strucutre in the Graben	one rock	1		34°14.41	30°09.88	34°14.24	30°09.66	5266	4866		
24.03.19	MSM82_9-1	9-DR	Eastern RGR, rift valley, upper northern slope of finger-like strucutre in the Graben	empty	0		34°13.69	30°09.97	34°13.55	30°09.80	4594	4090		
25.03.19	MSM82_10-1	10-DR	Eastern RGR, rift valley, uppermost northern slope of finger-like structure in the Graben	few rocks	1	angular volcanic rocks, carbonates, few corals	33°47.65	30°41.50	33°47.43	30°41.26	2140	1580	1	1
25.03.19	MSM82_11-1	11-DR	Eastern RGR, rift valley, northern slope, uppermost part of a small superimposed seamount	full	1	pillows, basalt columne?, corals, Mn-crust	33°41.65	30°51.48	33°41.46	30°51.24	1320	915	1	
25.03.19	MSM82_12-1	12-DR	Eastern RGR, rift valley, lowermost slope of northern slope between 10-DR & 9-DR	two rocks	1	volcanic rocks	34°00.79	30°27.85	34°00.75	30°27.62	4670	4360	1	
25.03.19	MSM82_13-1	13-DR	Eastern RGR, rift valley, 600 m above 12-DR	one rock	1		33°59.62	30°27.77	33°59.54	30°27.41	3760	3257		
31.03.19	MSM82_16-1	16-DR	Jokat Seamount, western flank	empty	0		32°17.82	32°11.53	32°17.83	32°11.51	2819	2780		
31.03.19	MSM82_17-1	17-DR	Jokat Seamount, southern slope	few rocks	1	coral, carbonates	32°20.61	32°06.12	32°20.61	32°06.12	2760	2600		1
01.04.19	MSM82_20-1	20-DR	Sirius Seamount, lower SW flank	empty	0		32°05.58	32°59.16	32°05.59	32°59.36	3517	3562		
01.04.19	MSM82_21-1	21-DR	Sirius Seamount, SW lower slope	empty	0		32°04.97	33°00.59	32°04.94	33°00.27	3731	3554		
01.04.19	MSM82_23-1	23-DR	Central RGR, rift valley	one rock	1	carbonate	31°23.96	34°02.44	31°23.92	34°02.06	2192	1812		1
01.04.19	MSM82_24-1	24-DR	Central RGR, rift valley, northern slope	few rocks	1	igneous, carbonate, coral fragments, starfish	31°23.16	34°02.91	31°23.11	34°02.59	2224	1828	1	1
02.04.19	MSM82_25-1	25-DR	Central RGR, rift valley, northern slope	few rocks	1	carbonates	31°11.59	34°13.25	31°11.59	34°13.24	1962	1961		1
02.04.19	MSM82_26-1	26-DR	Central RGR, rift valley, uppermost part of northern slope	few rocks	1	sediments	31°05.85	34°20.86	31°05.80	34°20.53	1153	987		1
02.04.19	MSM82_27-1	27-DR	Central RGR, rift valley, lower slope east of 26-DR	empty	0		31°03.69	34°24.82	31°03.69	34°24.82	1417	1464		
02.04.19	MSM82_28-1	28-DR	Central RGR, rift valley, lowermost slope, debris fan	empty	0		30°59.29	34°31.64	30°59.27	34°31.44	1792	1710		
02.04.19	MSM82_29-1	29-DR	Central RGR, rift valley, uppermost cliff edge	few rocks	1		30°59.30	34°29.11	30°59.20	34°28.81	1330	930		
08.04.19	MSM82_34-1	34-DR	Central RGR, westernmost part of the rift valley	half full	1	pillows, volcanoclastics, carbonates	30°51.54	35°23.34	30°51.31	35°23.22	1100	788	1	1
08.04.19	MSM82_35-1	35-DR	Central RGR, western part of the rift valley	empty	0	few corals	30°51.93	35°22.15	30°51.77	35°22.08	1320	1136		
10.04.19	MSM82_37-1	37-DR	Southern Charcot Seamounts, sothernmost smt	empty	0		34°00.17	38°59.08	34°00.42	38°59.25	4483	4180		
10.04.19	MSM82_38-1	38-DR	Southern Charcot Seamounts, southernmost smt.	empty	0		34°01.11	39°00.42	34°01.38	39°00.55	3620	3230		
10.04.19	MSM82_40-1	40-DR	Southern Charcot Seamounts, southernmost smt., upper southern slope	empty	0		34°04.53	38°56.41	34°04.25	38°56.29	3440	3258		
11.04.19	MSM82_41-1	41-DR	Next to Charcot smt, southern slope of E-W oriented (late stage?) rift zone extending from seamount summit	empty	0		33°35.74	39°14.52	33°35.48	39°14.38	4115	3879		
11.04.19	MSM82_42-1	42-DR	Charcot smt chain, second to the south, southern slope of main edifice	empty	0		33°34.93	39°03.45	33°34.63	39°03.33	3671	3327		
11.04.19	MSM82_44-1	44-DR	Charcot smt.chain, southern portion, small flat-topped smt., southern slope, uppermost part	one rock	1	volcanic/sedimentary	32°23.88	38°20.55	32°23.70	38°20.33	3260	2970	1	
12.04.19	MSM82_45-1	45-DR	Charcot smt.chain, southern portion, small flat-topped smt., southern slope, south of 44-DR, lowermost part	two rocks	1	volcanic rocks	32°25.16	38°22.00	32°24.94	38°21.70	3980	3641	1	
12.04.19	MSM82_46-1	46-DR	Charcot smt.chain, southern portion, small flat-topped smt., southern slope, east of 44-DR	crusts	1	3 crusts, one with altered volcanic fragments	32°24.12	38°20.35	32°23.83	38°20.06	3273	2890		
12.04.19	MSM82_48-1	48-DR	Southern Charcot smt., flat-topped smt, ~110 E from 46-DR, NE-slope upper part	half full	1	lava fragments, volcanoclastic rocks, carbonate	31°40.77	37°19.12	31°40.91	37°19.47	2759	2418	1	1
12.04.19	MSM82_49-1	49-DR	Southern Charcot smts, same smt as 48-DR, eastern slope, small "cone" lower most part	half full	1	biology, angular lavas	31°48.71	37°15.17	31°48.78	37°15.52	3335	3021	1	
13.04.19	MSM82_51-1	51-DR	Flat smt. at entrance of western rift opening, ridge-like structure a NW corner of the smt., southern slope	few rocks	1	carbonate crusts	30°39.57	36°54.80	30°39.33	36°54.49	1515	1303		1
13.04.19	MSM82_52-1	52-DR	Charcot smt. chain, (JCS-3 = south of 51-DR), southern slope, uppermost part	empty	0	one coral	30°51.00	36°47.36	30°50.98	36°47.72	1360	1160		
13.04.19	MSM82_53-1	53-DR	Small smt., 40 km north of 51-DR, western slope, lowermost part	empty	0		30°19.51	36°56.08	30°19.37	36°55.81	2007	1740		
14.04.19	MSM82_54-1	54-DR	Smt.10 km north of 53-DR, western slope, lowermost part	few rocks	1	volcanic clasts of moderate preservation state with ~2 cm Mn-crust	30°14.02	36°58.22	30°14.06	36°58.31	1818	1824	1	
14.04.19	MSM82_55-1	55-DR	Northern entrance of rift, steep nose at lower rift valley slope	1/3 full	1	volcanic rocks	30°24.41	36°19.48	30°24.42	36°19.84	1297	924	1	
14.04.19	MSM82_56-1	56-DR	RGR rift, northern entrance, NE side, western slope of isolated graben shoulder block that Rohde et al. (2012) dated with young age	few rocks	1	conglomerate, carbonatic rock, coral	30°19.10	36°04.45	30°19.88	36°04.35	1140	1050		
14.04.19	MSM82_57-1	57-DR	RGR rift, northern entrance, NE side, ~2 km SE from 56-DR	few rocks	1	rounded rocks, corals	30°20.80	36°03.97	30°20.87	36°03.62	1100	800		
14.04.19	MSM82_58-1	58-DR	NW-RGR rift valley, N-rift slope. ~ 35 km NW from 57-DR	1/2 full	1	several angular and rounded rocks/blocks	30°06.61	36°20.70	30°06.66	36°20.34	1484	1080		
15.04.19	MSM82_59-1	59-DR	"Continental" seamount in the "river" valley, eastern slope, NE sector of smt.	few rocks	1	few carbonate crusts	30°10.03	36°53.95	30°10.13	36°53.56	1290	1066		
15.04.19	MSM82_60-1	60-DR	RGR, NE corner, guyot-shaped ridge, eastern flank	1/2 full	1	mainly dense sheet lava	29°40.25	36°59.82	29°40.25	36°59.49	1780	1647	1	
15.04.19	MSM82_62-1	62-DR	NE Charcot smts., southern smt., southern slope, upper part	1 rock	1	carbonate	29°15.85	36°57.06	29°15.77	36°57.40	3300	3000		
15.04.19	MSM82_63-1	63-DR	Charcot smts., ~ 30 nm N of 62-DR, northern slope, upper part	Mn-crust	0		28°38.09	37°00.13	28°38.45	37°00.19	2060	1680		
16.04.19	MSM82_64-1	64-DR	Charcot smts., same smt. As 63-DR, small "cone" at eastern flank	1 rock	1	volcanic rock, coral	28°39.54	36°56.56	28°39.82	36°56.54	2587	2227	1	
16.04.19	MSM82_65-1	65-DR	Elongated Charcot smt., just west of DR-64, ridge-like extension, steep SW slope, upper part	few rocks	1	volcanic	28°37.03	37°25.62	28°36.80	37°25.44	3223	2762	1	
16.04.19	MSM82_66-1	66-DR	Smt. south of "Vema-channel", small rift-arm at the western part of the rift	few rocks	1	volcanoclastic rocks, lava fragments, Mn-crust	28°20.43	37°51.43	28°20.61	37°51.58	3720	3420	1	
16.04.19	MSM82_67-1	67-DR	NW Charcot smts., flat-topped smt., SW-slope, lowermost part	few rocks	1	sediments with Mn-crust	27°54.88	38°02.93	27°54.72	38°02.67	4040	3680		1
16.04.19	MSM82_68-1	68-DR	N group of Charcot smts., easternmost smt., deep eastern lower slope	1 rock	0	Mn-nodule	26°59.72	38°11.04	26°59.82	38°11.36	3383	3168		
17.04.19	MSM82_69-1	69-DR	Charcot smts., smt. ~ 45 km E from 68-DR, uppermost slope of the southern flank	few rocks	1	carbonates	27°03.19	38°41.17	27°03.18	38°41.13	2335	2250		1
17.04.19	MSM82_70-1	70-DR	Charcot smts., same smt. as 69-DR, lowermost slope	empty	0		27°05.00	38°40.23	27°04.83	38°39.91	3268	3026		
18.04.19	MSM82_71-1	71-DR	Charcot smts., southernmost smt., cone/top, western slope, uppermos part	empty	0		27°18.11	39°04.90	27°18.00	39°04.59	720	440		
18.04.19	MSM82_72-1	72-DR	"Engagement ring smt.", Charcot smt., deep gorge running down southern flank (western slope)	1/3 full	1	well preserved volcanic rocks	27°21.01	39°04.37	27°21.15	39°04.76	2269	1681	1	
18.04.19	MSM82_73-1	73-DR	Charcot smt. group, northern portion, NW-SE striking ridge-like structure, NW corner, upper western slope	two rocks	1	basalt , carbonate	26°42.56	39°33.11	26°42.34	39°32.80	3068	2515	1	
19.04.19	MSM82_74-1	74-DR	Charcot smts., northern portion, NE-seamount, E-slope in a small "rift-valley"	few rocks	1	volcanoclastic rocks	26°11.84	39°11.10	26°11.77	39°10.99	2761	2750	1	
19.04.19	MSM82_75-1	75-DR	Charcot smts., northern portion, E-W oriented valley a E-slope	one rock	1	breccia	26°13.64	39°12.80	26°13.59	39°13.11	2519	2235		
19.04.19	MSM82_76-1	76-DR	Northern Charcot smts., small seamount, steep NW flank of flat topped smt.	few rocks	1	volcanoclastics, cruts	26°14.23	39°29.56	26°14.23	39°29.56	2838	2276	1	
19.04.19	MSM82_77-1	77-DR	Northeastern most Charcot smt., southern slope, steep step	1 rock	1	carbonates	26°23.57	39°55.04	26°23.28	39°55.22	3080	2487		1
19.04.19	MSM82_78-1	78-DR	Northeasternmost Charcot smt., western slope, lowermost part	empty	0		26°22.12	40°02.39	26°22.12	40°02.03	3533	3160		
19.04.19	MSM82_79-1	79-DR	Northeasternmost Charcot smt., northern slope, uppermost part	empty	0		26°09.83	40°04.35	26°09.97	40°04.20	2470	2199		
20.04.19	MSM82_80-1	80-DR	Northernmost Charcot smt., eastern slope in a small valley	1 rock	1	volcanic	26°20.52	40°00.68	26°20.53	40°00.66	2657	2594	1	

Shore-Based Analyses

The magmatic rocks retrieved from the ocean floor by *MARIA S. MERIAN* will be analyzed using a combination of different analytical methods. Mineralogical composition will be determined by thin sections and x-ray powder diffraction (XRD). The ages of whole rocks and separated minerals will be determined by $^{40}Ar/^{39}Ar$ laser dating and thermochronological modeling will be conducted using U-Th/He methodology. Major element geochemistry by X-ray fluorescence (XRF) and electron microprobe (EMP) as well as trace element data measured by inductively coupled plasma mass spectrometry (ICP-MS) will give information on melting conditions and possible contamination by crustal/continental rocks. Thermal Ionization Mass Spectrometry (TIMS) will be used to analyze heavy radiogenic isotopic ratios, ($^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, $^{176}Hf/^{177}Hf$ and $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$ - Double Spike) which are powerful tools for identifying magmatic source components in the project study area (e.g. distinguish between depleted upper mantle or enriched material indicative for the presence of continental crust in the magma source).

5.2.2 Rock Sampling Report and Preliminary Results

The following section briefly describes dredging locations and summarizes recovered lithologies

AREA 1: Eastern end of the Cruzeiro do Sul Lineament Rift Valley (06-DR – 13-DR)

The first dredges (06-DR & 07-DR) of the cruise were carried out at the north shoulder of the rift valley ("Cruzeiro do Sul Lineament, CdSL"). Dredge 06-DR was on the upper slope between 3252 to 2944 m.b.s.l and 07-DR was nearer the base from 3800 to 3674 m.b.s.l. Dredges 08-DR & 09-DR were on a finger-like structure extending into the floor of the rift valley between 5266 to 4866 m.b.s.l and 4594 to 4090 m.b.s.l., respectively.

06-DR: numerous fine-grained moderately altered aphanitic basalt samples (Fig. 5.13) with manganese crusts up to 4 cm and pieces of conglomerate/breccia.
07-DR fine-medium grained slightly altered aphanitic basalt samples with a thin manganese coating.
08-DR fine-grained moderately altered aphanitic basalt
09-DR empty

Dredge 10-DR was located near the top of the valley wall between 2140 to 1580 m.b.s.l, 11-DR near the top of north wall between 1320 to 915 m.b.s.l., 12-DR near the bottom of the valley wall between 4670 to 4360 m.b.s.l., and dredge 13-DR was located towards the middle between 3760 to 3257 m.b.s.l. In Area 1, a wide range of depths were sampled that might allow us to define a possible magma evolution trend.

10-DR: fine-grained aphanitic basalts with a relatively thick manganese coating.
11-DR: fresh porphyritic and weakly altered aphanitic basalt with a thin manganese coat along with some conglomerate/breccia and carbonate material.
12-DR: weakly altered fine-grained aphanitic and fresh porphyritic basalts.
13-DR: conglomerate/breccia composed of sub-angular to sub-rounded fragments of fine-grained volcanic material indicating multi-stage volcanism.

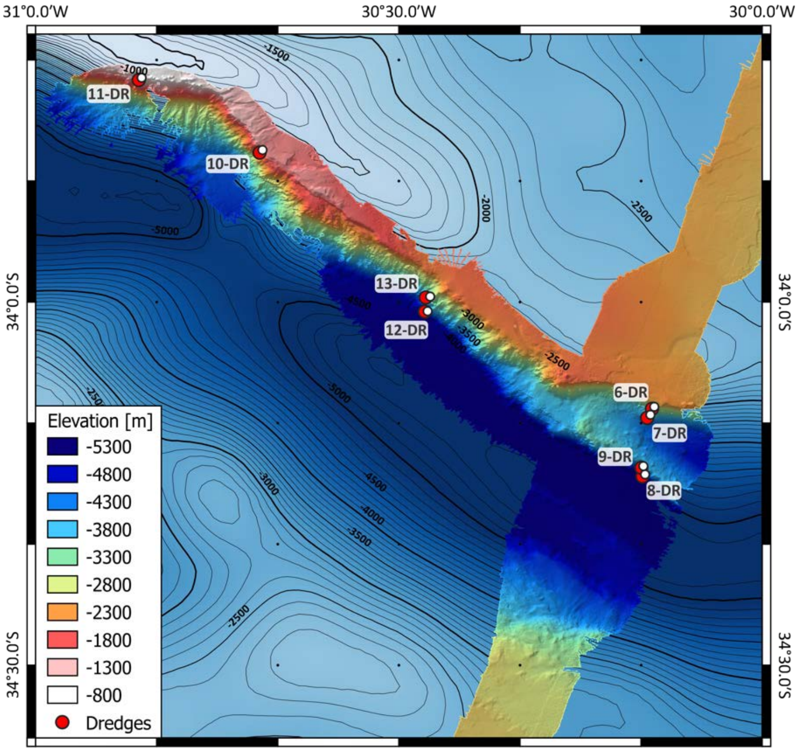

Figure 5.11 Overview of MSM82 dredge sites at the eastern end of the rift valley**.** Map shows EM122 multi-beam data recorded on MSM82 (exaggeration: 200 m; interval of contour lines: 200 m) superimposed on the GEBCO_2014 Grid, version 20150318, http://www.gebco.net.

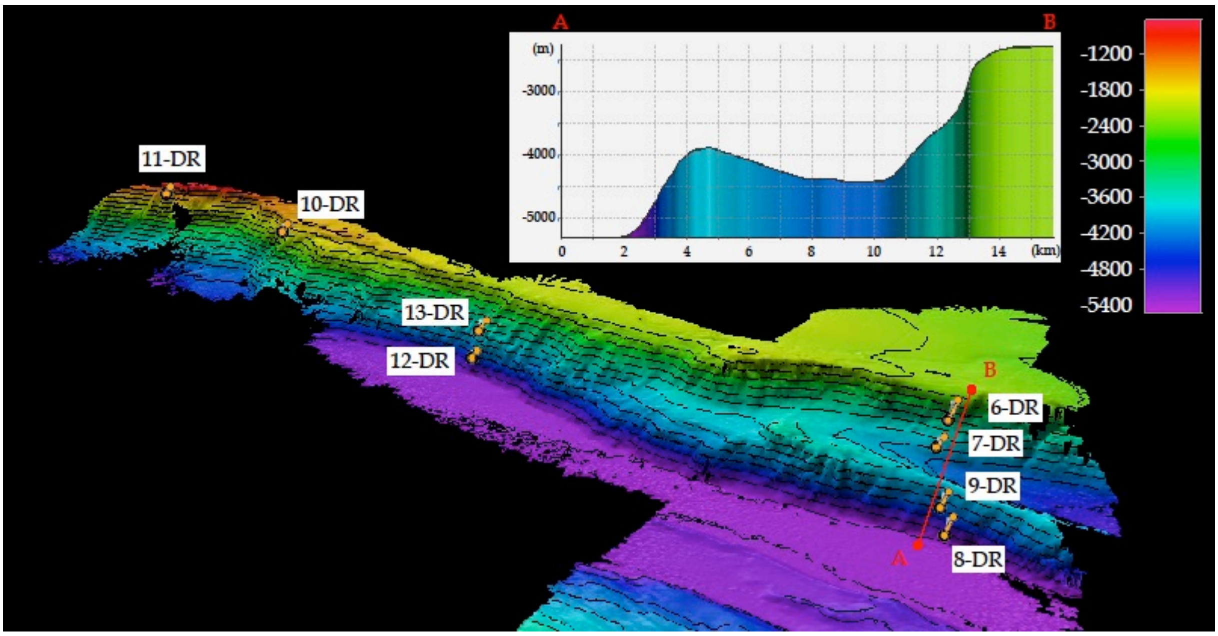

Figure 5.12 A 3-D projection of the multi-beam data shown Fig. 5.2.2 (exaggeration: 2x; interval of contour lines: 200 m). The insert illustrates the very steep northern wall of the rift valley.

Figure 5.13 Fine-grained aphanitic olivine? basalt with thin manganese coating on surface.

AREA 2: Jokat (16-17-DR) and Sirius (20-21-DR) Seamounts

Dredges 16-DR and 17-DR (Fig. 5.14) on Jokat seamount recovered some carbonate and brachiopods. Dredges 20-DR and 21-DR on Sirius seamount were empty.

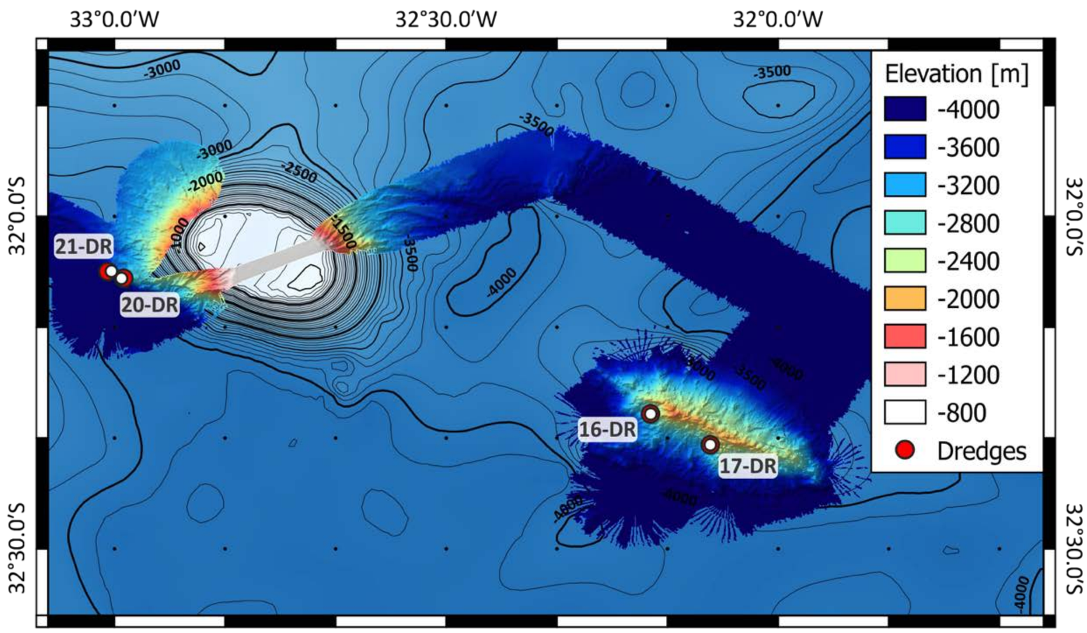

Figure 5.14 Overview of dredge sites on Jokat and Sirius seamounts.

AREA 3: Central Cruzeiro do Sul Lineament Rift Valley (23-29-DR & 34-35-DR)

In total nine dredge stations were conducted along the north wall in the middle region of the rift valley (Figs 5.15 & 5.16) at depths between c. 1100 to 4500 m and recovered the following:

23-DR: limestone
24-DR: medium-coarse grained igneous rock, strongly altered fine-grained aphanitic basalt with thin manganese coating, limestone and coral fragments (Fig. 5.17)
25-DR: limestone and conglomerate/breccia

26-DR: highly altered fine-grained aphanitic basalt with a thin manganese coating
27-DR: aphanitic to porphyritic basalt, conglomerate/breccia and limestone
28-DR: empty
29-DR: fine- to medium-grained well-rounded volcanic rock (rhyolite?), fine-grained, volcanoclastic conglomerate
34-DR: aphanitic to porphyritic basalt, volcano-clastite with large volcanic fragments, and carbonate.
35-DR: few corals

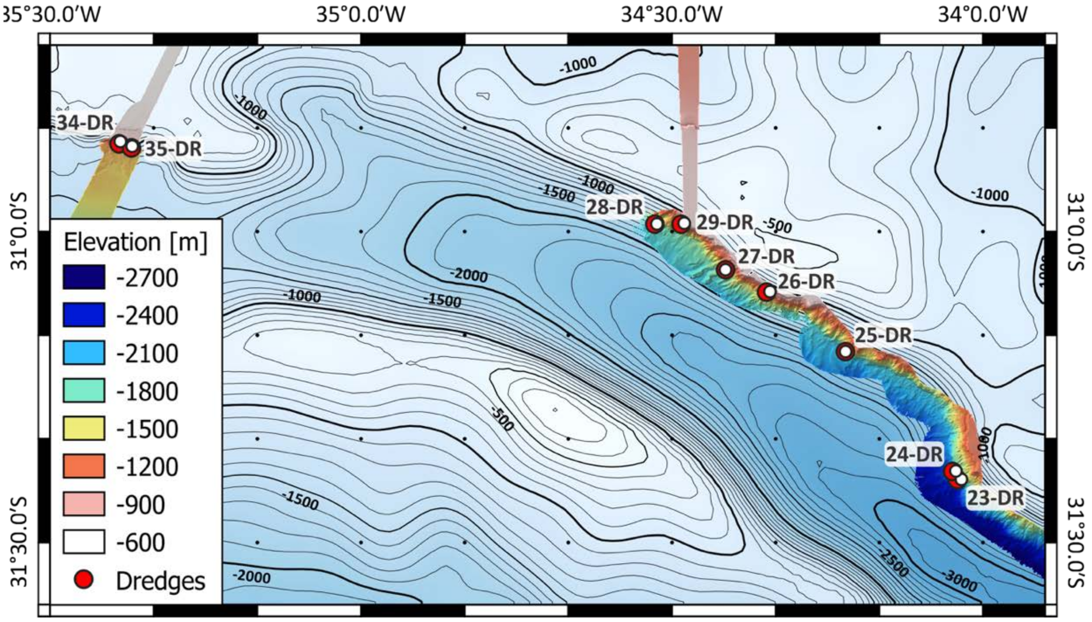

Figure 5.15 Overview of dredge sites in the central part of the Rift Valley.

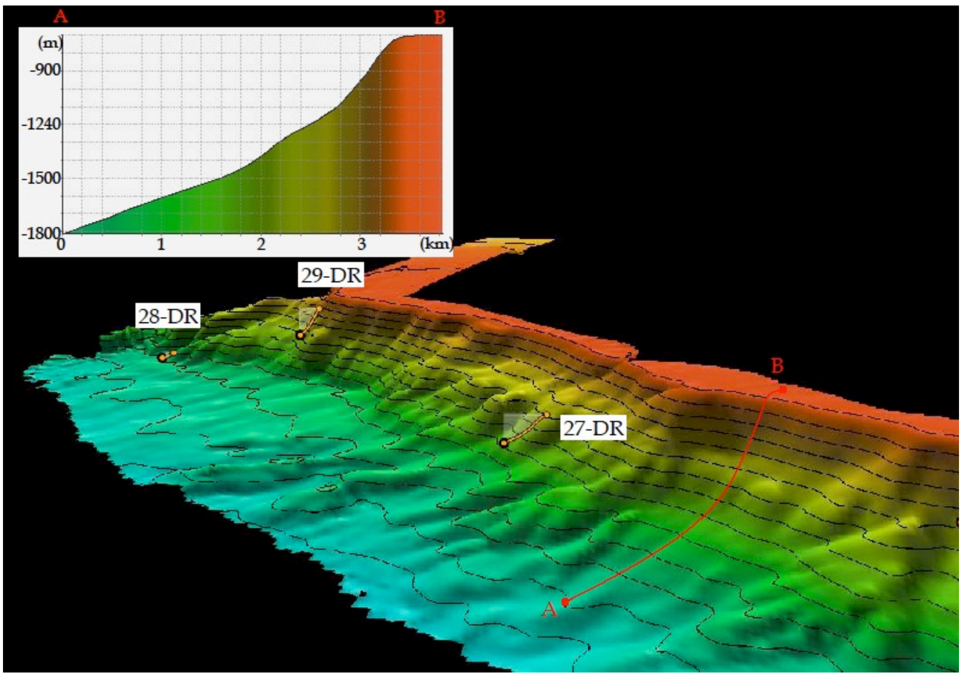

Figure 5.16 3-D projection of the multi-beam data used Fig. 5.2.6 (exaggeration: 2x; interval of contour lines: 200 m). The insert illustrates the very steep northern wall of the rift valley.

Figure 5.17 Strongly altered (hydrothermal?) medium to coarse grained igneous rock.

AREA 4: Southern Jean Charcot Seamounts(37-42-DR)

No samples were recovered. It seems, that these potentially very old volcanic structures (Fig. 5.18) are covered by thick, unconsolidated sediments.

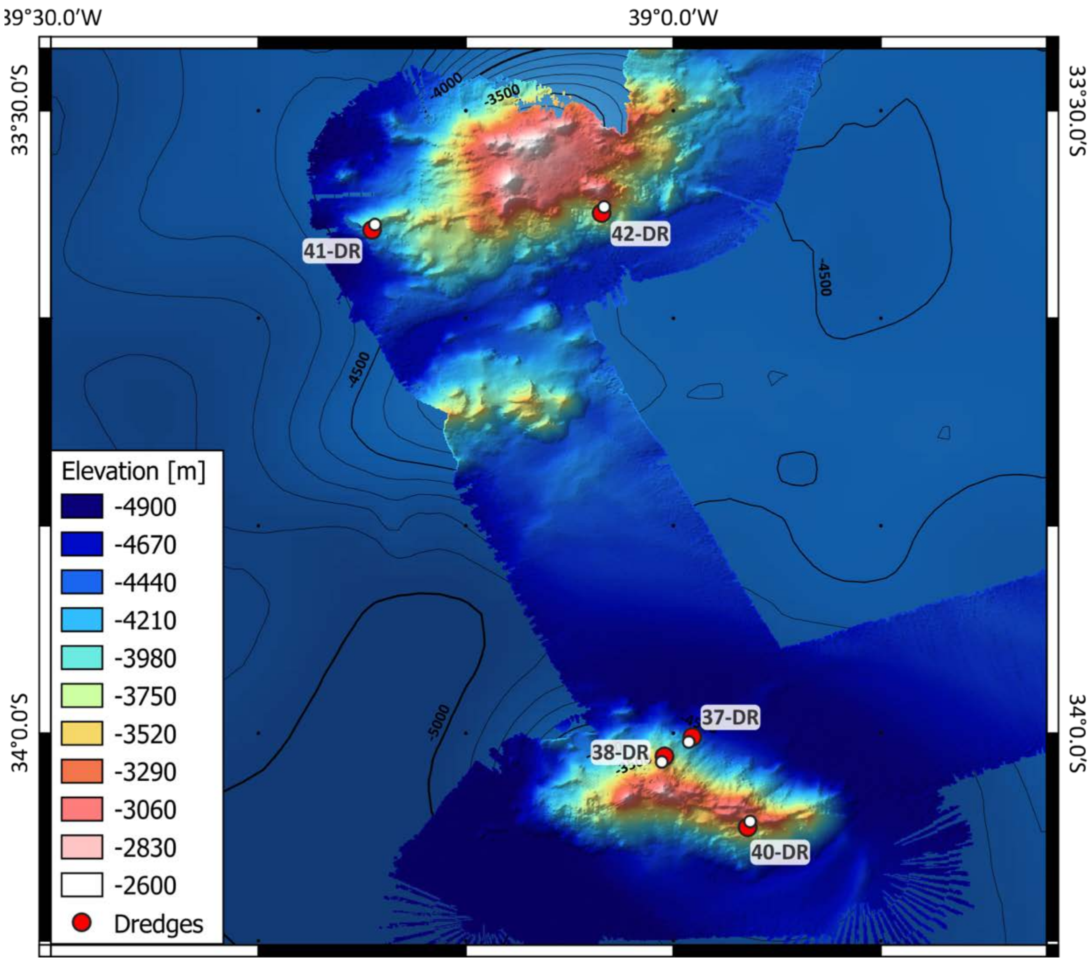

Figure 5.18 Overview of dredge sites at the southern end of the Jean Charcot Chain.

AREA 5: Southern Jean Charcot Seamounts (44-46-DR)

Three dredge hauls on a seamount in the middle of the southern Jean Charcot Chain (Figs 5.19 & 5.20*)* recovered a variety of rock types.

44-DR volcanic breccia
45-DR medium-grained crystalline granodiorite (rounded, dropstone?), volcanic breccia, siltstone or altered tuff and sandstone (Fig. 5.21).
46-DR volcanic breccia

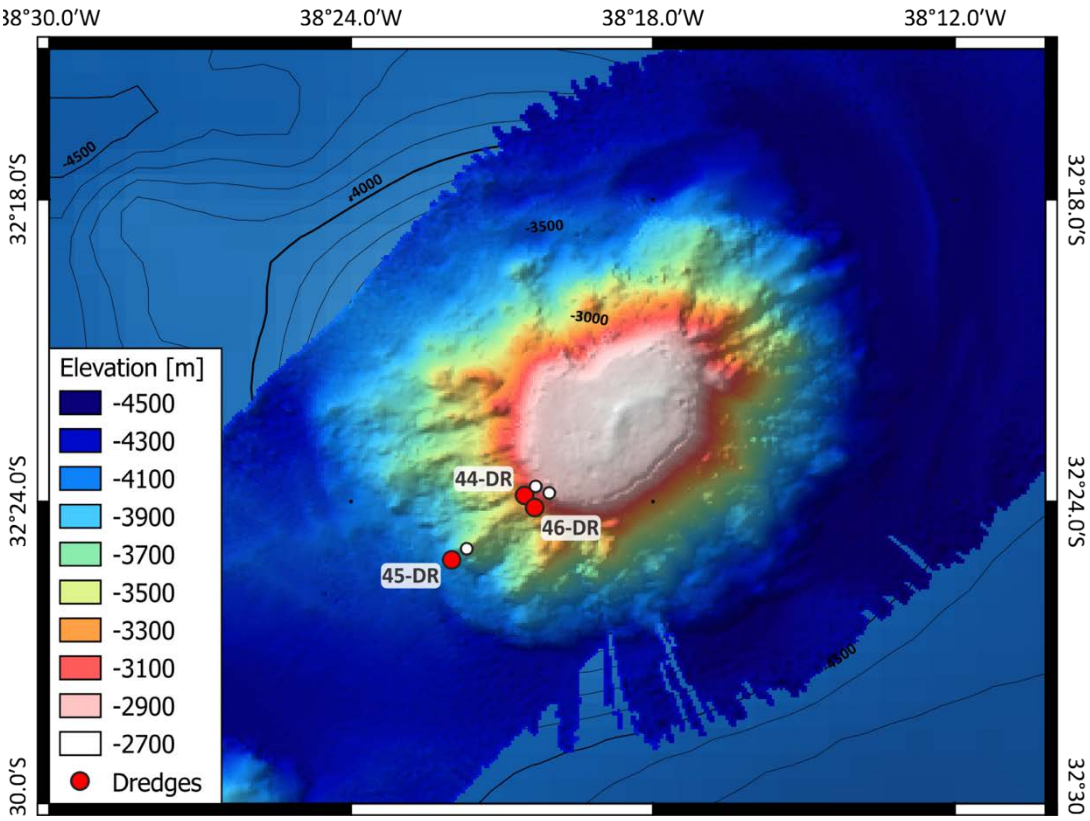

Figure 5.19 Dredge sites on a seamount in the middle of the southern Jean Charcot Chain.

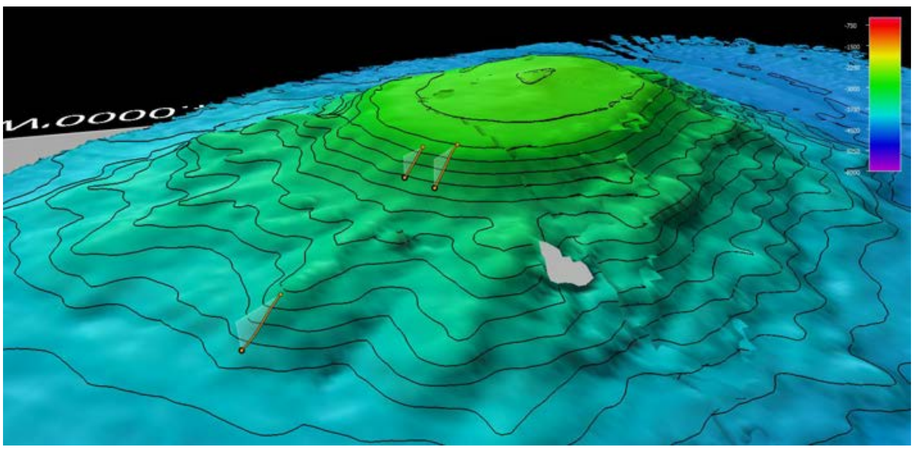

Figure 5.20 Dredge sites on a seamount in the middle of the southern Jean Charcot Chain.

Figure 5.21 Weakly altered yellow sandstone or phosphorite (?).

AREA 6: Southern Jean Charcot Seamounts (48-49-DR) (Figs. 5.22 & 5.23)

48-DR: fresh fine to porphyritic pillow basalt with a thin manganese coating, a possible lava flow with fresh olivine (Fig. 5.24).

49-DR: weathered fine-grained aphanitic basalt with a thin manganese coating (Fig. 5.25).

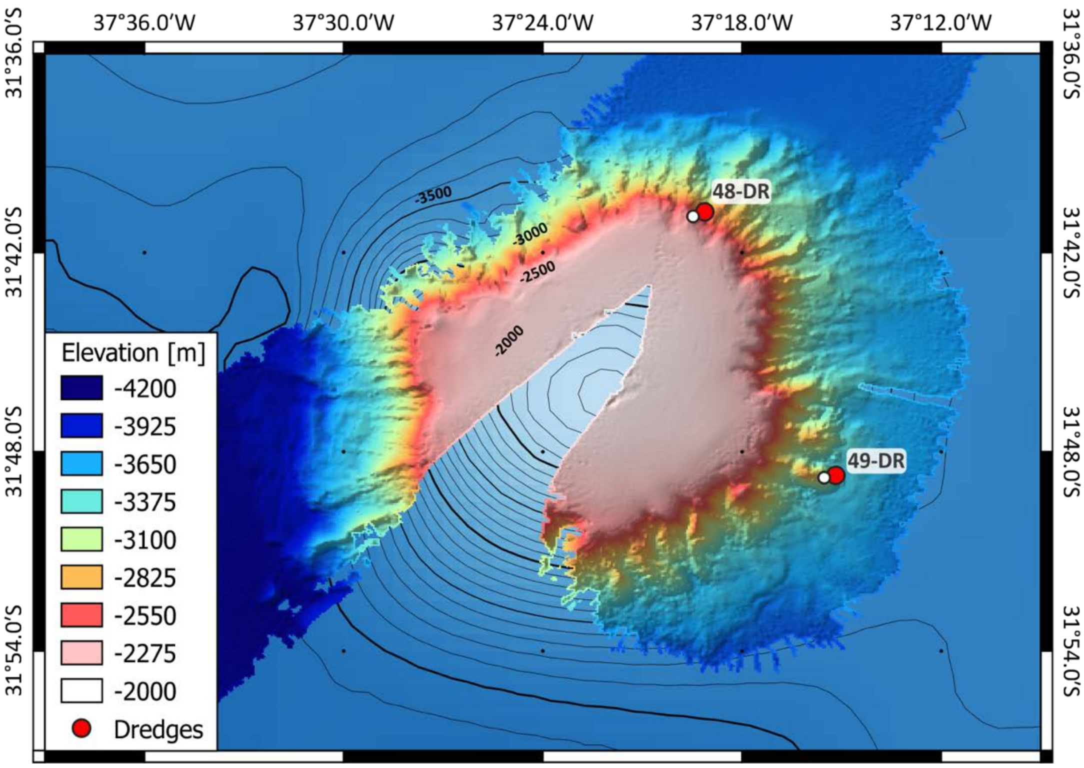

Figure 5.22 *Dredge sites on a seamount in the southern Jean Charcot Chain.*

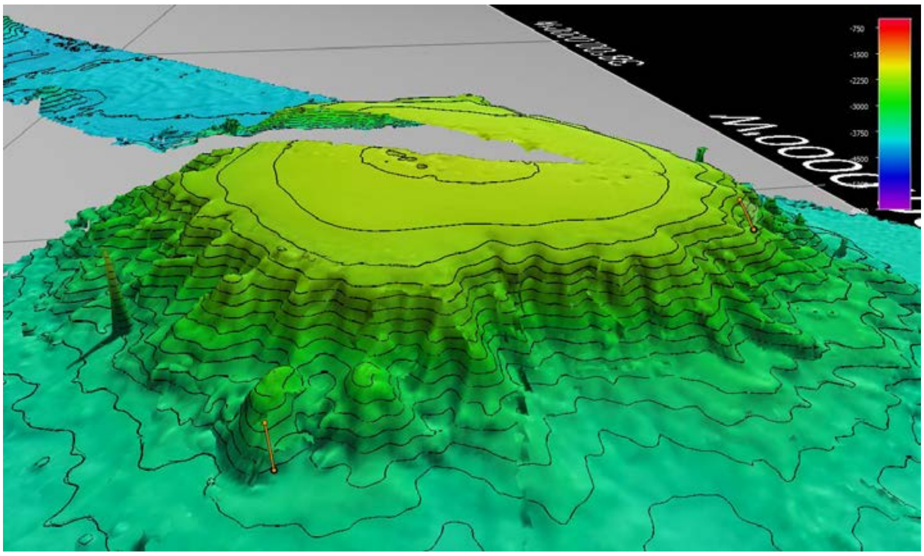

Figure 5.23 Dredge sites on a seamount in the southern Jean Charcot Chain.

Figure 5.24 Fresh fine to porphyritic pillow basalt with a thin manganese coating.

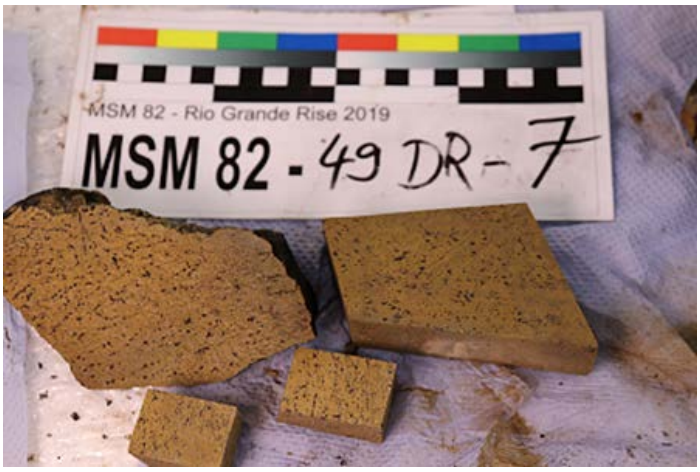

Figure 5.25 *Weathered fine-grained aphanitic basalt with a thin manganese coating.*

AREA 7:

Central Jean Charcot Seamounts (51-54, 59DR) (Fig. 5.24)

51-DR and 59-DR recovered only carbonates.
52-DR and 53-DR were empty.
54-DR: fine-grained aphanitic to porphyritic weakly altered basalt with a thin manganese coating, volcanoclastite with large volcanic and coarse-grained fragments, and breccia.

Northwestern end of the Cruzeiro do Sul Lineament Rift Valley (55-58DR) (Fig. 5.24)

55-DR: fine-medium grained weakly altered aphanitic and porphoritic basalt and volcanic breccia.
56-DR: volcanic breccia.
57-DR: fine-grained fresh aphanitic basalt with thin manganese coating and volcanic breccia (Fig. 5.25).
58-DR: fine-grained vesicular aphanitic and porphoritic basalt with a thin manganese coating, and volcanoclastite.

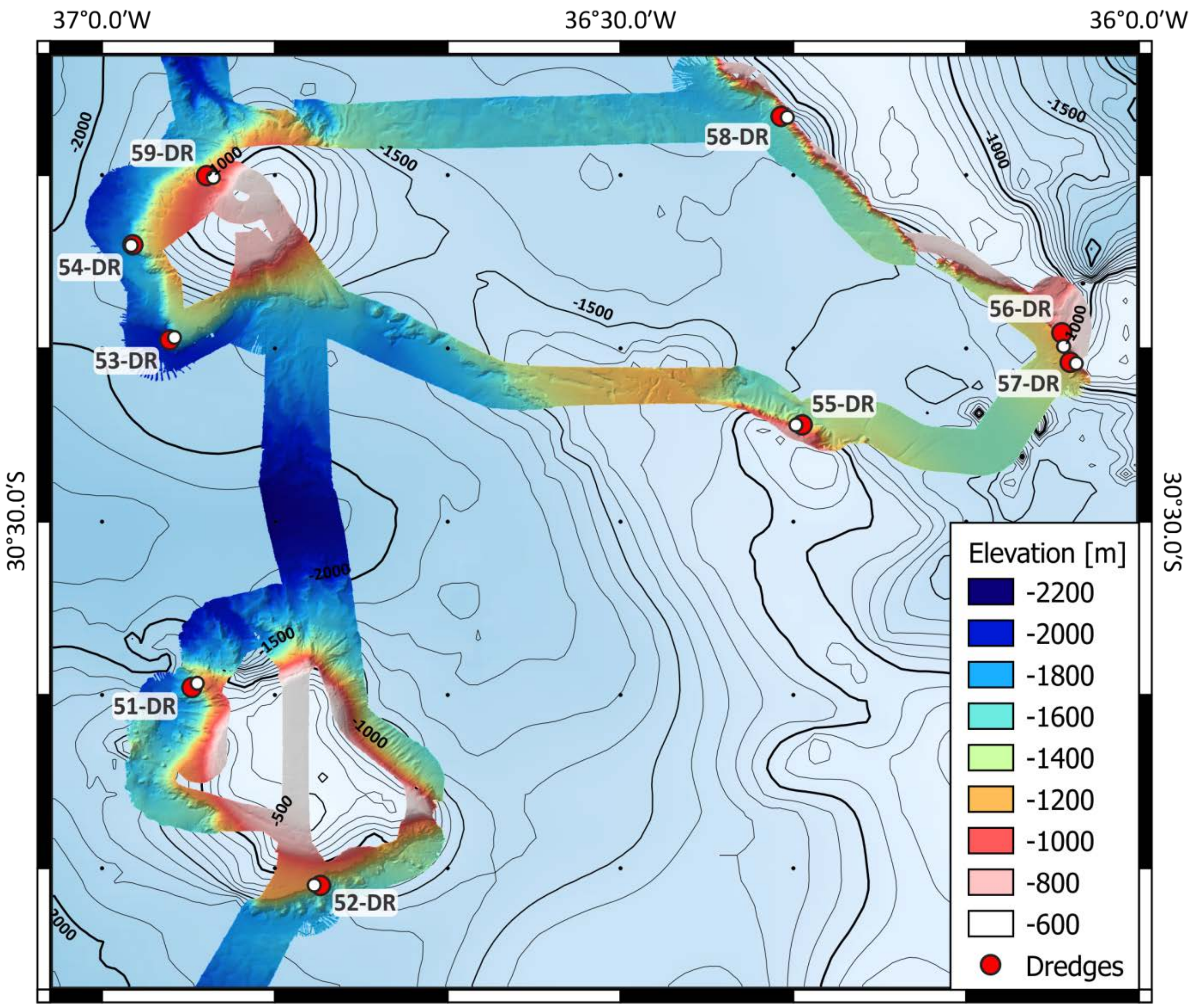

Figure 5.24 Dredge sites at the northern end of the Southern Jean Charcot Seamounts and the rift valley.

Figure 5.25 Fine-grained fresh aphanitic basalt with thin manganese coating.

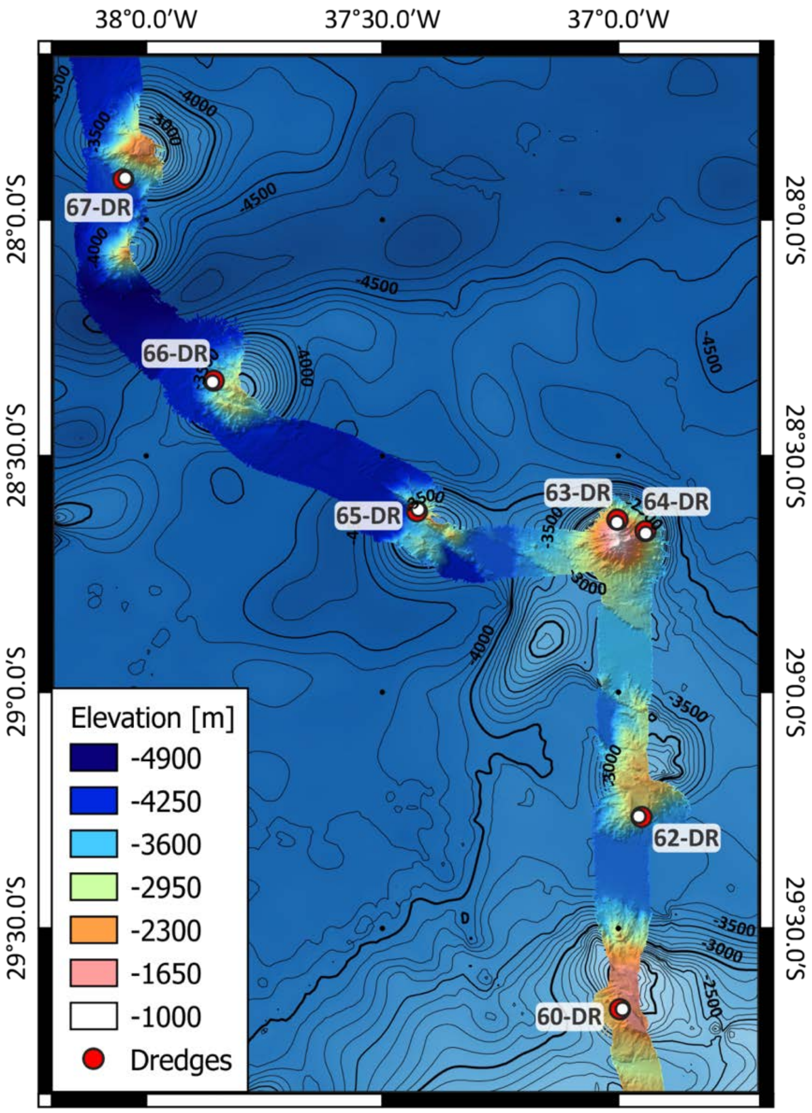

Figure 5.26 Dredge sites on Jean Charcot seamounts north of RGR.

AREA 8: Northern Jean Charcot Seamounts (60-67DR) (Figs. 5.26 & 5.27)

60-DR: fine-grained aphanitic basalt (guyot-shaped ridge, NW flank of the RGR)
62-DR: breccia
63-DR: highly altered volcano-clastite coated with manganese
64-DR: fine-grained (intermediate?) aphanitic basalt with thick manganese (up to 4 cm)
65-DR: weathered porphyritic and fine-grained aphanitic basalt and volcanic breccia
66-DR: porphyritic basalt and coarse-grained rocks (rhyolitic matrix?) with volcanoclastic fragments (Figs. 5.28 & 5.29)
67-DR: coarse grained rocks (rhyolitic matrix?) with volcanoclastic fragments and *vice versa*.

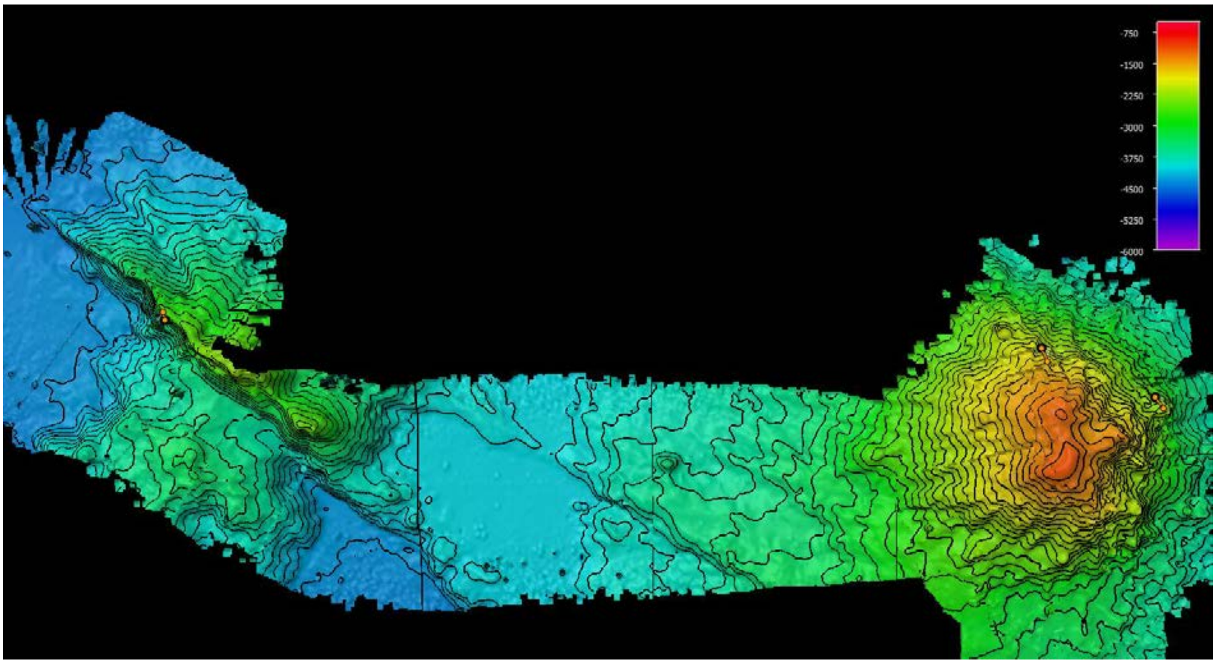

Figure 5.27 Dredges 63-65DR on Jean Charcot seamounts north of RGR.

Figure 5.28 Fine grained volcanic rock with coarse grained fragments.

Figure 5.29 Coarse grained rock in rhyolitic matrix (?) with volcanoclastic fragments.

AREA 9: Northern Jean Charcot Seamounts (68-72DR) (Fig. 5.30)

Dredges 68-71DR were empty or recovered limestone. Dredge 72-DR recovered a potentially very interesting collection of rocks ranging from volcanic to coarse grained igneous rock (Fig. 5.31).

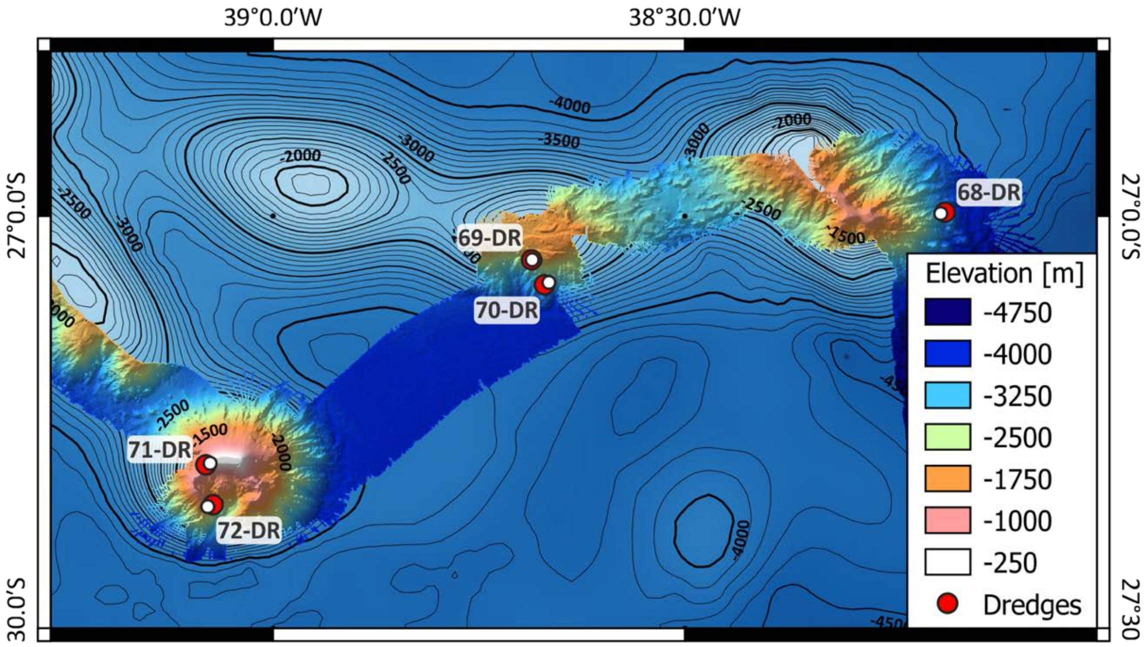

Figure 5.30 Dredge sites on Jean Charcot seamounts north of RGR.

AREA 10: Northern Jean Charcot Seamounts (73-80DR) (Fig. 5.31)

73-DR: fine grained porphyritic basalt and limestone
74-DR: olivine basalt, breccia and volcano-clastite
75-DR: volcano-clastite
76-DR: porphyritic basalt
77-DR: limestone
78-DR: empty
79-DR: empty
80-DR: fresh porphyritic basalt

Figure 5.31 Basic to intermediate rock (72-DR).

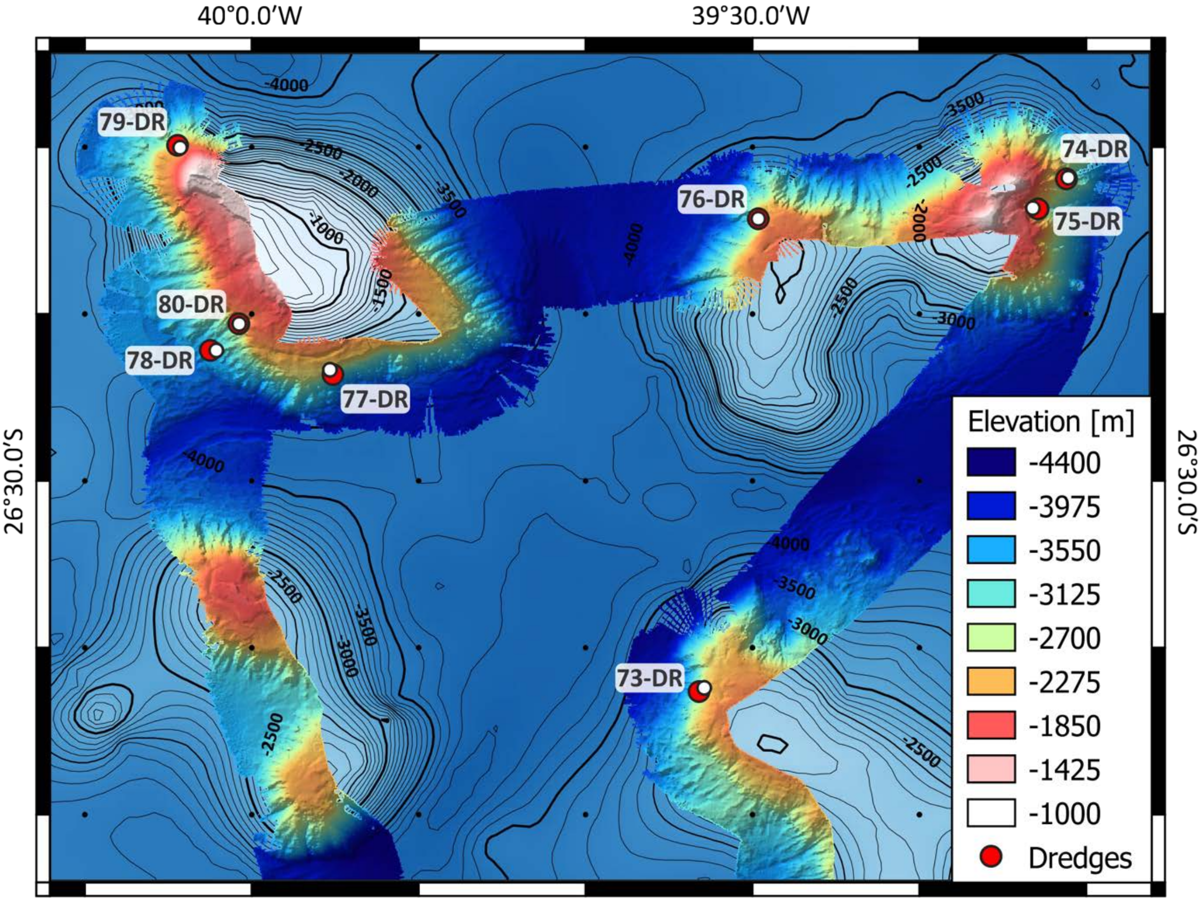

Figure 5.31 Dredge sites at the northern end of the Jean Charcot seamounts.

5.3 Seismic Profiling

(T. Altenbernd [1], W. Geissler [1], H. Kirk [1], A. Pfeiffer [1], T. Funck [2], U. Schlager [1], C. Lehmann [1], K. Korsch [1], K. Hättig [1])

[1] AWI

[2] GEUS

5.3.1 Objectives

Seismic experiments were conducted along two profiles to investigate the characteristics of the sedimentary layers, the structure of the sub-sedimentary basement and the upper and lower crustal units of the Rio Grande Rise (RGR). The basic principles of refraction- and reflection seismic data acquisition are explained in Fig. 5.32. The main objectives were to study the composition of the upper and lower crustal units, to determine the type of crust underlying the RGR and to decipher the origin and nature of the Cruzeiro do Sul Lineament (CdSL). The experiment was also designed to reveal the depth of the crust-mantle boundary (Moho) and to investigate the upper mantle.

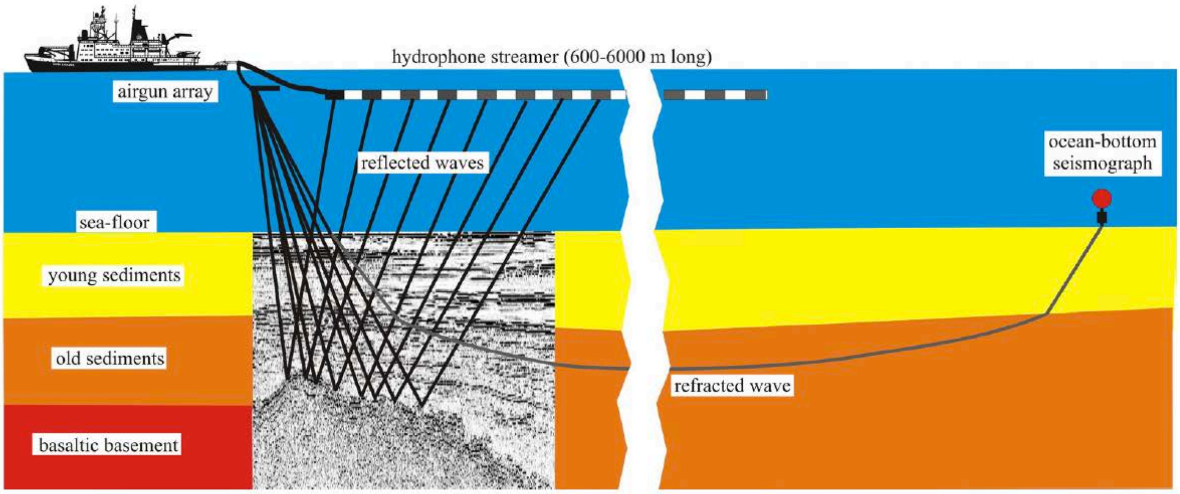

Figure 5.32 Basic principles of refraction- and reflection seismic data acquisition.

5.3.2 Seismic Source, Triggering and Timing

8 G-Guns were used as seismic source for the seismic experiments (Fig. 5.33). Two clusters of 2x2 guns each were towed at a distance of 43 m behind the ship's stern and at a depth of 10 m. Every gun had a volume of 520 cubic inch, which results in a total volume of 4160 cubic inch (68 l). The shot interval was 60 s. The trigger time was given by a Meinberg GPS clock. The system was operated during the first profile AWI-20190100 at a pressure of 200 bar and during the second profile AWI-20190200 at a pressure of 170-180 bar due to problems with one G-gun.

In compliance with the regulation for the protection of marine mammals, we gradually increased the number of operating G-guns over an interval of 20 to 40 minutes (soft start) at the beginning of every profile. The presence of marine mammals within a mitigation zone would have led to a shutdown of the G-guns (see also chapter 5.6). Since no marine mammals entered the mitigation zone during the operation of the G-guns, the profiles were acquired without marine-mammal related shot gaps.

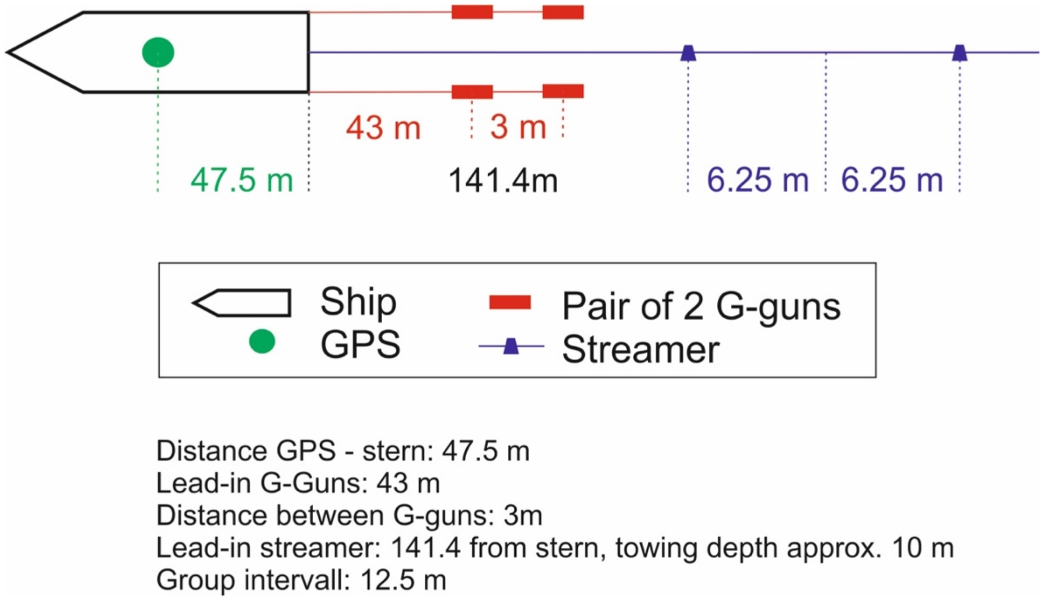

Figure 5.33 Setup of the seismic system during cruise MSM82.

Figure 5.34 A cluster of two G-Guns used as seismic source. Photo credit: Wolfram Geissler.

5.3.3 Seismic Wide-angle Reflection and Refraction Experiments

We used wide-angle reflection techniques to obtain the distribution of seismic P- and S-wave velocity fields from recordings of large-offset and deeply penetrating refracted and reflected waves at wide angles using ocean-bottom seismometer (OBS). Two wide-angle seismic profiles were acquired during the cruise to reveal the deep structure and seismic velocity distribution of the crust and upper mantle. Both profiles extend in an NNE-SSW direction (Fig. 5.35-5.37).

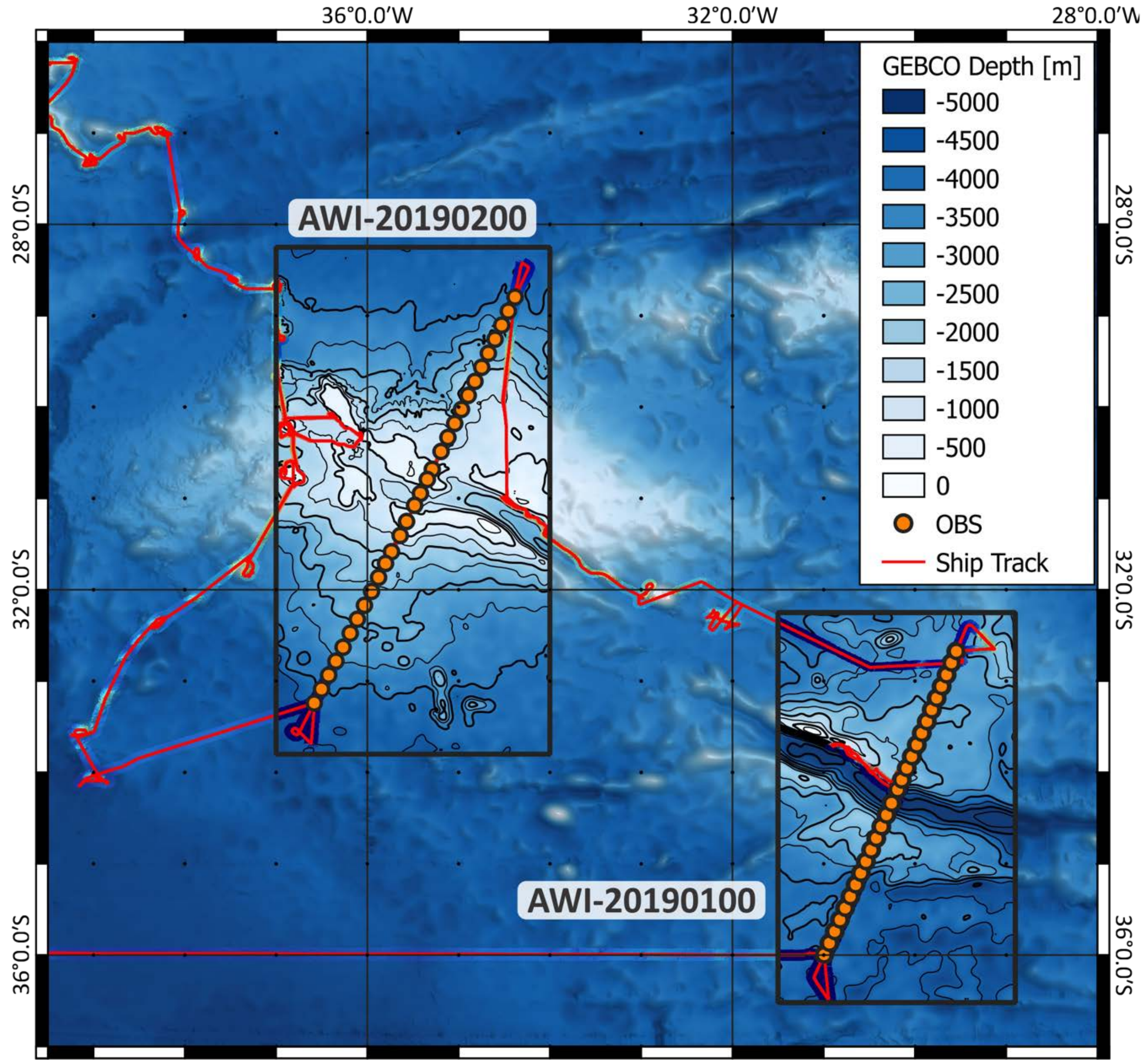

Figure 5.35 Bathymetric map (GEBCO, 2014) showing the location of seismic refraction profiles AWI-20190100 and AWI-20190200 and the ship track.

Wide-Angle Refraction Seismic Data Acquisition and Processing

All the OBS were provided by the AWI-run DEPAS pool (German Instrument Pool for Amphibian Seismology). Two different types of OBS systems were used for the offshore data acquisition: The LOBSTER systems (Fig. 5.38) and NAMMU systems are both manufactured by K.U.M. (Umwelt- und Meerestechnik Kiel GmbH). In general, both OBS systems consist of flotation units attached to a titanium frame, a pressure cylinder containing the data logger and batteries, a hydrophone, a flash and radio beacon, and a flag (Fig. 5.38). All OBS were also equipped with a 3-component seismometer type Trillium Compact (manufactured by Nanometrics), or a 60 sec or 120sec broadband seismometer (Güralp) (Tab. 5.3.1 & 5.3.2). The type of data logger also varied depending on the OBS system: The NAMMU were equipped with a 6d6-recorder manufactured by K.U.M. and the LOBSTER system with an MCS-recorder manufactured by SEND. Different anchor weights were used for the different OBS systems. The anchor weight was connected to the OBS frame via a KUMquat (manufactured by KUM) acoustic release unit (releaser).

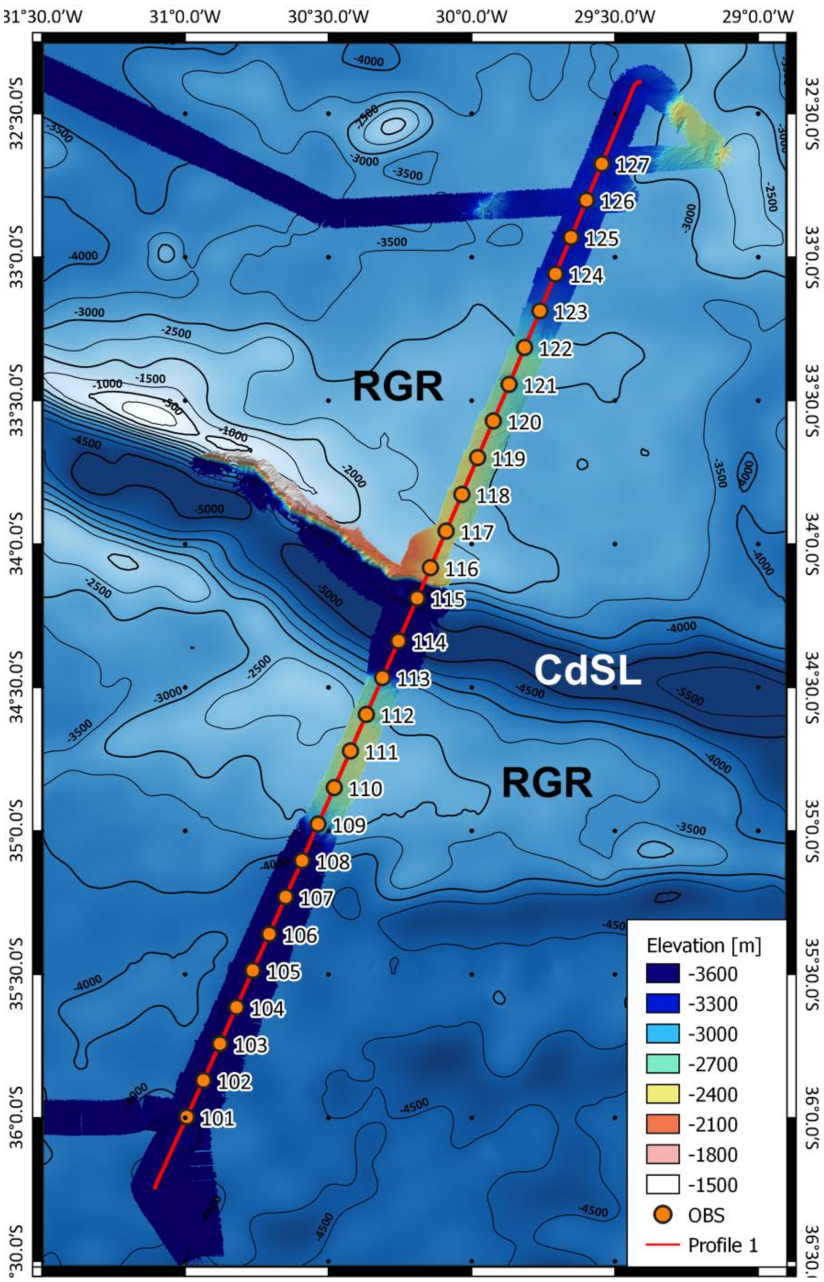

Figure 5.36 Bathymetric map showing the location of profile AWI-20190100. The OBS stations are labelled. The bathymetry recorded during the cruise is highlighted with brighter colors.

Prior to deployment, the OBS systems were prepared, the recorders were programmed and the internal clocks of the recorders synchronized. The time synchronization was conducted with external GPS clocks. The gain for the three seismometer channels (X, Y, Z) was set to 1. The gain for the hydrophone channel was set to 4 for all OBS equipped with a SEND recorder (LOBSTER) and to 1 for all OBS equipped with a 6d6-recorder (NAMMU). A sampling frequency of 250 Hz was used for all recorders. The recorded data were stored on internal flash cards (LOBSTER) or data sticks (NAMMU).

Deployment of the OBS was conducted without any problems. The OBS deployment positions for both profiles are listed in Tab. 5.3.1 and 5.3.2. A first leveling of all seismometers on the seafloor was conducted before the beginning of seismic profiling. Levelling of the

Trillium Compact seismometers also took place every hour as needed. To recover the OBS, hydro-acoustic signals were sent from the ship-owned transducer to the releaser. When receiving the signal, the releaser hook connecting the anchor weight with the OBS was opened and the OBS returned to the sea surface. An automatic release time was also set as backup, but was not needed since all OBS were successfully released.

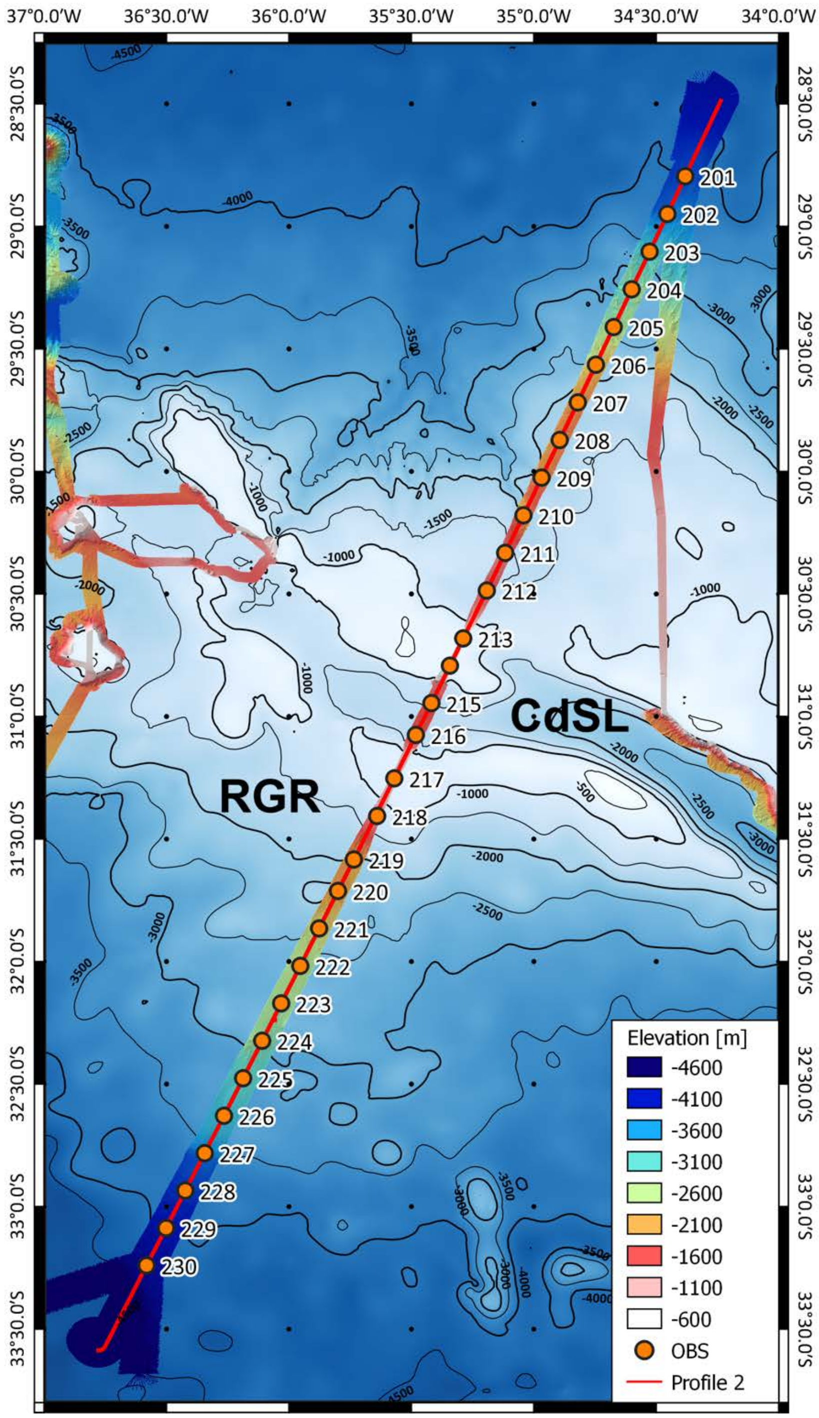

Figure 5.37 Bathymetric map showing the location of profile AWI-20190200. The OBS stations are labelled. The bathymetry recorded during the cruise is highlighted with brighter colors.

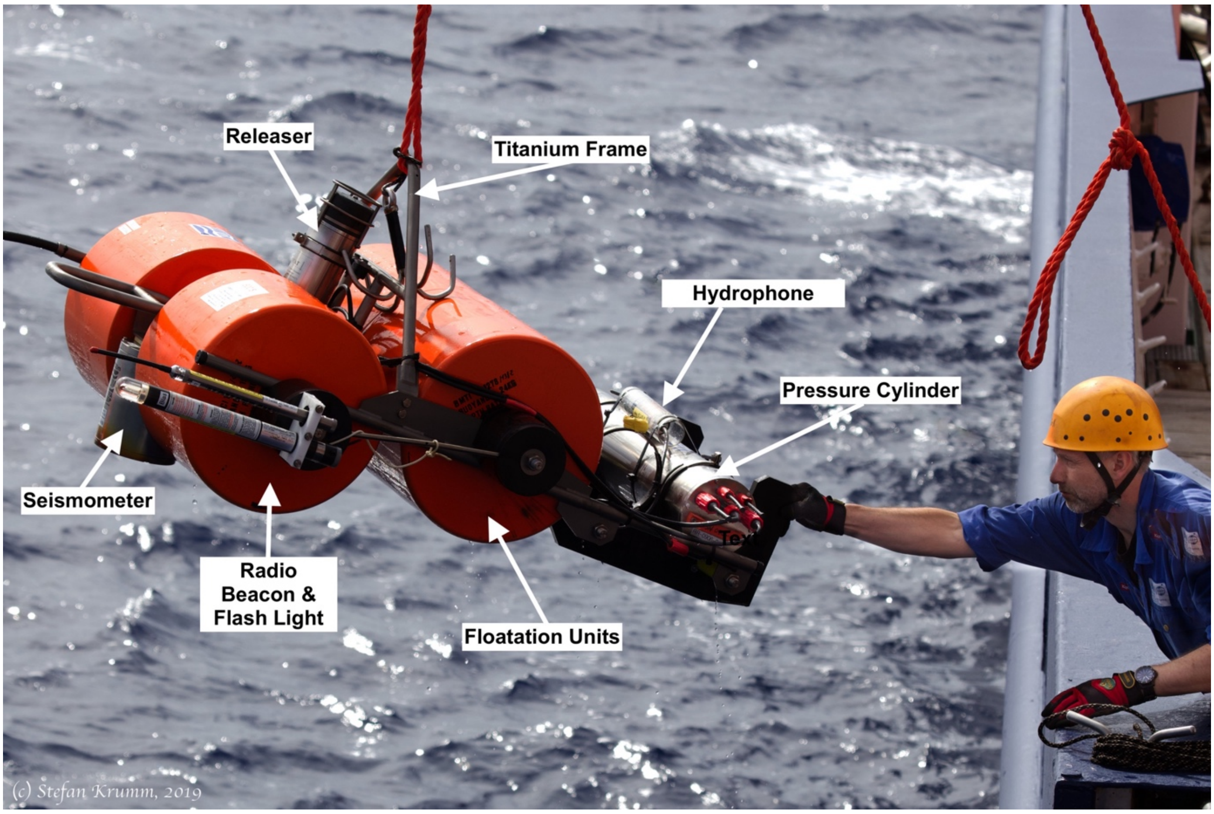

Figure 5.38 Recovery of a LOBSTER OBS. The main components of the OBS are labelled. Photo credit: Stefan Krumm.

Processing

The majority of the OBS worked without any problems. After recovery, the data recording was stopped and the internal clock of every recorder was synchronized again with the GPS signal. The linear drift (skew) of every internal clock was determined. Raw data and recorder parameter files were downloaded to an external Linux computer. Depending on the recorder, the raw data were stored in 6d6-format (6d6 recorder) and s2x-format (MCS recorder). In a first processing step, the recorded raw data were cut into 60s traces, the drift of the internal clock (skew) was corrected (a linear drift is assumed) and the data was converted to SEGY-format. After the conversion to SEGY format, the offsets for every trace were calculated based on the deployment position of the OBS and shot positions and added to the SEGY header via a shell script. A first quality control was conducted with the software zp (by B. Zelt, http://www.soest.hawaii.edu/users/bzelt/zp/zp.html).

Relocalization of OBS Positions

The position of the OBS at the seafloor differs from its deployment position because of currents, which cause the OBS to drift away from their deployment position when sinking to the seafloor. Hence, the initial offsets calculated from the deployment position of the OBS have to be recalculated based on the direct wave: the trace with the shortest arrival time of the direct wave was determined and shifted to zero offset. Afterwards, the determined value was added to or subtracted from the previously determined offsets. The new calculated offsets were then written to the SEGY headers.

Preliminary Results and Data Quality

Profile AWI-20190100

The first profile AWI-20190100 crosses the CdSL, which is assumed to be a pronounced rift graben and is much deeper in this area than in the western part of the RGR (Fig. 5.36). Based on the acquired wide-angle refraction seismic data, the P-wave and S-wave velocity structure of the sub-surface was investigated. The acquired data will clarify whether the CdSL in this area is part of a continental rift zone or oceanic crust modified by unknown tectonic processes. The profile will allow us to investigate the nature of crust north and south of the CdSL to determine differences and similarities between both crustal domains.

27 OBS systems were deployed at a distance of 15 km along the 455 km long profile AWI-20190100. Because two planned OBS position were located on a steep slope within the CdSL, their deployment positions were slightly changed and shifted along the profile. All OBS systems were successfully recovered and recorded data, although not always on all channels. Unfortunately, the seismometer of OBS103 had a malfunction, but the hydrophone channel was successfully recorded. The data quality of the P-wave phases ranges from good to excellent. P-wave phases are present at up to 170 km source-receiver offsets in the best records. Refracted first-arrival phases from the sedimentary layers, the upper and lower crust and uppermost mantle as well as high-amplitude reflections from the Moho can be identified within the data. A data example is shown in Fig. 5.39. Medium-quality S-wave phases were also recorded by some OBS systems. The S-wave records mostly contain upper and lower crustal refractions.

Profile AWI-20190200

The second profile AWI-20190200 crosses the western RGR (Fig. 5.37). The location of the profile has been chosen to test if this part of the RGR consists of extended continental crust and if plume-related magmatic intrusions are present. Furthermore, a pronounced Bouguer anomaly of unclear origin is present in the investigated area. As is the case with the first profile, AWI-20190200 also crosses the CdSL giving us the opportunity to investigate how deeply the crust has been affected by the CdSL in different areas of the RGR.

The profile is 609 km long and most of the 30 OBS were deployed at a distance of 18.5 km. If the planned OBS position was located on a steep slope, the deployment position of the OBS was slightly changed to prevent the OBS from sliding down the slope. All OBS systems were recovered and recorded data. The data quality of the P-wave phases is comparable to the quality of the first profile and ranges from good to excellent. P-wave phases are present at up to 250 km source-receiver offsets in the best records. Refracted first-arrival phases from the sedimentary layers, the upper and lower crust and uppermost mantle as well as high-amplitude reflections from the Moho can be identified within the data. A data example is shown in Fig. 5.40. Some OBS systems also recorded S-wave phases of medium to low quality. The S-wave records mostly contain phases from the sedimentary cover and upper and lower crustal refractions.

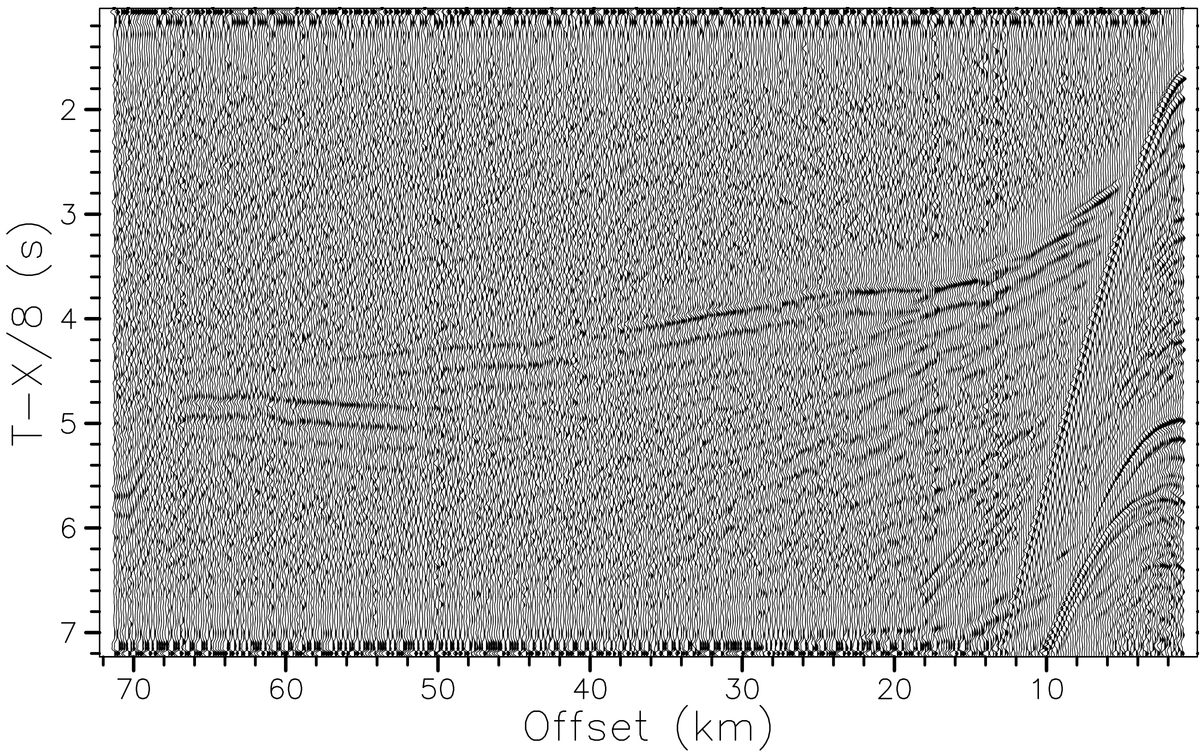

Figure 5.39 Data example of a seismic section, profile AWI-20190100.

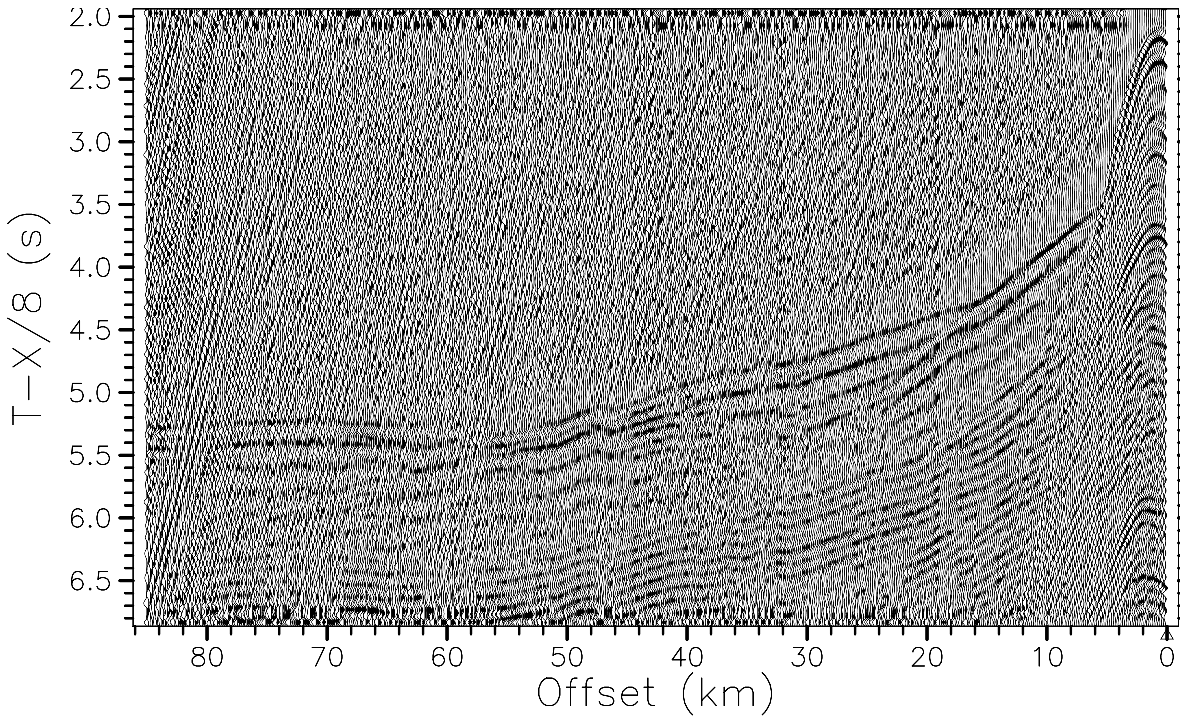

Figure 5.40 Data example of a seismic section, profile AWI-20190200.

5.3.4 Seismic Reflection Data

It was also planned to acquire standard multi-channel seismic reflection (MCS) data to image the outline and reflectivity characteristics of the sedimentary layers and the structure of the sub-sedimentary basement and lower crust by recording the returning near-vertical wavefield. Unfortunately, the system was only working for a short while during the acquisition of the first profile. The reason were major problems with a broken lead-in cable. Unfortunately, the problem could not be solved on board. However, we acquired some data pieces along the first profile.

Multi-channel Seismic Recording System for AWI-20190100

A digital SERCEL SEAL™408 streamer with an active length of 3000 m (12 sections) was used to acquire seismic reflection data. The streamer is a 240-channel hydrophone array, which is coupled to the onboard recorder via a fibre-optic tow lead and a deck lead. The group interval of the active sections is 12.5 m. The data collected by the hydrophone array is firstly converted from an analogue signal to digital via an A/D converter and then converted to a 24-bit complement format at 0.25 ms sample rate by a DSP. The data is routed to a Line Acquisition Unit Marine (LAUM) at this point, one of these being located every five Acquisition Line Sections or 750 m. The LAUM decimates, filters and compresses the data before routing them through the tow leader and deck lead to the on-board equipment.

The lead-in together with the inactive sections, measured from stern, was 141.4 m (distance to first channel, Fig. 5.3.1). The streamer was towed at a depth of approximately 10 m. Cable depth keeping was monitored on Digicourse™ software, and adjustment to depths was made with Digibirds™, Model 5010. The Digicourse™ software gives a continuously updated graphical display of depths and wing angles via the Digibirds™, which are situated at 300 m intervals along the streamer. All deployment and recovery actions went smoothly and without problems.

The coupling of the streamer with the Control Module (CMXL) is made via the Deck Cable Crossing Unit (DCXU), which also acts as a LAUM for the first 60 channels of the streamer. The CMXL decompresses, demultiplexes and then performs IEEE 32-bit conversion to the data. The data are collected via a network switch and converted to SEGD by the PRM, the PRM being a processor software module used for formatting data to and from the cartridge drives, the plotters and Seapro QC™. All system parameters can be set through the Human Computer Interface (HCI) which displays the systems activity such as print parameters, log files, high resolution graphic display and test results.

Seismic reflection data were recorded with acquisition software provided by Sercel internally on a hard disc. Sample rate was set to one sample per 2 ms. Data were recorded as multiplexed SEG-D. Recording length was 18 seconds. One file was generated per shot. Online quality control was performed displaying shot gathers and as single channel profile.

Seismic Recording System for AWI-20190200

After it was clear that the Streamer could not be used to record data along the second seismic profile 20190200, it was decided to build an experimental “mini streamer” in an effort to record data along the second profile. The ship kindly provided material to reconstruct a steel frame, which was then build by the ship´s mechanics. Two spare Lobster OBS systems were used to equip the experimental streamer: Two titanium pressure cylinders, each containing alkali batteries and an MCS recorder, were towed to the steel frame (Fig. 5.41). Two hydrophones were placed behind the pressure cylinders and fixed to the steel frame. We used two hydrophones to increase the chance that the experiment would be successful in case one of the instruments malfunctioned. Both hydrophones were connected via a cable to the recorders within the pressure cylinder. MCS recorders were programmed and the internal clock synchronised with an external GPS prior to deployment. The gain of the hydrophone channel for both hydrophones was set to 4. A sampling frequency of 250 Hz was used. The recorded data were stored on the internal hard-drives of the MCS recorders.

The mini-streamer was successfully deployed before the acquisition of the second profile AWI-20190200. Two inflatable buoys (blobs) were towed to the mini streamer to prevent it from sinking. The mini-streamer was towed at a depth of 10 m 500 m behind the ship during data acquisition. The distance of 500 m between mini-streamer and ship was chosen to reduce the ship´s noise recorded by the hydrophones.

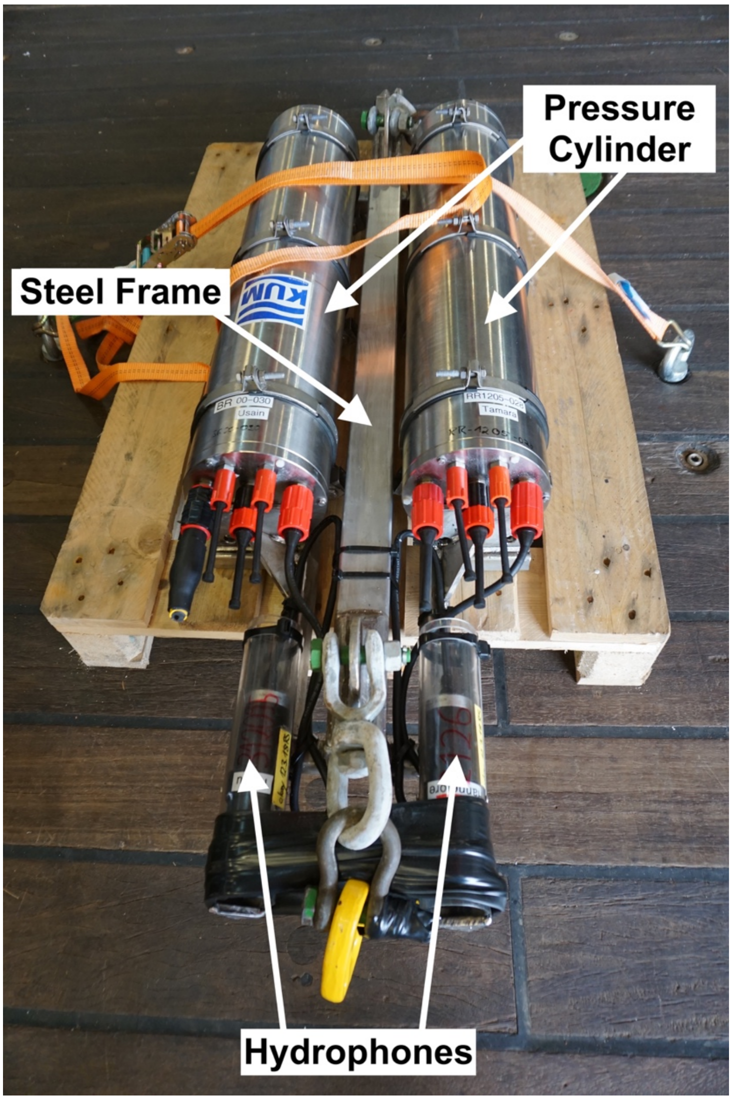

Figure 5.41 The experimental one-channel mini streamer, called "Südatlantischer Kugelfisch". Photo credit: Tabea Altenbernd.

Table 5.3 Deployment positions of AWI-20190100.

OBS Nr.	Latitude	Longitude	Depth (m)	Seismometer	OBS type
101	-35.99707	-30.99455	3876	CMG 40T (Güralp)	Lobster
102	-35.86958	-30.93660	4247	CMG 40T (Güralp)	Lobster
103	-35.74192	-30.87897	4279	CMG 40T (Güralp)	Lobster
104	-35.61450	-30.82120	4395	120 s (Güralp)	Lobster
105	-35.48622	-30.76447	4254	Trillium Compact (KUM)	Nammu
106	-35.35938	-30.70678	4256	CMG 40T (Güralp)	Lobster
107	-35.23007	-30.64980	4295	120s (Güralp)	Lobster
108	-35.10367	-30.59237	4199	Trillium Compact (KUM)	Nammu
109	-34.97610	-30.53698	3049	CMG 40T (Güralp)	Lobster
110	-34.84883	-30.47983	2611	CMG 40T (Güralp)	Lobster
111	-34.72115	-30.42347	2551	CMG 40T (Güralp)	Lobster
112	-34.59383	-30.36802	2623	CMG 40T (Güralp)	Lobster
113	-34.46560	-30.31162	3097	CMG 40T (Güralp)	Lobster
114	-34.33788	-30.25570	5188	CMG 40T (Güralp)	Lobster
115	-34.18867	-30.19028	3900	CMG 40T (Güralp)	Lobster
116	-34.08237	-30.14432	2319	CMG 40T (Güralp)	Lobster
117	-33.95498	-30.08978	2402	CMG 40T (Güralp)	Lobster
118	-33.82688	-30.03435	2466	Trillium Compact (KUM)	Lobster
119	-33.69867	-29.97953	2475	CMG 40T (Güralp)	Lobster
120	-33.57083	-29.92483	2599	Trillium Compact (KUM)	Lobster
121	-33.44342	-29.86980	2750	CMG 40T (Güralp)	Lobster
122	-33.31467	-29.81567	2756	CMG 40T (Güralp)	Lobster
123	-33.18725	-29.76200	3139	Trillium Compact (KUM)	Lobster
124	-33.05878	-29.70775	3296	CMG 40T (Güralp)	Lobster
125	-32.93077	-29.65345	3348	Trillium Compact (KUM)	Lobster
126	-32.80148	-29.59987	3269	CMG 40T (Güralp)	Lobster
127	-32.67472	-29.54627	3318	Trillium Compact (KUM)	Lobster

After shooting the second profile, the mini streamer was successfully recovered without any visible damages on the outside. The recording was stopped, the internal clock was again synchronized and the skew was determined. Unfortunately, we had problems to download the raw data recorded by both recorders: Apparently, the movement of the mini streamer in the water damaged the hard drive or it was not possible for the recorder to write the data error-free on the disk. Therefore, it was impossible to download the raw data with the Sendcom software. However, we were able to download the greatest part of the data by disk dump (dd). Since some time is needed to get the data into a format that allows us to make statements about the quality of the data we don't know yet whether the experiment has been successful.

Table 5.4 Deployment positions of AWI-20190200.

OBS Nr.	Latitude	Longitude	Depth (m)	Seismometer	OBS type
201	-28.79532	-34.38197	3895	CMG 40T (Güralp)	Lobster
202	-28.94920	-34.45480	3792	Trillium Compact (KUM)	Lobster
203	-29.10300	-34.52745	3247	CMG 40T (Güralp)	Lobster
204	-29.25672	-34.60067	2751	Trillium Compact (KUM)	Nammu
205	-29.41073	-34.67402	2701	CMG 40T (Güralp)	Lobster
206	-29.56445	-34.74693	2263	CMG 40T (Güralp)	Lobster
207	-29.71820	-34.82080	1968	Trillium Compact (KUM)	Lobster
208	-29.87173	-34.89467	1930	CMG 40T (Güralp)	Lobster
209	-30.02523	-34.96875	1993	CMG 40T (Güralp)	Lobster
210	-30.17898	-35.04273	2081	120s (Güralp)	Lobster
211	-30.33233	-35.11738	1397	Trillium Compact (KUM)	Nammu
212	-30.48602	-35.19238	1485	CMG 40T (Güralp)	Lobster
213	-30.68142	-35.28875	640	CMG 40T (Güralp)	Lobster
214	-30.79252	-35.34298	632	Trillium Compact (KUM)	Lobster
215	-30.94545	-35.41850	1473	CMG 40T (Güralp)	Lobster
216	-31.07552	-35.48223	1550	CMG 40T (Güralp)	Lobster
217	-31.25257	-35.57018	843	CMG 40T (Güralp)	Lobster
218	-31.40618	-35.64017	1247	CMG 40T (Güralp)	Lobster
219	-31.58373	-35.73538	2041	Trillium Compact (KUM)	Nammu
220	-31.71200	-35.80037	2021	CMG 40T (Güralp)	Lobster
221	-31.86490	-35.87720	2409	CMG 40T (Güralp)	Lobster
222	-32.01793	-35.95413	2549	Trillium Compact (KUM)	Lobster
223	-32.17075	-36.03212	2664	CMG 40T (Güralp)	Lobster
224	-32.32333	-36.10977	2747	120s (Güralp)	Lobster
225	-32.47648	-36.18755	3094	Trillium Compact (KUM)	Nammu
226	-32.62960	-36.26573	3287	CMG 40T (Güralp)	Lobster
227	-32.78203	-36.34438	3736	Trillium Compact (KUM)	Lobster
228	-32.93478	-36.42368	3975	CMG 40T (Güralp)	Lobster
229	-33.08753	-36.50220	4135	CMG 40T (Güralp)	Lobster
230	-33.24023	-36.58195	4341	CMG 40T (Güralp)	Lobster

5.4 Gravity Measurements

(C. Lehmann [1], H. Kirk [1], W. Geissler [1], U. Schlager [1], K. Unger Moreno [1])

[1] AWI

5.4.1 Work at sea

A gravimeter was taken on board to measure gravity values during MSM82. The gravimeter ZLS-S56 is a dynamic marine/airborne gravimeter with a constantly moving and monitored spring at its core. It was installed on a destined table in the gravimeter room on the tween deck of *MARIA S. MERIAN* on March 16, 2019. To fit the holes in the table, a 4 cm thick wooden plate was installed on which the frame with the gravimeter was mounted. The table is slightly shifted to the portside with respect to the center line of the vessel. The room temperature was regulated and constant to ±0.1°C. The gravimeter was heated internally. It was ready for measurements in the morning of March 17, 2019.

The gravity meter measured the relative gravity throughout the cruise starting and ending at the edge the 200 miles Uruguayan EEZ. A gyro-based aero frame compensates for the vessel movement (Fig. 5.42) to avoid any cross-coupling errors. Data acquisition started on March 19, 2019 at 17:16 UTC and stopped on March 23, 2019 at 04:00 UTC. The time was synchronized before measuring started. The data were recorded every 10 second with a 4-minute filter and are stored in daily files. The gravimeter worked fine and without any problems during the whole cruise. To get the absolute gravity values and to correct the instrument drift, two tie measurements were performed before the start of the cruise and after the arrival in the port of Montevideo.

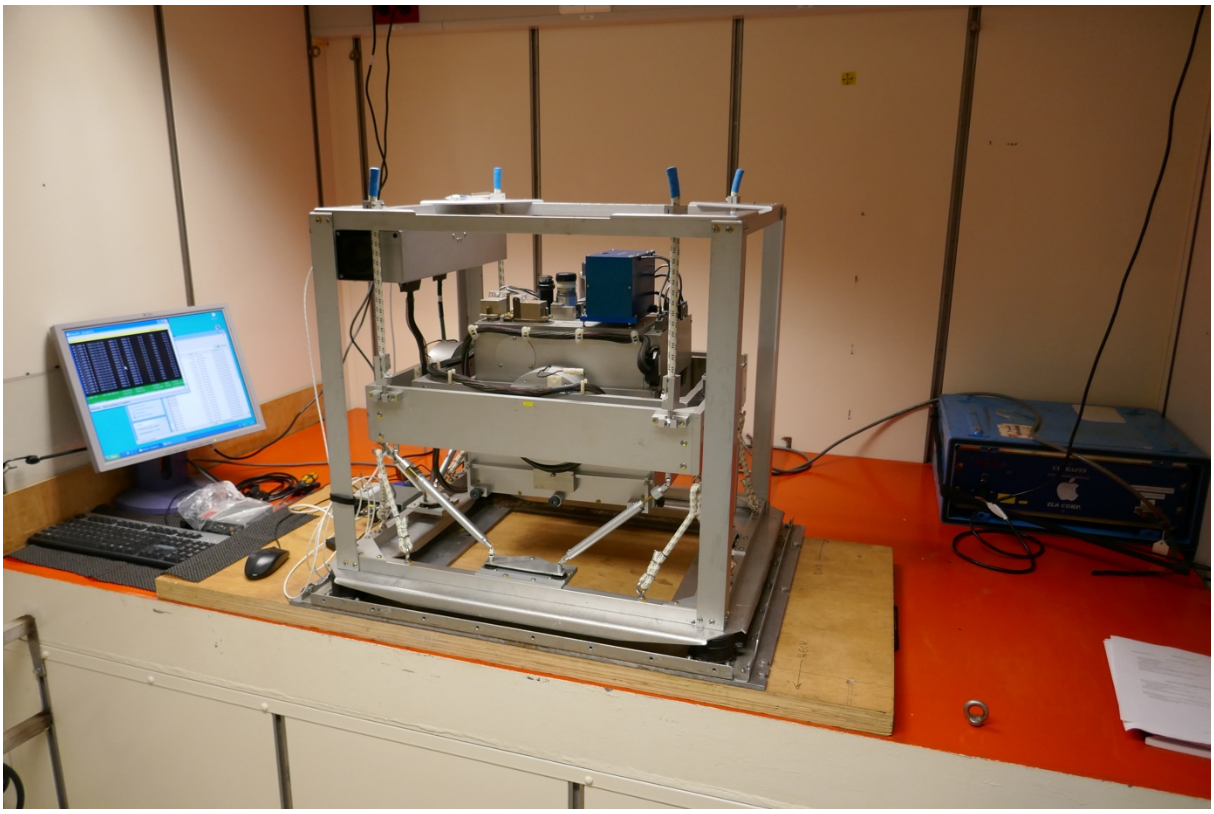

Figure 5.42 Gravimeter ZLS-S56 installed in the gravimeter room on *MARIA S. MERIAN*. Photo credit: Carsten Lehmann.

5.4.2 Tie Measurements

In order to compare different gravity surveys, the measured data have to be tied in the world-wide accepted International Gravity Standardization Net (IGSN71). This system was established in 1971 by the International Union of Geodesy and Geophysics (Morelli, 1974). The IGSN71 is a set of world-wide distributed locations with absolute gravity values known better than a few tenths of mGal. According to the recommendations of the IUGG, every gravity survey, marine or land, should be related to the datum and to the scale of the IGSN71. With those tie measurements it is possible to convert the relative gravity data recorded during the leg in absolute values and correct the instrument drift.

For cruise MSM82, those tie measurements were carried out with a Lacoste&Romberg gravimeter G-744 manually and with a feedback with five values at each point one day before leaving port and on the day of arrival. Due to the harbor environment with strong lorries traffic and moving cranes, strong vibrational disturbances increased the acquisition uncertainty especially at the reference point “Muelle B”.

Tie Measurement 17.03.19

For the tie measurements, four points were measured in Montevideo harbor. At all spots, the instrument was put on a plate. The gravimeter’s temperature showed constantly 49,9°C. The measurements ran without any problems. Factory repetitivity is given as within ±0.02 mGal, and is summed to the observation estimated error of ±0.05 mGal. For consistency only, the feedback measurements are considered for the calculation of the absolute gravity.

The measured point A was conducted next to the *MARIA S. MERIAN’s* starboard side alongside the gravimeter room. The first point was A, followed by the reference points “Darsena I Quay” and “Muelle B”. The last point has been measured again at Point A. Both reference points are taken from the BGI website (http://bgi.omp.obs-mip.fr/). The reference points are actually marked by red color.

Point A, 1st (Table 5.5, Fig. 5.43) & A, 2nd (Table 5.8)
Vessel coordinates: 34°54.096’S, 56°12.436‘W
Position: directly starboard side of *MARIA S. MERIAN*, approximately alongside of gravity meter room, 10 m to east of reference point “Darsena I Quay”, between bollards #86 and #87
Height above waterline: 3.40 m (Point A, 1st), 3.55 m (Point A, 2nd)
Draft of vessel: 6.8 m
Conditions: harbor traffic, high level of disturbance for 1st measurement; calm for 2nd measurement

Reference point: Darsena I Quay, Montevideo Harbour 106171 (Table 5.6, Fig. 5.45)
Coordinates: 34° 54,12' S, 56° 12,39' W (BGI)
Position: Montevideo, Darsena I Quay, 1 m west of the second bollard (#87) from eastern corner
Conditions: harbor traffic, high level of disturbance
Absolute Gravity: 979745,940 mGal at 3 m above normal null

Figure 5.43 Location of Point A in Montevideo Harbor. Photo credit: Katharina Unger Moreno.

Figure 5.44 Location of *MARIA S. MERIAN* on March 17, 2019 and location of point A in Montevideo Harbor. Image credit: Google Maps, 2019.

Figure 5.45 Location of Reference point "Darsena I Quay", Montevideo Harbour 106171 in Montevideo Harbor. Image credit: Google Maps, 2019.

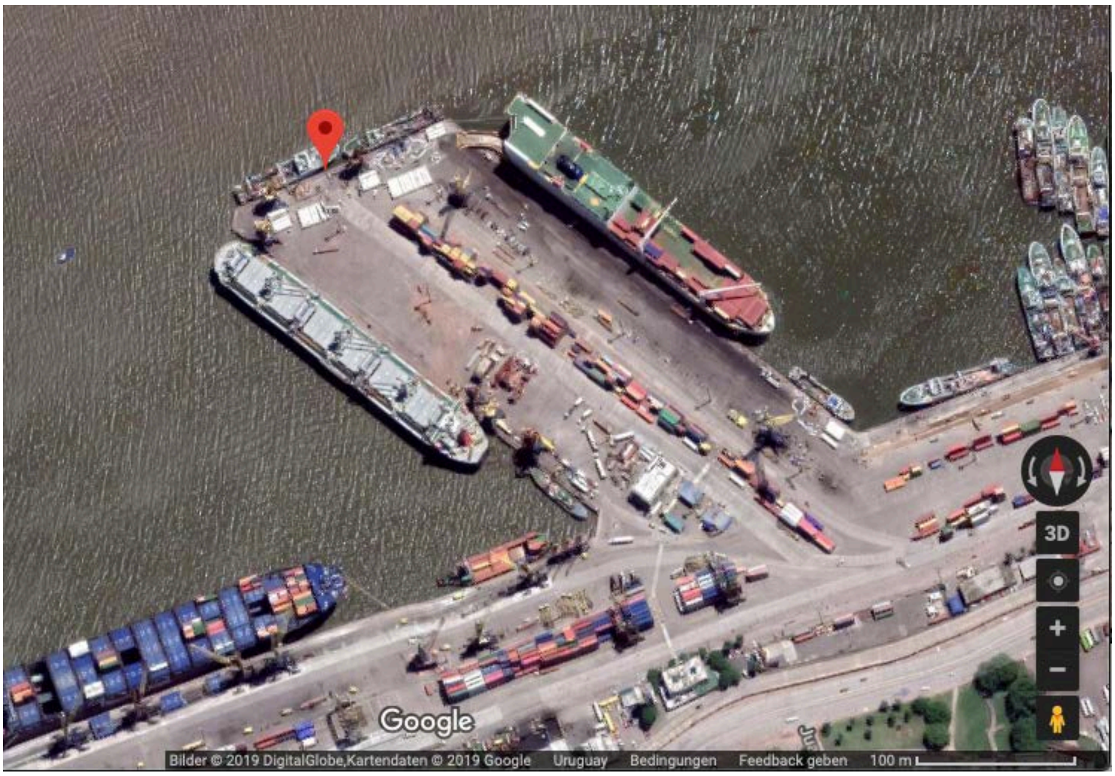

Figure 5.46 Location of reference point "Muelle B", Montevideo Harbour 106170 in Montevideo Harbor. Image credit: Google Maps, 2019.

Reference point:	Muelle B, Montevideo Harbour 106170 (Table 5.7, Fig. 5.46)
Coordinates:	34°53.98'S 56°12.52'W (BGI)
Position:	Montevideo, Muelle B, 4 m east of third bollard at western edge of jetty
Conditions:	harbor traffic, very high level of disturbance
Absolute Gravity:	979746.280 mGal

Table 5.5 Measurements at point A,1st in Montevideo Harbor.

17.03.2019 (local) all feedback measurements					
Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
19:12	22:12	3165.00	-0.97	3212.74	3211.77
19:16	22:16	3166.99	-1.92	3214.75	3212.83
19:20	22:20	3167.00	-2.94	3214.76	3211.82
19:23	22:23	3168.00	-3.98	3215.78	311.80
19:26	22:26	3169.00	-4.97	3216.79	3211.82
19:31	22:31	3170.00	-6.00	3217.81	3211.81
$G_{tot,rel}$ of the feedback measurement			**3211.97 ± 0.03 mGal**		
all manual measurements from right					
19:43	22:43			3212.14	
19:45	22:45			3212.15	
19:47	22:47			3212.18	
19:48	22:48			3212.15	
19:49	22:49			3212.18	
19:51	22:51			3212.13	
$G_{tot,rel}$ of the manual measurement			**3212.16 ± 0.03 mGal**		

Table 5.6 Measurements at point "Darsena I Quay (106171)" in Montevideo Harbor.

17.03.2019 (local) all feedback measurements					
Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
20:40	23:40	3165.00	-0.87	3212.74	3211.87
20:42	23:42	3166.00	-1.88	3213.75	3211.82
20:44	23:44	3167.00	-2.89	3214.76	3211.88
20:46	23:46	3168.00	-3.89	3215.78	3211.88
20:48	23:48	3169.00	-4.90	3216.79	3211.89
20:50	23:50	3170.00	-5.92	3217.81	3211.89
$G_{tot,rel}$ of feedback measurement				**3211.88 ± 0.03 mGal**	
all manual measurements from right					
20:13	23:13			3212.24	
20:14	23:14			3212.22	
20:15	23:15			3212.26	
20:17	23:17			3212.21	
20:18	23:18			3212.24	
20:19	23:19			3212.22	
$G_{tot,rel}$ of feedback measurement				**3212.23 ± 0.03 mGal**	

Table 5.7 Measurements at point "Muelle B (106170)" in Montevideo Harbor.

17.03.2019 (local) all feedback measurements

Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
21:12	00:12	3165.00	-0.70	3212.74	3212.04
21:16	00:16	3166.00	-1.70	3213.75	3212.05
21:20	00:20	3167.00	-2.73	3214.76	3212.04
21:23	00:23	3168.00	-3.74	3215.78	3212.04
21:25	00:25	3169.00	-4.77	3216.79	3212.03
21:28	00:28	3170.00	-5.74	3217.81	3212.07
$G_{tot,rel}$ of feedback measurement				**3212.04 ± 0.03 mGal**	
all manual measurements from right					
21:31	00:31			3212.36	
21:32	00:32			3212.41	
21:33	00:33			3212.39	
21:34	00:34			3212.35	
21:35	00:35			3212.41	
21:36	00:36			3212.39	
$G_{tot,rel}$ of the manual measurement				**3212.38 ± 0.03 mGal**	

Table 5.8 Measurements at point A, 2nd in Montevideo Harbor next to vessel.

17.03.2019 (local) all feedback measurements

Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
21:59	00:59	3165.00	-0.98	3212.74	3211.75
22:02	01:02	3166.00	-1.98	3213.75	3211.77
22:05	01:05	3167.00	-2.99	3214.76	3211.78
22:07	01:07	3168.00	-4.00	3215.78	3211.78
22:09	01:09	3169.00	-5.01	3216.79	3211.78
22:11	01:11	3170.00	-6.02	3217.81	3211.79
$G_{tot,rel}$ of feedback measurement				**3211.77 ± 0.03 mGal**	
all manual measurements from right					
21:51	00:51			3212.14	
21:52	00:52			3212.12	
21:53	00:53			3212.12	
21:54	00:54			3212.13	
21:55	00:55			3212.12	
21:56	00:56			3212.12	
$G_{tot,rel}$ of the manual measurement				**3212.13 ± 0.03 mGal**	

To derive the total relative gravity $G_{tot,rel}$, the measured counter units (CU) of the L&R land gravimeter have to be calculated in relative gravity units. Therefore, every instrument has its own specific interpolation table. All measured values M are between 3100 and 3200 CU. By taking the lower value, the calibration fix C is set to 3146.81 mGal and the calibration factor f is 1.01424. While the measurement is performed in feedback mode, a sensor gives an additional offset value FO in mGal. With the formula:

$G_{tot,rel}$=C + f(M-3100)+FO = 3146.81 mGal + 1.01424(M-3100) + FO

The vertical difference D between land-based measurements at the pier and the ZLS-S56 is corrected by a free air correction. This difference changed slightly due to tides. The calculated distance between the working deck and water surface at a vessel draft of 6.80±0.05 m was R_w=2.7±0.05 m. The measured altitude L_w between the land gravimeter and the water surface was for point A, 1st L_w(A, 1st)=3.55±0.05 m and for point A, 2nd L_w(A, 2nd)=3.40±0.05 m. The calculated, fixed vertical distance is from the center of the sea gravity meter's sensor to the working deck R_s=2.00±0.05 m. This results in:

$D = -R_s - (L_w - R_w)$

$D_{A,1st}$= - 2.86 ±0.05 m

$D_{A,2nd}$= - 2.71±0.05 m

A negative D means a lower altitude of the sea gravimeter compared to the L&R. With both D it is possible to calculate the free-air corrections for the point A, 1st and point A, 2nd by:

FA= 0.3086 mGal/m * D

This results in $FA_{A,1st}$ = - 0.88±0.01 mGal with $D_{A,1st}$= - 2.86±0.05 m and $FA_{A,2nd}$ = - 0.84±0.01 mGal with $D_{A,2nd}$ = - 2.71±0.05 m.

With the given and measured values, it is possible to calculate the absolute gravity value at the position of the sea gravimeter.

For the point directly next to the vessel the absolute value is calculated via the total, relative gravity value $G_{tot,rel}$ between the reference points within the harbor area of Montevideo. Additionally, the free air correction FA is summed to the absolute gravity value at all points.

For Point A, 1st the both estimations are given by:

G_{abs}(A,1st)= G_{abs}(Darsena I Quay)+$G_{tot,rel}$(A,1st)-$G_{tot,rel}$(Darsena I Quay)+$F_{A,1st}$

= 979745.94 mGal + 3211.97±0.03 mGal – 3211.88±0.03 mGal – 0.88±0.01 mGal

= 979745.15±0.02 mGal

G_{abs}(A,1st)= G_{abs}(Muelle B)+$G_{tot,rel}$(A,1st)-$G_{tot,rel}$(Muelle B)+$F_{A,1st}$

= 979746.28 mGal + 3211.97±0.03 mGal – 3212.04±0.03 mGal – 0.88±0.01 mGal

= 979745.33±0.02 mGal

By averaging the values, we get for the first point an absolute gravity value of

G_{abs}(A,1st)= 979745.24±0.02 mGal

For Point A,2nd the estimations are given by:

G_{abs}(A,2nd)= G_{abs}(Darsena I Quay)+$G_{tot,rel}$(A,2nd)-$G_{tot,rel}$(Darsena I Quay)+$F_{A,2nd}$

= 979745.94 mGal + 3215.77±0.03 mGal – 3211.88±0.03 mGal – 0.84±0.01 mGal

= 979745.00±0.02 mGal

$G_{abs}(A,2nd) = G_{abs}(Muelle\ B) + G_{tot,rel}(A,2nd) - G_{tot,rel}(Muelle\ B) + F_{A,2nd}$

$= 979746.28$ mGal + 3215.77 ± 0.03 mGal – 3212.04 ± 0.03 mGal – 0.84 ± 0.04 mGal

$= 9797455.38 \pm 0.02$ mGal

For the second point, we get by averaging:

$G_{abs}(A,2nd) = 979745.19 \pm 0.02$ mGal

The ZLS-S56 was running during the tie measurement. The average digital gravity during the tie measurement is 9778.184 mGal. In conclusion, averaging the values of Point A, 1st and Point A, 2nd, gives an absolute gravity value of **979745.2±0.2** mGal at a relative digital gravity of 9778.2 mGal of the ZLS-S56 on 17.03.19 at 01:11 UTC.

Second Tie Measurement at Montevideo Harbor, 24.04.2019

After the arrival in the harbor of Montevideo, the second tie measurement was conducted. *MARIA S. MERIAN* was docked at Quay H10. Again, the first and the last measured point is beside the vessel and named Point B. It is located 3 m east of the 5th bollard. Because of the heavy harbor traffic, the reference point “Muelle B” was skipped and only the reference point “Darsena I Quay” was surveyed again. However, a harbor crane was operating next to “Darsena I Quay” causing strong vibrations during the measurement.

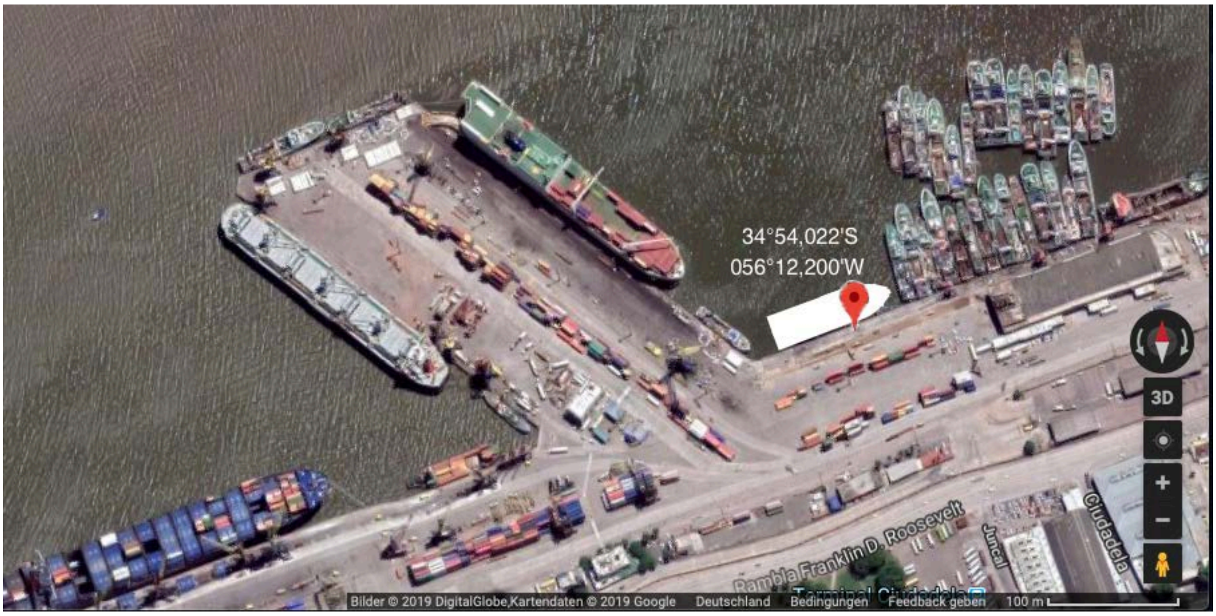

Figure 5.47 Location of *MARIA S. MERIAN* on April 24, 2019 and location of Point B in Montevideo Harbor.

Point B, 1st (Fig. 5.47, Table 5.9) & B, 2nd (Table 5.11)
Vessel Coordinates: 34° 54.022’S, 56° 12.200’W
Position: directly portside of *MARIA S. MERIAN*, approximately alongside of gravity meter room, 3 m east of the 5th bollard counted from east
Height above waterline: 2.80 m (Point B, 1st & 2nd)
Draft of vessel: 6.30 m
Conditions: harbor traffic, high level of disturbance for 1st measurement; calm for 2nd measurement

Reference point:	Darsena I Quay, Montevideo Harbour 106171 (Table 5.10, Fig. 5.45)
Coordinates:	34° 54,12' S, 56° 12,39' W (BGI)
Position:	Montevideo, Darsena I Quay, 1 m west of the second bollard (#87) from eastern corner
Conditions:	harbor traffic, high level of disturbance
Absolute Gravity:	979745.940 mGal at 3 m above normal null

Table 5.9 Measurements at point B, 1st in Montevideo Harbor next to vessel.

24.04.2019 (local) all feedback measurements

Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
11:09	14:09	3164.00	-1.52	3211.72	3210.20
11:10	14:10	3165.00	-2.52	3212.74	3210.21
11:13	14:13	3166.00	-2.54	3213.75	3211.21
11:19	14:19	3167.00	-4.57	3214.76	3210.20
11:21	14:21	3168.00	-5.56	3215.78	3210.22
11:23	14:23	3169.00	-6.55	3216.79	3210.24
$G_{tot,rel}$ of feedback measurement				**3210.38 ± 0.03 mGal**	
all manual measurements from right					
10:59	13:59	3162.82		3210.52	
11:00	14:00	3162.80		3210.50	
11:01	14:01	3162.76		3210.46	
11:03	14:03	3162.84		3210.54	
11:04	14:04	3162.78		3210.48	
11:05	14:05	3162.82		3210.52	
$G_{tot,rel}$ of the manual measurement				**3210.51 ± 0.03 mGal**	

Table 5.10 Measurements at reference point "Darsena I Quay" (101671) in Montevideo Harbor.

24.04.2019 (local) all feedback measurements

Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
11:45	14:45	3164.00	-1.48	3211.72	3210.24
11:49	14:49	3165.00	-2.48	3212.74	3210.26
11:53	14:53	3166.00	-3.48	3213.75	3210.27
11:58	14:58	3167.00	-4.52	3214.76	3210.25
12:01	15:01	3168.00	-5.52	3215.78	3210.26
12:04	15:04	3169.00	-6.52	3216.79	3210.27
$G_{tot,rel}$ of feedback measurement				**3210.26 ± 0.03 mGal**	
all manual measurements from right					
12:07	15:07	3162.89		3210.60	
12:09	15:09	3162.87		3210.57	
12:10	15:10	3162.91		3210.62	
12:12	15:12	3162.88		3210.59	
12:13	15:13	3162.85		3210.55	
12:14	15:14	3162.89		3210.60	
$G_{tot,rel}$ of manual measurement				**3210.59 ± 0.03 mGal**	

Table 5.11 Measurements at Point B,2nd in Montevideo Harbor next to vessel.

Time (local)	Time (UTC)	Counter reading (CU)	Feedback offset ±0.05 (mGal)	Counter reading ±0.02 (mGal)	Total gravity $G_{tot,rel}$ ±0.07 (mGal)
24.04.2019 (local) all feedback measurements					
12:33	15:33	3164.00	-1.53	3211.72	3210.20
12:36	15:36	3165.00	-2.50	3212.74	3210.24
12:38	15:38	3166.00	-3.51	3213.75	3210.24
12:42	15:42	3167.00	-4.55	3214.76	3210.21
12:45	15:45	3168.00	-5.53	3215.78	3210.25
12:48	15:48	3169.00	-6.54	3216.79	3210.25
$G_{tot,rel}$ of feedback measurement				**3210.23 ± 0.03 (mGal)**	
all manual measurements from right					
12:24	15:24	3162.79		3210.49	
12:25	15:25	3162.76		3210.46	
12:26	15:26	3162.78		3210.48	
12:27	15:27	3162.80		3210.50	
12:29	15:29	3162.79		3210.49	
12:30	15:30	3162.76		3210.46	
$G_{tot,rel}$ of the manual measurement				**3210.48 ± 0.03 mGal**	

The vertical difference D between land-based measurements at the pier and the ZLS-S56 is calculated the same as was the tie measurement on the March 17, 2019. The calculated distance between the working deck and water surface at a vessel's draft of 6.30±0.05 m was Rw=3.45±0.05 m. The measured altitude Lw between the land gravimeter and the water surface was for point B for both (B, 1st & B, 2nd) Lw(B)=2.80±0.05 m. The calculated, fixed vertical distance is from the center of the sea gravity meter's sensor to the working deck Rs=2.00±0.05 m. This results in the following:

$$D= - R_s - (L_w - R_w)$$

$$D_B= - 1.36\pm0.05 \text{ m}$$

The free air correction between both gravimeters is:

$$FA = 0.3086 \text{ mGal/m} * D$$

$$FA_B = -0.42\ 0.42\pm0.01 \text{ mGal}$$

With those values the absolute gravity at the sea gravimeter sensor can be calculated:

$G_{abs}(B,1st)= G_{abs}(\text{Darsena I Quay})+G_{tot,rel}(B,1st)-G_{tot,rel}(\text{Darsena I Quay})+F_{B,1st}$

$= 979745.94 \text{ mGal} + 3210.38\pm0.03 \text{ mGal} – 3210.26\pm0.03 \text{ mGal} – 0.42\pm0.01 \text{ mGal}$

$= 979745.66\pm0.02 \text{ mGal}$

$G_{abs}(B,2nd)= G_{abs}(\text{Darsena I Quay})+G_{tot,rel}(B,2nd)-G_{tot,rel}(\text{Darsena I Quay})+F_{B,2nd}$

$= 979745.94 \text{ mGal} + 3210.23\pm0.03 \text{ mGal} – 3210.26\pm0.03 \text{ mGal} – 0.\ 42\pm0.01 \text{ mGal}$

$= 979745.50\pm0.02 \text{ mGal}$

Averaging the values G_{abs}(B, 1st) and G_{abs}(B, 2nd), gives an absolute gravity value of **979745.6±0.2** mGal.

The sea gravimeter showed an averaged digital gravity of 9767.6 mGal during the tie measurement. Therefore, we calculate an absolute value of **979745.6 mGal** at a sea gravimeter value of 9767.6 mGal at 15:48 UTC.

Both tie measurements show that the instrumental drift of the ZLS-S56 is **11 mGal** in 39 days or a drift of 0.28 mGal/day. A cross-point near the EEZ can also be used to determine the instrumental drift.

5.4.3 *Data Quality Checks und Preprocessing*

Data was regularly retrieved from the recording PC and checked during the cruise. Using scripts provided by B. Coakley, the fundamental corrections (latitude and Eötvös corrections) were applied to the data. Figures 5.48 and 5.49 show data examples for a day with frequent changes in vessel speed and heading during OBS deployments at the southern flank of the western RGR (day 094) and during measurements along the seismic profile 20190200 across the top of the western RGR (day 097).

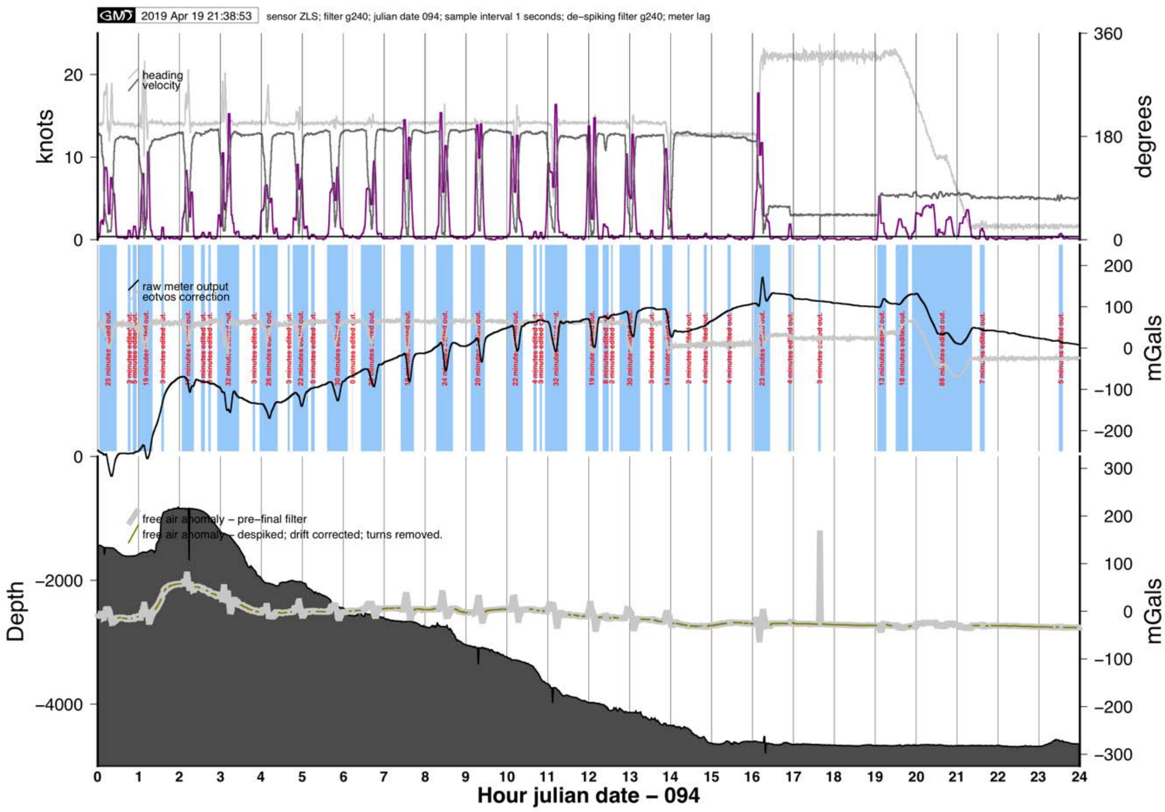

Figure 5.48 Gravity data example. For the final accepted gravity (green line) we used a threshold of the gradient in the Eötvös corrections of 0.003 mGal/s.

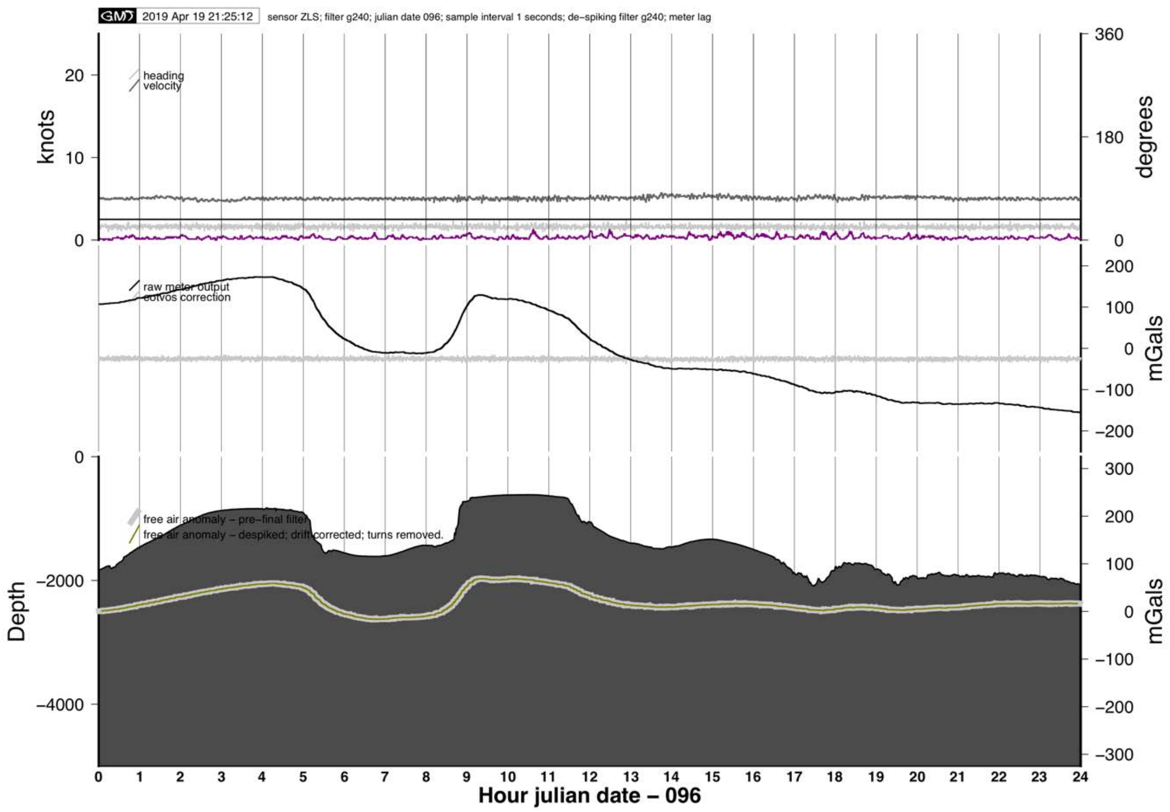

Figure 5.49 Gravity data example. For the final accepted gravity (green line) we used a threshold of the gradient in the Eötvös corrections of 0.02 mGal/s.

5.5 Magnetic Measurements

(W. Geissler [1], T. Funck [2], C. Lehmann [1])

[1] AWI

[2] GEUS

On the transits to and from the working area and between petrological sampling areas we acquired magnetic data to complement the existing magnetic data, which still has gaps around the Rio Grande Rise. We also measured magnetic data along seismic profile AWI-20190100. We used a towed SeaSPY2TM longitudinal gradiometer system (Fig. 5.50), manufactured by Marine Magnetics Corp. The two de-rated SeaSPY2TM tow fishes are equipped with Overhauser sensors (proton magnetometer), measuring simultaneously the total intensity of the magnetic field with an absolute accuracy of 0.1 nT without drift (specifications of the system). The front fish was towed ~680 m behind the stern. The tow point (cable sheave) was located 15 m to back board from the center line. Due to the long distance between sensor and vessel, there is no need to correct for any magnetic signals caused by the vessel itself.

The magnetic anomalies can be calculated by subtracting the reference field (IGRF12). The IGRF12 reference field consists of coefficients that describe the Earth's magnetic field in 2015 and coefficients that describe changes in the following years. After subtracting the reference field, single sensor measurements might be still disturbed by magnetic field variations.

Figure 5.50 Magnetometer system (Marine Magnetics SeaSPY2™ longitudinal gradiometer). Photo credit: Wolfram Geissler.

Tab. 5.12 Statistics of magnetic measurements.

Survey Name	mode	Start Date	UTC	End Date	UTC	Start Lat	Start Lon	End Lat	End Lon	Readings	comments
MSM82_36S_Profile1	grad	19-Mar-2019	23:03	20-Mar-2019	0:03					1211	no navigation, only clock
MSM82_Survey_1A	grad	20-Mar-2019	00:44	20-Mar-2019	17:08					19656	no navigation, only clock
MSM82_Survey_1B1	grad	20-Mar-2019	17:11	20-Mar-2019	17:15					82	no navigation, only clock
MSM82_Survey_1B2	grad	20-Mar-2019	17:15	20-Mar-2019	21:15					4742	no navigation, only clock
MSM82_Survey_1C	grad	20-Mar-2019	21:19	22-Mar-2019	13:42	-35,966	-44,952	-35,990	-35,223	48369 (48488)	clock lost at the end, transceiver failure
MSM82_Survey_1D	grad	22-Mar-2019	14:01	23-Mar-2019	06:10	-35,990	-35,148	-35,999	-31,250	19384	
MSM82_20190100_A	grad	26-Mar-2019	14:41	27-Mar-2019	21:27	-32,390	-29,384	-34,775	-30,447	36909	failure in recording (interaction with BOB software
MSM82_20190100_B	grad	28-Mar-2019	03:16	28-Mar-2019	15:31	-35,231	-30,650	-31,083	-31,083	14650	
MSM82_Survey_2A	grad	30-Mar-2019	17:32	31-Mar-2019	07:20	-32,693	-29,536	-32,374	-32,154	15862	
MSM82_Survey_3A	grad	31-Mar-2019	19:50	01-Apr-2019	02:56	-32,394	-32,047	-32,143	-33,025	8513	
MSM82_Survey_4A	grad	02-Apr-2019	19:26	03-Apr-2019	05:54	-30,960	-34,470	-28,892	-34,393	12565	
MSM82_20190200_A	grad	04-Apr-2019	19:14	04-Apr-2019	22:27	-33,555	-36,747	-33,481	-36,705	3871	connection to sensors lost, recovered
MSM82_Survey_5B	mag	09-Apr-2019	22:34	09-Apr-2019	22:53					388	no clock synchronization, transceiver failure
MSM82_Survey_5C	mag	09-Apr-2019	22:58	09-Apr-2019	23:26	-33,281	-36,711	-33,311	-36,806	583	partly without navigation
MSM82_Survey_5D-5J	grad	09-Apr-2019	23:30	10-Apr-2019	10:00						no navigation, only logged
MSM82_Survey_6A	grad	11-Apr-2019	13:11	11-Apr-2019	21:17	-33,567	-39,032	-32,316	-38,279	9724	mag clock ignored
MSM82_Survey_7A	grad	12-Apr-2019	08:28	12-Apr-2019	14:51	-32,390	-38,324	-31,650	-37,315	7661	mag clock ignored
MSM82_Survey_8A	grad	13-Apr-2019	00:24	13-Apr-2019	08:08	-31,823	-37,277	-30,609	-36,814	9280	mag clock ignored
MSM82_Survey_9A	grad	20-Apr-2019	04:31	22-Apr-2019	16:00	-26,347	-40,012	-34,877	-47,864	71388	mag clock ignored

To acquire magnetic data void off these field variations, a longitudinal gradiometer system of two sensors (distance 50 m) is normally used. The horizontal gradient of the field can be obtained by subtracting the two values from each other, and dividing the obtained difference by the distance between the sensors. Assuming that the time variations of the earth magnetic field are spatially constant over the distance of the two sensors, one can calculate the total magnetic field (apart from a constant value) through integration of the gradients over the distance of the ship track.

The data acquisition was performed with a PC notebook (OS Windows-10) and Marine Magnetics Software BOBTM. NMEA navigation information was received from the vessel's DGPS/SeaPath via Ethernet, LANTRONIX port (TC/IP), and Serial-USB adapter. The GPS reference point is 58.5 m in front of the stern. At the beginning of the cruise we had problems with importing the navigation data, since the wrong transfer protocol was used on the MOXA port. Therefore, data was only sampled with the time stamp and has to be combined with the navigation data at a later stage.

The general sailing speed varied between 5 knots along seismic profiles and <13 knots on transit. We used a sampling rate of 0.3 Hz for the data acquisition.

Sometimes, we could only measure with a single sensor. Due to technical problems with the transceiver boxes, we experienced several interruptions in the acquisition (Table 5.12). The acquired data have a very good to excellent quality (Fig. 5.51).

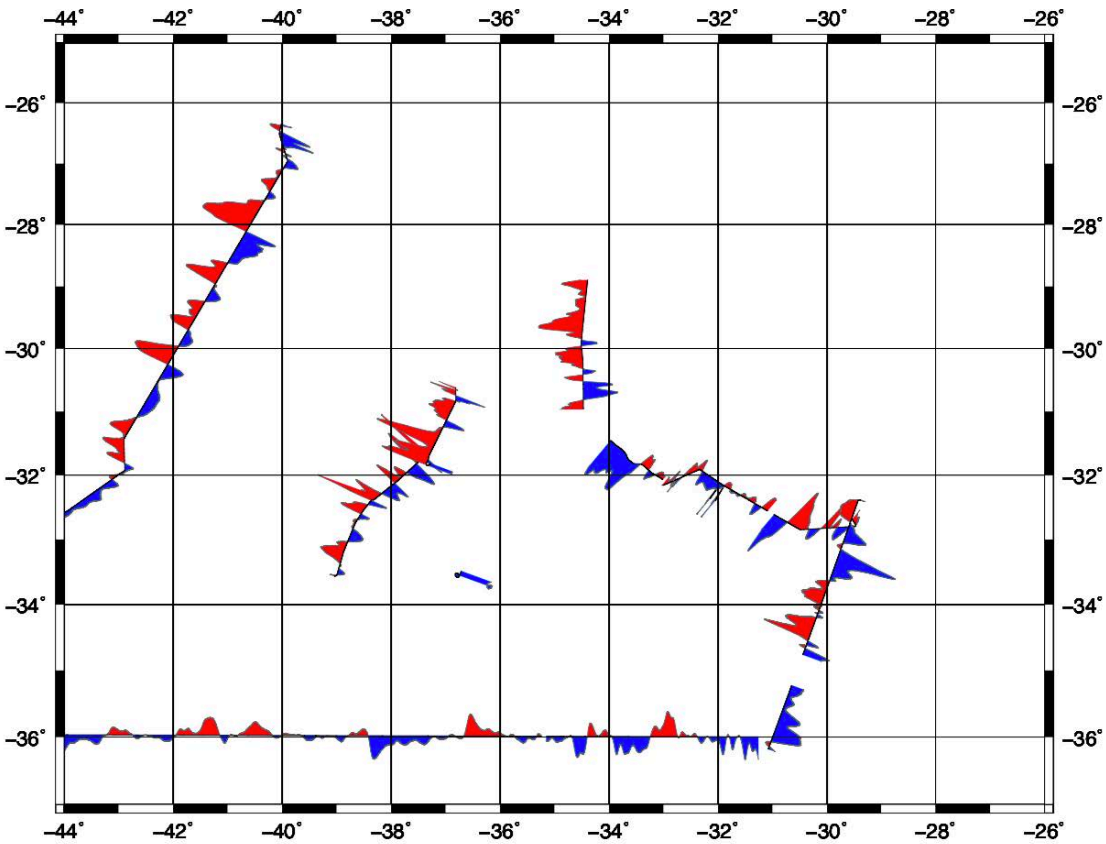

Figure 5.51 Map showing coverage of IGRF corrected magnetic data measured with the front sensor of the longitudinal gradiometer.

5.6 Marine Mammal Monitoring

(J. Shearing [1], J. Purdon [1])

[1] Seiche

5.6.1 Objectives

This chapter presents the findings of dedicate marine mammal monitoring during a research cruise at the Rio Grande Rise (RGR) in the South Atlantic Ocean. This survey was conducted for AWI and FAU on board *MARIA S. MERIAN*, with marine fauna mitigation required during seismic profiling. The vessel left port on 18/03/2019 and returned to port on 24/04/2019. The survey period, i.e. when the vessel was in the survey area, was from 23/03/2019 to 19/04/2019.

The South Atlantic Ocean has a high abundance of marine mammals with over 50 different species being documented in its waters. Given the geographic location of the survey area, as well as the complex bathymetry associated with the locations of the seismic profiles, it is expected that there is equally large biodiversity of marine mammals in the waters around the RGR. The RGR presents a severely understudied area with very little knowledge on either local and regional scales (Monserrat *et al*., 2019), hence a detailed picture of the presence and seasonal occurrence of marine mammals is not conceivable. Table 5.13 shows some of the marine fauna potentially found around the RGR.

Due to the survey being in international waters, no specific national regulations for marine mammal protection were applicable. However, AWI and FAU chose to voluntarily adopt marine mammal and sea turtle mitigation measures in order to protect any marine megafauna that would have the potential to be encountered in the survey area during geophysical data acquisition. Therefore, a Marine Mammal Impact Assessment (MMIA) was conducted prior to the survey with the aim of identifying the potential impacts of the seismic operations to marine mammals and turtles in the area, and to determine steps to avoid, remedy or mitigate any negative effects arising from the operations.

Three data acquisition profiles were planned for the survey using Ocean Bottom Seismometers (OBS) but due to time constraints data acquisition was only possible for two of them. For details about the seismic survey see chapter 5.3.

5.6.2 Marine Mammal Monitoring Methodology

A Marine Mammal Mitigation Plan (MMMP) was compiled based on the MMIA in order to outline specific protocols to be followed during the survey. A summary of mitigation requirements can be found in Table 5.14 and a flow chart in Figure 5.52 while further details are outlined below.

Where possible, the seismic source was to be initiated during daylight hours, allowing enough time to carry out a visual pre-shooting watch of at least 60 minutes. There were two mitigation zones for this survey: 1,600 m for high frequency marine mammals (e.g. *kogia* sp. & porpoises) and 500 m for all other marine mammals and sea turtles. If marine mammals or sea turtles were sighted within their respective mitigation zones (MZs) during the pre-shooting watch then a delay of 30 minutes from the last sighting within the zone was required. Soft-starts were to be between 20 and 40 minutes. Breaks in firing that were less than 10 minutes in duration immediately following normal operations at full power and single airgun tests did not require another soft-start. If marine mammals or sea turtles were sighted in their respective MZs during airgun operations, then a full shutdown of the source was required until 30 minutes after the last sighting within the MZ. This would then need to be followed by another soft-start, once given the all clear from the MMOs.

Table 5.13 Marine mammals and sea turtles potentially found around the Rio Grande Rise, South Atlantic.

SPECIES GROUP	SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	IUCN STATUS
Baleen whales	Blue whale	*Balaenoptera musculus*	Endangered
	Bryde's whale	*Balaenoptera edeni*	Least Concern
	Common minke whale	*Balaenoptera acutorostrata*	Least Concern
	Southern right whale	*Eubalaena australis*	Least Concern
	Fin whale	*Balaenoptera physalus*	Vulnerable
	Pygmy right whale	*Caparea marginata*	Least Concern
	Sei whale	*Balaenoptera borealis*	Vulnerable
Toothed whales and dolphins	Clymene dolphin	*Stenella clymene*	Least Concern
	Cuvier's beaked whale	*Ziphius cavirostris*	Least Concern
	Pygmy sperm whale	*Kogia breviceps*	Data Deficient
	Arnoux's beaked whale	Berardius arnuxii	Data Deficient
	Blainville's beaked whale	*Mesoplodon densirostris*	Data Deficient
	Strap-toothed whale	*Mesoplodon layardii*	Data Deficient
	True's beaked whale	*Mesoplodon mirus*	Data Deficient
	Hector's beaked whale	*Mesoplodon hectori*	Data Deficient
	Gray's beaked whale	*Mesoplodon grayi*	Data Deficient
	Killer whale	*Orcinus orca*	Data Deficient
	False killer whale	*Pseudorca crassidens*	Near Threatened
	Pygmy killer whale	*Feresa attenuata*	Least Concern
	Bottlenose dolphin	*Tursiops truncatus*	Least Concern
	Pantropical spotted dolphin	*Stenella attenuata*	Least Concern
	Spinner dolphin	*Stenella longirostris*	Least Concern
	Fraser's dolphin	*Lagenodelphis hosei*	Least Concern
	Striped dolphin	*Stenella coeruleoalba*	Least Concern
	Short beaked common dolphin	*Delphinus delphis*	Least Concern
	Pilot whales	*Globicephala sp.*	Least Concern
	Risso's dolphin	*Grampus griseus*	Least Concern
	Rough-toothed dolphin	*Steno bredanensis*	Least Concern
	Southern right whale dolphin	*Lissopelphis peronii*	Data Deficient
	Spectacled porpoise	*Phocoena dioptrica*	Data Deficient
	Sperm whale	*Physeter macrocephalus*	Vulnerable
Pinnipeds	South American fur seal	*Arctocephalus australis*	Least Concern
	South American sea lion	*Otaria byronia*	Least Concern
Sea Turtles	Loggerhead turtle	*Caretta caretta*	Endangered
	Leatherback turtle	*Dermochelys coriacea*	Endangered
	Green turtle	*Chelonia mydas*	Endangered

Table 5.14 Mitigation measures summary.

SUMARRY	
Mitigation zone size:	500 m and 1,600 m
Pre-watch period:	60 min
Soft start length:	20-40 min
Soft-start delays:	Yes
Shut-down during production:	Yes
Species covered:	Marine mammals and sea turtles
No. of MMOs:	2

Two trained and dedicated MMOs (J. Shearing, J. Purdon) were present on board the *MARIA S. MERIAN* throughout the survey. The main role of the MMOs was to monitor for marine megafauna immediately prior or during seismic activity in order to ensure no marine mammals or sea turtles are in the respective MZs. The MMOs also carried out watches during transits to and from port to lower the risk of ship strikes with marine mammals, particularly large whale species.

The MMOs carried out dedicated watches for marine mammals during daylight hours throughout the survey. Watches during transits were also carried out to minimise the risk of any collisions with marine megafauna. The MMOs monitored the area with the naked eye and 7 x 50 binoculars checking for visual cues such as seabirds, splashes, blows and sea surface disturbance. When marine mammals were observed, the distance and bearing to the sighting were recorded along with the species, time, position and other data required for the completion of the sightings forms. Species identification was aided when possible by photographic records of sightings, taken using digital SLR cameras. Species identification was also confirmed by reference to a field guide (Shirihai & Jarrett, 2006).

Observations were carried out mainly from the bridge (height 15 m) and the monkey island (height 17 m), which were approximately 90 m from the centre of the mitigation zones. These observation points provided clear views of the MZs. Distances to sightings were estimated by reticule binoculars and range finder sticks.

The scientific team on board were in charge of acoustic monitoring using QuietSea, which was incorporated in the streamer.

The MMOs compiled data throughout the survey into three main data sheets: Location and Effort, Operations and Sightings. Cumulative totals and statistics of the data were compiled throughout the survey. Where possible photographs were taken of sightings to allow for analysis after the sighting was made to help with obtaining a positive ID and group sizes. Any sightings details and photographs were given to the chief scientist to include in the weekly report. At the end of the survey, all sightings data was tabulated, summarised and plotted onto a distribution map.

There was a pre-survey start-up meeting where marine fauna mitigation protocol was addressed and accepted by all parties involved. The chief scientist kept the MMOs up to date with plans for any upcoming seismic survey activity.

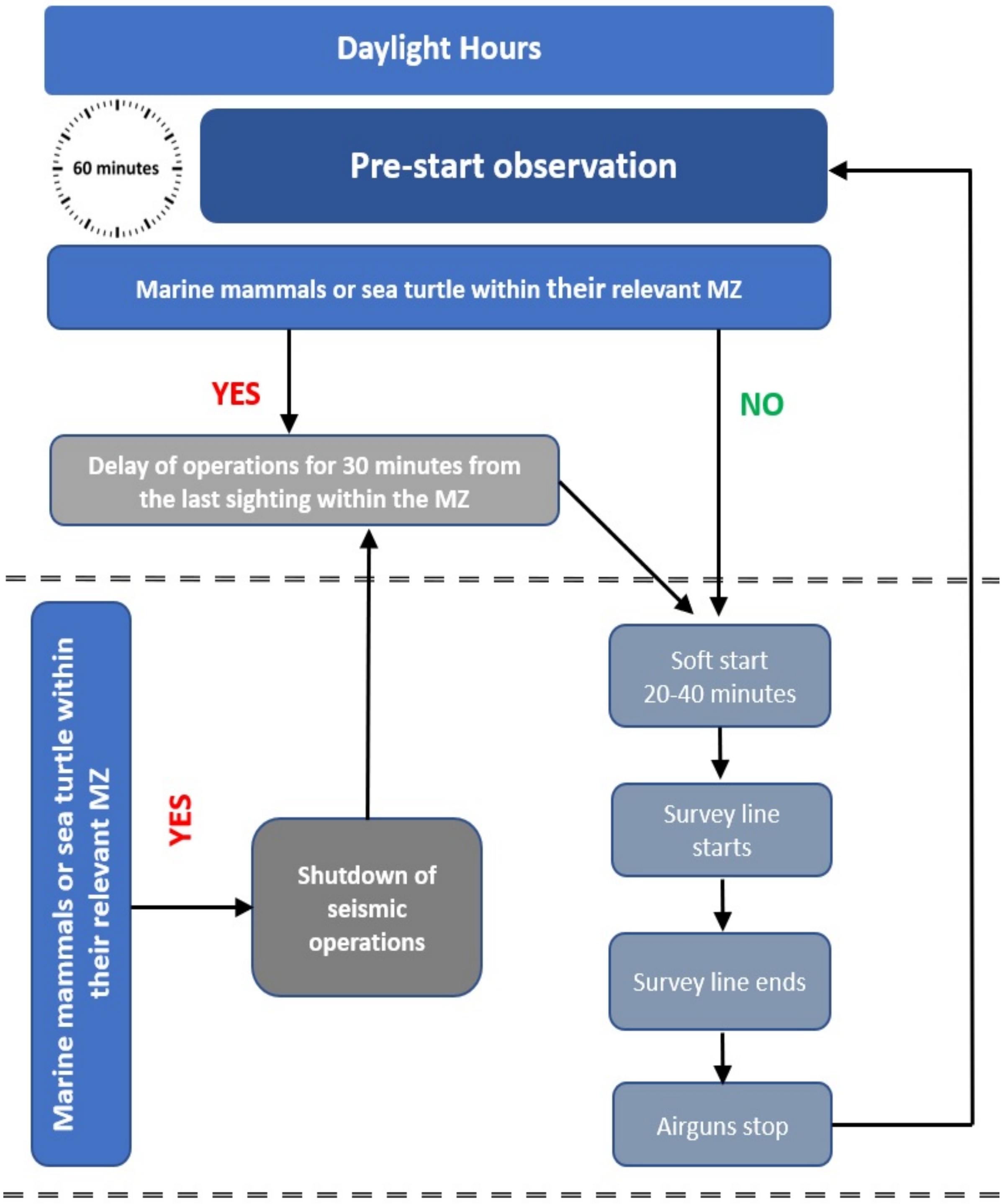

Figure 5.52 Marine mammal and sea turtle mitigation flow chart.

All communication followed the agreed protocol. Communication with the seismic scientists and the MMOs was achieved via the bridge crew. Notice was given to the MMOs to start the pre-shooting watch at least one hour before source operation and clearance was sort before commencing with the soft-start. The seismic scientists informed the bridge crew of any change to source activity, which was then relayed to the MMOs. In the case of a mitigation action, the MMOs would communicate via the bridge crew.

5.6.3 Results

Only two out of the three seismic profile lines were run due to time constraints. For seismic profile 2, 30 OBS were used and for seismic profile 3, 27 OBS were used. The streamer, which has a dual potential of acquiring data as well as acoustic monitoring with QuietSea, was not operational throughout seismic surveying due to technical problems. Multiple attempts were made to fix the problems, but to no avail. All other equipment worked effectively and all OBS were successfully retrieved. The soft-start for seismic profile 3 was conducted during the day. Due to technical delays with the airguns, the soft-start for seismic profile 2 was conducted during dusk. No downtime or delays occurred for weather or marine fauna. A summary of operations and marine fauna mitigation can be found in Table 5.15.

A total of 327 hours and 47 minutes of dedicated marine fauna watches were carried out by the MMOs between 23rd March and 19th April 2019 within the survey area. Of this total monitoring effort, 58 hours and 16 minutes (18%) were completed whilst the guns were active (full power, soft starts) and 269 hours and 31 minutes (82%) whilst the guns were silent. Further watches were carried out during the transit to and from the survey area, totaling 77 hours and 32 minutes. Overall the MMOs carried out dedicated watches from leaving port until returning, totaling 405 hours and 23 minutes.

Table 5.15 Operation and marine mammal mitigation summary.

REPORT PERIOD (23/03/2019 to 19/04/2019)	
Total visual observation (hrs/min)	405:23
Total visual observation in survey area (hrs/min)	327:47
Total visual observation during transit	77:32
Total effort whilst seismic source was active	58:16
Total effort whilst seismic source was inactive	269:31
Total gun activity (hrs/min)	116:36
Total No. of survey lines	2
Total time data acquisition (hr/min)	115:37
Total No. of source tests	0
Total No. of source tests followed by a line	0
Total time source tests (hrs/min)	0
Total No. of soft starts	2
Total no. of soft starts during dawn/day	1
Total no. of soft starts during dusk/night	1
Minimum soft start time (hrs/min)	27
Maximum soft start time (hrs/min)	30
No. of visual pre-watch periods	2
Total visual pre-watch (hr/min)	02:00
No. of cetacean sightings in survey area	4
No. of turtle sightings in survey area	0
No. of seal sightings in survey area	0
No. of mitigation actions initiated	0

The predominant weather conditions experienced during the survey were choppy sea state (55%), low swell (85%), Beaufort wind force 5 (33%), south-easterly winds (34%) and strong forward sun glare (33%). For all weather conditions experienced during the survey period please refer to Figures 5.53, 5.54 and 5.55.

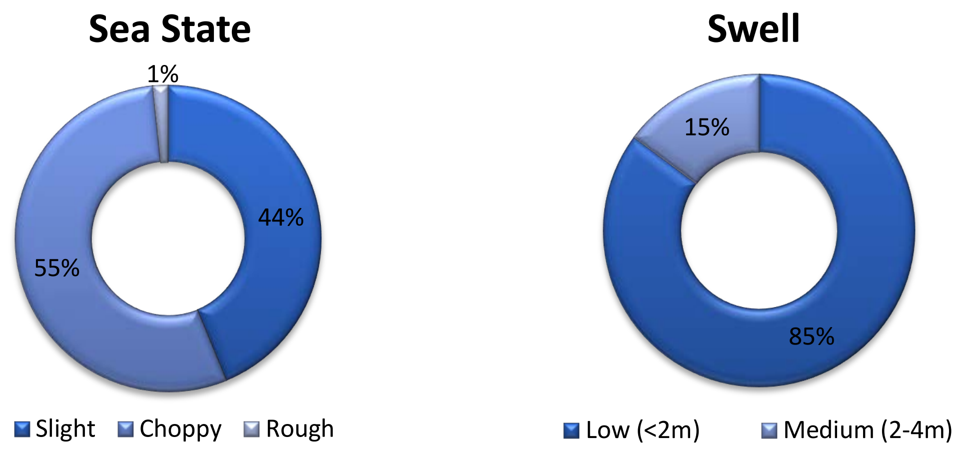

Figure 5.53 Sea state and swell height recorded during the survey.

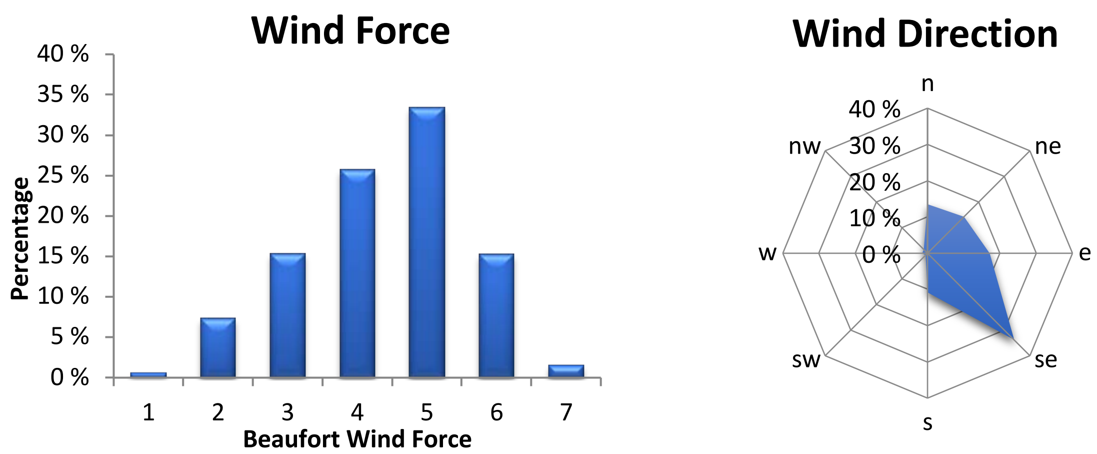

Figure 5.54 Beaufort wind force and direction recorded during the survey.

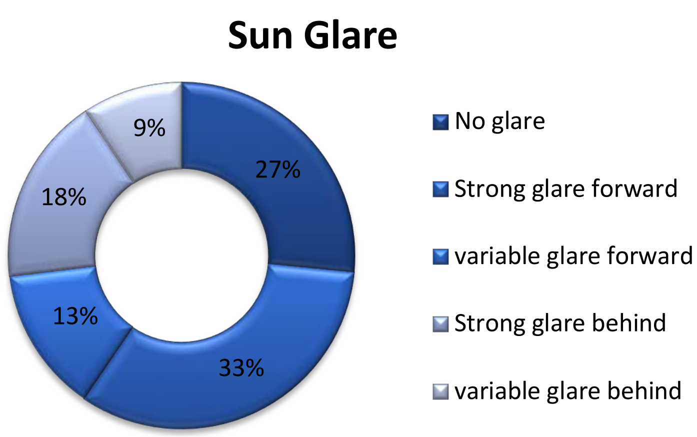

Figure 5.55 Visibility recorded during the survey.

Marine Mammal and Sea Turtle Sightings

There was a total of four sightings in the survey area, all of which were of marine mammals. Table 5.16 shows a short summary of the sightings and the following subsections provide further details.

Table 5.16 Summary of marine mammal sightings during the survey.

SPECIES	DATE	NUMBER OF ANIMALS	MITIGATION ACTIONS
Sperm whale	04/04/2019	1	None
Fin whale	05/04/2019	2	None
Pygmy blue whale	15/04/2019	1	None
Pilot whale	16/04/2019	>10	None

Sperm whale (Physeter macrocephalus)

A sperm whale was sighted on 4th April 2019 at 19:44 UTC. The whale was approximately 4,000 m away from the vessel in water depths of > 4500 m. During the sighting, a sequence of blows every 10-12 seconds was observed before the animal took a short dive. This was followed by another brief resurface before the animal was lost due to diminishing light following sunset. The sighting took place during a pre-shooting watch, however, due to the distance no mitigation actions were required. Photographs of the sighting can be found in Figure 5.56.

Fin whale (Balaenoptera physalus)

A mother and calf pair of fin whales were sighted on 5th April 2019 at 11:32 UTC. Initially at a distance of 2,000 m, the pair appeared to be milling in one area. Following this period of milling, the whales began a slow travel in a south westerly direction. The airguns were operating at full volume and the closest the whales came to the seismic source was 1,000 m. No mitigation actions were necessary for this sighting. Photographs of the sighting can be found in Figure 5.57.

Pygmy blue whale (Balaenoptera musculus brevicauda)

A pygmy blue whale was sighted on 15th April 2019 at 09:45 UTC, at a distance of approximately 1,000 m away from the vessel. The whale was undertaking dives in a regular pattern every 10-12 seconds for 2.5 minutes, followed by dives of approximately 10 minutes. The vessel was stationary due to dredging operations which allowed the sighting to continue for 1.5 hours. It was only when the vessel moved away that the whale was lost out of sight. A photograph of the sighting can be found in Figure 5.58.

Pilot whale (Globicephala sp.)

A group of pilot whales was sighted on 16th April 2019 at 09:46 UTC. The group were at a distance of approximately 3,000 m ahead of the vessel. The vessel was stationary for dredging operations. There were at least 10 individuals in the group, which appeared to be feeding due to the nature of their surfacing behaviour. A seabird was also seen diving in the same spot, further affirming the likelihood of feeding behaviour. A photograph of the sighting can be found in Figure 5.59.

Figure 5.56 Sperm whale (*Physeter macrocephalus*). Photo credit: Jean Purdon.

Figure 5.57 Fin whales (*Balaenoptera physalus*). Photo credit: Jean Purdon.

Figure 5.58 Pygmy blue whale (*Balaenoptera musculus brevicauda*). Photo credit: Jean Purdon.

Sightings Distribution

Figure 5.60 shows the distribution of the sightings made during the survey period. Limited number of sightings precludes detailed analysis of distribution patterns. Therefore, more in-depth surveys on marine megafauna in the area surrounding the RGR would be required to gain more of an understanding of the spatio-temporal distribution of marine mammals.

Transit Watches and Sightings

The MMOs carried out watches during the transit to and from the survey area, which greatly reduced the potential for any ship strikes during these periods of increased vessel speed. During these watches a number of marine mammals were sighted. On the way out and back into Uruguay, multiple South American fur seals were seen. This was to be expected due to the close proximity of a breeding island to the vessel's sailing track on the way to and from the survey area. Additionally, a small group of sperm whales, at great distance from the vessel, were seen during the transit back to port.

Other Marine Fauna

Bird transects were carried out throughout the survey using standardized bird surveying techniques set out by Tasker *et al.* (1984). This consisted of 5- or 10-minute bird counts of the forward 180° of the vessel, up to 300 m away. Other marine fauna seen during the survey included various fish species such as flying fish, sunfish and a shark. A crew member also reported seeing a turtle very briefly next to the vessel. For photographs of some of the birds surveyed during the research cruise, as well as a flying fish and animals seen in transit, please refer to Appendix 11.3.

Figure 5.59 Pilot whales (Globicephala sp.). Photo credit: Jean Purdon.

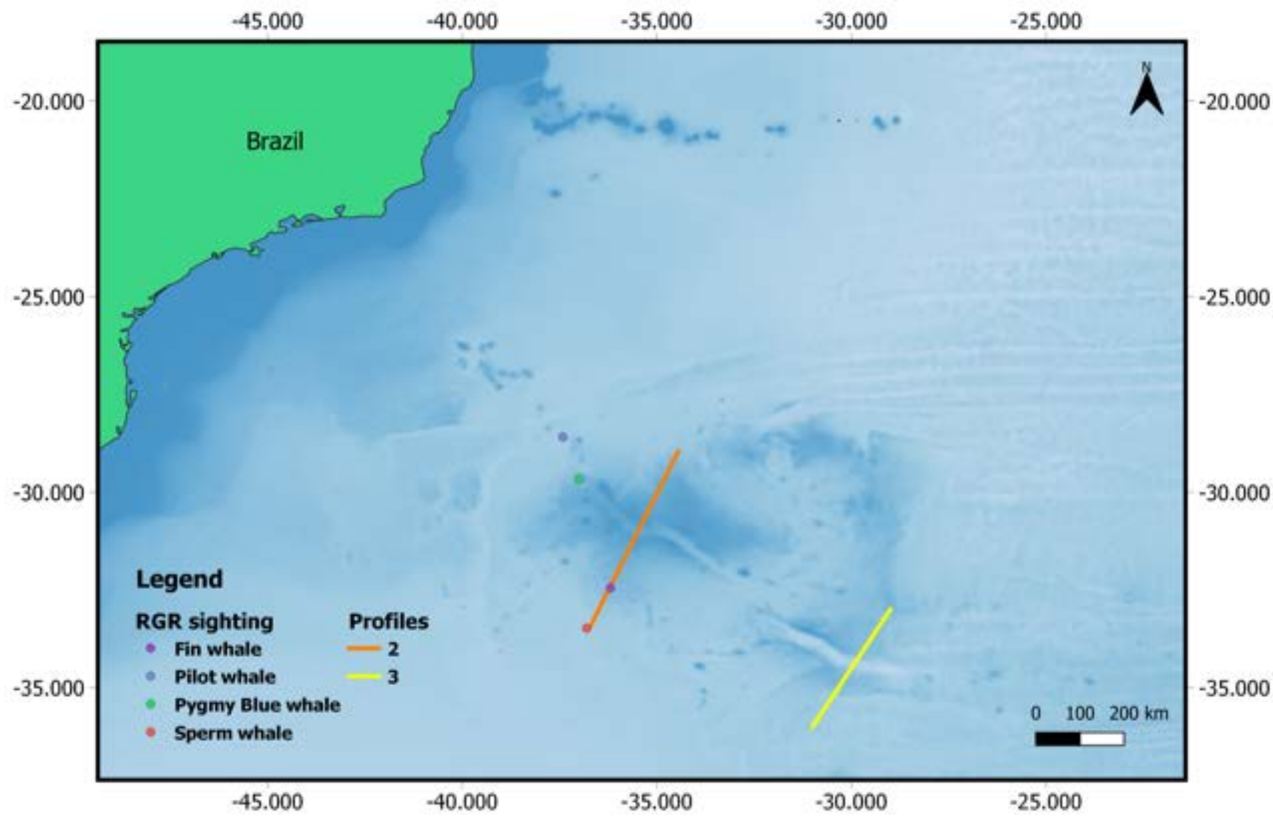

Figure 5.60 Marine mammal sightings in the survey area.

Marine Mammal Acoustic Detections

Due to the technical problems with the streamer, QuietSea was not operational throughout the survey. Therefore, no acoustic detections of marine mammals were made.

Mitigation Incidences

No mitigation instances were required and there were no instances of variations to the agreed mitigation procedures.

5.6.4 Discussion

Probability of Marine Mammal Sightings

There are a number of factors that may have influenced the detection of marine mammals and sea turtles within the survey area.

Weather can affect the ability to detect marine animals in a number of ways, with increasing sea state, wind force and poor visibility reducing the detection probability of marine animals (Forney, 2000), particularly those with inconspicuous surfacing behaviour (Palka, 1996). More specifically, weather conditions during this survey characterised with predominantly Beaufort force 5 and a choppy sea state could certainly have hindered the chances of seeing marine megafauna. Strong winds can disperse whale blows, resulting in a lowered likelihood of these being seen, particularly at greater distances. Sperm whales for instance have a low forward angled blow, which would make this species extremely hard to spot in periods of increased wind speeds and choppy sea states. There were likely instances where some animals, particularly those at greater distances, were missed during the survey. It could also be that certain areas are less productive than others, resulting in fewer species presence. To gain a full understanding of the animals found in different areas of the RGR, favourable weather conditions would be required throughout observations.

The spatio-temporal distribution and high mobility of marine animals may also have had an effect on detection. Many species of marine animal migrate at certain times of the year, primarily in relation to prey abundance and distribution, breeding opportunities and availability of space (Stern, 2002; Plotkin, 2003). In the survey area the distribution of marine animals is seasonally variable. Therefore, certain species may not have been present, or present in abundance, in the area during the survey period.

There were specific types of areas more compatible to certain species and this may have increased the chances of sightings. Deeper waters off a continental shelf or subaquatic canyons may have posed more popular with deep diving species such as sperm whales as this species primarily feed on squid in deeper waters. The time of day may have also affected the sightings observed. This was likely to be a factor when considering the feeding habits of certain species. Common nocturnal or dawn/dusk feeders such as pilot whales may have been more common during these times, especially if foraging on shoals of surface fish. The pilot whales sighted during this survey were seen a little after dawn and it was assumed that they were engaged in feeding activity.

Finally, it is possible that seismic operations may have an effect on the observations of marine mammals, most likely with the distance to which the animals are observed to the vessel.

Significant Sightings

Sightings of sperm whales in deep waters of the survey area were expected due to their preferences for such habitat and previous records for this area. However, two more interesting sightings were of fin and pygmy blue whales. Exact migration route and location of calving and nursing grounds for fin whales in the SW Atlantic are largely unknown. Previous surveys along the Brazilian continental slope and shelf documented three sightings of fin whales during autumn months, suggesting their presence in this part of the SW Atlantic during this season (Di Tullio *et al*., 2016). The mother and calf sighting during this survey is particularly interesting as it demonstrates fin whales could be utilising the area for nursing during autumnal months. On the other hand, although pygmy blue whales are expected to potentially be in the area, significance of this sighting is that it is the first documented sighting of the species around the RGR. Hence a more detailed study of the species in the area would be required to ascertain species presence and abundance.

Recommendations

The acoustic detection of marine mammals is generally not as restricted by the weather as visual observations, although the range of hydrophones is occasionally reduced during poor weather conditions due to increased levels of background noise. The main limitation of Passive Acoustic Monitoring (PAM) is that the animal must be vocalising in order to be detected. For some species, particularly baleen whales, vocal activity may vary with season, location, behaviour and gender (Mellinger *et al*., 2007; Boisseau *et al*., 2008). The vocal repertoires of many marine mammal species are poorly-described or unknown and efforts need to be made to address this. Despite this many species of cetacean are audible for a greater proportion of time than they are visible at the surface (Gordon *et al*., 2003). In general, PAM has the advantage of being able to detect elusive or small mammals, that can often be missed by observers during unfavourable weather conditions and the hours of darkness (O'Brien, 2009). It is therefore unfortunate that the streamer with the QuietSea PAM capability was not usable for the duration of the survey as it meant no mitigation was possible at night. As such, it would have been useful to have a standalone PAM system on board to act as a back-up. The only limitation to this would be having personnel capable of operating the kit in order to effectively mitigate for marine mammals during hours of darkness and poor visibility. This should be taken into account should this option be utilised for future research cruises.

5.6.5 Conclusions

All communications during the survey were excellent and all mitigation protocols were adhered to effectively. The weather likely played a role in the lack of sightings, but also some areas may also have been less productive than others hence not attracting high abundance of marine mammals. However, the two sightings of the large rorqual whales (fin and pygmy blue) pose as interesting findings given the lack of previous data on these species in the waters of RGR.

6 Station List MSM82

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_1-1	19.03.19 15:31	Releaser Test	in the water	35° 55.511' S	050° 02.117' W	4171	0	61	201	30
MSM82_1-2	19.03.19 18:14	Releaser Test	in the water	35° 55.730' S	050° 01.542' W	4212	0	297	191	30
MSM82_1-3	19.03.19 20:54	Releaser Test	in the water	35° 55.318' S	049° 58.236' W	4229	1	120	178	29
MSM82_2-1	19.03.19 23:38	Magnetometer	profile start	35° 58.428' S	049° 56.206' W	4261	12	92	185	30
MSM82_2-1	23.03.19 06:11	Magnetometer	profile end	35° 59.964' S	031° 14.738' W	4020	12	93	129	13
MSM82_3-1	23.03.19 07:37	Seismic Ocean Bottom Receiver	OBS deployed	35° 59.824' S	030° 59.674' W	3877	0	317	130	13
MSM82_3-2	23.03.19 08:35	Seismic Ocean Bottom Receiver	OBS deployed	35° 52.172' S	030° 56.199' W	4247	1	3	139	14
MSM82_3-3	23.03.19 09:33	Seismic Ocean Bottom Receiver	OBS deployed	35° 44.518' S	030° 52.734' W	4285	1	319	145	16
MSM82_3-4	23.03.19 10:28	Seismic Ocean Bottom Receiver	OBS deployed	35° 36.872' S	030° 49.270' W	4396	1	279	100	8
MSM82_3-5	23.03.19 11:22	Seismic Ocean Bottom Receiver	OBS deployed	35° 29.174' S	030° 45.868' W	4254	1	22	138	17
MSM82_4-1	23.03.19 12:23	CTD	in the water	35° 21.553' S	030° 42.419' W	4255	0	13	119	14
MSM82_3-6	23.03.19 14:14	Seismic Ocean Bottom Receiver	OBS deployed	35° 21.563' S	030° 42.407' W	4256	0	248	103	11
MSM82_3-7	23.03.19 15:16	Seismic Ocean Bottom Receiver	OBS deployed	35° 13.776' S	030° 38.976' W	4296	2	28	121	14
MSM82_3-8	23.03.19 16:09	Seismic Ocean Bottom Receiver	OBS deployed	35° 06.218' S	030° 35.542' W	4200	2	359	122	15
MSM82_3-9	23.03.19 17:03	Seismic Ocean Bottom Receiver	OBS deployed	34° 58.562' S	030° 32.221' W	3049	2	329	118	14
MSM82_3-10	23.03.19 18:03	Seismic Ocean Bottom Receiver	OBS deployed	34° 50.921' S	030° 28.792' W	2611	2	340	116	17
MSM82_3-11	23.03.19 19:02	Seismic Ocean Bottom Receiver	OBS deployed	34° 43.268' S	030° 25.408' W	2551	1	339	97	16
MSM82_3-12	23.03.19 20:01	Seismic Ocean Bottom Receiver	OBS deployed	34° 35.621' S	030° 22.084' W	2621	1	345	110	19
MSM82_3-13	23.03.19 21:00	Seismic Ocean Bottom Receiver	OBS deployed	34° 27.929' S	030° 18.703' W	3105	1	321	111	19
MSM82_5-1	23.03.19 22:13	CTD	in the water	34° 20.265' S	030° 15.389' W	5218	0	207	108	15

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_3-14	24.03.19 01:10	Seismic Ocean Bottom Receiver	OBS deployed	34° 20.272' S	030° 15.342' W	5189	0	167	107	14
MSM82_3-15	24.03.19 02:23	Seismic Ocean Bottom Receiver	OBS deployed	34° 11.317' S	030° 11.419' W	3893	1	332	117	11
MSM82_3-16	24.03.19 03:23	Seismic Ocean Bottom Receiver	OBS deployed	34° 04.944' S	030° 08.658' W	2319	1	330	124	13
MSM82_6-1	24.03.19 04:13	Dredge	in the water	34° 08.822' S	030° 09.100' W	3311	0	178	131	15
MSM82_7-1	24.03.19 07:30	Dredge	in the water	34° 09.569' S	030° 09.486' W	3870	0	150	118	16
MSM82_8-1	24.03.19 11:41	Dredge	in the water	34° 14.407' S	030° 09.881' W	5283	0	216	125	18
MSM82_9-1	24.03.19 15:54	Dredge	in the water	34° 13.690' S	030° 09.972' W	4628	0	105	134	11
MSM82_10-1	25.03.19 00:14	Dredge	in the water	33° 47.658' S	030° 41.501' W	2109	0	93	124	7
MSM82_11-1	25.03.19 05:15	Dredge	in the water	33° 41.650' S	030° 51.492' W	1341	0	169	63	6
MSM82_12-1	25.03.19 09:39	Dredge	in the water	34° 00.793' S	030° 27.847' W	4686	0	165	37	6
MSM82_13-1	25.03.19 13:05	Dredge	in the water	33° 59.598' S	030° 27.767' W	3706	0	84	5	14
MSM82_3-17	25.03.19 19:12	Seismic Ocean Bottom Receiver	OBS deployed	33° 57.301' S	030° 05.392' W	2402	1	236	349	19
MSM82_3-18	25.03.19 20:17	Seismic Ocean Bottom Receiver	OBS deployed	33° 49.613' S	030° 02.061' W	2466	1	248	336	21
MSM82_3-19	25.03.19 21:19	Seismic Ocean Bottom Receiver	OBS deployed	33° 41.921' S	029° 58.776' W	2475	1	228	336	20
MSM82_3-20	25.03.19 22:20	Seismic Ocean Bottom Receiver	OBS deployed	33° 34.252' S	029° 55.493' W	2598	1	245	334	20
MSM82_3-21	25.03.19 23:23	Seismic Ocean Bottom Receiver	OBS deployed	33° 26.608' S	029° 52.191' W	2748	1	215	345	21
MSM82_3-22	26.03.19 00:35	Seismic Ocean Bottom Receiver	OBS deployed	33° 18.881' S	029° 48.940' W	2756	1	335	339	25
MSM82_3-23	26.03.19 01:46	Seismic Ocean Bottom Receiver	OBS deployed	33° 11.234' S	029° 45.723' W	3137	1	275	332	23
MSM82_3-24	26.03.19 02:49	Seismic Ocean Bottom Receiver	OBS deployed	33° 03.526' S	029° 42.464' W	3296	1	228	339	24
MSM82_3-25	26.03.19 03:50	Seismic Ocean Bottom Receiver	OBS deployed	32° 55.846' S	029° 39.204' W	3347	1	279	331	25
MSM82_3-26	26.03.19 04:55	Seismic Ocean Bottom Receiver	OBS deployed	32° 48.160' S	029° 35.989' W	3268	1	332	322	21

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_3-27	26.03.19 06:00	Seismic Ocean Bottom Receiver	OBS deployed	32° 40.485' S	029° 32.767' W	3320	1	280	330	23
MSM82_3-28	26.03.19 09:43	Seismic Towed Receiver	informati on	32° 37.010' S	029° 09.525' W	2680	4	319	315	21
MSM82_3-29	26.03.19 14:32	Seismic Source	informati on	32° 23.904' S	029° 22.239' W	3291	6	318	296	17
MSM82_14-1	26.03.19 15:00	Magnetometer	profile start	32° 23.340' S	029° 24.837' W	3309	5	248	310	19
MSM82_3-29	26.03.19 15:00	Seismic Source	profile start	32° 23.342' S	029° 24.843' W	3308	5	254	311	20
MSM82_14-1	28.03.19 15:32	Magnetometer	profile end	36° 11.519' S	031° 05.007' W	4460	5	202	143	13
MSM82_3-29	28.03.19 16:13	Seismic Source	profile end	36° 14.699' S	031° 06.277' W	4436	4	178	164	10
MSM82_3-28	28.03.19 17:08	Seismic Towed Receiver	informati on	36° 17.694' S	031° 04.806' W	4340	4	160	127	13
MSM82_3-1	29.03.19 00:25	Seismic Ocean Bottom Receiver	OBS on deck	36° 00.083' S	030° 59.618' W	0	1	245	128	11
MSM82_3-2	29.03.19 01:47	Seismic Ocean Bottom Receiver	OBS on deck	35° 52.470' S	030° 55.912' W	0	0	172	141	9
MSM82_3-3	29.03.19 04:14	Seismic Ocean Bottom Receiver	OBS on deck	35° 44.645' S	030° 52.280' W	0	1	91	160	9
MSM82_3-4	29.03.19 06:07	Seismic Ocean Bottom Receiver	OBS on deck	35° 36.901' S	030° 48.967' W	0	0	9	157	8
MSM82_3-5	29.03.19 08:02	Seismic Ocean Bottom Receiver	recovered	35° 29.208' S	030° 45.511' W	0	0	290	151	9
MSM82_3-6	29.03.19 09:42	Seismic Ocean Bottom Receiver	OBS on deck	35° 21.341' S	030° 42.175' W	0	0	166	148	10
MSM82_3-7	29.03.19 11:20	Seismic Ocean Bottom Receiver	OBS on deck	35° 13.477' S	030° 38.936' W	0	0	354	145	9
MSM82_3-8	29.03.19 13:07	Seismic Ocean Bottom Receiver	OBS on deck	35° 06.045' S	030° 35.548' W	0	1	229	148	10
MSM82_3-9	29.03.19 14:22	Seismic Ocean Bottom Receiver	OBS on deck	34° 58.452' S	030° 32.315' W	0	1	221	150	12
MSM82_3-10	29.03.19 15:56	Seismic Ocean Bottom Receiver	OBS on deck	34° 50.912' S	030° 28.892' W	2609	1	205	127	13
MSM82_3-11	29.03.19 17:44	Seismic Ocean Bottom Receiver	OBS on deck	34° 43.334' S	030° 25.494' W	0	1	256	116	14
MSM82_3-12	29.03.19 19:12	Seismic Ocean Bottom Receiver	OBS on deck	34° 35.684' S	030° 22.166' W	0	1	184	105	12
MSM82_3-13	29.03.19 20:35	Seismic Ocean Bottom Receiver	OBS on deck	34° 27.967' S	030° 18.780' W	0	1	186	122	18

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_3-14	29.03.19 22:45	Seismic Ocean Bottom Receiver	OBS on deck	34° 20.196' S	030° 15.307' W	0	0	174	113	16
MSM82_3-15	30.03.19 00:29	Seismic Ocean Bottom Receiver	OBS on deck	34° 11.299' S	030° 11.489' W	0	1	316	123	17
MSM82_3-16	30.03.19 01:38	Seismic Ocean Bottom Receiver	OBS on deck	34° 04.910' S	030° 08.742' W	2319	1	285	120	17
MSM82_3-17	30.03.19 02:55	Seismic Ocean Bottom Receiver	OBS on deck	33° 57.307' S	030° 05.411' W	0	0	203	117	16
MSM82_3-18	30.03.19 04:20	Seismic Ocean Bottom Receiver	OBS on deck	33° 49.629' S	030° 02.063' W	0	0	247	127	18
MSM82_3-19	30.03.19 05:45	Seismic Ocean Bottom Receiver	OBS on deck	33° 42.007' S	029° 58.874' W	0	1	182	135	19
MSM82_3-20	30.03.19 07:09	Seismic Ocean Bottom Receiver	OBS on deck	33° 34.286' S	029° 55.659' W	2534	1	259	120	16
MSM82_3-21	30.03.19 08:33	Seismic Ocean Bottom Receiver	OBS on deck	33° 26.688' S	029° 52.254' W	0	1	215	131	19
MSM82_3-22	30.03.19 09:49	Seismic Ocean Bottom Receiver	OBS on deck	33° 18.969' S	029° 49.047' W	2751	2	240	122	21
MSM82_3-23	30.03.19 11:16	Seismic Ocean Bottom Receiver	OBS on deck	33° 11.162' S	029° 45.830' W	3131	2	272	107	23
MSM82_3-24	30.03.19 12:43	Seismic Ocean Bottom Receiver	OBS on deck	33° 03.436' S	029° 42.657' W	0	0	283	123	17
MSM82_3-25	30.03.19 14:11	Seismic Ocean Bottom Receiver	OBS on deck	32° 55.789' S	029° 39.416' W	3347	1	293	118	20
MSM82_3-26	30.03.19 15:45	Seismic Ocean Bottom Receiver	OBS on deck	32° 48.088' S	029° 36.149' W	0	1	128	123	19
MSM82_3-27	30.03.19 17:18	Seismic Ocean Bottom Receiver	OBS on deck	32° 40.518' S	029° 33.069' W	0	1	245	134	20
MSM82_15-1	30.03.19 17:56	Magnetometer	profile start	32° 44.266' S	029° 30.066' W	3282	9	148	119	20
MSM82_15-1	31.03.19 07:21	Magnetometer	profile end	32° 22.688' S	032° 09.459' W	3801	12	213	119	17
MSM82_16-1	31.03.19 09:49	Dredge	in the water	32° 17.821' S	032° 11.538' W	2877	0	193	110	16
MSM82_17-1	31.03.19 15:07	Dredge	in the water	32° 20.610' S	032° 06.118' W	2776	0	345	91	17
MSM82_18-1	31.03.19 19:32	Expendable Sound Velocimeter	in the water	32° 24.982' S	032° 03.643' W	4010	5	25	106	15
MSM82_19-1	31.03.19 20:08	Magnetometer	profile start	32° 21.987' S	032° 01.691' W	2710	8	32	103	15
MSM82_19-1	01.04.19 02:57	Magnetometer	profile end	32° 08.438' S	033° 01.516' W	3956	6	4	115	14

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_20-1	01.04.19 06:11	Dredge	in the water	32° 05.573' S	032° 59.193' W	3536	0	171	112	15
MSM82_21-1	01.04.19 09:47	Dredge	in the water	32° 04.972' S	033° 00.590' W	3733	0	197	105	16
MSM82_22-1	01.04.19 13:14	Magnetometer	profile start	32° 02.542' S	033° 03.660' W	3909	8	299	93	9
MSM82_22-1	01.04.19 18:33	Magnetometer	profile end	31° 27.077' S	033° 59.021' W	2053	10	312	84	7
MSM82_23-1	01.04.19 19:50	Dredge	in the water	31° 23.962' S	034° 02.441' W	2194	0	195	109	20
MSM82_24-1	01.04.19 23:13	Dredge	in the water	31° 23.156' S	034° 02.918' W	2223	0	90	105	18
MSM82_25-1	02.04.19 04:09	Dredge	in the water	31° 11.582' S	034° 13.268' W	1997	0	145	107	17
MSM82_26-1	02.04.19 08:29	Dredge	in the water	31° 05.853' S	034° 20.861' W	1155	0	196	92	16
MSM82_27-1	02.04.19 12:16	Dredge	in the water	31° 03.678' S	034° 24.836' W	1412	0	30	92	13
MSM82_28-1	02.04.19 15:21	Dredge	in the water	30° 59.298' S	034° 31.656' W	1796	0	58	60	13
MSM82_29-1	02.04.19 17:20	Dredge	in the water	30° 59.314' S	034° 29.123' W	1343	0	334	78	15
MSM82_30-1	02.04.19 19:47	Magnetometer	profile start	30° 55.042' S	034° 28.238' W	699	8	3	73	15
MSM82_30-1	03.04.19 05:54	Magnetometer	profile end	28° 53.358' S	034° 23.567' W	3782	12	6	84	21
MSM82_31-1	03.04.19 06:56	CTD	in the water	28° 47.727' S	034° 22.916' W	3894	0	286	83	20
MSM82_32-1	03.04.19 08:29	Seismic Ocean Bottom Receiver	OBS deployed	28° 47.719' S	034° 22.918' W	3895	1	315	85	18
MSM82_32-2	03.04.19 09:32	Seismic Ocean Bottom Receiver	OBS deployed	28° 56.952' S	034° 27.288' W	3790	0	14	86	19
MSM82_32-3	03.04.19 10:33	Seismic Ocean Bottom Receiver	OBS deployed	29° 06.179' S	034° 31.647' W	3251	0	280	75	19
MSM82_32-4	03.04.19 11:36	Seismic Ocean Bottom Receiver	OBS deployed	29° 15.403' S	034° 36.041' W	2751	1	309	83	16
MSM82_32-5	03.04.19 12:38	Seismic Ocean Bottom Receiver	OBS deployed	29° 24.645' S	034° 40.438' W	2699	0	332	73	19
MSM82_32-6	03.04.19 13:40	Seismic Ocean Bottom Receiver	OBS deployed	29° 33.866' S	034° 44.822' W	2264	1	298	76	17
MSM82_32-7	03.04.19 15:22	Seismic Ocean Bottom Receiver	OBS deployed	29° 43.092' S	034° 49.243' W	1969	2	89	64	17

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_32-8	03.04.19 17:41	Seismic Ocean Bottom Receiver	OBS deployed	29° 52.300' S	034° 53.672' W	1927	1	66	63	17
MSM82_32-9	03.04.19 18:40	Seismic Ocean Bottom Receiver	OBS deployed	30° 01.515' S	034° 58.126' W	1993	1	79	45	16
MSM82_32-10	03.04.19 19:37	Seismic Ocean Bottom Receiver	OBS deployed	30° 10.747' S	035° 02.574' W	2084	1	248	333	8
MSM82_32-11	03.04.19 20:32	Seismic Ocean Bottom Receiver	OBS deployed	30° 19.937' S	035° 07.043' W	1396	1	174	23	8
MSM82_32-12	03.04.19 21:27	Seismic Ocean Bottom Receiver	OBS deployed	30° 29.176' S	035° 11.549' W	1488	1	203	320	7
MSM82_32-13	03.04.19 22:31	Seismic Ocean Bottom Receiver	OBS deployed	30° 40.864' S	035° 17.312' W	639	1	214	347	9
MSM82_32-14	03.04.19 23:15	Seismic Ocean Bottom Receiver	OBS deployed	30° 47.541' S	035° 20.583' W	633	1	149	316	12
MSM82_32-15	04.04.19 00:19	Seismic Ocean Bottom Receiver	OBS deployed	30° 56.742' S	035° 25.117' W	1474	1	205	318	13
MSM82_32-16	04.04.19 01:10	Seismic Ocean Bottom Receiver	OBS deployed	31° 04.530' S	035° 28.947' W	1546	1	264	336	11
MSM82_32-17	04.04.19 02:11	Seismic Ocean Bottom Receiver	OBS deployed	31° 15.153' S	035° 34.209' W	845	1	237	360	15
MSM82_32-18	04.04.19 03:07	Seismic Ocean Bottom Receiver	OBS deployed	31° 24.386' S	035° 38.875' W	1250	2	280	12	11
MSM82_32-19	04.04.19 04:08	Seismic Ocean Bottom Receiver	OBS deployed	31° 35.025' S	035° 44.125' W	2041	1	237	338	13
MSM82_32-20	04.04.19 04:54	Seismic Ocean Bottom Receiver	OBS deployed	31° 42.722' S	035° 48.024' W	2021	1	216	307	9
MSM82_32-21	04.04.19 05:49	Seismic Ocean Bottom Receiver	OBS deployed	31° 51.900' S	035° 52.635' W	2405	2	201	257	9
MSM82_32-22	04.04.19 06:41	Seismic Ocean Bottom Receiver	OBS deployed	32° 01.080' S	035° 57.250' W	2549	1	206	293	10
MSM82_32-23	04.04.19 07:34	Seismic Ocean Bottom Receiver	OBS deployed	32° 10.245' S	036° 01.926' W	2664	0	94	243	10
MSM82_32-24	04.04.19 08:28	Seismic Ocean Bottom Receiver	OBS deployed	32° 19.399' S	036° 06.584' W	2746	0	97	258	7
MSM82_32-25	04.04.19 09:20	Seismic Ocean Bottom Receiver	OBS deployed	32° 28.590' S	036° 11.251' W	3094	1	103	251	12
MSM82_32-26	04.04.19 10:13	Seismic Ocean Bottom Receiver	OBS deployed	32° 37.791' S	036° 15.941' W	3288	1	174	298	17
MSM82_32-27	04.04.19 11:08	Seismic Ocean Bottom Receiver	OBS deployed	32° 46.922' S	036° 20.663' W	3736	1	87	240	14
MSM82_32-28	04.04.19 12:06	Seismic Ocean Bottom Receiver	OBS deployed	32° 56.089' S	036° 25.416' W	3974	1	106	251	13

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_32-29	04.04.19 13:02	Seismic Ocean Bottom Receiver	OBS deployed	33° 05.252' S	036° 30.131' W	4135	1	122	266	16
MSM82_32-30	04.04.19 13:57	Seismic Ocean Bottom Receiver	OBS deployed	33° 14.421' S	036° 34.911' W	4341	1	132	279	17
MSM82_32-31	04.04.19 16:20	Seismic Towed Receiver	informati on	33° 40.647' S	036° 37.461' W	4625	3	322	214	11
MSM82_32-32	04.04.19 20:21	Seismic Source	informati on	33° 32.839' S	036° 49.465' W	4656	5	170	208	5
MSM82_33-1	04.04.19 20:53	Magnetometer	profile start	33° 35.124' S	036° 47.357' W	4667	6	111	189	4
MSM82_32-32	04.04.19 20:53	Seismic Source	profile start	33° 35.131' S	036° 47.336' W	4667	6	107	190	4
MSM82_33-1	04.04.19 22:55	Magnetometer	profile end	33° 26.666' S	036° 41.178' W	4680	5	24	78	3
MSM82_32-32	07.04.19 15:18	Seismic Source	profile end	28° 29.137' S	034° 14.182' W	4195	5	24	297	14
MSM82_32-31	07.04.19 16:30	Seismic Towed Receiver	MCS on deck	28° 25.657' S	034° 17.524' W	4257	5	308	297	12
MSM82_32-1	07.04.19 19:31	Seismic Ocean Bottom Receiver	OBS on deck	28° 47.639' S	034° 23.032' W	0	1	238	267	11
MSM82_32-2	07.04.19 21:15	Seismic Ocean Bottom Receiver	OBS on deck	28° 56.877' S	034° 27.339' W	0	1	347	324	14
MSM82_32-3	07.04.19 22:57	Seismic Ocean Bottom Receiver	OBS on deck	29° 05.984' S	034° 31.718' W	0	1	281	233	4
MSM82_32-4	08.04.19 01:13	Seismic Ocean Bottom Receiver	OBS on deck	29° 15.188' S	034° 36.252' W	0	1	308	292	1
MSM82_32-5	08.04.19 02:51	Seismic Ocean Bottom Receiver	OBS on deck	29° 24.432' S	034° 40.603' W	0	1	350	95	4
MSM82_32-6	08.04.19 04:31	Seismic Ocean Bottom Receiver	OBS on deck	29° 33.807' S	034° 45.052' W	2286	1	215	344	2
MSM82_32-7	08.04.19 05:59	Seismic Ocean Bottom Receiver	OBS on deck	29° 43.094' S	034° 49.393' W	1969	0	174	330	2
MSM82_32-8	08.04.19 07:22	Seismic Ocean Bottom Receiver	OBS on deck	29° 52.369' S	034° 53.806' W	1934	1	245	55	1
MSM82_32-9	08.04.19 08:51	Seismic Ocean Bottom Receiver	OBS on deck	30° 01.839' S	034° 58.066' W	1905	3	172	137	7
MSM82_32-10	08.04.19 10:10	Seismic Ocean Bottom Receiver	OBS on deck	30° 10.789' S	035° 02.339' W	0	1	164	113	9
MSM82_32-11	08.04.19 11:31	Seismic Ocean Bottom Receiver	OBS on deck	30° 20.063' S	035° 06.900' W	0	1	244	123	10
MSM82_32-12	08.04.19 12:51	Seismic Ocean Bottom Receiver	OBS on deck	30° 29.255' S	035° 11.266' W	1486	0	25	94	8

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_32-13	08.04.19 14:24	Seismic Ocean Bottom Receiver	OBS on deck	30° 40.824' S	035° 17.173' W	639	1	28	129	7
MSM82_32-14	08.04.19 15:37	Seismic Ocean Bottom Receiver	OBS on deck	30° 47.512' S	035° 20.377' W	633	1	328	144	12
MSM82_34-1	08.04.19 16:21	Dredge	in the water	30° 51.536' S	035° 23.340' W	1095	0	353	121	13
MSM82_35-1	08.04.19 18:26	Dredge	in the water	30° 51.927' S	035° 22.151' W	1322	0	280	101	17
MSM82_32-15	08.04.19 20:55	Seismic Ocean Bottom Receiver	OBS on deck	30° 56.772' S	035° 25.087' W	1475	1	198	97	15
MSM82_32-16	08.04.19 22:15	Seismic Ocean Bottom Receiver	OBS on deck	31° 04.710' S	035° 28.995' W	0	3	197	109	21
MSM82_32-17	08.04.19 23:37	Seismic Ocean Bottom Receiver	OBS on deck	31° 15.202' S	035° 34.421' W	845	2	243	84	23
MSM82_32-18	09.04.19 00:56	Seismic Ocean Bottom Receiver	OBS on deck	31° 24.335' S	035° 38.769' W	1243	1	350	88	14
MSM82_32-19	09.04.19 02:50	Seismic Ocean Bottom Receiver	OBS on deck	31° 35.231' S	035° 44.239' W	2047	3	198	116	18
MSM82_32-20	09.04.19 04:20	Seismic Ocean Bottom Receiver	OBS on deck	31° 42.755' S	035° 48.278' W	2017	2	225	111	17
MSM82_32-21	09.04.19 05:58	Seismic Ocean Bottom Receiver	OBS on deck	31° 51.957' S	035° 53.020' W	2412	2	225	113	16
MSM82_32-22	09.04.19 07:27	Seismic Ocean Bottom Receiver	OBS on deck	32° 01.139' S	035° 57.679' W	2561	2	252	118	20
MSM82_32-23	09.04.19 09:04	Seismic Ocean Bottom Receiver	OBS on deck	32° 10.294' S	036° 02.412' W	2667	2	280	132	28
MSM82_32-24	09.04.19 10:40	Seismic Ocean Bottom Receiver	OBS on deck	32° 19.476' S	036° 06.891' W	2757	1	201	130	23
MSM82_32-25	09.04.19 12:26	Seismic Ocean Bottom Receiver	OBS on deck	32° 28.636' S	036° 11.465' W	0	1	277	137	22
MSM82_32-26	09.04.19 14:39	Seismic Ocean Bottom Receiver	OBS on deck	32° 37.854' S	036° 16.115' W	3296	1	263	134	20
MSM82_32-27	09.04.19 16:26	Seismic Ocean Bottom Receiver	OBS on deck	32° 46.910' S	036° 20.697' W	3731	1	211	143	23
MSM82_32-28	09.04.19 18:13	Seismic Ocean Bottom Receiver	OBS on deck	32° 56.191' S	036° 25.551' W	3983	2	233	144	24
MSM82_32-29	09.04.19 20:01	Seismic Ocean Bottom Receiver	OBS on deck	33° 05.225' S	036° 30.356' W	4109	2	239	141	30
MSM82_32-30	09.04.19 21:59	Seismic Ocean Bottom Receiver	OBS on deck	33° 14.446' S	036° 35.122' W	4342	1	279	144	26
MSM82_36-1	09.04.19 22:47	Magnetometer	profile start	33° 16.179' S	036° 40.555' W	4605	8	243	135	23

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_36-1	10.04.19 10:18	Magnetometer	profile end	34° 06.066' S	039° 06.855' W	4929	6	215	103	17
MSM82_37-1	10.04.19 13:45	Dredge	in the water	34° 00.143' S	038° 59.071' W	5057	0	319	106	16
MSM82_38-1	10.04.19 17:02	Dredge	in the water	34° 01.095' S	039° 00.445' W	3573	0	181	96	17
MSM82_39-1	10.04.19 19:58	CTD	in the water	34° 01.412' S	039° 00.687' W	3604	0	8	88	18
MSM82_40-1	10.04.19 22:08	Dredge	in the water	34° 04.530' S	038° 56.416' W	5093	0	115	90	16
MSM82_41-1	11.04.19 05:48	Dredge	in the water	33° 35.740' S	039° 14.533' W	4106	0	208	52	14
MSM82_42-1	11.04.19 10:50	Dredge	max depth/on ground	33° 34.929' S	039° 03.470' W	3680	0	27	46	16
MSM82_43-1	11.04.19 13:34	Magnetometer	profile start	33° 32.549' S	038° 59.467' W	3903	11	13	41	20
MSM82_43-1	11.04.19 21:18	Magnetometer	profile end	32° 18.926' S	038° 16.665' W	3768	5	68	86	14
MSM82_44-1	11.04.19 23:04	Dredge	in the water	32° 23.875' S	038° 20.554' W	4280	0	251	84	20
MSM82_45-1	12.04.19 02:03	Dredge	in the water	32° 25.212' S	038° 22.030' W	3977	0	19	66	17
MSM82_46-1	12.04.19 05:31	Dredge	in the water	32° 24.139' S	038° 20.361' W	3304	0	46	42	16
MSM82_47-1	12.04.19 08:51	Magnetometer	profile start	32° 21.897' S	038° 17.195' W	2822	8	55	54	11
MSM82_47-1	12.04.19 14:51	Magnetometer	profile end	31° 38.966' S	037° 18.812' W	3547	7	46	272	8
MSM82_48-1	12.04.19 16:06	Dredge	in the water	31° 40.773' S	037° 19.137' W	2751	0	266	257	7
MSM82_49-1	12.04.19 20:52	Dredge	in the water	31° 48.714' S	037° 15.174' W	3356	0	346	120	10
MSM82_50-1	13.04.19 00:26	Magnetometer	profile start	31° 49.468' S	037° 16.744' W	3256	6	234	200	14
MSM82_50-1	13.04.19 08:10	Magnetometer	profile end	30° 36.265' S	036° 48.852' W	1628	10	4	172	8
MSM82_51-1	13.04.19 10:13	Dredge	in the water	30° 39.564' S	036° 54.804' W	1528	0	122	153	8
MSM82_52-1	13.04.19 15:17	Dredge	in the water	30° 50.997' S	036° 47.377' W	1343	0	321	149	5
MSM82_53-1	13.04.19 22:29	Dredge	in the water	30° 19.516' S	036° 56.078' W	2008	0	117	131	5

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_54-1	14.04.19 02:12	Dredge	in the water	30° 14.021' S	036° 58.245' W	1821	0	66	133	7
MSM82_55-1	14.04.19 09:01	Dredge	in the water	30° 24.412' S	036° 19.586' W	1287	0	153	144	14
MSM82_56-1	14.04.19 14:06	Dredge	in the water	30° 19.924' S	036° 04.465' W	1124	0	54	135	15
MSM82_57-1	14.04.19 16:25	Dredge	in the water	30° 20.781' S	036° 03.976' W	1116	0	151	121	12
MSM82_58-1	14.04.19 21:16	Dredge	in the water	30° 06.575' S	036° 20.724' W	1505	0	222	139	11
MSM82_59-1	15.04.19 02:56	Dredge	in the water	30° 10.017' S	036° 53.979' W	1290	0	146	104	11
MSM82_60-1	15.04.19 08:46	Dredge	in the water	29° 40.254' S	036° 59.821' W	1952	0	20	66	8
MSM82_61-1	15.04.19 14:23	CTD	in the water	29° 15.755' S	036° 57.778' W	2876	0	283	152	7
MSM82_62-1	15.04.19 16:10	Dredge	in the water	29° 15.852' S	036° 57.065' W	3363	0	165	125	5
MSM82_63-1	15.04.19 23:22	Dredge	in the water	28° 38.092' S	037° 00.126' W	2092	0	200	135	7
MSM82_64-1	16.04.19 03:08	Dredge	in the water	28° 39.537' S	036° 56.574' W	2613	0	203	125	6
MSM82_65-1	16.04.19 09:13	Dredge	in the water	28° 37.025' S	037° 25.619' W	3193	0	57	117	5
MSM82_66-1	16.04.19 16:31	Dredge	in the water	28° 20.432' S	037° 51.402' W	3710	0	136	109	6
MSM82_67-1	16.04.19 22:51	Dredge	in the water	27° 54.881' S	038° 02.926' W	3967	0	311	86	19
MSM82_68-1	17.04.19 09:12	Dredge	in the water	26° 59.722' S	038° 11.045' W	4559	0	77	60	26
MSM82_69-1	17.04.19 15:40	Dredge	in the water	27° 03.198' S	038° 41.186' W	2318	0	68	52	21
MSM82_70-1	17.04.19 18:31	Dredge	in the water	27° 04.997' S	038° 40.240' W	3262	0	347	59	35
MSM82_71-1	18.04.19 00:55	Dredge	in the water	27° 18.159' S	039° 04.903' W	722	0	218	25	21
MSM82_72-1	18.04.19 03:49	Dredge	in the water	27° 21.013' S	039° 04.375' W	2260	0	141	26	23
MSM82_73-1	18.04.19 13:41	Dredge	in the water	26° 42.583' S	039° 33.119' W	3045	0	41	22	25
MSM82_74-1	18.04.19 21:30	Dredge	in the water	26° 11.840' S	039° 11.110' W	2722	0	112	46	19

Station	Date / Time	Device	Action	Position	Position	Depth	Speed	Course	Wind Direction	Wind Velocity
No.	[UTC]			Lat	Lon	[m]	kn	[°]	[°]	m/s
MSM82_75-1	19.04.19 00:43	Dredge	in the water	26° 13.641' S	039° 12.806' W	2511	0	162	98	21
MSM82_76-1	19.04.19 05:21	Dredge	in the water	26° 14.225' S	039° 29.591' W	2894	0	185	113	18
MSM82_77-1	19.04.19 12:05	Dredge	in the water	26° 23.577' S	039° 55.035' W	3075	0	274	124	12
MSM82_78-1	19.04.19 17:02	Dredge	in the water	26° 22.117' S	040° 02.408' W	3538	0	97	169	11
MSM82_79-1	19.04.19 21:56	Dredge	in the water	26° 09.827' S	040° 04.394' W	2449	0	238	126	8
MSM82_80-1	20.04.19 01:21	Dredge	in the water	26° 20.514' S	040° 00.674' W	2671	0	102	100	5
MSM82_81-1	20.04.19 04:19	Expendable Sound Velocimeter	in the water	26° 20.566' S	040° 00.681' W	2635	2	185	34	2
MSM82_82-1	20.04.19 04:58	Magnetometer	profile start	26° 23.964' S	040° 01.680' W	3719	7	197	42	4
MSM82_82-1	22.04.19 16:00	Magnetometer	profile end	34° 52.877' S	047° 52.191' W	4680	8	217	205	14

7 Data and Sample Storage and Availability

Petrological samples will be archived at FAU. Geochemical and age data will be made available as publications in scientific journals. Geophysical (including hydro-acoustic) data will be archived at the Geophysics Section at AWI and via PANGAEA database.

Table 7.1 Overview of data availability

Type	Database	Available	Free Access	Contact
		Date	Date	E-Mail
Bathymetry	AWI / PANGAEA	Sep. 19	Sep. 23	Wolfram.Geissler@awi.de
Parasound	AWI	Sep. 19	Sep. 23	Wolfram.Geissler@awi.de
Rock samples	FAU	Sep. 19	Sep. 23?	Karsten.Haase@fau.de
Seismic	AWI	Sep. 19	Sep. 23	Wolfram.Geissler@awi.de
Gravity	AWI	Sep. 19	Sep. 23	Wolfram.Geissler@awi.de
Magnetics	AWI	Sep. 19	Sep. 23	Wolfram.Geissler@awi.de
CTD, ADCP	AWI / PANGAEA	Dec. 19	Dec. 19	Wolfram.Geissler@awi.de

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10 Abbreviations

ASD	Atlas sounding data
CdSL	Cruzeiro do Sul Lineament
DSDP	Deep Sea Drilling Program
IODP	International Ocean Discovery Program
JCSC	Jean Charcot Seamount Chain
MBES	multi-beam echo-sounder
MMO	Marine Mammal Observer
MMIA	Marine Mammal Impact Assessment
MMMT	Marine Mammal Mitigation Team
MMMP	Marine Mammal Mitigation Plan
MZ	Mitigation Zone
NM	Nautical Miles
OBS	ocean bottom seismometer
PAM(S)	Passive Acoustic Monitoring (System)
PHF	primary high frequency
P-SBP	parametric sub-bottom profiling
PS3	export format of PARASOUND data
RGR	Rio Grande Rise
SBES	single-beam echo-sounder
SHF	secondary high frequency
SLF	secondary low frequency

11 Appendices

11.1 Rock Sample Description

MSM82-6-DR-1

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 4 cm); alteration along fractures; vesicles are secondary filled with brownish to black material and calcite; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-2

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium- grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 15x15x15 cm

Samples at: GZN

MSM82-6-DR-3

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Medium-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are secondary filled with calcite and black material; mineral phases: fsp, px,10x10x10 cm

Samples at: GZN

MSM82-6-DR-4

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained, dark aphanitic basalt with brecciated area and thin MnOOH coating on surface; alteration along fractures; vesicles are common and party filled with brownish material; mineral phases: plag, px, ol (?); 15x10x10 cm

Samples at: GZN

MSM82-6-DR-5

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH crust on surface; weak alteration along fractures; vesicles display gradation in grain size (size increases from core to rim); mineral phases: plag, px; 20x10x10 cm

Samples at: GZN

MSM82-6-DR-6

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-7

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained grey to greenish aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black and/or white material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-8

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

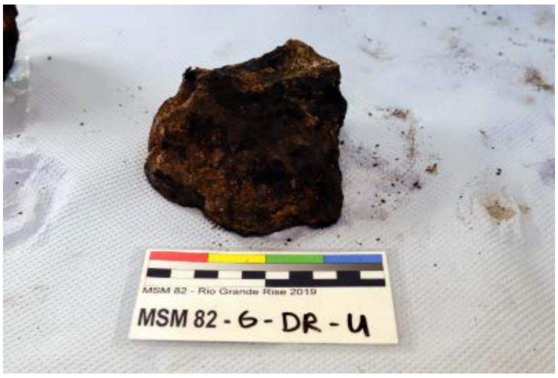
MSM82-6-DR-9

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface; alteration along fractures; vesicles are secondary filled with black or white material; mineral phases: plag, px; 15x15x10 cm

Samples at: GZN

MSM82-6-DR-10



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
conglomerate/breccia composed of angular to rounded fragments of brownish material bounded by a fine black matrix; thin MnOOH coating on surface; alteration along fractures; unknown mineal phases; 5x5x5 cm

Samples at: GZN

MSM82-6-DR-11

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 15x7.5x7.5 cm

Samples at: GZN

MSM82-6-DR-12

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black and brownish material; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-6-DR-13

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH coating on surface, weak alteration along fractures; vesicles secondary filled with black material; mineral phases: plag, px; 10x7.5x5 cm

Samples at: GZN

MSM82-6-DR-14

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 20x20x15 cm

Samples at: GZN

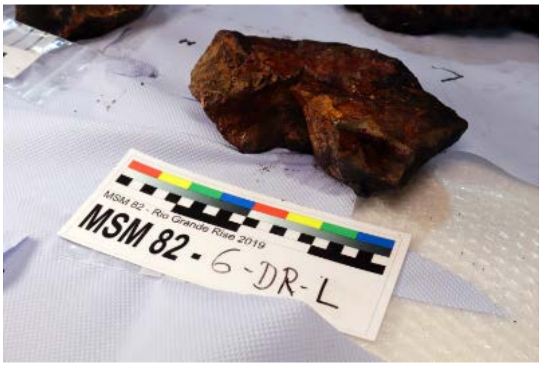
MSM82-6-DR-15

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Highly fragmented fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 2.5 cm); strong alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 10x10x7.5cm

Samples at: GZN

MSM82-6-DR-16



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-graind aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 10x5x5 cm

Samples at: GZN

MSM82-6-DR-17

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium-grained aphanitic basalt with thick MnOOH crust on surface (up to 3 cm); vesicles ae rare and secondary filled with black material; alteration along fractures; mineral phases: plag, px; 15x10x10 cm

Samples at: GZN

MSM82-6-DR-18

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Highly fractured fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 4 cm); highly altered along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 20x20x10 cm

Samples at: GZN

MSM82-6-DR-19

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with breccia on surface; thick MnOOH crust on surface (up to 1 cm); weak alteration along fractures; vesicles are common; mineral phases: plag, px; 15x15x7.5 cm

Samples at: GZN

MSM82-6-DR-20

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Medium-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along small cracks; vesicles are partly filled with black material; mineral phases: plag, px; 15x15x10 cm

Samples at: GZN

MSM82-6-DR-21

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; slightly altered along fractures, vesicles are secondary filled with calcite and black material; mineral phases: plag, px; 20x10x10 cm

Samples at: GZN

MSM82-6-DR-22

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with greyish material; mineral phases: plag, px; 20x10x10 cm

Samples at: GZN

MSM82-6-DR-23

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface; weak alteration along fractures; vesicles are secondary filled with bright material (pyrite?); mineral phases: plag, px; 25x10x7.5 cm

Samples at: GZN

MSM82-6-DR-24

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 2 cm); weak alteration along fractures; vesicles are secondary filled with brownish material; mineral phases: plag, px; 10x10x5 cm

Samples at: GZN

MSM82-6-DR-25

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along smaller cracks; vesicles are secondary filled with brownish material; mineral phases: plag, px; 10x7.5x5 cm

Samples at: GZN

MSM82-6-DR-26

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with with thin MnOOH crust; altered along fractures, vesicles are secondary filled with calcite and probably MnOOH; mineral phases: plag, px, ol (?); 10x10x10 cm

Samples at: GZN

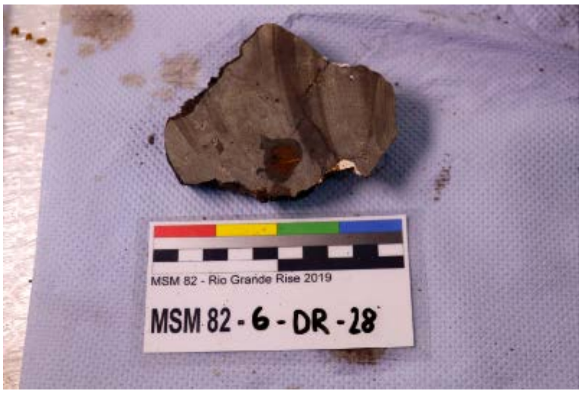
MSM82-6-DR-27

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-6-DR-28

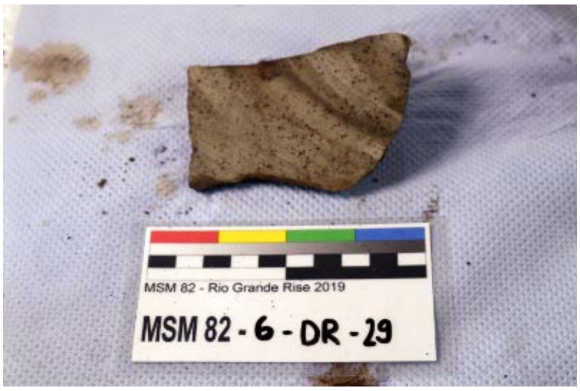


Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with calcite and black material; mineral phases: plag, px, ol (?); 7.5x7.5x7.5 cm

Samples at: GZN

MSM82-6-DR-29



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with black material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-30

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of angular to rounded brownish fragments of unknown material; matrix is fine-grained and greyish; thick MnOOH crust on surface (up to 3 cm); unknown mineral phases; 15x10x10 cm

Samples at: GZN

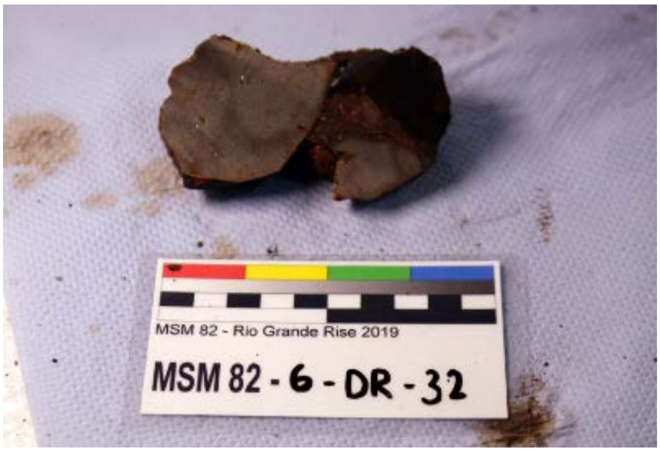
MSM82-6-DR-31

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of sub-angular brownish fragments of unknown material; matrix is fine-grained and greyish to black; thin MnOOH crust on surface; unknown mineral phases; 15x10x10 cm

Samples at: GZN

MSM82-6-DR-32



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust (up to 3 cm); altered along fractures; vesicles are secondary filled with brownish material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-33

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 3 cm); weak alteration along fractures; vesicles are secondary filled with black material and/or zeolite (?); mineral phases: plag, px, ol (?); 15x15x15 cm

Samples at: GZN

MSM82-6-DR-34

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of sub- angular brownish fragments of unknown material; matrix is dark and fine-grained; thick MnOOH crust on surface (up to 2 cm); unknown mineral phases; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-35

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with calcite and black material; mineral phases: plag, px; 15x10x10 cm

Samples at: GZN

MSM82-6-DR-36

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with brownish material; mineral phases: plag, px; 10x10x5 cm

Samples at: GZN

MSM82-6-DR-37

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of sub-angular brownish fragments of unknown material; matrix is dark and fine-grained; thick MnOOH crust on surface (up to 3 cm); unknown mineral phases; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-38

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of sub-angular greyish fragments of basalt; fine-grained brownish matrix; thin MnOOH coating on surface; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-39

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are secondary filled with brownish to black material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-40

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; vesicles are elongated and secondary filled with brownish material, displaying gradation in size to top; mineral phases: plag, px, spl (?); 10x10x10 cm

Samples at: GZN

MSM82-6-DR-41

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and partly filled with calcite and black material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-42

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are secondary filled with calcite; minerals phases: plag. px; rare phenocrysts of plag with size up to 2 mm; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-43

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of sub-rounded brown to redish fragments; fine-grained brownish matrix; thin MnOOH coating on surface; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-44

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 1.5 cm); highly altered long fractures; vesicles are rare and secondary filled with brownish material; mineral phases: plag, px, ol (?); 10x10x10 cm

Samples at: GZN

MSM82-6-DR-45

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Conglomerate/breccia composed of sub-angular to sub-rounded brownish fragments; fine-grained dark matrix; thin MnOOH coating on surface; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-46

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; vesicles are rare and secondary filled with brownish material; waek alteration along fractures; mineral phases: plag, px, ol (?); 10x10x10 cm

Samples at: GZN

MSM82-6-DR-47

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 1.5 cm); weak alteration along fractures; vesicles are rare and secondary filled with dark material; mineral phases: plag, px, ol (?); 10x10x10 cm

Samples at: GZN

MSM82-6-DR-48

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Fine- to medium grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are partly filled with brownish to black material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-6-DR-49

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Medium-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and partly filled with greyish to black material; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-6-DR-50

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°08.82 S, 30°09.09 W
Date and Time Start (UTC): 24.03.19, 5:15
Depth Start [m]: 3252

Sample description:
Large boulder of hyaloclastite breccia composed of sub-angular to sub-rounded brownish fragment and some fresh glass; thin MnOOH crust on surface; highly altered along fractures; > 50x50x50 cm

Samples at: GZN

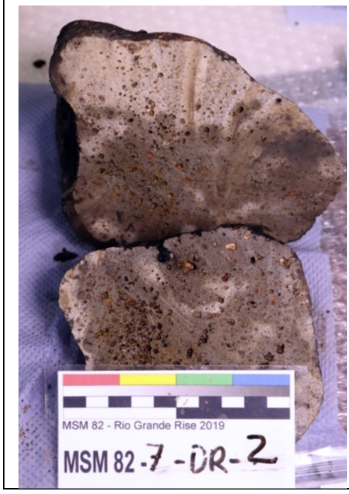
MSM82-7-DR-1

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°09.57 S, 30°09.49 W
Date and Time Start (UTC): 24.03.2019, 8:45
Depth Start [m]: 3991

Sample description:
Medium-grained aphanitic to porphyritic basalt with thin MnOOH coating on surface; weak alteration along fractures; mineral phases: plag, px

Samples at: GZN

MSM82-7-DR-2



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°09.57 S, 30°09.49 W
Date and Time Start (UTC): 24.03.2019, 8:45
Depth Start [m]: 3991

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH coating on surface; high amount of vesicles (approx. 40 %); weak alteration; mineral phases: plag, px, bt (?)

Samples at: GZN

MSM82-7-DR-3

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°09.57 S, 30°09.49 W
Date and Time Start (UTC): 24.03.2019, 8:45
Depth Start [m]: 3991

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and partly filled with zeolite (?); mineral phases: plag, px, bt (?)

Samples at: GZN

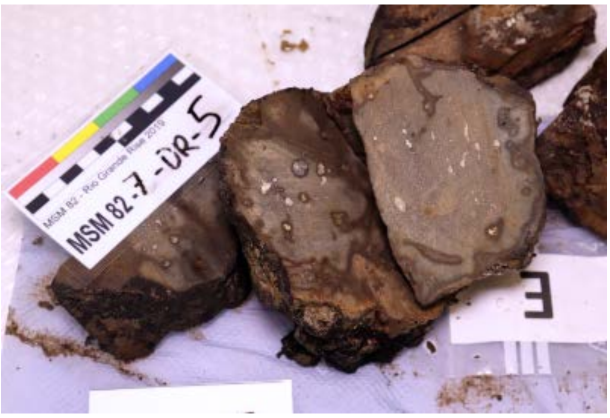
MSM82-7-DR-4

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°09.57 S, 30°09.49 W
Date and Time Start (UTC): 24.03.2019, 8:45
Depth Start [m]: 3991

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; mineral phases: plag, px

Samples at: GZN

MSM82-7-DR-5



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°09.57 S, 30°09.49 W
Date and Time Start (UTC): 24.03.2019, 8:45
Depth Start [m]: 3991

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface; altered along fractures; vesicles are secondary filled with carbonate; mineral phases: plag, px

Samples at: GZN

MSM82-8-DR-1

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°14.41 S, 30°09.88 W
Date and Time Start (UTC): 24.03.2019, 13:11
Depth Start [m]: 5266

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; vesicles are rare (approx. 5 %); mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-1

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; not weathered; mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-2

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; not weathered; mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-3

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; not weathered; vesicles are common (approx. 10 %); mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-4

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; not weathered; mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-5

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; not weathered; mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-6

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
Fine-grained aphanitic basalt with MnOOH coating on surface; not weathered; mineral phases: plag, px

Samples at: GZN

MSM82-10-DR-7

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
carbonate

Samples at: GZN

MSM82-10-DR-8

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°47.65 S, 30°41.50 W
Date and Time Start (UTC): 25.03.2019, 01:00
Depth Start [m]: 2140

Sample description:
carbonate

Samples at: GZN

MSM82-11-DR-1

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface; weak alteration along fractures; vesicles secondary filled with brownish material; phenocrysts of plag and ol (15% of matrix); matrix composed of plag and px; 30x30x30 cm

Samples at: GZN

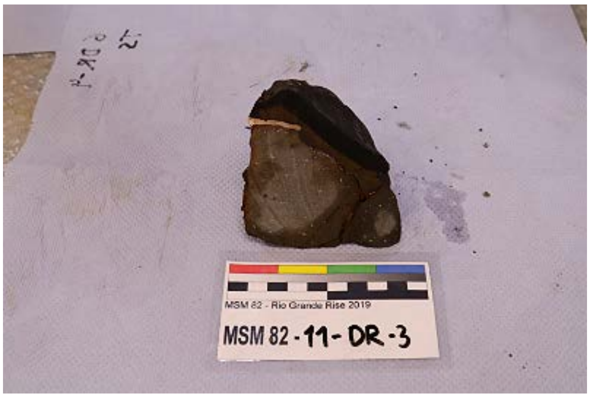
MSM82-11-DR-2

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles secondary filled with brownish material; xenolites and/or xenocrysts of carbonatic material; phenocrysts of plag (10% of matrix); matrix composed of plag and px; 20x20x20 cm

Samples at: GZN

MSM82-11-DR-3



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface; weathered along fractures, cracks partly filled with carbonatic material; vesicles secondary filled with brownish material; phenocrysts of plag (5% of matrix); matrix composed of plag and px; 15x10x10 cm

Samples at: GZN

MSM82-11-DR-4

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles partly filled with brownish material; phenocrysts of plag and ol (10% of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-11-DR-5

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; brownish alteration halo on rock rim; vesicles are rare; phenocrysts of plag and ol (?) (5% of matrix); matrix composed of plag and px; 20x10x10 cm

Samples at: GZN

MSM82-11-DR-6

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; thin MnOOH coating and brownish alteration on surface; vesicles are secondary filled with brownish material; phenocrysts of plag (15% of matrix); matrix composed of plag, px and spl (?); 10x10x10 cm

Samples at: GZN

MSM82-11-DR-7

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fine-grained aphanitic basalt with weak alteration and thin MnOOH crust on surface; vesicles are secondary filled with brownish material; mineral phases: plag, px; 15x10x5 cm

Samples at: GZN

MSM82-11-DR-8

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fresh basalt with aphanitic to porphyritic texture and fine- to medium-grained matrix; thin MnOOH coating on surface; weak alteration along fractures, vesicles are secondary filled with brownish material; few phenocrysts of plag (approx. 1 % of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-11-DR-9

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Fine-grained aphanitic basalt with weak alteration and thin MnOOH crust on surface; vesicles are rare; mineral phases: plag, px; 15x5x5 cm

Samples at: GZN

MSM82-11-DR-10

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Conglomerate/breccia composed of angular brownish mineral phases bounded by a carbonatic matrix; thick MnOOH crust (up to 4 cm); strong alteration along fractures; 20x10x10 cm

Samples at: GZN

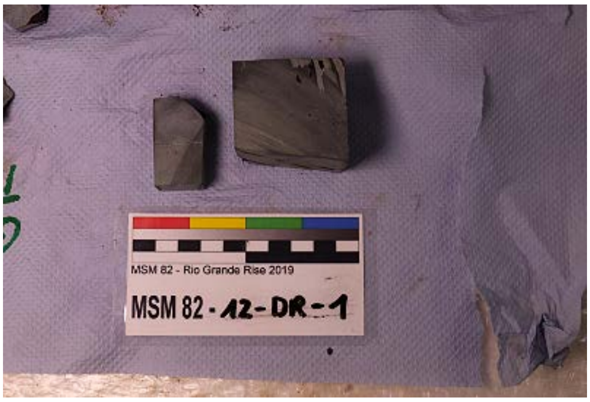
MSM82-11-DR-11

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°41.65 S, 30°51.48 W
Date and Time Start (UTC): 25.03.2019, 05:42
Depth Start [m]: 1320

Sample description:
Carbonatic rock; crinoidal-bivalve pack- to grainstone; components mm to cm in size; porosity; 10x10x10 cm

Samples at: GZN

MSM82-12-DR-1



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°00.79 S, 30°27.85 W
Date and Time Start (UTC): 25.03.2019, 11:00
Depth Start [m]: 4670

Sample description:
Fine-grained aphanitic basalt with weak alteration and thin MnOOH coating on surface; possible gradation in grain size to top; vesicles are elongated and rare; mineral phases: plag, px and ol (?); 10x5x5 cm

Samples at: GZN

MSM82-12-DR-2

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°00.79 S, 30°27.85 W
Date and Time Start (UTC): 25.03.2019, 11:00
Depth Start [m]: 4670

Sample description:
Fresh fine-grained aphanitic basalt without alteration and MnOOH coating on surface; very dense and dark matrix; vesicles are absent; mineral phases: plag, px; 7.5x7.5x7.5 cm

Samples at: GZN

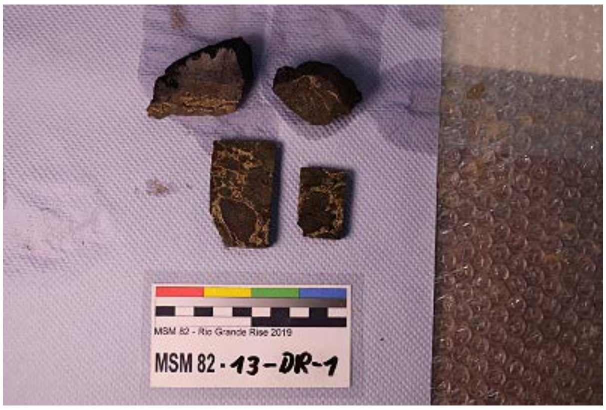
MSM82-12-DR-3

Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 34°00.79 S, 30°27.85 W
Date and Time Start (UTC): 25.03.2019, 11:00
Depth Start [m]: 4670

Sample description:
Fresh basaltic rock with porphyritic texture and fine-grained matrix; no coatings/crusts or weathering/alteration visible; vesicles are absent; phenocrysts of plag and ol (?) (5 - 10 % of matrix); matrix composed of plag, px and spl (?); 5x5x5 cm

Samples at: GZN

MSM82-13-DR-1



Locality description: Eastern Rio Grande Rise, Rift Valley
Location: 33°59.62 S, 30°27.77 W
Date and Time Start (UTC): 25.03.2019, 14:12
Depth Start [m]: 3760

Sample description:
Conglomerate/breccia composed of sub-angular to sub-rounded fragments of fine-grained greyish to black material bounded by a white to light grey matrix; thick MnOOH crust on surface (up to 4 cm); highly altered along fractures; vesicles are secondary filled with black material; 7.5x5x5 cm

Samples at: GZN

MSM82-17-DR-1

Locality description: Wilfried Seamount
Location: 32°20.61 S, 32°06.12 W
Date and Time Start (UTC): 31.03.2019, 15:57
Depth Start [m]: 2760

Sample description:
Carbonate crust with micritic texture and thin MnOOH on surface; strong alteration; vesicles are elongated to subrounded and partly filled with brownish material; 100x40x20 cm

Samples at: GZN

MSM82-23-DR-1

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°23.96 S, 34°02.44 W
Date and Time Start (UTC): 01.04.2019, 20:31
Depth Start [m]: 2192

Sample description:
Coarse-grained grey to yellowish sparitic limestone; thin MnOOH coating on surface; weak alteration; fragments of bryozoan (up to 3 mm in size); detrital qz.; ratio cement/comp.: 50/50; 10x8x6 cm

Samples at: GZN

MSM82-24-DR-1

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°23.16 S, 34°02.91 W
Date and Time Start (UTC): 01.04.2019, 23:55
Depth Start [m]: 2224

Sample description:
Medium- to coarse-grained igneous rock with a fine-grained dense xenolite; thin MnOOH coating on surface; strong (hydrothermal?) alteration; mineral phases: plag, hydrothermal mineral phases (?); 30x25x20 cm

Samples at: GZN

MSM82-24-DR-1-A

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°23.16 S, 34°02.91 W
Date and Time Start (UTC): 01.04.2019, 23:55
Depth Start [m]: 2224

Sample description:
Fine-grained well-rounded volcanic rock fragment separated from the coarse-grained igneous rock described above (MSM82-24-DR-1); vesicles are common, well-rounded and secondary filled with calcite; mineral phases: plag, px (?); 5x5x5 cm

Samples at: GZN

MSM82-24-DR-2

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°23.16 S, 34°02.91 W
Date and Time Start (UTC): 01.04.2019, 23:55
Depth Start [m]: 2224

Sample description:
Fine-grained layered limestone; 20x10x10 cm

Samples at: GZN

MSM82-24-DR-3

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°23.16 S, 34°02.91 W
Date and Time Start (UTC): 01.04.2019, 23:55
Depth Start [m]: 2224

Sample description:
Fine-grained aphanitic volcanic rock with reddish matrix and fragments of bright material; thin MnOOH coating on surface; strong alteration; vesicles are secondary filled with bright and/or black material; unknown mineral phases; 12x10x5 cm

Samples at: GZN

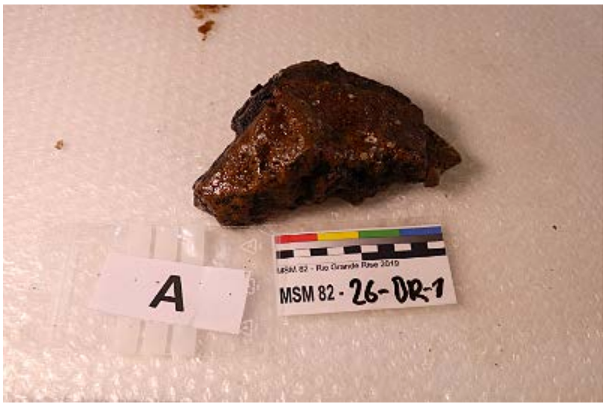
MSM82-24-DR-4

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°23.16 S, 34°02.91 W
Date and Time Start (UTC): 01.04.2019, 23:55
Depth Start [m]: 2224

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are layered and secondary filled with calcite; 12x10x3 cm

Samples at: GZN

MSM82-25-DR-1



Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°11.59 S, 34°13.25 W
Date and Time Start (UTC): 02.04.2019, 04:28
Depth Start [m]: 1962

Sample description:
Fine-grained limestone with thin MnOOH crust on surface; weak alteration; 15x10x5 cm

Samples at: GZN

MSM82-25-DR-2

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°11.59 S, 34°13.25 W
Date and Time Start (UTC): 02.04.2019, 04:28
Depth Start [m]: 1962

Sample description:
Conglomerate/breccia composed of unknown mineral phases and/or fine-grained volcanic fragments of fine-grained greyish basalt bounded by a calcitic matrix; thin MnOOH crust on surface; highly altered along fractures; vesicles are absent; 10x10x10 cm

Samples at: GZN

MSM82-26-DR-1

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°05.85 S, 34°20.86 W
Date and Time Start (UTC): 02.04.2019, 08:52
Depth Start [m]: 1153

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; Matrix highly altered; vesicles are common and secondary filled with calcite and/or black material; mineral phases: plag (?), px (?); 15x10x5 cm

Samples at: GZN

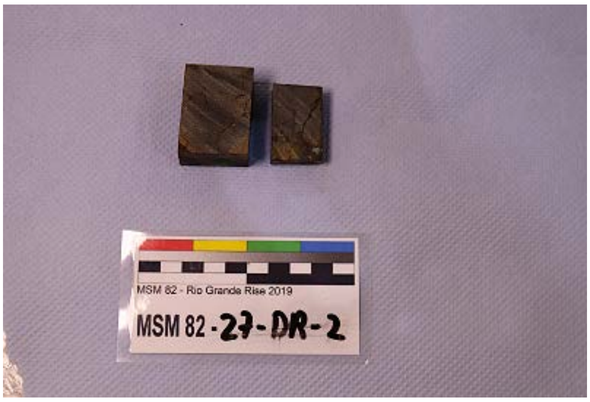
MSM82-27-DR-1

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°03.69 S, 34°24.82 W
Date and Time Start (UTC): 02.04.2019, 12:46
Depth Start [m]: 1417

Sample description:
Basaltic rock with aphanitic to porphyritic texture and fine-grained matrix; thick MnOOH crust on surface (up to 3 cm); strong alteration along fractures; vesicles are rare and secondary filled with calcite and/or brownish material; phenocrysts of plag and px (?) (5 - 10 % of matrix); matrix composed of plag, px; 30x20x20 cm

Samples at: GZN

MSM82-27-DR-2



Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°03.69 S, 34°24.82 W
Date and Time Start (UTC): 02.04.2019, 12:46
Depth Start [m]: 1417

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface; strong alteration along fractures, fractures partly filled with calcite; vesicles are rare and secondary filled with calcite and/or brownish material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

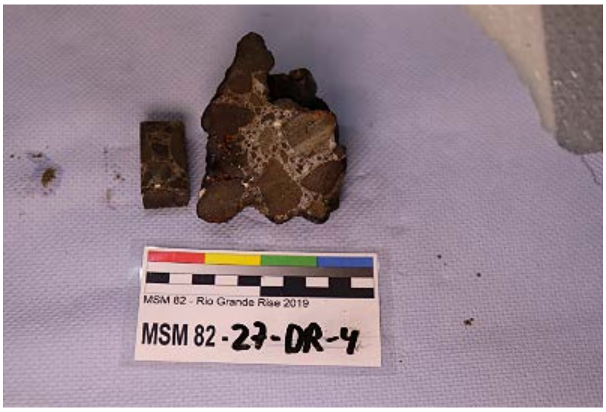
MSM82-27-DR-3

Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°03.69 S, 34°24.82 W
Date and Time Start (UTC): 02.04.2019, 12:46
Depth Start [m]: 1417

Sample description:
Conglomerate/breccia composed of well-rounded fragments of fine-grained greyish basalt bounded by a calcitic matrix; thin MnOOH crust on surface; highly altered along fractures, fractures filled with calcite; vesicles are rare; 20x20x10 cm

Samples at: GZN

MSM82-27-DR-4

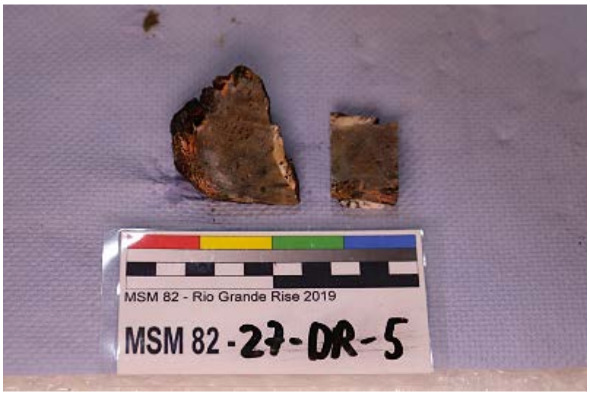


Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°03.69 S, 34°24.82 W
Date and Time Start (UTC): 02.04.2019, 12:46
Depth Start [m]: 1417

Sample description:
Conglomerate/breccia composed of well-rounded fragments of fine-grained greyish basalt bounded by a calcitic matrix; thin MnOOH crust on surface; highly altered along fractures, fractures filled with calcite; vesicles are rare; 20x15x10 cm

Samples at: GZN

MSM82-27-DR-5



Locality description: Central Rio Grande Rise, Rift Valley
Location: 31°03.69 S, 34°24.82 W
Date and Time Start (UTC): 02.04.2019, 12:46
Depth Start [m]: 1417

Sample description:
Fine-grained greyish limestone with thin MnOOH crust on surface; weak alteration; vesicles are common and elongated; 5x5x5 cm

Samples at: GZN

MSM82-29-DR-1

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°59.30 S, 34°29.11 W
Date and Time Start (UTC): 02.04.2019, 17:45
Depth Start [m]: 1330

Sample description:
Conglomerate composed of rock fragments bounded by a sandy matrix; thin MnOOH crust on surface; strong alteration along fractures; 15x15x15 cm

Samples at: GZN

MSM82-29-DR-1-A

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°59.30 S, 34°29.11 W
Date and Time Start (UTC): 02.04.2019, 17:45
Depth Start [m]: 1330

Sample description:
Fine- to medium-grained well-rounded volcanic rock fragment separated from the conglomerate described above (MSM82-29-DR-1); thin FeOOH coating on surface; vesicles are common, well-rounded and secondary filled with calcite; mineral phases: plag, px, kfsp (?); possible andesite or rhyolite; 3x2x2 cm

Samples at: GZN

MSM82-29-DR-2

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°59.30 S, 34°29.11 W
Date and Time Start (UTC): 02.04.2019, 17:45
Depth Start [m]: 1330

Sample description:
Polymict volcanoclastic conglomerate composed of greenish sub-rounded to rounded fragments; graded bedding, some imbrications at bottom; thick MnOOH crust on surface (up to 1 cm); 30x20x15 cm

Samples at: GZN

MSM82-29-DR-3

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°59.30 S, 34°29.11 W
Date and Time Start (UTC): 02.04.2019, 17:45
Depth Start [m]: 1330

Sample description:
Polymict volcanoclastic conglomerate composed of rounded fragments bounded by a sandy matrix; thick MnOOH crust on surface (up to 2 cm); stron alteration along fractures; 15x15x15 cm

Samples at: GZN

MSM82-29-DR-7

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°59.30 S, 34°29.11 W
Date and Time Start (UTC): 02.04.2019, 17:45
Depth Start [m]: 1330

Sample description:
Fine-grained aphanitic volcanic rock with medium- to coarse-grained xenolites; MnOOH coating on surface; alteration along fractures; mineral phases: plag; 15x15x15 cm

Samples at: GZN

MSM82-34-DR-1

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Volcanoclastic conglomerate composed of rounded fragments bounded by a brownish matrix; thin MnOOH crust on surface; Fragments are fine-grained aphanitic basalts with weak alteration along fractures; vesicles are elongated and secondary filled with calcite and/or brownish material; mineral phases: plag, px; px occur as phenocrysts in matrix; 10x10x8 cm

Samples at: GZN

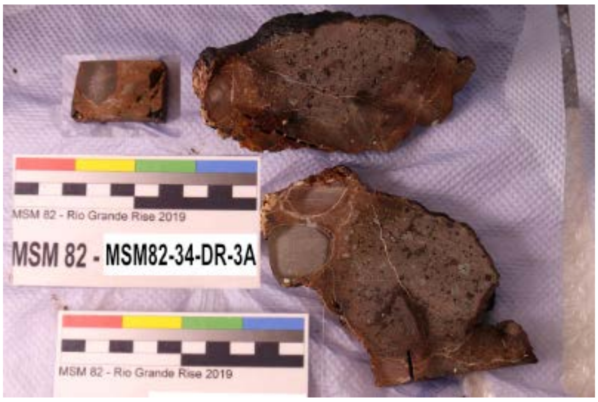
MSM82-34-DR-2

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Basaltic rock with aphanitic to porphyritic texture and fine-grained matrix; thin MnOOH crust on surface; weak alteration along fractures; vesicles are common and secondary filled with calcite and/or brownish material; phenocrysts of px (5 % of matrix); matrix composed of plag, px; 20x13x10 cm

Samples at: GZN

MSM82-34-DR-3-A



Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Volcanoclastic conglomerate composed of rounded fragments bounded by a brownish matrix; thin MnOOH crust on surface; Fragments are fine-grained aphanitic basalts with ranging size and alteration; vesicles are secondary filled with calcite and/or brownish material; mineral phases: plag, px; 50x30x20 cm

Samples at: GZN

MSM82-34-DR-3-B

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface; rounded fragment of volcanoclastic conglomerate described above (sample MSM82-34-DR-3-A); weak alteration along fractures; vesicles are rare; mineral phases: plag, px; 10x15x10 cm

Samples at: GZN

MSM82-34-DR-3-C

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface; rounded fragment of volcanoclastic conglomerate described above (sample MSM82-34-DR-3-A); weak alteration along fractures; vesicles are common and secondary filled with calcite and/or brownish material; mineral phases: plag, px; 15x15x10 cm

Samples at: GZN

MSM82-34-DR-3-D

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface; rounded fragment of volcanoclastic conglomerate described above (sample MSM82-34-DR-3-A); weak alteration along fractures; vesicles are common and secondary filled with calcite and/or brownish material; mineral phases: plag, px; px occur as phenocrysts in matrix (up to 2 mm); 15x5x3 cm

Samples at: GZN

MSM82-34-DR-3-E

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Conglomerate/breccia composed of well-rounded fragments of fine-grained greyish basalt bounded by a brownish matrix; fragment of volcanoclastic conglomerate described above (sample MSM82-34-DR-3-A); thin MnOOH crust on surface; highly altered along fractures, fractures filled with calcite; vesicles are rare; possible glass in matrix; 10x5x5 cm

Samples at: GZN

MSM82-34-DR-4

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Basaltic rock with aphanitic to porphyritic texture and fine-grained matrix; thin MnOOH crust on surface; alteration along fractures, fractures filled with calcite; vesicles absent; phenocrysts of px (5 % of matrix); matrix composed of plag, px; 15x10x5 cm

Samples at: GZN

MSM82-34-DR-5

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Conglomerate/breccia composed of well-rounded fragments of fine- to medium-grained greyish basalt bounded by a brownish matrix; thin MnOOH crust on surface; alteration along fractures; vesicles are absent; mineral phases: plag, px; 15x10x5 cm

Samples at: GZN

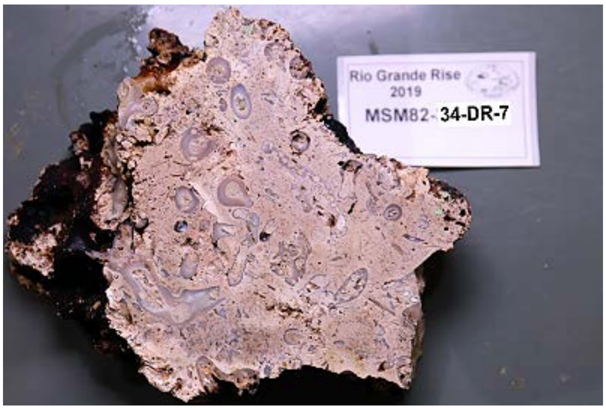
MSM82-34-DR-6

Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Conglomerate/breccia composed of well-rounded fragments of fine- to medium-grained greyish basalt bounded by a brownish matrix; thin MnOOH crust on surface; alteration along fractures; vesicles are absent; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-34-DR-7



Locality description: Central Rio Grande Rise, Rift Valley
Location: 30°51.54 S, 35°23.33 W
Date and Time Start (UTC): 08.04.2019, 16:42
Depth Start [m]: 1100

Sample description:
Carbonate crust with large corals (up to 3 cm) consolidated in fine matrix; possible float to rudstone; 40x20x20 cm

Samples at: GZN

MSM82-44-DR-1

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°23.88 S, 38°20.55 W
Date and Time Start (UTC): 12.04.2019, 00:05
Depth Start [m]: 3260

Sample description:
Conglomerate/breccia composed of volcanic fragments bounded by a yellow to grey fine-grained matrix; thin MnOOH crust on surface; mineral phases: qz (?); 4x4x4 cm

Samples at: GZN

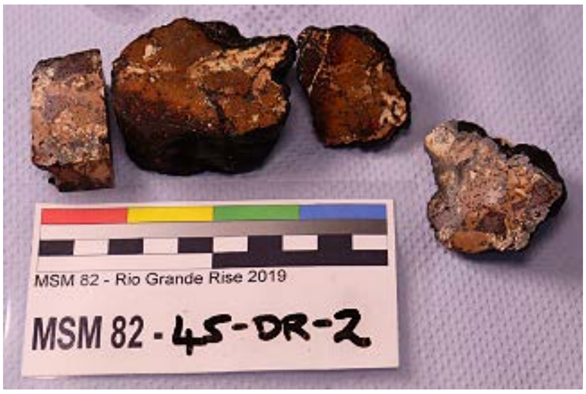
MSM82-45-DR-1

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°25.16 S, 38°22.00 W
Date and Time Start (UTC): 12.04.2019, 03:13
Depth Start [m]: 3980

Sample description:
Medium-grained crystalline granodiorite (?) with igneous foliation; weak alteration; mineral phases: plag, bt (?); possible dropstone; 10x4x5 cm

Samples at: GZN

MSM82-45-DR-2



Locality description: Southern Jean Charcot Seamount Chain
Location: 32°25.16 S, 38°22.00 W
Date and Time Start (UTC): 12.04.2019, 03:13
Depth Start [m]: 3980

Sample description:
Volcanic breccia composed of brownish fragments bounded by a fine-grained matrix; thin MnOOH crust on surface; strong alteration along fractures; mineral phases: plag; 5x3x5 cm

Samples at: GZN

MSM82-45-DR-3

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°25.16 S, 38°22.00 W
Date and Time Start (UTC): 12.04.2019, 03:13
Depth Start [m]: 3980

Sample description:
Fine-grained beige siltstone or altered tuff with thick MnOOH crust on surface (up to 3 cm); layered; weak alteration; mineral phases: qz; 5x3x5 cm

Samples at: GZN

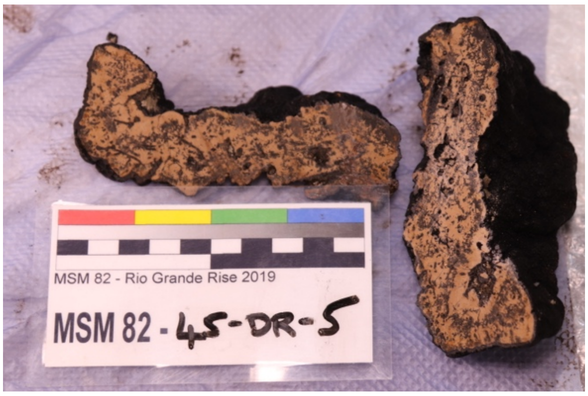
MSM82-45-DR-4

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°25.16 S, 38°22.00 W
Date and Time Start (UTC): 12.04.2019, 03:13
Depth Start [m]: 3980

Sample description:
Fine-grained beige siltstone or altered tuff with thin MnOOH crust on surface; layered; weak alteration; mineral phases: qz; 4x3x5 cm

Samples at: GZN

MSM82-45-DR-5



Locality description: Southern Jean Charcot Seamount Chain
Location: 32°25.16 S, 38°22.00 W
Date and Time Start (UTC): 12.04.2019, 03:13
Depth Start [m]: 3980

Sample description:
Yellow sandstone on phosphorite (?) with thin MnOOH crust on surface; mineral phases: qz; 4x3x5 cm

Samples at: GZN

MSM82-45-DR-6

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°25.16 S, 38°22.00 W
Date and Time Start (UTC): 12.04.2019, 03:13
Depth Start [m]: 3980

Sample description:
Fine-grained beige siltstone or tuff with thin MnOOH crust on surface; possible phosphorite mineralization; mineral phases: qz; 4x3x5 cm

Samples at: GZN

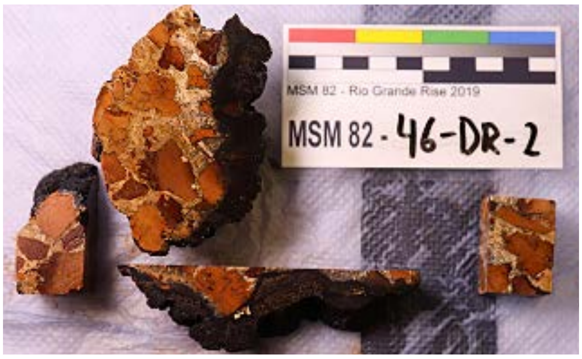
MSM82-46-DR-1

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°24.12 S, 38°20.35 W
Date and Time Start (UTC): 12.04.2019, 06:30
Depth Start [m]: 3273

Sample description:
Dark-coloured volcanic breccia composed of sub-angular brownish fragments bounded by a fine-grained bright matrix; fragments are few mm in size, dense and aphanitic; thick MnOOH crust on surface (up to 3 cm); highly altered; 20x15x5 cm

Samples at: GZN

MSM82-46-DR-2



Locality description: Southern Jean Charcot Seamount Chain
Location: 32°24.12 S, 38°20.35 W
Date and Time Start (UTC): 12.04.2019, 06:30
Depth Start [m]: 3273

Sample description:
Volcanic breccia composed of sub-angular brownish fragments bounded by a fine-grained bright matrix; fragments are dense, aphanitic and range from few mm to 5 cm in size, thin MnOOH crust on surface (up to 1 cm); highly altered; 30x15x10 cm

Samples at: GZN

MSM82-46-DR-3

Locality description: Southern Jean Charcot Seamount Chain
Location: 32°24.12 S, 38°20.35 W
Date and Time Start (UTC): 12.04.2019, 06:30
Depth Start [m]: 3273

Sample description:
Beige to dark brownish fine-grained sediment rock with thin MnOOH crust on surface (up to 0.5 cm); Mn dendrite; reddish sub-angular to well-rounded fragments; strong alteration; vesicles are rare and elongated; 25x15x5 cm

Samples at: GZN

MSM82-48-DR-1

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and secondary filled with black material; phenocrysts of plag, px and ol (?) (5 - 10 % of matrix); matrix composed of plag and px ; 20x20x15 cm

Samples at: GZN

MSM82-48-DR-2

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine- to medium-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and secondary filled with black material; phenocrysts of plag, px and ol (?) (5 % of matrix); matrix composed of plag and px ; 40x20x15 cm

Samples at: GZN

MSM82-48-DR-3

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; igneous foliation; thin MnOOH coating on surface; weak alteration along fractures; vesicles are common and secondary filled with black material; phenocrysts of px (15 % of matrix); matrix composed of plag and px ; 20x10x10 cm

Samples at: GZN

MSM82-48-DR-4

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; possible igneous foliation; thin MnOOH coating on surface; weak alteration along fractures; vesicles are common and secondary filled with black material; phenocrysts of px (10 - 15 % of matrix); matrix composed of plag and px ; 10x10x10 cm

Samples at: GZN

MSM82-48-DR-5

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine- to medium-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are common and secondary filled with black material; phenocrysts of px (10 % of matrix); matrix composed of plag and px ; 5x5x5 cm

Samples at: GZN

MSM82-48-DR-6

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; possible igneous foliation; thin MnOOH coating on surface; weak alteration along fractures; vesicles are common and secondary filled with calcite and/or black material; phenocrysts of px (2 - 5 % of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-48-DR-7

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare; phenocrysts of plag (5 % of matrix); matrix composed of plag and px; 20x10x10 cm

Samples at: GZN

MSM82-48-DR-8

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare; phenocrysts of plag (5 - 10 % of matrix); matrix composed of plag and px; 20x10x10 cm

Samples at: GZN

MSM82-48-DR-9

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and secondary filled with calcite and/or black material; phenocrysts of plag (10 % of matrix); matrix composed of plag and px; 15x15x15 cm

Samples at: GZN

MSM82-48-DR-10

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and secondary filled with black material; phenocrysts of plag and px (?) (10 % of matrix); matrix composed of plag and px; 15x15x15 cm

Samples at: GZN

MSM82-48-DR-11

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; alteration along fractures; vesicles are common and secondary filled with calcite and/or black material; phenocrysts of plag (2 - 5 % of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-48-DR-12

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°40.77 S, 37°19.12 W
Date and Time Start (UTC): 12.04.2019, 16:58
Depth Start [m]: 2759

Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and partly filled with black material; phenocrysts of plag (10 - 15 % of matrix); matrix composed of plag and px; 15x15x15 cm

Samples at: GZN

MSM82-49-DR-1

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 20x10x10 cm

Samples at: GZN

MSM82-49-DR-2

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

MSM82-49-DR-3

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, elongated and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

MSM82-49-DR-4

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, elongated and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

MSM82-49-DR-5

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

MSM82-49-DR-6

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

MSM82-49-DR-7

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

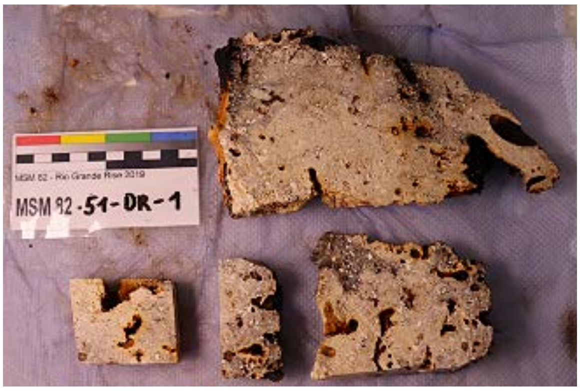
MSM82-49-DR-8

Locality description: Southern Jean Charcot Seamount Chain
Location: 31°48.71 S, 37°15.17 W
Date and Time Start (UTC): 12.04.2019, 21:54
Depth Start [m]: 3335

Sample description:
Weathered fine-grained holocrysatalline basalt with thin MnOOH coating on surface; layered; alteration along fractures; vesicles are common and secondary filled with black material; mineral phases: plag, px (partly substituted by Mn); 10x10x10 cm

Samples at: GZN

MSM82-51-DR-1



Locality description: Central Jean Charcot Seamount Chain
Location: 30°39.57 S, 36°54.80 W
Date and Time Start (UTC): 13.04.2019, 10:47
Depth Start [m]: 1515

Sample description:
Medium- to coarse-grained carbonatic rock with thin MnOOH coating on surface; weathered along cracks; vesicles are common and elongated; 40x18x10 cm

Samples at: GZN

MSM82-51-DR-2

Locality description: Central Jean Charcot Seamount Chain
Location: 30°39.57 S, 36°54.80 W
Date and Time Start (UTC): 13.04.2019, 10:47
Depth Start [m]: 1515

Sample description:
Medium- to coarse-grained carbonatic rock with thin MnOOH coating on surface; weathered along cracks; vesicles are common and elongated; 18x18x14 cm

Samples at: GZN

MSM82-51-DR-3

Locality description: Central Jean Charcot Seamount Chain
Location: 30°39.57 S, 36°54.80 W
Date and Time Start (UTC): 13.04.2019, 10:47
Depth Start [m]: 1515

Sample description:
Fine- to medium-grained carbonatic rock with thick MnOOH crust on surface (up to 2.5 cm); weak alteration along cracks; vesicles are rare and predominantly located at the rims; 15x15x5 cm

Samples at: GZN

MSM82-51-DR-4

Locality description: Central Jean Charcot Seamount Chain
Location: 30°39.57 S, 36°54.80 W
Date and Time Start (UTC): 13.04.2019, 10:47
Depth Start [m]: 1515

Sample description:
Fine- to medium-grained carbonatic rock with thick MnOOH crust on surface (up to 2.5 cm); strong alteration along cracks; vesicles are rare, elongated and partly filled with felsic (?) material; 15x15x7.5 cm

Samples at: GZN

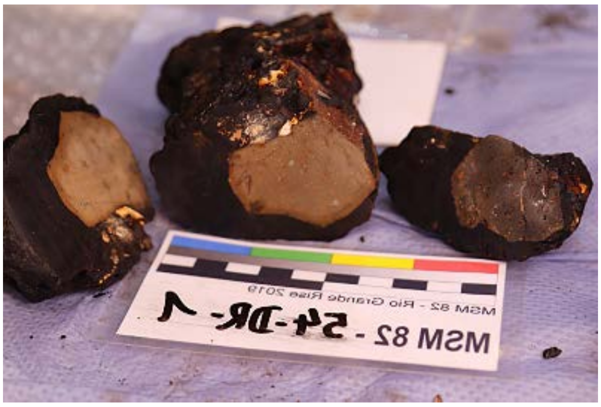
MSM82-51-DR-5

Locality description: Central Jean Charcot Seamount Chain
Location: 30°39.57 S, 36°54.80 W
Date and Time Start (UTC): 13.04.2019, 10:47
Depth Start [m]: 1515

Sample description:
Fine-grained carbonatic rock with thin MnOOH coating on surface; weak alteration along cracks; vesicles are absent; 18x15x3 cm

Samples at: GZN

MSM82-54-DR-1



Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Fine-grained greyish to dark aphanitic basalt with thick MnOOH crust on surface (up to 3 cm); weak alteration along fractures; vesicles are common and secondary filled with light and/or brownish material; mineral phases: plag, px; 4x4x4 cm

Samples at: GZN

MSM82-54-DR-2

Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Volcanic breccia composed of fragments of fine-grained dark aphanitic basalt bounded by a light calcitic matrix; thin MnOOH crust on surface; strong alteration along fractures; vesicles are commen, elongated and secondary filled with calcite and/or brownish material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

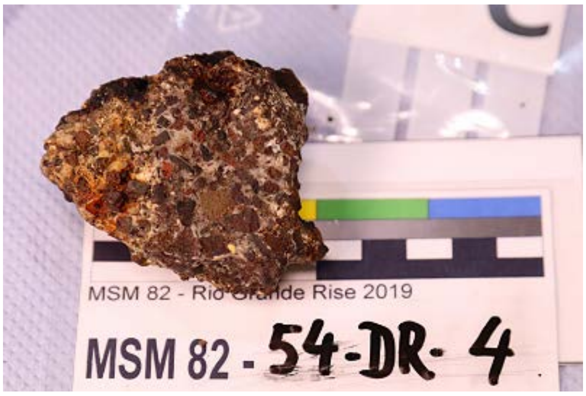
MSM82-54-DR-3

Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Volcanic breccia composed of fragments of fine-grained dark aphanitic basalt bounded by a light calcitic matrix; thick MnOOH crust on surface (up to 4 cm); strong alteration along fractures; vesicles are commen, elongated and secondary filled with calcite and/or brownish material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-54-DR-4



Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Breccia composed of angular to sub-rounded fragments of fine-grained brown to reddish volcanic rocks bounded by a light matrix; thick MnOOH crust on surface (up to 4 cm); strong alteration along fractures; vesicles are rare; mineral phases: plag, px; 7x5x5 cm

Samples at: GZN

MSM82-54-DR-5

Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Breccia composed of angular to sub-rounded fragments of fine-grained brown to reddish volcanic rocks bounded by a light matrix; thick MnOOH crust on surface (up to 4 cm); strong alteration along fractures; vesicles are rare; mineral phases: plag, px; 10x5x5 cm

Samples at: GZN

MSM82-54-DR-6

Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Breccia composed of angular to sub-rounded fragments of fine-grained brown to reddish volcanic rocks bounded by a light matrix; thick MnOOH crust on surface (up to 4 cm); strong alteration along fractures; vesicles are rare; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-54-DR-7

Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Breccia composed of angular to sub-rounded fragments of fine-grained brown to reddish volcanic rocks bounded by a light matrix; thin MnOOH crust on surface (up to 1 cm); strong alteration along fractures; vesicles are rare; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-54-DR-8

Locality description: Central Jean Charcot Seamount Chain
Location: 30°14.02 S, 36°58.22 W
Date and Time Start (UTC): 14.04.2019, 02:43
Depth Start [m]: 1818

Sample description:
Breccia composed of angular to sub-rounded fragments of fine-grained brown to reddish volcanic rocks bounded by a light matrix; thin MnOOH crust on surface (up to 1.5 cm); strong alteration along fractures; vesicles are rare; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-55-DR-1

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fine- to medium-grained aphanitic basalt with thick MnOOH crust on surface (up to 2 cm); weak alteration along fractures; vesicles are rounded and secondary filled with calcite; mineral phases: plag, px, spl (?); 30x20x20 cm

Samples at: GZN

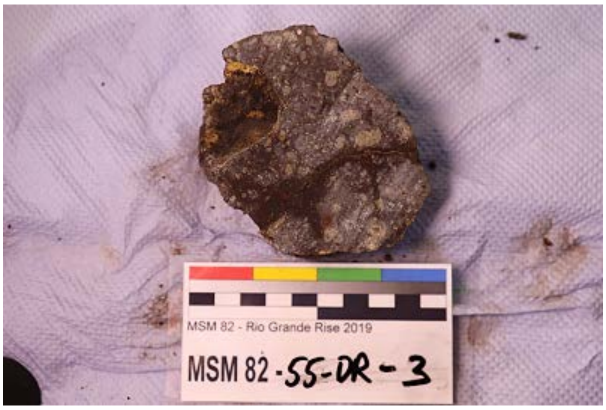
MSM82-55-DR-2

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fine-grained aphanitic to porphyritic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare and secondary filled with calcite; few phenocrysts of plag (2% of matrix); matrix composed of plag and px; 15x10x10 cm

Samples at: GZN

MSM82-55-DR-3



Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Vent-breccia (?) composed of at least two types of angular xenolites in a dense dark-coloured matrix; First type consists of hypideomorph to ideomorph px and fine-grained grey-greenish material (ol?); Second type consists of fine-grained reddish material; thin MnOOH coating on surface, vesicles are common and secondary filled with calcite; weak alteration along fractures; 10x10x10 cm

Samples at: GZN

MSM82-55-DR-4

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Vent-breccia (?) composed of at least two types of angular xenolites in a dense dark-coloured matrix; First type consists of hypideomorph to ideomorph px and fine-grained grey-greenish material (ol?); Second type consists of fine-grained reddish material; thin MnOOH coating on surface, vesicles are common and secondary filled with calcite; weak alteration along fractures; 18x12x8 cm

Samples at: GZN

MSM82-55-DR-5

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fine-grained dense aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are absent; mineral phases: plag, px; 10x10x5 cm

Samples at: GZN

MSM82-55-DR-6-A

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Volcanic breccia composed of elongated sub-rounded fragments of aphanitic grey basalt bounded by a fine-grained calcitic matrix; thick MnOOH crust on surface (up to 3 cm); alteration along fractures; 20x15x10 cm

Samples at: GZN

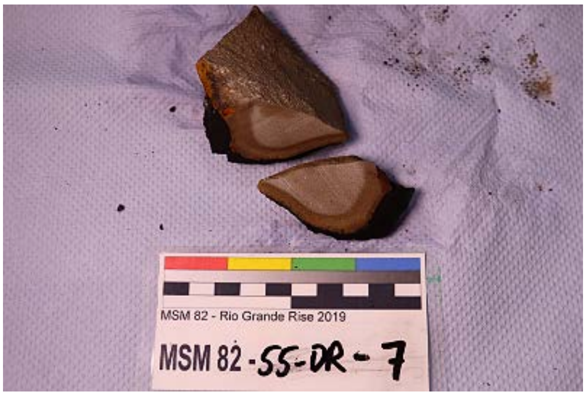
MSM82-55-DR-6-B

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Sub-rounded fragment separated from sample MSM82-55-DR-6-A; fine-grained aphanitic basalt with thin MnOOH crust on surface (up to 1 cm); very fresh, weak alteration along fractures; vesicles are rare and secondary filled with calcite and/or brownish material; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-55-DR-7



Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Slightly weathered fine-grained aphanitic basalt with thin MnOOH crust on surface; matrix slightly altered, alteration along fractures; vesicles are rare and secondary filled with calcite; mineral phases: plag, px; 10x10x2 cm

Samples at: GZN

MSM82-55-DR-8

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Slightly weathered fine-grained aphanitic basalt with thin MnOOH crust on surface; matrix slightly altered, alteration along fractures; vesicles are common, well-rounded and secondary filled with calcite; mineral phases: plag, px; 10x10x7 cm

Samples at: GZN

MSM82-55-DR-9

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare, well-rounded and secondary filled with calcite; ; few phenocrysts of plag (< 1 % of matrix); matrix composed of plag and px; 15x15x10 cm

Samples at: GZN

MSM82-55-DR-10

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Volcanic breccia composed of sub-rounded fragments of aphanitic grey basalt bounded by a fine-grained calcitic matrix; fragments range from mm to few cm in size; thin MnOOH coating on surface; strong alteration along fractures; 25x12x8 cm

Samples at: GZN

MSM82-55-DR-11

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Vent-breccia (?) composed of at least two types of angular xenolites in a dense dark-coloured matrix; First type consists of hypideomorph to ideomorph px and fine-grained grey-greenish material (ol?); Second type consists of fine-grained reddish material; thin MnOOH coating on surface, vesicles are common and secondary filled with calcite; weak alteration along fractures; 8x8x5 cm

Samples at: GZN

MSM82-55-DR-12

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface (up to 0.5 cm); weak alteration along fractures; vesicles are common, elongated and secondary filled with calcite; mineral phases: plag and px; 10x10x3 cm

Samples at: GZN

MSM82-55-DR-13

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Vent-breccia (?) composed of at least two types of angular xenolites in a dense dark-coloured matrix; First type consists of hypideomorph to ideomorph px and fine-grained grey-greenish material (ol?); Second type consists of fine-grained reddish material; thin MnOOH coating on surface, vesicles are common and secondary filled with calcite; weak alteration along fractures; 10x10x10 cm

Samples at: GZN

MSM82-55-DR-14

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fresh fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures, fractures filled with calcite; vesicles are common, rounded and secondary filled with calcite; mineral phases: plag and px; 10x10x10 cm

Samples at: GZN

MSM82-55-DR-15

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Volcanic breccia composed of angular to sub-rounded fragments of aphanitic grey basalt bounded by a fine-grained calcitic matrix; thin MnOOH crust on surface (0.5 cm); strong alteration along fractures; vesicles are rare, angular and secondary filled with calcite; 15x10x5 cm

Samples at: GZN

MSM82-55-DR-16

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°24.41 S, 36°19.58 W
Date and Time Start (UTC): 14.04.2019, 09:28
Depth Start [m]: 1297

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface; weak alteration along fractures, fractures filled with calcite; vesicles are common, rounded and partly filled with calcite and/or brownish material; mineral phases: plag and px; 15x15x7 cm

Samples at: GZN

MSM82-56-DR-1

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°19.10 S, 36°04.45 W
Date and Time Start (UTC): 14.04.2019, 14:20
Depth Start [m]: 1140

Sample description:
Volcanic breccia composed of angular to sub-rounded fragments of aphanitic volcanic rocks bounded by a fine-grained brownish matrix (partly calcitic); thick MnOOH crust on surface (up to 1.5 cm); strong alteration along fractures; 8x8x4 cm

Samples at: GZN

MSM82-56-DR-2

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°19.10 S, 36°04.45 W
Date and Time Start (UTC): 14.04.2019, 14:20
Depth Start [m]: 1140

Sample description:
Volcanic breccia composed of sub-rounded brown to reddish material bounded by a dark matrix; highly vesicular, vesicles are elongated and filled with calcite; thick MnOOH crust on surface (up to 1.5 cm); strong alteration along fractures; 8x5x3 cm

Samples at: GZN

MSM82-57-DR-1

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°20.80 S, 36°03.97 W
Date and Time Start (UTC): 14.04.2019, 16:48
Depth Start [m]: 1100

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; rounded: possible dropstone (?); very fresh, only weak alteration along fractures; vesicles are rare, sub-rounded and partly filled with calcite and/or black material; few phenocrysts of px (?) (< 1% of matrix); matrix composed of plag and px; 30x10x10 cm

Samples at: GZN

MSM82-57-DR-2

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°20.80 S, 36°03.97 W
Date and Time Start (UTC): 14.04.2019, 16:48
Depth Start [m]: 1100

Sample description:
Fine-grained aphanitic basalt with thin MnOOH crust on surface (up to 1 cm); rounded: possible dropstone (?); very fresh, only weak alteration along fractures; vesicles are rare, sub-rounded and partly filled with calcite and/or black material; mineral phases: plag; px; 7.5x7.5x7.5 cm

Samples at: GZN

MSM82-57-DR-3

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°20.80 S, 36°03.97 W
Date and Time Start (UTC): 14.04.2019, 16:48
Depth Start [m]: 1100

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; fresh, only weak alteration along fractures; vesicles are rare, sub-rounded and partly filled with calcite and/or black material; mineral phases: plag; px; 5x5x5 cm

Samples at: GZN

MSM82-57-DR-4

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°20.80 S, 36°03.97 W
Date and Time Start (UTC): 14.04.2019, 16:48
Depth Start [m]: 1100

Sample description:
Volcanic breccia composed of angular to sub-rounded fragments of fine-grained aphanitic basalt bounded by a dark matrix; fragments are weathered; vesicles are rare and filled with calcite; thin MnOOH coating on surface; strong alteration along fractures; 10x5x5 cm

Samples at: GZN

MSM82-58-DR-1

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or black material few phenocrysts of ol (?) (5 -10 % of matrix); matrix composed of plag and px; possible olivine completely replaced by iddingsite; 5x5x5 cm

Samples at: GZN

MSM82-58-DR-2

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, elongated and secondary filled with calcite and/or black material; few phenocrysts of ol (?) (5 -10 % of matrix); matrix composed of plag and px; possible olivine completely replaced by iddingsite; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-3

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, elongated and secondary filled with calcite and/or black material; few phenocrysts of ol (?) (5 -10 % of matrix); matrix composed of plag and px; possible olivine completely replaced by iddingsite; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-4

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite, black and/or greenish material; few phenocrysts of ol (?) (5 -10 % of matrix); matrix composed of plag and px; possible olivine completely replaced by iddingsite; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-5

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, rounded and filled with calcite and black, brownish and/or greenish material; few phenocrysts of weathered plag and px (?) (< 1% of matrix); matrix composed of plag and px; 5x5x5 cm

Samples at: GZN

MSM82-58-DR-6

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, rounded and filled with calcite and brownish, black and/or greenish material; few phenocrysts of weathered plag and px (?) (< 1% of matrix); matrix composed of plag and px; 15x10x5 cm

Samples at: GZN

MSM82-58-DR-7

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, rounded and filled with calcite and black and/or greenish material; few phenocrysts of weathered plag and px (?) (2 - 4 % of matrix); matrix composed of plag and px; 10x10x5 cm

Samples at: GZN

MSM82-58-DR-8

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Basalt with porphyritic texture and fine-grained weatherd matrix; thin MnOOH crust on surface; weak alteration along fractures; vesicles are common and secondary filled with calcite and/or black material; weathered phenocrysts of plag and px (?) (5 - 10% of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-9

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Basalt with porphyritic texture and fine-grained weathered matrix; thin MnOOH crust on surface; weak alteration along fractures; vesicles are common, angular and secondary filled with calcite and/or black material; weathered phenocrysts of plag and px (?) (5 % of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-10

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Basalt with porphyritic texture and fine-grained weathered matrix; thin MnOOH crust on surface; weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or black or greenish material; weathered phenocrysts of plag and px (?) (5 % of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-11

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Basalt with porphyritic texture and fine-grained weathered matrix; thin MnOOH crust on surface; weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or black material; weathered phenocrysts of plag and px (?) (5 % of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-58-DR-12

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, rounded and filled with calcite and black and/or reddish material; few phenocrysts of weathered plag and px (?) (2 - 4 % of matrix); matrix composed of plag and px; 10x10x5 cm

Samples at: GZN

MSM82-58-DR-13

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, sub-rounded to rounded and filled with calcite and black and/or yellowish material; mineral phases: plag, px; 10x10x5 cm

Samples at: GZN

MSM82-58-DR-14

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, sub-rounded to rounded and filled with brownish and/or black material; mineral phases: plag, px; 10x5x5 cm

Samples at: GZN

MSM82-58-DR-15

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; matrix strongly weathered; vesicles are common, sub-rounded to rounded and partly filled with calcite and/or black material; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-58-DR-16

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; matrix strongly weathered; vesicles are common, angular to rounded and filled with calcite and/or brownish material; mineral phases: plag, px; 10x10x5 cm

Samples at: GZN

MSM82-58-DR-17

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 3 cm); alteration along fractures; matrix strongly weathered; vesicles are common, angular to rounded and filled with calcite and/or brownish material; mineral phases: plag, px; 10x10x5 cm

Samples at: GZN

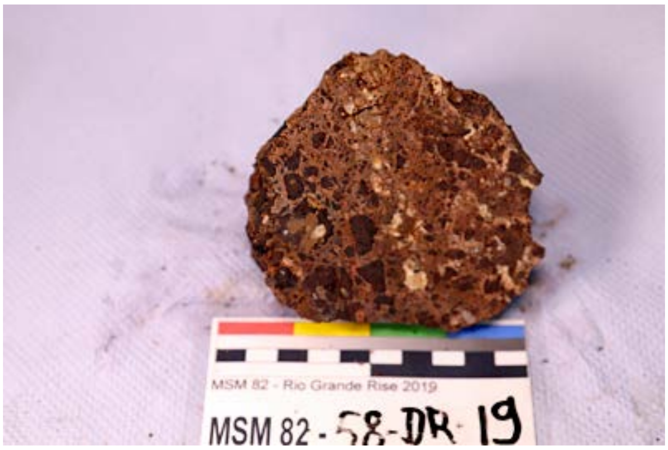
MSM82-58-DR-18

Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Volcanic breccia composed of angular to sub-rounded brown to reddish material bounded by a greyish matrix; vesicles are rare and partly filled with calcite; thin MnOOH coating on surface; strong alteration along fractures; 10x5x5 cm

Samples at: GZN

MSM82-58-DR-19

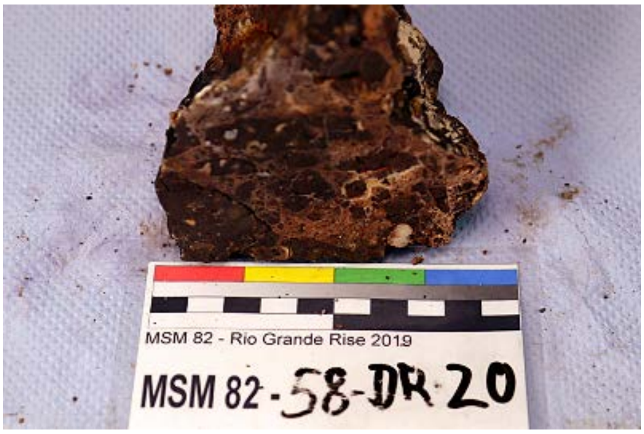


Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Volcanic breccia composed of angular to sub-rounded brown to reddish material bounded by a greyish matrix; vesicles are rare and partly filled with calcite; thin MnOOH coating on surface; strong alteration along fractures; 8x5x5 cm

Samples at: GZN

MSM82-58-DR-20



Locality description: Western Rio Grande Rise, Rift Valley
Location: 30°06.61 S, 36°20.70 W
Date and Time Start (UTC): 14.04.2019, 21:46
Depth Start [m]: 1484

Sample description:
Volcanic breccia composed of angular to sub-rounded brown to reddish material bounded by a greyish matrix; vesicles are rare and partly filled with calcite; thin MnOOH coating on surface; strong alteration along fractures; 8x5x5 cm

Samples at: GZN

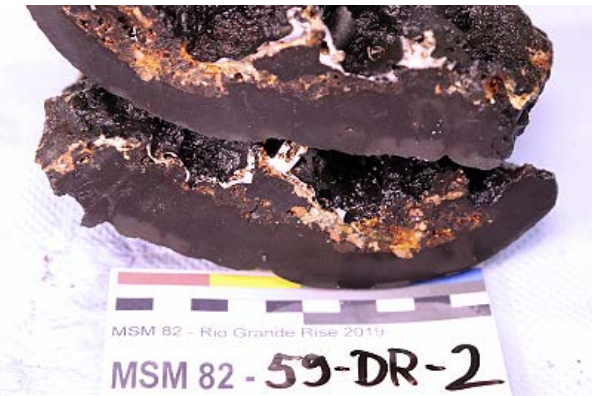
MSM82-59-DR-1

Locality description: Central Jean Charcot Seamount Chain
Location: 30°10.03 S, 36°53.95 W
Date and Time Start (UTC): 15.04.2019, 03:22
Depth Start [m]: 1290

Sample description:
Carbonatic rock with thin MnOOH coating on surface; 10x10x5 cm

Samples at: GZN

MSM82-59-DR-2



Locality description: Central Jean Charcot Seamount Chain
Location: 30°10.03 S, 36°53.95 W
Date and Time Start (UTC): 15.04.2019, 03:22
Depth Start [m]: 1290

Sample description:
Piece of cut MnOOH crust

Samples at: GZN

MSM82-59-DR-3

Locality description: Central Jean Charcot Seamount Chain
Location: 30°10.03 S, 36°53.95 W
Date and Time Start (UTC): 15.04.2019, 03:22
Depth Start [m]: 1290

Sample description:
Carbonatic rock with thick MnOOH crust on surface (up to 2 cm); 10x10x5 cm

Samples at: GZN

MSM82-60-DR-1

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; very fresh, only weak alteration along fractures; vesicles are rare, sub-rounded and partly filled with calcite and/or brownish or black material; few phenocrysts of plag (< 1% of matrix); matrix composed of plag and px; 50x40x40 cm

Samples at: GZN

MSM82-60-DR-2

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 2 cm); strong alteration along fractures; vesicles are common, angular and secondary filled with calcite and/or brownish or black material; mineral phases: plag, px; 50x25x25 cm

Samples at: GZN

MSM82-60-DR-3

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, sub-rounded, range in size between few mm and 2 cm and are partly filled with calcite and/or brownish or black material; mineral phases: plag, px; 12x10x10 cm

Samples at: GZN

MSM82-60-DR-4

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 1.5 cm); alteration along fractures; vesicles are common, sub-rounded and secondary filled with calcite and/or black material; mineral phases: plag, px; 50x25x25 cm

Samples at: GZN

MSM82-60-DR-5

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 2 cm); alteration along fractures; vesicles are common, sub-rounded and secondary filled with calcite and/or black material; mineral phases: plag, px; 25x20x10 cm

Samples at: GZN

MSM82-60-DR-6

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH crust on surface (up to 0.5 cm); weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite; mineral phases: plag, px; ol (?); possible olivine completely replaced by iddingsite; 25x15x10 cm

Samples at: GZN

MSM82-60-DR-7

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with medium-grained rounded xenolites, composed of plag, px and ol (?); thin MnOOH crust on surface (up to 1 cm); alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px; 14x10x6 cm

Samples at: GZN

MSM82-60-DR-8

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Volcanic breccia composed of angular to sub-rounded fragments of fine-grained-aphanitic basalt bounded by calcitic matrix; fragments are weathered; vesicles are rare, angular and filled with calcite; thick MnOOH crust on surface (up to 4 cm); strong alteration along fractures; 23x20x8 cm

Samples at: GZN

MSM82-60-DR-9

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fresh, dense and fine-grained carbonatic rock with thin MnOOH coating on surface; weak alteration; vesicles are common and range from few mm to 1.5 cm in size; 9x9x3 cm

Samples at: GZN

MSM82-60-DR-10

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine- to medium-grained aphanitic basalt with thin MnOOH crust on surface (up to 0.5 cm); weak alteration along fractures, matrix display increasing alteration to top; vesicles are common, rounded and secondary filled with calcite and/or black material; mineral phases: plag, px; ol (?); possible olivine completely replaced by iddingsite; 11x6x10 cm

Samples at: GZN

MSM82-60-DR-11

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Fine-grained aphanitic basalt with medium-grained rounded xenolites, composed of plag, px and ol (?); thin MnOOH coating on surface; alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px; 17x9x5 cm

Samples at: GZN

MSM82-60-DR-12

Locality description: Northern Jean Charcot Seamount Chain (guyot-shaped ridge; NW corner RGR)
Location: 29°40.25 S, 36°59.82 W
Date and Time Start (UTC): 15.04.2019, 09:25
Depth Start [m]: 1780

Sample description:
Piece of cut MnOOH crust

Samples at: GZN

MSM82-62-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 29°15.85 S, 36°57.06 W
Date and Time Start (UTC): 15.04.2019, 16:56
Depth Start [m]: 3300

Sample description:
Medium- to coarse-grained sedimentary rock (?) with yellowish to brownish matrix; thin MnOOh-crust on surface (up to 1 cm); strong alteration along fractures; possible mineral phases: qz, px, zrn

Samples at: GZN

MSM82-63-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°38.09 S, 37°00.13 W
Date and Time Start (UTC): 16.04.2019, 00:02
Depth Start [m]: 2060

Sample description:

Samples at: GZN

MSM82-63-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°38.09 S, 37°00.13 W
Date and Time Start (UTC): 16.04.2019, 00:02
Depth Start [m]: 2060

Sample description:

Samples at: GZN

MSM82-64-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°39.54 S, 36°56.56 W
Date and Time Start (UTC): 16.04.2019, 03:55
Depth Start [m]: 2587

Sample description:
Fine-grained aphanitic basalt with thick MnOOH crust on surface (up to 4 cm); alteration along fractures; vesicles are rare and partly filled with black material; mineral phases: plag, px; 20x10x5 cm

Samples at: GZN

MSM82-64-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°39.54 S, 36°56.56 W
Date and Time Start (UTC): 16.04.2019, 03:55
Depth Start [m]: 2587

Sample description:
Fine-rained carbonatic rock

Samples at: GZN

MSM82-65-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Weathered basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; alteration along fractures; vesicles are common, well-rounded and secondary filled with calcite; phenocrysts of plag and px (5% of matrix); matrix composed of plag and px; 10x8x6 cm

Samples at: GZN

MSM82-65-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Slightly weathered basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or brownish material; phenocrysts of plag, px and ol (?) (5% of matrix); possible ol completely replaced by iddingsite; matrix composed of plag and px; 11x8x5 cm

Samples at: GZN

MSM82-65-DR-3

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Weathered basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 0.5 cm); weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite; phenocrysts of plag and px (2% of matrix); matrix composed of plag and px; 12x8x7 cm

Samples at: GZN

MSM82-65-DR-4

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Weathered basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 0.5 cm); alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or brownish material; phenocrysts of plag, px and ol (?) (5% of matrix); possible ol completely replaced by iddingsite; matrix composed of plag and px; 10x7x7 cm

Samples at: GZN

MSM82-65-DR-5

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Fine-grained aphanitic basalt with thin MnOOH coating on surface; alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or black material; few phenocrysts of px (< 1% of matrix); matrix composed of plag and px; 11x8x5 cm

Samples at: GZN

MSM82-65-DR-6-A

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Volcanic breccia composed of angular to rounded fragments of fine-grained highly vesicular basalt bounded by greyish matrix; fragments are described in MSM82-65-DR-3-B; thin MnOOH crust on surface (up to 1 cm); strong alteration along fractures; 30x25x20 cm

Samples at: GZN

MSM82-65-DR-6-B

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Fine-grained rounded fragment separated from the breccia described above (MSM82-65-DR-6-A); fine-grained aphanitic basalt; highly vesicular, vesicles are rounded and secondary filled with calcite; mineral phases: plag, px; 9x5x4 cm

Samples at: GZN

MSM82-65-DR-7

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°37.03 S, 37°25.62 W
Date and Time Start (UTC): 16.04.2019, 10:12
Depth Start [m]: 3223

Sample description:
Cut blocks of highly weathered porphyritic basalt; few phenocrysts of px and plag (?); further mineral separation necessary; 15x7x7 cm

Samples at: GZN

MSM82-66-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°20.43 S, 37°51.43 W
Date and Time Start (UTC): 16.04.2019, 17:36
Depth Start [m]: 3720

Sample description:
Fine-grained volcanic rock with thin MnOOH coating on surface; strong alteration along fractures; highly vesicular,vesicles are partly filled with calcite and/or brownish material; mineral phases: plag, px; 4x4x4 cm

Samples at: GZN

MSM82-66-DR-3

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°20.43 S, 37°51.43 W
Date and Time Start (UTC): 16.04.2019, 17:36
Depth Start [m]: 3720

Sample description:
Medium- to coarse-grained crystalline rock with rounded porphyritic xenolites and thin MnOOH crust on surface; xenolites composed of phenocrytst of px and reddish mineral phases bounded by a fine-grained matrix; strong alteration along fractures; possible mineral phases: plag, px (?); amph (?), bt (?), qz (??); possible rhyolite/granite (?); 4x4x4 cm

Samples at: GZN

MSM82-66-DR-4

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°20.43 S, 37°51.43 W
Date and Time Start (UTC): 16.04.2019, 17:36
Depth Start [m]: 3720

Sample description:
Fine-grained volcanic rock with thin MnOOH coating on surface; strong alteration along fractures; highly vesicular,vesicles are partly filled with greyish fine-grained sediment; mineral phases: plag, px; 4x4x4 cm

Samples at: GZN

MSM82-66-DR-5

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°20.43 S, 37°51.43 W
Date and Time Start (UTC): 16.04.2019, 17:36
Depth Start [m]: 3720

Sample description:
Breccia (?) composed of sub-rounded reddish fragments of fine- to medium-grained sandy material bounded by a calcitic matrix; thin MnOOH coating on surface; strong alteration along fractures; 10x7x7 cm

Samples at: GZN

MSM82-66-DR-6

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°20.43 S, 37°51.43 W
Date and Time Start (UTC): 16.04.2019, 17:36
Depth Start [m]: 3720

Sample description:
Breccia (?) composed of angular to sub-rounded reddish fragments of fine-grained volcanic material bounded by a greyish fine-grained matrix; thick MnOOH crust on surface (up to 3 cm); strong alteration along fractures; 10x7x7 cm

Samples at: GZN

MSM82-66-DR-7

Locality description: Northern Jean Charcot Seamount Chain
Location: 28°20.43 S, 37°51.43 W
Date and Time Start (UTC): 16.04.2019, 17:36
Depth Start [m]: 3720

Sample description:
Medium-grained crystalline rock with rounded porphyritic xenolites and thin MnOOH crust on surface; xenolites composed of phenocrytst of px and reddish mineral phases bounded by a fine-grained matrix; strong alteration along fractures; possible mineral phases: plag, px (?); amph (?), bt (?), qz (??); possible rhyolite (?); 7x7x5 cm

Samples at: GZN

MSM82-67-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 27°54.88 S, 38°02.93 W
Date and Time Start (UTC): 17.04.2019, 00:06
Depth Start [m]: 4040

Sample description:
Medium-grained crystalline rock with rounded volcanic xenolites and thin MnOOH coating on surface; xenolites are fine-grained and reddish; strong alteration along fractures; possible mineral phases: plag, px (?); amph (?), bt (?), qz (??); possible rhyolite (?); 7x5x5 cm

Samples at: GZN

MSM82-67-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 27°54.88 S, 38°02.93 W
Date and Time Start (UTC): 17.04.2019, 00:06
Depth Start [m]: 4040

Sample description:
Fine- to medium-grained crystalline rock with thin MnOOH coating on surface; strong alteration along fractures; possible mineral phases: plag, px (?); amph (?), bt (?), qz (??); possible rhyolite (?); 4x4x4 cm

Samples at: GZN

MSM82-67-DR-3

Locality description: Northern Jean Charcot Seamount Chain
Location: 27°54.88 S, 38°02.93 W
Date and Time Start (UTC): 17.04.2019, 00:06
Depth Start [m]: 4040

Sample description:
Fine- to medium-grained crystalline rock with thin MnOOH coating on surface; strong alteration along fractures; possible mineral phases: plag, px (?); amph (?), bt (?), qz (??); possible rhyolite (?); 3x3x3 cm

Samples at: GZN

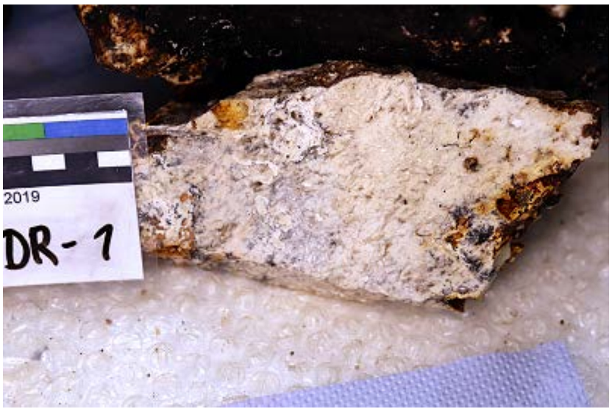
MSM82-68-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°59.72 S, 38°11.04 W
Date and Time Start (UTC): 17.04.2019, 10:13
Depth Start [m]: 3383

Sample description:
Rounded siltstone (?) with thin MnOOH crust on surface (up to 1 cm); alteration along fractures; 12x10x7 cm

Samples at: GZN

MSM82-69-DR-1



Locality description: Northern Jean Charcot Seamount Chain
Location: 27°03.19 S, 38°41.17 W
Date and Time Start (UTC): 17.04.2019, 16:23
Depth Start [m]: 2335

Sample description:
Boulder of silicified, very hard carbonate; grainstone; white to beige, mm sized shell fragments and other fossils; layering visible; vein 2cm, filled with syntactic crystals; rim overprinted by pressure solution; Mn-dendrites throughout cut surface; 40x20x20 cm

Samples at: GZN -> carb. TS

MSM82-69-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 27°03.19 S, 38°41.17 W
Date and Time Start (UTC): 17.04.2019, 16:23
Depth Start [m]: 2335

Sample description:
Boulder of silicified, very hard carbonate; wacke- to packstone; beige to pink; generally layerd (up to 3 cm); layer rims overprinted by stylolithes; up to 1 cm complete brachiopod shells; broken shells and other fossils of mm size in the rest of the sample; 20x25x15 cm

Samples at: GZN -> carb. TS

MSM82-72-DR-1

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are common, rounded and secondary filled with calcite and/or brownish material; hypideomorph phenocrysts of px (5% of matrix); matrix composed of plag and px; 25x15x10 cm

Samples at: GZN

MSM82-72-DR-2-A

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained dark-coloured crystalline basic to intermediate volcanic rock with rounded porphyritic xenolites (MSM82-72-DR-2-B), transitions are gradational to sharp; weak alteration on surface and along fractures, fractures are partly filled with calcite; vesicles are absent; mineral phases: plag, px; 10x10x10 cm

Samples at: GZN

MSM82-72-DR-2-B

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix; xenolite separated from sample MSM82-72-DR-2-A, transitions are graditional to sharp; weak alteration on surfaces and along fractures; vesicles are rare, angular to sub-rounded and secondary filled with calcite and/or brownish material; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

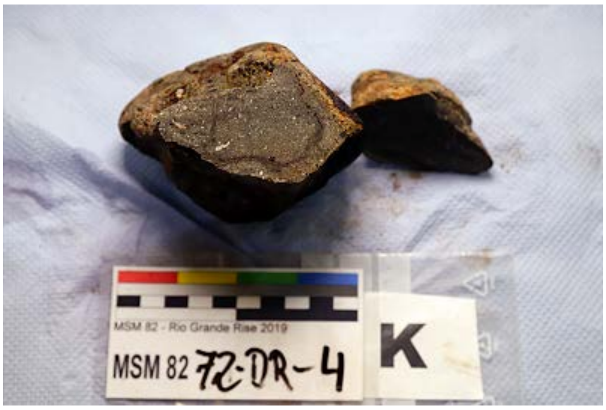
MSM82-72-DR-3

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained dark-coloured crystalline basic to intermediate volcanic rock; weak alteration on surface and along fractures, fractures are partly filled with calcite; vesicles are rare, angular to sub-rounded and partly filled with calcite; mineral phases: plag, px; 5x5x5 cm

Samples at: GZN

MSM82-72-DR-4



Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix with grey to reddish medium-grained xenolites (similar to sample MSM82-72-DR-5); transitions are sharp; weak alteration on surfaces and along fractures; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (15% of matrix); matrix composed of plag and px; 15x10x5 cm

Samples at: GZN

MSM82-72-DR-5

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with rounded porphyritic xenolites (similar to sample MSM82-72-DR-2-B), transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-6

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with at least two different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A and MSM82-72-DR-4; transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-7

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with at least two different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A and MSM82-72-DR-4; transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-8

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with at least two different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A and MSM82-72-DR-4; transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-9

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with at least two different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A and MSM82-72-DR-4; transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-10

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with at least two different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A and MSM82-72-DR-4; transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-11

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; thin carbonate crust on surface (up to 1.5 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 30x20x15 cm

Samples at: GZN

MSM82-72-DR-12

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with at least two different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A and MSM82-72-DR-4; transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 20x20x20 cm

Samples at: GZN

MSM82-72-DR-13

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 30x20x15 cm

Samples at: GZN

MSM82-72-DR-14

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 15x10x10 cm

Samples at: GZN

MSM82-72-DR-15

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures, matrix weathered; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 15x10x10 cm

Samples at: GZN

MSM82-72-DR-16

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix; weak alteration on surfaces and along fractures; vesicles are rare, angular to sub-rounded and secondary filled with calcite and/or brownish material; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 10x5x5 cm

Samples at: GZN

MSM82-72-DR-17

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures, matrix weathered; vesicles are common, well-rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-72-DR-18

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Volcanic breccia composed of angular to sub-rounded fragments of at least three different rock-types bounded by a fine-grained calcitic matrix; rock fragments are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; thin MnOOH coating on surface; strong alteration along fractures; 15x15x10 cm

Samples at: GZN

MSM82-72-DR-19

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; thin MnOOH crust on surface (up to 0.5 cm) weak alteration along fractures, matrix weathered; vesicles are common, well-rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 10x10x10 cm

Samples at: GZN

MSM82-72-DR-20

Locality description: Northern Jean Charcot Seamount Chain (“Engagement Ring Seamount”)
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Volcanic breccia composed of angular to sub-rounded fragments of at least three different rock-types bounded by a fine-grained calcitic matrix; rock fragments are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; thin MnOOH coating on surface; strong alteration along fractures; 10x10x10 cm

Samples at: GZN

MSM82-72-DR-21

Locality description: Northern Jean Charcot Seamount Chain (“Engagement Ring Seamount”)
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures, matrix weathered; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 15x15x10 cm

Samples at: GZN

MSM82-72-DR-22

Locality description: Northern Jean Charcot Seamount Chain (“Engagement Ring Seamount”)
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures, matrix weathered; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 15x5x5 cm

Samples at: GZN

MSM82-72-DR-23

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate grey to greenish volcanic rock with porphyritic texture and fine-grained matrix with at least three different types of xenolites; xenolites are similar to samples MSM82-72-DR-2-A, MSM82-72-DR-2-B and MSM82-72-DR-5; transitions are sharp; weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 15x5x5 cm

Samples at: GZN

MSM82-72-DR-24

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix with rounded xenolites (similar to sample MSM82-72-DR-2-A), transitions are sharp; weak alteration on surfaces and along fractures; vesicles are rare, angular to sub-rounded and secondary filled with calcite and/or brownish material; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 8x5x5 cm

Samples at: GZN

MSM82-72-DR-25

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained grey to reddish crystalline intermediate to felsic (?) volcanic rock with rounded porphyritic xenolites (similar to sample MSM82-72-DR-2-B), transitions are sharp; weak alteration on surface and along fractures; vesicles are rare, rounded and secondary filled with calcite; mineral phases: plag, px, qz (?), kfsp (?); 10x5x5 cm

Samples at: GZN

MSM82-72-DR-26

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix; weak alteration on surfaces and along fractures; vesicles are rare, angular to sub-rounded and secondary filled with calcite and/or brownish material; hypideomorph to ideomorph phenocrysts of px (5 - 10% of matrix); matrix composed of plag and px; 10x7x5 cm

Samples at: GZN

MSM82-72-DR-27

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix; weak alteration on surfaces and along fractures; vesicles are rare, angular to sub-rounded and secondary filled with calcite and/or brownish material; hypideomorph to ideomorph phenocrysts of px (< 2% of matrix); matrix composed of plag and px; 15x7x2 cm

Samples at: GZN

MSM82-72-DR-28

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Intermediate volcanic rock with porphyritic texture and fine-grained matrix; weak alteration on surfaces and along fractures; vesicles are rare, angular to sub-rounded and secondary filled with calcite and/or brownish material; hypideomorph to ideomorph phenocrysts of px (10% of matrix); matrix composed of plag and px; 5x5x5 cm

Samples at: GZN

MSM82-72-DR-29

Locality description: Northern Jean Charcot Seamount Chain ("Engagement Ring Seamount")
Location: 27°21.01 S, 39°04.37 W
Date and Time Start (UTC): 18.04.2019, 04:31
Depth Start [m]: 2269

Sample description:
Medium-grained dark-coloured crystalline basic to intermediate volcanic; alteration on surface and along fractures, fractures are partly filled with calcite; vesicles are absent; mineral phases: plag, px; 10x5x4 cm

Samples at: GZN

MSM82-73-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°42.56 S, 39°33.11 W
Date and Time Start (UTC): 18.04.2019, 14:39
Depth Start [m]: 3068

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare, rounded and partly filled with calcite; phenocrysts of plag and ol (15% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 10x10x5 cm

Samples at: GZN

MSM82-73-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°42.56 S, 39°33.11 W
Date and Time Start (UTC): 18.04.2019, 14:39
Depth Start [m]: 3068

Sample description:
Weathered fine- to medium-grained limestone with thin MnOOH coating on surface; 10x10x5 cm

Samples at: GZN

MSM82-74-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°11.84 S, 39°11.10 W
Date and Time Start (UTC): 18.04.2019, 22:23
Depth Start [m]: 2761

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; thin MnOOH crust on surface (up to 0.5 cm); strong alteration along fractures; vesicles are common, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (5% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 10x5x5 cm

Samples at: GZN

MSM82-74-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°11.84 S, 39°11.10 W
Date and Time Start (UTC): 18.04.2019, 22:23
Depth Start [m]: 2761

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; thick MnOOH crust on surface (up to 2 cm); strong alteration along fractures; vesicles are common, rounded and partly filled with calcite; phenocrysts of mainly ol and few of px and plag (10% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 7x7x5 cm

Samples at: GZN

MSM82-74-DR-3

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°11.84 S, 39°11.10 W
Date and Time Start (UTC): 18.04.2019, 22:23
Depth Start [m]: 2761

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; thin MnOOH coating on surface; strong alteration along fractures; vesicles are common, rounded and secondary filled with calcite; phenocrysts of ol and px (10% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 7x7x5 cm

Samples at: GZN

MSM82-74-DR-4

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°11.84 S, 39°11.10 W
Date and Time Start (UTC): 18.04.2019, 22:23
Depth Start [m]: 2761

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; thin MnOOH crust on surface (up to 0.5 cm); strong alteration along fractures; vesicles are common, rounded and partly filled with calcite; phenocrysts ol and px (10% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 7x7x5 cm

Samples at: GZN

MSM82-74-DR-5

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°11.84 S, 39°11.10 W
Date and Time Start (UTC): 18.04.2019, 22:23
Depth Start [m]: 2761

Sample description:
Basalt with porphyritic texture and fine- to medium-grained matrix; thick MnOOH crust on surface (up to 1.5 cm); strong alteration along fractures; vesicles are common, rounded and partly filled with calcite; phenocrysts ol and px (10% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 7x7x5 cm

Samples at: GZN

MSM82-74-DR-6

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°11.84 S, 39°11.10 W
Date and Time Start (UTC): 18.04.2019, 22:23
Depth Start [m]: 2761

Sample description:
Volcanic Breccia composed of angular to sub-rounded reddish fragments of fine-grained volcanic material bounded by a greyish fine-grained matrix; thin MnOOH coating on surface; strong alteration along fractures; 15x7x5 cm

Samples at: GZN

MSM82-75-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°13.64 S, 39°12.80 W
Date and Time Start (UTC): 19.04.2019, 01:31
Depth Start [m]: 2519

Sample description:
Volcanic rock with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; strong alteration along fractures; vesicles are common, elongated and partly filled with calcite; phenocrysts of weathered plag (10% of matrix); matrix composed of plag and px; 5x5x5 cm

Samples at: GZN

MSM82-76-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of plag, px and ol (40% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 10x10x8 cm

Samples at: GZN

MSM82-76-DR-2

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 0.5 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (5% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 13x8x4 cm

Samples at: GZN

MSM82-76-DR-3

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 1 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (5% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 18x14x6 cm

Samples at: GZN

MSM82-76-DR-4

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 1 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (10% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 14x10x4 cm

Samples at: GZN

MSM82-76-DR-5

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 1 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (< 5% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 15x7x3 cm

Samples at: GZN

MSM82-76-DR-6

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thick MnOOH crust on surface (up to 1.5 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (5% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 16x12x4 cm

Samples at: GZN

MSM82-76-DR-7

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 0.5 cm); weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (10% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 7x4x2 cm

Samples at: GZN

MSM82-76-DR-8

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°14.23 S, 39°29.56 W
Date and Time Start (UTC): 19.04.2019, 06:16
Depth Start [m]: 2838

Sample description:
Basalt with porphyritic texture and fine-grained matrix; thin MnOOH crust on surface (up to 1 cm); alteration along fractures, fractures filled with calcite; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of mainly ol and few of px and plag (5% of matrix); ol completely replaced by iddingsite; matrix composed of plag and px; 7x6x3 cm

Samples at: GZN

MSM82-77-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°23.57 S, 39°55.04 W
Date and Time Start (UTC): 19.04.2019, 13:03
Depth Start [m]: 3080

Sample description:
Very dense medium-grained limestone with thin MnOOH coating on surface; 50x50x10 cm

Samples at: GZN

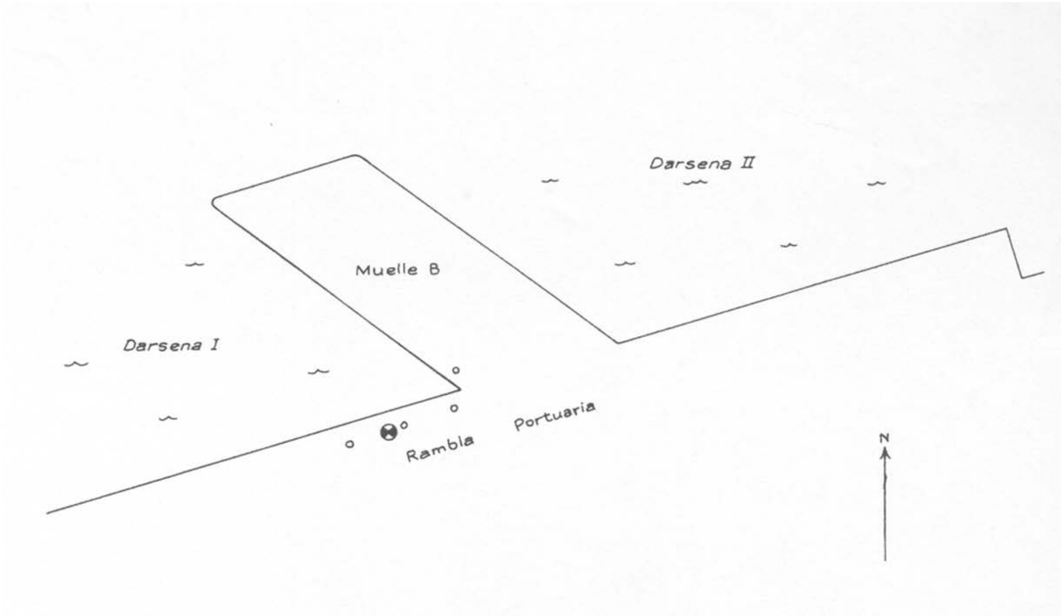
MSM82-80-DR-1

Locality description: Northern Jean Charcot Seamount Chain
Location: 26°20.52 S, 40°00.68 W
Date and Time Start (UTC): 20.04.2019, 02:12
Depth Start [m]: 2657

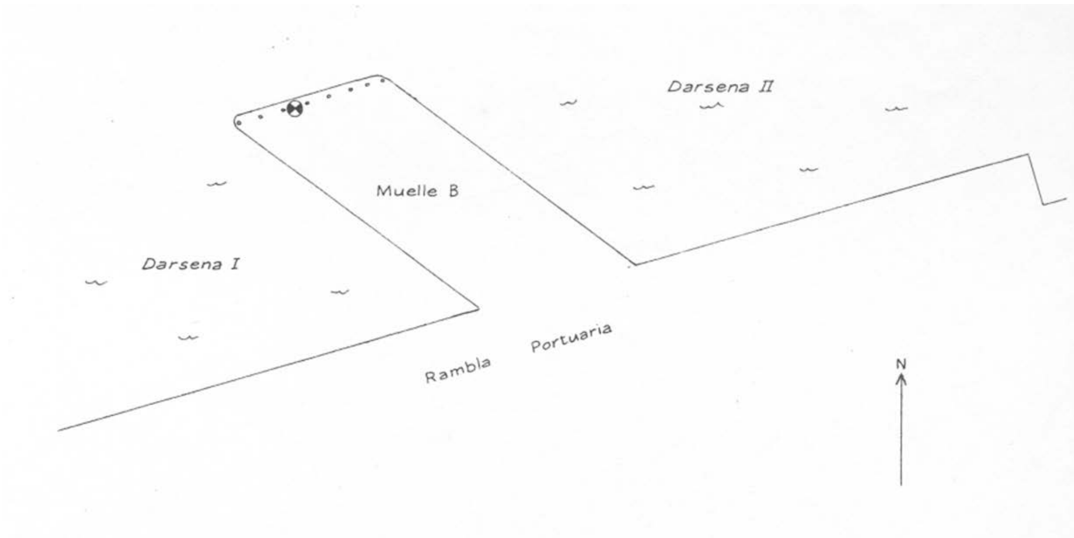
Sample description:
Fresh basalt with porphyritic texture and fine-grained matrix; thin MnOOH coating on surface; weak alteration along fractures; vesicles are rare, rounded and secondary filled with calcite; phenocrysts of ol, px and plag (20% of matrix); ol partly replaced by iddingsite; matrix composed of plag and px; 30x10x10 cm

Samples at: GZN

11.2 Gravity Reference Points



Sketch of location of reference point "Darsena I Quay" (106171) in Montevideo Harbor (source: BGI website http://bgi.omp.obs-mip.fr/).



Sketch of location of reference point "Darsena I Quay" (106171) in Montevideo Harbor (BGI website: http://bgi.omp.obs-mip.fr/).

11.3 Bird Species & Other Marine Fauna

Wandering Albatross (*Diomedea exulans*). Photo credit: Jean Purdon.

Great Shearwater (*Ardenna gravis*). Photo credit: Jean Purdon.

White-chinned Petrel (*Procellaria aequinoctialis*). Photo credit: Jean Purdon.

Cory's Shearwater (*Calonectris borealis*). Photo credit: Jean Purdon.

Atlantic Petrel (*Pterodroma incerta*). Photo credit: Jean Purdon.

Spectacled Petrel (*Procellaria conspicillata*). Photo credit: Jean Purdon.

Atlantic Yellow-nosed Albatross (*Thalassarche chlororhynchos*). Photo credit: Jean Purdon.

Great-winged Petrel (*Pterodroma macroptera*). Photo credit: Jean Purdon.

White-bellied Storm-Petrel (*Fregetta grallaria*). Photo credit: Jean Purdon.

Soft-plumaged Petrel (*Pterodroma mollis*). Photo credit: Jean Purdon.

Sooty Albatross (*Phoebetria fusca*). Photo credit: Jean Purdon.

Trindade Petrel (*Pterodroma arminjoniana*). Photo credit: Jean Purdon.

Antarctic Prion (*Pachyptila desolata*). Photo credit: Jean Purdon.

Black-browed Albatross (*Thalassarche melanophris*). Photo credit: Jean Purdon.

Light-mantled Albatross (*Phoebetria palpebrata*). Photo credit: Jean Purdon.

Subantarctic skua (*Catharacta antarctica*). Photo credit: Jean Purdon.

Flying fish (Family: *Exocoetidae*). Photo credit: Jean Purdon.

South American fur seal (*Arctocephalus australis*) – multiple sightings during transit. Photo credit: Jean Purdon.