IFM-GEOMAR REPORT

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Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

FS POSEIDON
Fahrtbericht / Cruise Report P379/1

Vulkanismus im Karibik-Kanaren-Korridor (ViKKi)

Las Palmas - Mindelo
25.01.-12.02.2009

Berichte aus dem Leibniz-Institut
für Meereswissenschaften an der
Christian-Albrechts-Universität zu Kiel

Nr. 28
June 2009

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* For the description of samples recovered from Rocket Seamount see report of cruise POS 379/2 (MARRVi).

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Front page photos: POS 379/1 scientific party.

1. Scientific Party & Crew

Scientific Party

Svend Duggen	IFM-GEOMAR[1]	Chief Scientist
Sandra Meissl	IFM-GEOMAR[1]	Petrology / Bathymetry
Nazli Olgun	IFM-GEOMAR[1]	Petrology / Volcanology
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Boris Kisjeloff	IFM-GEOMAR[1,*]	Bathymetry
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Andrés Cianca	ICCM[2,#]	Oceanography
Carolina Llerandi	ICCM[2,#]	Oceanography
Rayco Morán	ICCM[2,#]	Oceanography

[1] IFM-GEOMAR, Leibniz Institute of Marine Sciences at the University of Kiel
[2] Instituto Canario de Ciencias Marinas

[*] On board 25. Jan. – 28. Jan. for multi-beam installation and calibration
\# On board 25. Jan. – 28. Jan. for buoy maintenance and CTD sampling

Proponents of the proposal for ship time for the R.V. Poseidon from the Steuergruppe Mittelgroße Forschungsschiffe were: Colin Devey, Svend Duggen, Ingo Grevemeyer, Thor Hansteen, Kaj Hoernle and Thomas Kokfelt (alphabetical order).

Crew

Michael Schneider	Captain
Theo Griese	First mate
Bernhard Windscheid	Second mate
Hans-Otto Stange	First engineer
Günther Hagedorn	Second engineer
Hendrik Schmidt	Electrician
Rüdiger Engel	Motorman
Joachim Mischker	Bosun
Ronald Kuhn	Ship mechanic
Kai Riedel	Ship mechanic
Bernd Rauh	Ship mechanic
Jürgen Sauer	Ship mechanic
Pedro Barbosa	Seaman
Volkhardt Falk	Cook
Bernd Gerischewski	Steward

2. Introduction and Scientific Background

After their creation at the spreading axes, the oceanic plates are subject to progressive alteration and ageing, leading to significant changes in their chemistry, mineralogy and structure. Intraplate volcanism plays a major role in this context, by substantially changing the bulk chemistry of the crust and by creating pathways and thermal gradients that stimulate fluid circulation. Intraplate volcanoes are present either as age-progressive chains (hotspots) or as isolated seamounts, of which several tens of thousands are found on the Pacific plate alone. Despite this abundance, very little is known about the processes leading to their creation or their precise influences on the chemistry and structure of the plate. All that is known is that they are strongly distinct, geochemically, from the crust on which they are built, probably as a result of heterogeneity in the mantle source from which they stem. Why this mantle source is heterogenous, why it melts, and when and where it does is largely unknown.

We proposed a project ViKKi (**V**ulkan**i**smus im **K**aribik-**K**anaren-Korr**i**dor), specifically designed to investigate the causes for the origin of isolated intraplate volcanoes and their importance for the chemical evolution of the oceanic crust. Using the R.V. POSEIDON, we proposed to study selected seamounts in the eastern central Atlantic (Fig. 1) already known to show in some cases signs, from seismic measurements, of recent activity. We aimed to use a combination of mapping, seismology and sampling for subsequent geochemical analysis and age dating to help us determine why these volcanoes form where they do, how long they are active, and to what extent their activity changes the oceanic plate.

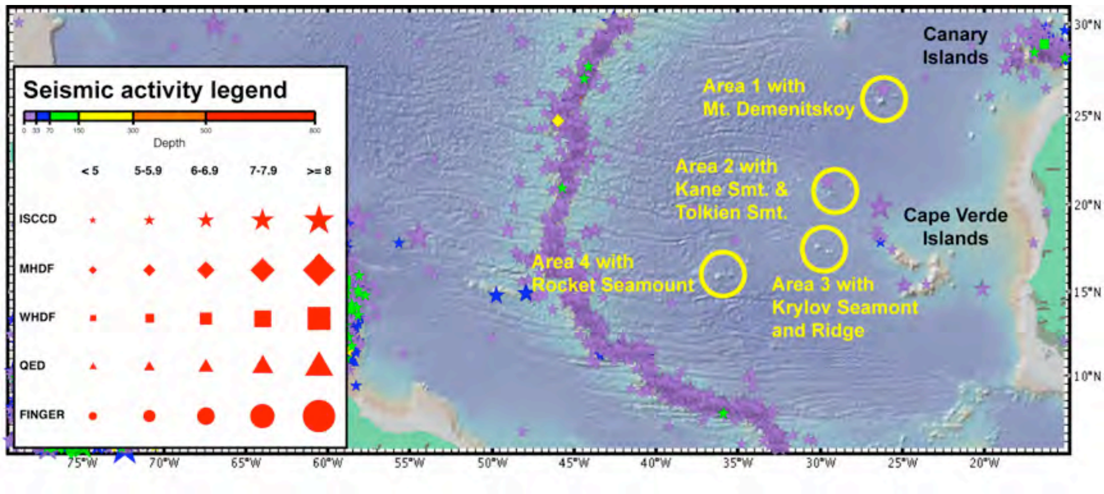


Figure 1*: Overview of the bathymetry and seismicity of the Carribean-Canary Corridor of the Central Atlantic Ocean. Also shown are the working areas with isolated seamounts (Mt. Demenitskoy, Kane Seamount, Krylov Seamount and Ridge, Rocket Seamount) or clusters of seamounts (Tolkien Seamount in the Three-Seamount-Chain) chosen as targets for the cruise POS 379/1 (ViKKi). Source: GeoMapApp.*

Isolated (solitary) seamounts (non-linear intraplate volcanism)

Despite their large number on the oceanic plates, isolated seamounts gained much less attention in the past decades than major structures such as mid-ocean ridges, archipelagos formed in hotspot areas and seamount chains. Isolated seamounts are most likely of igneous origin and may rise several kilometres above the surrounding deep sea floor. They are many (e.g. 70.000 occur in the Pacific Ocean alone) (Wessel and Lyons, 1997) and only a minor part has so far been named and sampled (see Seamount Catalog, http://earthref.org). Our incomplete knowledge about the causes for the origin of large isolated seamount is one of the major remaining riddles of the plate tectonic theory. Several possible mechanisms, however, exist. These are: 1) formation of a single seamount at or near a mid-ocean ridge and subsequent transport away from the mid-ocean ridge (MOR) as the oceanic basin ages (e.g. seamounts at the East Pacific Rise) (Niu et al., 1996), 2) a sole intraplate formation independent of any major neighbouring hotspot (e.g. Godzilla seamount in the eastern north Atlantic) (GELDMACHER et al., 2008; HAASE and DEVEY, 1994) and 3) initial formation at the MOR and subsequent re-activation in an intraplate setting.

While it is known that oceanic islands such as the Azores, Canaries and Cape Verdes are volcanically active, little information is available for isolated seamounts. Tele-seismic activity, however, reveals a magnitude 5 earthquake at the three kilometre tall, isolated Mt. Demenitskoy in 1976 (ISC Catalog) that may point to recent volcanic activity (Fig. 1). Hydrophone data also indicate increased seismic activity in the region between the Cape Verde Islands and the MOR, where several isolated seamounts are found. Only few geochemical and age data exist for isolated seamounts in the Carribean-Canary Corridor and neighbouring Atlantic areas that could provide constraints on their origin. Some geochemical data are available for slightly to moderately altered, partly biotite- and amphibole-bearing alkaline lavas from Tropic Seamount between the Canaries and Cape Verdes (Blum et al., 1996). More well-studied samples are amphibole- and phlogopite-bearing nephelinites of Cretaceous age from Godzilla Seamount located between the Madeira Archipelago and the Madeira-Tore Rise (GELDMACHER et al., 2008; HOERNLE et al., 2003). Lavas from Godzilla Seamount have an Enriched-Mantle I (EMI)-type geochemical composition and their origin was proposed to be associated with lithospheric/asthenospheric melting anomalies. To our knowledge, geochemical data and age constraints of the lavas from the isolated seamounts, selected for sampling during the POS 379/1 cruise (ViKKi), do not exist. Such data can provide new information for the origin of isolated seamounts and their role for the geochemical evolution of the oceanic lithosphere.

Hydrothermal alteration

The geochemical evolution of the oceanic crust starts already due after its formation at the MOR. High-temperature hydrothermal (ca. 200-400 °C) alteration is pronounced at the MOR and mostly affects oceanic crust less 10 m.y. old, although 30 % of the high-T alteration takes place within the first 1 m.y. (STAUDIGEL et al., 1981; STEIN and STEIN, 1994). As indicated in the literature, large-scale low-T alteration also mainly occurs within the first several million years after formation at the MOR (HAUFF et al., 2003; KROLIKOWSKA-CIAGLO et al., 2005). In the course of the formation of intraplate volcanoes, however, new hydrothermal systems may be activated on even old oceanic crust (Harris et al., 2004), which may have considerable consequences for the geochemical evolution of the oceanic crust. In such case it is unclear whether hydrothermal fluid flow solely affects the seamount structure or if fluids from the surrounding oceanic crust is entrained into the hydrothermal system. Geochemical analysis of recovered altered lavas and manganese crusts can provide new information on hydrothermal activity at isolated seamounts and its possible role for the chemical evolution of the oceanic crust.

3. Methods

ELAC multi-beam echosounder

Bathymetric information was generated by means of a mobile Seabeam 1000 system (ELAC Nautic GmbH). The ELAC system is build up by two transmitter/receiver units, motion sensor and CTD, which were installed in the moonpool (Hydrographenschacht) of the vessel Poseidon. GPS data stems from the vessel's DataVis-system. A first calibration was carried out in shallow water and a flat sea bottom to correct the bias between the ships vertical reference and the sonar. Supplementary a CTD was performed to obtain a sound velocity profile, determined by measuring the temperature, pressure and salinity.

The multi-beam-system was set at 50 kHz and to a 120° cover sector. Due to relatively great depth, the swath width was set between 60° and 80°. Data acquisition was done with the Hydrostar 3.4 software. The data were processed with the Mbsystem software package whereas MBedit was used for data editing and MBgrid for bathymetric grid calculation. Final bathymetric maps were realised in GMT. The 3D-Visualisation was done at IFM-GEOMAR with Fledermaus software. The ELAC multi-beam system is capable of giving trustful data down to a depth of around 2,000 m. Some of the areas of interest, however, were situated close to or below the recordable depth. We recognized a strong influence of weather conditions on the quality of the ELAC data. Under rough sea conditions it was only possible to record proper data if waves and swell came from astern. Together, 23 profiles in 4 areas were conducted during the cruise POS 379/1. Aim of the surveys was to provide bathymetric information of the summit region of selected seamounts and to determine areas of interest for dredging (preferentially relatively steep slopes).

For water depths greater than 2,000 m we used bathymetric data from previous cruises with research vessels permanently equipped with deep-sea multi-beam systems, if available. Alternatively, the single beam data, available from the DataVis system of the FS Poseidon with variable reliability was in some occasions used to add bathymetric information to that inferred from satellite altimetry.

The chain sack dredge

A fairly simple but effective way to obtain rock samples from seamounts is by dredging. Figure 2 shows a chain sack dredge used on POS 379/1 that weighs almost 500 kg. The bottom is open with a chain sack attached. Samples hauled into the dredge during the dredging process will usually fall into the chain sack and effectively be trapped there. During the POS 379/1 the dredge was mounted to a ca. 4,100 m long wire on the W3 heavy weight winch. With the given configuration sampling down to ca. 3,500 was possible, with several hundred metres in addition laid out on ground. The dredge can be used to sample the plateau region and flanks of seamounts and cone and ridge structures as well as the MOR axial valley and MOR shoulders. Inside the dredge four tubes are mounted in each corner, in which sediments can be trapped. Dredging and hauling is generally done with the winch rather than the ship.

Figure 2. *A chain sack dredge of the Department of Magmatic and Hydrothermal Systems at IFM-GEOMAR on the port side deck of the German research vessel Poseidon. Photo: POS 379/1 Scientific Party.*

4. Regional Geology and preliminary results

Isolated seamounts

The eastern central Atlantic basin hosts numerous isolated seamounts and clusters of several seamounts rising up to 3 km above the deep sea floor (Fig. 1). Some are only indicated from satellite altimetry (Smith and Sandwell, 1997) but the existence of others have already been reported from former cruises (e.g. Mt. Demenitskoy, Kane Seamount and Krylov Seamount).

Mt. Demenitskoy Seamount

The seamount measures ca. 55 km by 45 km at the base and rises up to ca. 1,770 mbsl at 25° 45´N, 26° 15´ W. In quite recent printed sea charts and in the Seamount Catalog (http://www.earthref.org/databases/SC/) the seamount appears as unnamed. On a recently updated electronic navigation sea chart of the R.V. Poseidon the name Mt. Demenitskoy was visible on the screen next to the location of the mountain, indicating that it has already been named on an earlier, presumably Russian cruise.

The about 3,200 m tall mountain is seen as a pronounced feature in the satellite altimetry. Its existence was recently confirmed by an E-W multi-beam profile made by the R.V. MARIA S. MERIAN (cruise MSM 4/3). During another cruise with the R.V. MARIA S. MERIAN in January 2009 the bathymetric mapping was largely completed by an additional N-S profile. The E-W-bathymetric profile indicated a part of a landslide scar at the southern edge of the plateau that was confirmed by an N-S bathymetric profile during the January 2009 cruise. A dive with a remotely operating vehicle (ROV) in January 2009 provided first pictures from the plateau (Fig. 3). The photos show dark sheet-like structures and lenses of white sand with ripples between.

Figure 3. *ROV photo from the plateau region of Mt. Demenitskoy at 1,770 mbsl showing lenses of sand with ripples between sheets of dark unknown material. Photo:* MSM 4/3 *Scientific Party.*

Dredging at Mt. Demenitskoy during the POS 379/1 cruise brought on deck a remarkably large range of lithologies. The rock types include well-lithified fossil-rich limestones covered by decimetre thick manganese crusts, brown clay-siltstones, carbonaceous sandstones, conglomerate of carbonate-matrix supported rounded pebbles of brown clay-siltstones, Mn-Fe-oxide impregnated carbonate breccia, and finally lava.

A huge metre-size block was dredged due below the plateau at the southern end of Mt. Demenitskoy and is a fossil-rich limestone covered by decimetre thick manganese crusts. The surface looks very similar to that seen in the ROV images of the plateau region (Fig. 3), indicating that the plateau is a carbonate platform covered by relatively thick manganese crust. The dark sheet-like structures on the plateau are therefore most likely manganese crusts rather that pahoehoe lava flows that may have very similar appearance. The range of carbonates and their fossil content obtained strongly suggests that the summit area of the seamount has been close to the sea level in an earlier stage of its evolution.

The vesicular lavas recovered are basaltic and, as indicated from the mineralogy (ca. 1 % olivine that is completely altered to iddingsite and ca. 2 % plagioclase), most likely tholeiites. Pillow fragments with palagonitised former glass rinds are associated with strongly altered hyaloclastites, suggesting eruption in a submarine environment. If the basalts are indeed tholeiites, then apparently the tholeiitic shield stage of the seamount (or former ocean island) was sampled, which needs to be tested by geochemical analysis. Although plagioclase phenocrysts are mostly altered, fresh parts contained may allow age dating by means of the laser-Ar/Ar method. Together, Mt. Demenitskoy appears to be a guyot with a carbonate platform some 100-200 m thick. The mountain may previously have been an ocean island with subaerial erosional processes in the summit area and coral reef growth at shallow water depths. Based on the preliminary results, the volcano was most likely formed in the vicinity of the mid-ocean ridge. If this is correct, then its origin in a geodynamic context, including mantle melting processes, would have to be explained by (near-) MOR processes, eventually involving a mantle plume or more likely, as Mt. Demenitskoy is an isolated seamount, a single major blob of enriched mantle material.

Kane Seamount

The seamount lies at 21° 09´ N, 28° 02´ W and the depth of the summit area is much deeper than indicated in the literature (Lowrie et al., 1978). We measured the depth to ca. 3,700 mbsl using the single beam echo sounder, consistent with the on board sea chart. The paper of Lowrie et al. shows a map with depth but does not indicate what the unit numbers refer to, neither in the map or elsewhere in the paper. We suspect that the numbers given in the map of Lowrie et al. are fathoms, so that 2000 below the sea level for the summit area corresponds to ca. 3,700 m (factor of ca. 1.85).

Tolkien Seamount

The seamount is located at 20° 37´ N, 29° 20´ W (Fig. 1) and has so far been unnamed both in the Seamount Catalog (http://www.earthref.org/databases/SC/) and in on-board printed and electronic sea charts. The seamount is the easternmost one of a NW-SE-trending chain of three seamounts that we here name “Three-Seamount-Chain”. To our knowledge no bathymetric data other than satellite altimetry has so far been available for this seamount system.

Since the summit area is below the range of our ELAC multi-beam, we used the night to sail several profiles across the mountain (E-W, N-S, SE-NW, NE-SW). The single beam data, continuously saved to the onboard DataVis system together with the position and other ship parameters, was extracted and displayed in three dimensions using Fledermaus software. According to these data, the summit raises to ca. 2,750 mbsl and thus ca. 2,000 m above the ocean floor (at 4,700 mbsl).

A dredge haul performed at the summit area brought on deck foraminifera sand in the sediments traps. A second deep dredge haul upslope the SW flank from 3,400 to 3,000 mbsl recovered numerous subangular to rounded fragments of basaltic lava embedded in moderately lithified carbonate with manganese crusts. Some lava pieces indicate pillow lava textures. The lava is almost non-vesicular to non-vesicular and moderately to strongly altered. Foraminifera sand and carbonate mud was found in the sediment traps. With the samples available we name this seamount Tolkien Seamount in honour of J.R. Tolkien and his books "The Hobbit " and "The Lord of the Rings".

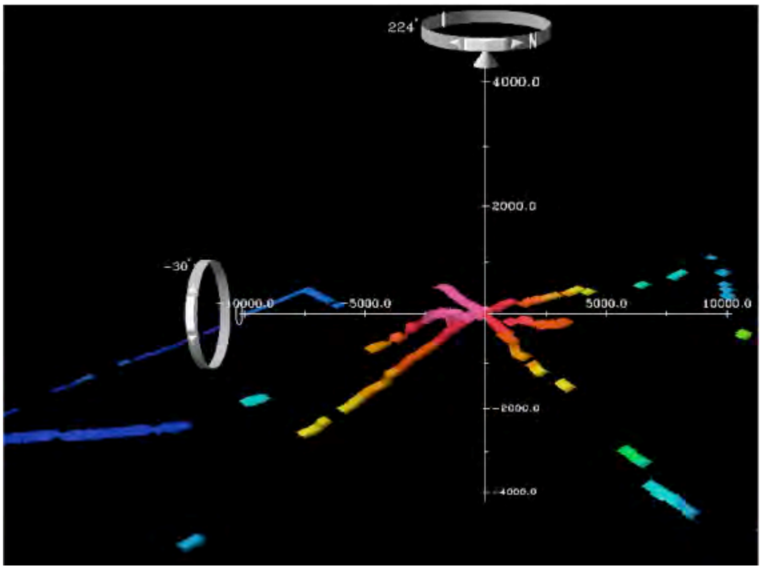


Figure 4. *Tolkien Seamount of the "Three Seamount Chain". The bathymetry is in parts visualised using single beam echo sound data that is displayed by means of Fledermaus software. View is towards the southwest. Axis numbers refer to metres. Exaggeration is 2.5-fold.*

Krylov Seamount

The seamount is located at 17° 31,0´ N, 30° 07,5´ W and thus ca. 300 km west of the Cape Verde Archipelago (Fig. 1). The seamount has been visited in the 1960ies in the course of a geological-geophysical survey by the Russian R.V. Akademik Nikolai Strakhov and was named Krylov Seamount. A two-dimensional bathymetric W-E profile was reported, arguing for a central caldera that is elongated in N-S direction. One main goal of the Russian cruise was to obtain manganese crusts, the mineralogy and major and trace element composition of which was presented in the literature (VARENTSOV et al., 1991a; VARENTSOV et al., 1991b). The manganese crust composition indicates initial growth under the influence of hydrothermal activity, whereas the later stage grew solely through hydrogenetic precipitation. Varentsov et al. report the finding of poorly differentiated sub-alkali to alkali basalts and hyaloclastites recovered together with manganese crusts with two dredge hauls; one at 2,000 m depth in what is considered a caldera and one at 2,740 m depth at the eastern slope of the seamount. The caldera was argued being filled with volcanic breccia. Basalts and hyaloclastites appear to have been hydrothermally altered to variable extent. The flanks down to 4,000 m depth are apparently to a large extent covered by manganese crusts on altered volcanic rocks, whereas marine sediments such as carbonate sand and bioclastic sediments onlap the outer and deeper sections of the flanks. The western shallower part of the seamount was suggested being covered by bioclastic limestone.

Our mapping survey using the ELAC multi-beam reveals a somewhat different bathymetry (Fig. 5). The data illustrate, from east to west, a cone that is about 10 km wide at 2,200 mbsl and raises to ca. 1,240 mbsl; a ca. 5 km wide morphological depression rather than a caldera, followed by a ca. 15-20 km long ridge rising to 1,700-1,900 mbsl. We name the structures Krylov Seamount and Krylov Ridge, respectively. Worth noting is that the Krylov-system is oriented largely perpendicular to the MOR, which has implications for any geodynamic explanation of the origin of the system.

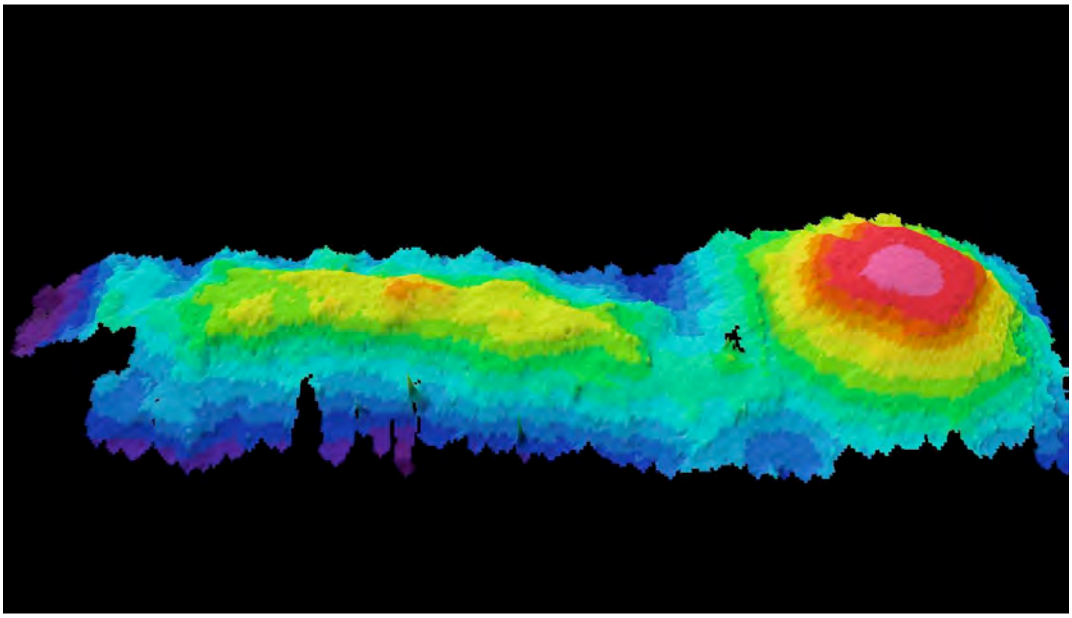


Figure 5: *3D-bathymetric data for the ca. 35 km long Krylov system (here named Krylov Ridge in the west and Krylov Seamount in the east). The image was generated by means of Fledermaus, using the ELAC multi-beam data of the cruise POS 379/1.*

Three dredge hauls at Krylov Seamount recovered variably, partly hydrothermally, altered lavas such as hyaloclastites, pillow fragments and pieces from lava flows. The mineralogy of the lavas indicate a considerable range in magmatic differentiation. Also found was foraminifera sand in the sediment traps, moderately to well-lithified sediments such as foraminifera carbonaceous sandstone (apparently lithified counterparts of the foraminifera sand), and corals. Four dredge hauls at Krylov Ridge recovered moderately to strongly altered lavas, mainly hyaloclastites and fragments of basaltic pillow lava. In general, the lava at Krylov Ridge appears to be basaltic, i.e. the samples show less degree of differentiation than those of the neighbouring Krylov Seamount. Foraminifera sand was found in the sediment traps. The dredge haul also recovered moderately to well-lithified sediments such as foraminifera carbonaceous sandstone, and corals. Biological activity seems to have been particularly abundant at the Krylov system in post-glacial times.

5. Cruise Narrative

Pre-cruise preparation

As part of the pre-cruise preparation we had to respond to an enquiry of the U.S. Navy regarding the coordinates of the working areas and a timetable in order to route submarines around safely as needed. The enquiry from January 8 was responded to immediately by providing coordinates and timetable (Table 1).

January 25th, 2009 – Sunday

The participating scientists from Germany arrived at Las Palmas. One container was already placed and lashed on the rear deck the day before. A second container was unloaded by the ship crew and left behind in Las Palmas. The scientific party started unloading the scientific equipment from the container on the rear deck with the aid of the ship crew. The bathymetry crew immediately started mounting the mobile ELAC multi-beam in the moon pool and to set up the electronic steering system in one of the laboratories (Trockenlabor).

January 26th, 2009 – Monday

The Spanish scientists from ICCM embarked Monday morning, bringing on board additional scientific equipment. A track due northeast Gran Canaria was chosen for calibration of the ELAC multi-beam. The vessel then headed for the buoy ESTOC ca. 60 nm north of Gran Canaria. On the way, the Spanish scientists used the CTD to take water samples down to ca. 2.500 m depth. In the meantime the remaining german scientists started to equip the other laboratory.

January 27th, 2009 – Tuesday

The vessel reached the buoy early in the morning. It turned out that the swell was too high for maintenance of the buoy at the side of the ship as planned and the vessel therefore headed back to Las Palmas. The German scientists finalised equipping the laboratories. Due after arrival to the harbour the Spanish scientist disembarked.

January 28th, 2009 – Wednesday

The R.V. Poseidon left the harbour of Las Palmas. Transit to the first working area, seamount Mt. Demenitskoy. The scientific party processed ELAC multi-beam data and checked and maintained the remaining scientific equipment.

January 29th, 2009 – Thursday

Vessel on transit to the first working area, Mt. Demenitskoy (Fig. 1). The scientific party prepared the dredge in order to be ready for dredging at working area 1. The chief scientist gave a power point introduction in the evening presenting the scientific goals and background of the cruise to the remaining scientific party and interested members of the ship crew.

Table 1:
Coordinates of the working areas and the timetable sent to the U.S. Navy Jan. 2009.

	Start (earliest)	End (latest)	Longitude	Latitude	Longitude	Latitude	Planned work
Working area 1 With unnamed seamount in box defined by:	28. Jan. 6 am	05. Feb. 6 pm	26.9°W	26.4°N	25.6°W	26.4°N	Bathymetric mapping using multi-beam-echosounder. Sampling of geological material by dredging (to max. 3500 mbsl).
			26.9°W	25.3°N	25.6°W	25.3°N	
Working area 2 With unnamed and Kane seamount(s) in box defined by:	30. Jan. 6 am	08. Feb. 6 pm	30.5°W	21.5°N	27.5°W	21.5°N	Bathymetric mapping using multi-beam-echosounder. Sampling of geological material by dredging (to max. 3500 mbsl).
			30.5°W	20.0°N	27.5°W	20.0°N	
Working area 3 With unnamed and Krylov seamount(s) in box defined by:	01. Feb. 6 am	12. Feb. 6 pm	30.8°W	18.0°N	28.8°W	18.0°N	Bathymetric mapping using multi-beam-echosounder. Sampling of geological material by dredging (to max. 3500 mbsl)
			30.8°W	16.8°N	28.8°W	16.8°N	
Working area 4 With unnamed and Rocket seamount(s) in box defined by: Incl. harbour stay in Mindelo, Cabo Verde	02. Feb. 6 am	23. Feb. 6 pm	38.0°W	17.0°N	34.0°W	17.0°N	Bathymetric mapping using multi-beam-echosounder. Sampling of geological material by dredging (to max. 3500 mbsl).
			38.0°W	14.5°N	34.0°W	14.5°N	
Working area 5 With Mid-Atlantic Ridge and seamounts in box defined by:	21. Feb. 6 am		47.2°W	18.0°N	44.0°W	18.0°N	Bathymetric mapping using multi-beam-echosounder. Sampling of geological material by dredging (to max. 3500 mbsl).
			47.2°W	12.5°N	44.0°W	12.5°N	
			46.0°W	15.5°N	44.0°W	15.5°N	Deploying magnetotelluric equipment at the seafloor for magnetic field measurements.
		04. March 6 pm	46.0°W	12.5°N	44.0°W	12.5°N	Ca. 12 devices each of ca. 20 m x 20 m x 20 m size. Standing time ca. 5 weeks.
Working area 6 With Researcher Ridge seamounts in box defined by:	22. Feb. 6 am	07. March 6 pm	52.0°W	16.0°N	46.5°W	16.0°N	Bathymetric mapping using multi-beam-echosounder. Sampling of geological material by dredging (to max. 3500 mbsl).
			52.0°W	14.0°N	46.5°W	14.0°N	
							No dredging during transits between the working areas.

January 30th, 2009 – Friday

Vessel still on transit to the first working area, seamount Mt. Demenitskoy. The chief scientist introduced the remaining scientific party to the process of dredging and as to how to process, describe and store dredged samples on deck and in the laboratories. A schedule for overnight mapping with the ELAC multi-beam and the first dredge station was handed over to the Captain.

January 31th, 2009 – Saturday

During the night the edges of the plateau of Mt. Demenitskoy were mapped by means of the ELAC multi-beam at a speed of ca. 5 knots along an E-W profile in the northern, a N-S profile in the western and an W-E profile along the southern margin of the plateau. General wave (swell) direction was from the north. The overnight mapping was terminated in time in order to arrive at the dredge location at sunrise (dredging was only possible during the day).

The first dredging location (DR 1) chosen was one of the ROV (Remotely Operating Vehicle) dives performed two weeks earlier during a cruise with the R.V. M.S. MERIAN (Fig. 3). Based on the ROV camera images the surface of the plateau was at ca. 1,770 mbsl, was characterised by dark sheet-like structures from a first glance reminding of pahoehoe lava flows as found on ocean islands. In shallow depressions between the sheet-like structures lighter material with ripples was accumulated, most likely sand. Since the swell was too high, dredging was postponed for safety reasons. As an alternative working programme, bathymetric mapping of the edges of the plateau was continued.

February 1st, 2009 – Sunday

At sunrise the vessel arrived to dredging position DR 1 (Table 2). A single dredge haul at 1,770 m mbsl on the plateau of Mt. Demenitskoy recovered two fossil corals (see section *7.1. Samples recovered from Mt. Demenitskoy*). A second dredge haul (DR2) at the southern rim of the plateau, in the upper section of the landslide scar-like structure, brought on deck a large, metre-sized flat block and numerous cobbles. The block consists of limestone containing shells of mussels, corals, serpulides etc. and a thick layer of manganese crust, on which more recent corals were found. Numerous cobbles recovered together with the block are slightly rounded pieces of carbonate and clay- to sandstone often overgrown by manganese crusts of variable thickness. A third dredge haul (DR3) was performed on a cone-like structure at the western flank of Mt. Demenitskoy and brought on deck two boulders of Mn-oxide impregnated biogenic carbonate breccia with thick Mn-crusts. At the end of the day the vessel returned to DR1 in order to measure the water sound speed, using a water sonic probe mounted to the CTD. Better constraints on the water sound speed can improve the multi-beam data quality.

February 2nd, 2009 – Monday

At sunrise the vessel arrived at the eastern flank of Mt. Demenitskoy. The bathymetry revealed two east-west trending ridge structures at about 3,000-3,200 mbsl. One dredge haul at the southern ridge structure did not recover any samples (DR 4). While the swell was increasing there was time for a last second dredge haul at the northern ridge structure (DR5). This dredge haul finally brought on board basaltic lavas from ca. 3,300 mbsl. The lavas are mostly variably altered pillow fragments with entirely palagonitised former glass rinds and strongly altered hyaloclastites. The pillow fragments are slightly to highly vesicular, nearly aphyric only containing ca. 1 % of completely altered former olivine and ca. 2 % of variably altered but partly fresh plagioclase. Due to increasing swell operations at Mt. Demenitskoy were terminated and the vessel headed for working area 2 further south.

February 3rd , 2009 – Tuesday

The night and the day was used for transit to the next working area. The scientists spent the day with sorting, washing, describing, cutting and packing the samples from Mt. Demenitskoy. Selected samples were prepared for further processing in the laboratories at IFM-GEOMAR as outlined in section *7. Sample description*. The night was scheduled for transit to Kane seamount and to find and map the summit area.

February 4th , 2009 – Wednesday

Kane seamount was found early in the morning but, unfortunately, its summit was detected to be located at 3,700 mbsl and thus too deep for dredging. Soon after leaving Kane seamount a few hours were spent above the deep sea basin at ca. 5,000 water depth with slacking and heaving most of the ca. 4,200 m long deep sea cable on winch W3 for maintenance reasons. In the evening the vessel arrived to the cluster of unnamed seamounts in working area 2, the eastern of which we named Tolkien Seamount. The night was used for bathymetric mapping as a preparation for dredging on the following day (Fig. 4).

February 5th , 2009 – Thursday

A dredge haul (DR6) at the summit area of Tolkien seamount recovered foraminifera sand from ca. 2,900 mbsl. A second dredge haul between 3,400 and 3,000 mbsl (DR7) recovered numerous samples of basaltic lava. The lava samples are subangular to rounded and partly reveal textures of pillow lavas, with former glass rinds completely altered to palagonite and sometimes altered hyaloclastite attached to basaltic lava fragments. The alteration varies from moderate to strong and colours of the basalts accordingly range from dark grey with some oxidation to strongly oxidised red-brownish or orange pieces. The lava fragments were embedded in moderately lithified carbonate and were matrix supported. The basaltic lava had thin, 1 mm, manganese crusts lacking at corners and edges of the subangular to rounded pieces. The carbonate was overgrown by ca. 1 cm manganese crust. The scientific party started processing the new samples. As sampling was successful and due to approaching increasing swell in the next days´ weather forecast the vessel headed for Krylov Seamount in working area 3 further south.

February 6th , 2009 – Friday

The night and daytime was used for transit and to complete processing of the samples from Tolkien Seamount. All samples so far obtained (from Mt. Demenitskoy and Tolkien Seamount) were stored in boxes in the container lashed on the rear deck. The bathymetry group prepared coordinates for five mapping tracks across Krylov Seamount, that were sailed in the evening and the following night.

February 7th , 2009 – Saturday

Early in the morning it turned out that the swell (actually two high crossing swells) was too high for station operation. A scheduled dredge haul was therefore postponed and the vessel continued with the remaining two bathymetric mapping tracks. In the meantime the bathymetry group processed the data obtained with the ELAC multi-beam, allowing a more detailed sampling of the seamount. It turned out that Krylov, rather than being a single seamount, consists of a seamount in the east and a neighbouring ridge in the west, here referred to as Krylov Seamount and Krylov Ridge (Fig. 5).

February 8th , 2009 – Sunday

Weather conditions were favourable for dredging. Three dredge stations were assigned based on wind-direction at Krylov Seamount (DR 8, DR9, DR10). These recovered variably, partly hydrothermally, altered lavas, such as hyaloclastites, pillow fragments and pieces from lava flows indicating some range in magmatic differentiation. Also found was foraminifera sand in the sediment traps, moderately to well-lithified sediments such as foraminifera carbonaceous sandstone (apparently lithified counterparts of the foraminifera sand), and corals. While dredging the scientific party as much as possible processed the new samples. During the night, bathymetric mapping of the Krylov system using the ELAC multi-beam was continued and tracks repeated. As swell and wave height were decreasing, re-mapping provided better bathymetric data.

February 9th , 2009 – Monday

Weather conditions were again favourable for dredging. Three dredge stations were assigned at Krylov Ridge: one at the eastern end (DR11), one in the centre (DR12) and one at the western end (DR13). The dredge hauls recovered moderately to strongly altered lavas, mainly hyaloclastites and fragments of basaltic pillow lava. In general the lavas at Krylov Ridge appears to be mainly basaltic with less range in magmatic differentiation, compared to those of Krylov Seamount. Foraminifera sand was found in the sediment traps. The dredge hauls also recovered moderately to well-lithified sediments such as foraminifera carbonaceous sandstone, and corals. The scientific party proceeded with processing the new samples. Due to decreasing swell and wave height, and because the vessel had to stay near the seamount for the night anyway, selected tracks for bathymentric mapping were repeated to optimise the bathymetric data quality (Fig. 5).

February 10th , 2009 – Tuesday

Weather conditions were favourable for dredging and one dredge haul was performed at the hill in the centre of Krylov Ridge (DR14) (Fig. 5). The dredge haul recovered a boulder of pillow lava and hyaloclastite similar to that found at deeper parts of the central Krylov Ridge the day before. The dredge contained some foraminifera-rich sediment and quite much biological and coral material, indicating that the hill hosts considerable biological activity. The schedule only allowed for one dredge station that day, as the vessel had to head for the harbour of Mindelo at the Cape Verdes Islands. In the meantime the scientific party continued processing the new samples.

February 11th , 2009 – Wednesday

Vessel on transit to Mindelo. The scientific party finalised processing the samples from cruise POS 379/1 (ViKKi).

February 12th , 2009 – Thursday
Vessel scheduled to arrive at Mindelo in the early morning. Harbour activity.

6. Station summary

Table 2: Summary of the dredge locations during the cruise POS 379/1 (ViKKi).

Date Time (UTC)	Station No.	Lat./Long. (start) Water depth	Lat./Long. (on bottom) Water depth	Lat./Long. (off bttm.) Water depth	Lat./Long. (end) Water depth	Operation Location
01.02.2009 8:45 - 10:41	DR1	25°47,07'N 26°14,34'W 1,760 m	25°41,13'N 26°14,12'W 1,758 m	25°47,43'N 26°13,94'W 1,737 m	25°47,43'N 26°13,75'W 1,737 m	Dredging Mt. Demenitskoy, plateau (R.V. Merian ROV dive station)
01.02.2009 11:30 - 14:01	DR2	25°45,55'N 26°13,19'W 2,390 m	25°45,59'N 26°13,01'W 2,381 m	25°45,99'N 26°12,76'W 1,923 m	25°46,10'N 26°12,56'W 1,897 m	Dredging Mt. Demenitskoy, slope at the southern edge of the plateau
01.02.2009 15:40 - 18:57	DR3	25°48,00'N 26°22,13'W 3,200 m	25°47,98'N 26°22,03'W 3,135 m	25°48,47'N 26°21,39'W 2,690 m	25°48,71'N 26°21,01'W 2,666 m	Dredging Mt. Demenitskoy, cone at the upper part of the west flank
02.02.2009 08:47 - 11:19	DR4	25°44,84'N 26°06,33'W 3,200 m	25°44,84'N 26°06,38'W 3,252 m	25°45,06'N 26°06,43'W 3,101 m	25°45,16'N 26°06,49'W 3,206 m	Dredging Mt. Demenitskoy E-W ridge at western flank
02.02.2009 12:10 - 14:56	DR5	25°47,52'N 26°05,14'W 3,400 m	25°47,64'N 26°05,18'W 3,350 m	25°48,06'N 26°05,00'W 3,120 m	25°48,18'N 26°04,99'W 3,200 m	Dredging Mt. Demenitskoy, another E-W ridge at western flank
05.02.2009 9:34 - 12:40	DR6	20°37,15'N 29°20,28'W 2,927 m	20°37,09'N 29°20,28'W 2,923 m	20°37,22'N 29°20,04'W 2,849 m	20°37,17'N 29°19,99'W 2,845 m	Dredging Tolkien Seamount, summit area
05.02.2009 13:43 - 19:10	DR7	20°34,24'N 29°23,16'W 3,300 m	20°34,22'N 29°23,08'W 3,386 m	20°34,90'N 29°22,47'W 3,100 m	20°35,07'N 29°22,12'W 3,053 m	Dredging Tolkien Seamount, southwestern flank
08.02.2009 09:30 - 11:25	DR8	17°31,32'N 30°04,19'W 2,090 m	17°31,41'N 30°03,87'W 1,950 m	17°31,49'N 30°03,20'W 1,750 m	17°31,50'N 30°03,20'W 1,750 m	Dredging Krylov Seamount, southwestern flank
08.02.2009 12:50 - 15:00	DR9	17°31,92'N 30°04,06'W 1,700 m	17°31,94'N 30°04,01'W 1,732 m	17°32,07'N 30°03,34'W 1,367 m	17°32,05'N 30°03,25'W 1,367 m	Dredging Krylov Seamount, western flank
08.02.2009 15:45 - 18:10	DR10	17°32,75'N 30°04,19'W 1,815 m	17°32,71'N 30°03,96'W 1,800 m	17°32,42'N 30°03,52'W 1,385 m	17°32,36'N 30°03,35'W 1,385 m	Dredging Krylov Seamount, western flank
09.02.2009 10:06 - 12:30	DR11	17°31,07'N 30°07,05'W 2,259 m	17°31,38'N 30°06,64'W 2,118 m	17°31,71'N 30°06,14'W 1,864 m	17°31,71'N 30°06,14'W 1,864 m	Dredging Krylov Ridge, southern slope of the eastern part of the ridge
09.02.2009 13:28 - 16:16	DR12	17°31,58'N 30°09,75'W 2,183 m	17°31,72'N 30°09,47'W 2,034 m	17°32,16'N 30°08,68'W 1,617 m	17°32,22'N 30°08,58'W 1,617 m	Dredging Krylov Ridge, southern slope of the central part of the ridge
09.02.2009 17:02 - 19:30	DR13	17°31,73'N 30°11,32'W 1,973 m	17°31,74'N 30°11,00'W 2,028 m	17°32,13'N 30°10,39'W 1,920 m	17°32,13'N 30°10,39'W 1,920 m	Dredging Krylov Ridge, southern slope of the western part of the ridge
10.02.2009 09:13 - 11:27	DR14	17°31,96'N 30°09,68'W 1,778 m	17°32,20'N 30°09,14'W 1,900 m	17°32,33'N 30°08,87'W 1,614 m	17°32,30'N 30°08,96'W 1,602 m	Dredging Krylov Ridge, hill in the central part of the ridge

7. Sample description

As soon as brought on deck new samples were sorted and washed. The first lava samples were immediately cut with the rock saw for an initial petrographic description, based on which the scientific party could decide to perform another dredge haul at the same location or to move on to the next dredge station. Other types of samples were eventually cut with the rock saw as part of the sample preparation procedure too. In general, volcanic rock samples were cut before manganese crusts in order to minimize the risk of cross-contamination (e.g. trace element concentrations can be orders of magnitude higher in manganese crusts than associated volcanic rocks).

The sample numbers include the cruise number (here POS 379/1), followed by the dredge number (DR1 to DR14) as outlined in the aforementioned station list (Table 2). The subsequent numbers and letters refer to the number and type of sample:

A – Archive sample (either the whole sample or a part of it is stored in the archive)

B – Biology sample (e.g. living organisms sampled and dried such as soft corals, sea stars, crabs etc.)

C – Corals and sponges (mostly skeletal and other hard material)

GC – Geochemistry part (most altered parts and surfaces and manganese crusts were removed from the volcanic rocks by means of the rock saw).

M – Mangenese crust

S – Sediment

TS – A ca. 3 cm by 1.5 cm, thin (3-5 mm) slice cut from the GC for thin section petrography.

V – Volcanic material

W – Working half for further laboratory procedures, if a sub-sample was stored in the archive.

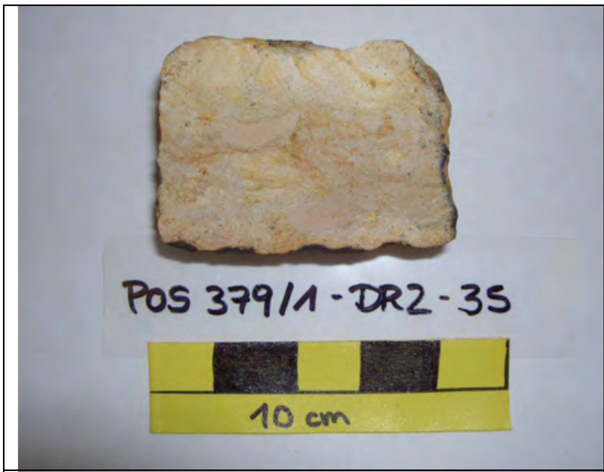
Letters may be combined, indicating that a sample contains two types of material, e.g. SM or VM for a sediment or volcanic rock having a relatively thick manganese crust. Thin sections and geochemistry pieces were transported back to the institute in the personal luggage, whereas all remaining samples and the equipment was shipped back with the container.

7.1. Samples recovered from Mt. Demenitskoy

	**POS379/1-DR1-1C** *Plateau of Mt. Demenitskoy, ca. 1,750 mbsl* 2 branching corals 10-12 cm high and covered with thin manganese-crust.
	**POS379/1-DR2-1B** *Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* Crab found dead in a cave of the large limestone boulder POS379/1-DR2-5SM. It hided red eggs under its body.
	**POS379/1-DR2-1C** *Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* Several pieces (1 to 6 cm) of corals covered by thin manganese-crust.

	**POS379/1-DR2-5SM** *Southern flank of Mt. Dementitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* Large 1.3 m by 0.3 m piece of a fossil-rich bioclastic limestone (probably reef detritus). The carbonate is covered by manganese crust up to 8 cm thick, of which the upper 3 cm are dense and well layered. This sample is be stored in the Lithothek at IFM-GEOMAR, except one ca. 20 cm by 10 cm piece of limestone, which will go to the archive (POS379/1-DR2-5SMA) and three subsamples of managenese crust (POS379/1-DR2-1M, -2M and -3M).
	**POS379/1-DR2-1M** *Southern flank of Mt. Dementitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* 3 cm thick and 15 cm long manganese crust subsample from large block (POS379/1-DR2-5SM). The upper 0.5 cm of the manganese-crust is denser and well laminated.
	**POS379/1-DR2-2M** *Southern flank of Mt. Dementitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* 7 cm thick, well laminated manganese crust (subsample from large block (POS379/1-DR2-5SM)). The upper section (2.5 cm) is black and denser than the lower section (4.5 cm), which contains brown, few mm thick iron-oxide layers.

	**POS379/1-DR2-3M** *Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* 6 cm thick, finely laminated manganese crust (subsample from large block (POS379/1-DR2-5SM)). Similar to -2M.
	**POS379/1-DR2-4M** *Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* Various pieces of manganese crust fragments found in the dredge. One piece has an interlayered chert-like lense (probably coral material).
	**POS379/1-DR2-1SM** *Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* Piece of clay-siltstone covered by a black, dense 1.5 cm thick manganese crust.
	**POS379/1-DR2-1S** *Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.* Several brown, angular to subrounded cobbles of clay-siltstone (2-15 cm), partly with sand layers. Several pieces are laminated and impregnated by Fe-Mn-oxides. One laminated piece containing a coral fragment is taken for thin section and geochemistry (**POS379/1-DR2-2S**). The remaining samples are stored in the archive.



POS379/1-DR2-3S

Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.

Several pale, yellowish cobbles of calcareous sandstone, 4 to 12 cm in diameter, and with rounded edges and corners. The samples are covered with a thin black manganese-crust, except on the rounded corners and show traces of drilling organisms. One half of a sample is taken for thin section and geochemistry, the other half is stored in the archive together with the remaining sandstone samples.

POS379/1-DR2-4S

Southern flank of Mt. Demenitskoy, due below the plateau at ca. 2,380-1,920 mbsl.

10 cm cobble of conglomerate with rounded pebbles (2 – 3 cm) of brown clay-siltstone (see POS379/1-DR2-1S). The pebbles are embedded in a pale white-yellowish limestone matrix and are matrix supported. The sample is stored in the archive.

POS379/1-DR3-1SM

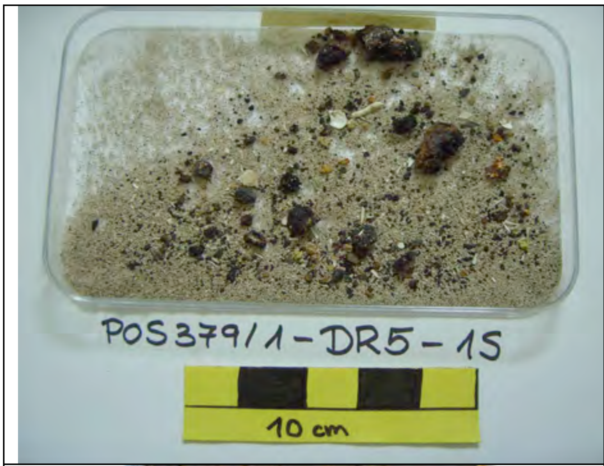
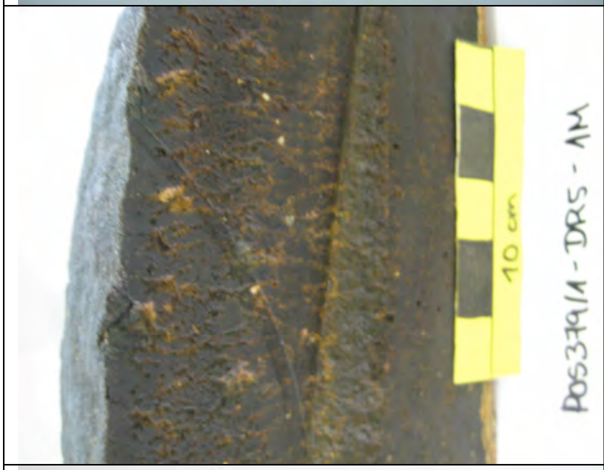
1 km high cone at the east flank of Mt. Demenitskoy, at ca. 3,140-2,690 mbsl.

15 cm piece of strongly Fe-Mn-oxide impregnated carbonate breccia, covered by 4 cm thick black and dense manganese crust.

POS379/1-DR3-2SM

1 km high cone at the east flank of Mt. Demenitskoy, at ca. 3,140-2,690 mbsl.

16 cm by 6 cm sample of Fe-Mn-oxide impregnated carbonate breccia with 5 cm thick manganese crust.

	**POS379/1-DR5-1SA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* Foraminifera sand (apparently with *G. Rubber white, G. Bulloides, G. Sacculifer*) from the sediment trap. Also found are fragments of various fossils and manganes-crusts. Stored in the archive.
	**POS379/1-DR5-1M** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* 28 cm long fragment of 12 cm thick manganese crust that is fairly porous and less laminated. Underneath is a 0.5-1 cm layer of palagonite and pieces of basaltic lava, indicating that the manganese crust grew on pillow lava with a (former) glass rind. The sample is stored in the archive.
	**POS379/1-DR5-1V** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* Angular cobbles of variably vesicular dark grey basaltic with ~1% oxidized olivine and ~2% plagioclase indicating a tholeiitic composition. Alteration is slight to moderate, partly strong. Vesicles are often not or only partly filled. Rims of palagonite may exist indicating former glass rinds as typically found on pillow lava. One half is taken for TS and GC, the other half is stored in the archive.
	**POS379/1-DR5-2VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. Sample found in the archive.

	**POS379/1-DR5-3V** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. One half of this sample is taken for thin section and geochemistry, the other half is stored in the archive.
	**POS379/1-DR5-4VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. Stored in the archive.
	**POS379/1-DR5-5VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. Stored in the archive.
	**POS379/1-DR5-6V** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. One half of this sample is taken for thin section and geochemistry, the other half is stored in the archive.

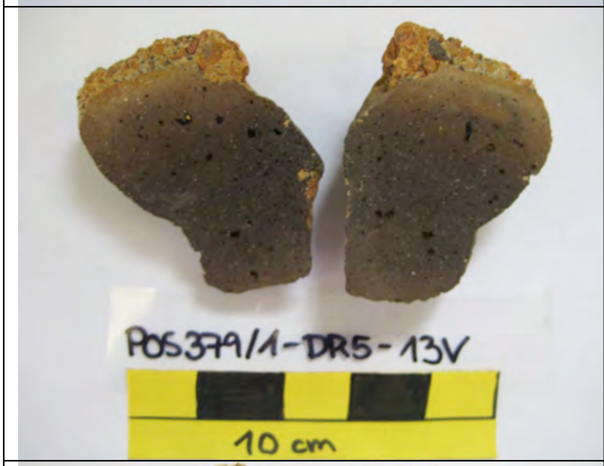
	**POS379/1-DR5-7VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. Stored in the archive.
	**POS379/1-DR5-8VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. Stored in the archive.
	**POS379/1-DR5-9V** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. One half of this sample is taken for thin section and geochemistry, the other half is stored in the archive.
	**POS379/1-DR5-10VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. Stored in the archive.

POS379/1-DR5-11VA
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. Stored in the archive.

POS379/1-DR5-12VA
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. Stored in the archive.



POS379/1-DR5-13VA
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. Stored in the archive.

POS379/1-DR5-14VA
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. Stored in the archive.

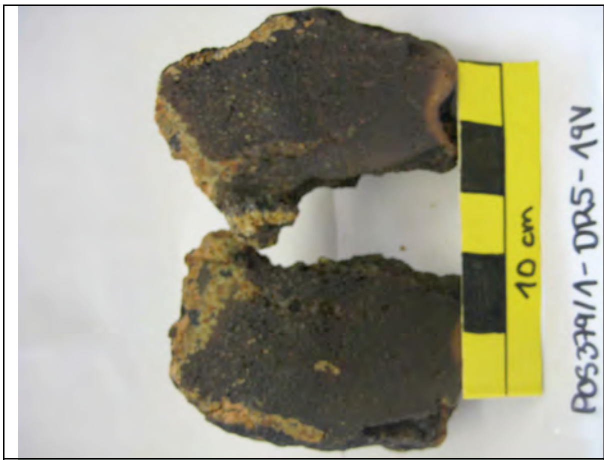
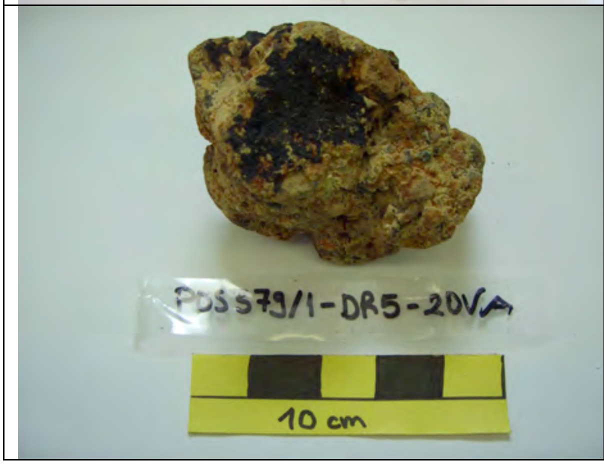
<table>
<tr><td>
</td><td>POS379/1-DR5-15V
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. One half of this sample is taken for thin section and geochemistry, the other half is stored in the archive.</td></tr>
<tr><td>
</td><td>POS379/1-DR5-16VA
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. Stored in the archive.</td></tr>
<tr><td>
</td><td>POS379/1-DR5-17VA
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. Stored in the archive.</td></tr>
<tr><td>
</td><td>POS379/1-DR5-18V
Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.

For description see POS379/1-DR5-1V. One half of this sample is taken for thin section and geochemistry, the other half is stored in the archive.</td></tr>
</table>

	**POS379/1-DR5-19V** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* For description see POS379/1-DR5-1V. One half of this sample is taken for thin section and geochemistry, the other half is stored in the archive.
	**POS379/1-DR5-20VA** *Ridge structure at the eastern flank of Mt. Demenitskoy at ca. 3,350-3,120 mbsl.* Strongly altered hyaloclastite with palagonite. Stored in the archive.

7.2. Samples recovered from Tolkien Seamount

<table>
<tr>
<td></td>
<td>POS379/1-DR6-1S
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Sand from the sediment traps containing planktonic and benthic foraminifera and fragements of fossils.</td>
</tr>
<tr>
<td></td>
<td>POS379/1-DR7-1S
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Light pink to red clay from the sediment traps.</td>
</tr>
<tr>
<td></td>
<td>POS379/1-DR7-2S
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Foraminiferous sand with pelagic forms like Globigerina from the sediment traps.</td>
</tr>
</table>

POS379/1-DR7-1C
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Moderately lithified limestone with manganese crust with remnants of a single coral on the surface.

POS379/1-DR7-3S
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Several 5 cm to 15 cm fragments of slightly lithified carboniferous mud with a thin manganese crust.

POS379/1-DR7-4S
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

5 cm by 10 cm matrix supported breccia. The matrix is similar to **DR7-3S**. The up to 2 cm clasts are angular fragments of lava and palagonitised former glass rinds.

POS379/1-DR7-5S
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Several 5 cm to 25 cm pieces of pink limestone similar to **DR7-3S** but more lithified. The samples have manganese crusts up to 3 cm thick.

	**POS379/1-DR7-6SM** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 4.5 cm – 7 cm pink limestone similar to **DR7-5S** with 1.5 cm manganese crust.
	**POS379/1-DR7-7SM** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 5 cm – 12 cm limestone similar to **DR7-5S** with 1.5 cm manganese crust.
	**POS379/1-DR7-8SM** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* limestone similar to **DR7-5S** with 3 cm manganese crust and some single corals on the surface.
	**POS379/1-DR7-9SM** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 8 cm fragment of breccia similar to **DR7-4S** with 3 cm manganese crust. The sample contains also palagonitised lava fragments.

	**POS379/1-DR7-1V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 4,5 cm subangular. moderately altered, most likely basaltic lava fragment. Former phenocrysts are completely altered to brown oxides. Pseudomorphs indicate that these were ferromagnesian minerals such as olivine and clinopyroxene (ca. 3%). The matrix is dense, basically non-vesicular and contains frequent feldspar (plagioclase) needles. Some small vesicles seem to have been present and are now filled with secondary minerals (<1%). The sample was selected for thin section and geochemistry.
	**POS379/1-DR7-2V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 4 cm fragment of probably basaltic pillow lava with ca. 10% pseudomorphs (brown oxides) indicating former ferromagnesian minerals (e.g. ol, cpx). Vesicles (<2%) are small and now filled with secondary minerals. A 6 mm palagonite rim indicates a former glass rind. Phenocrysts are entirely altered but alteration in the dense matrix is only moderate. The matrix is less crystallized than in sample **DR7-1V**. The sample was selected for thin section and geochemistry.
	**POS379/1-DR7-3V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 5 cm by 3 cm lava fragment, which is very similar to **DR7-1V**. The sample was selected for thin section and geochemistry.
	**POS379/1-DR7-4V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 4 cm by 3 cm lava fragment similar to **DR7-1V**. The sample was selected for thin section and geochemistry.

POS379/1-DR7-5V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

4 cm by 2.5 cm lava fragment similar to **DR-7 2V** but with 0.8 cm manganese crust. The sample shows an alteration front 5 mm thick (red-brownish), while the centre is less, but still moderately altered.

POS379/1-DR7-6V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

2.5 cm by 2 cm lava pebble very similar to **DR-7 2V**.

POS379/1-DR7-7V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

3 cm by 3cm lava fragment very similar to **DR-7 2V**.

POS379/1-DR7-8V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

16 cm by 10 cm piece of cracked pillow lava with 2 cm manganese crust. The sample is similar to **DR7-2V** but alteration is more variable, including some grey less altered domains. The sample was selected for thin section and geochemistry.

POS379/1-DR7-9V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

6 cm by 4 cm lava fragment very similar to **DR-7 1V** but is much more altered (red-brown). The sample was selected for thin section and geochemistry.

POS379/1-DR7-10V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

4 cm by 3 cm lava fragment very similar to **DR-7 1V** but is much more altered (red-brown). The sample was selected for thin section and geochemistry.

POS379/1-DR7-11V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

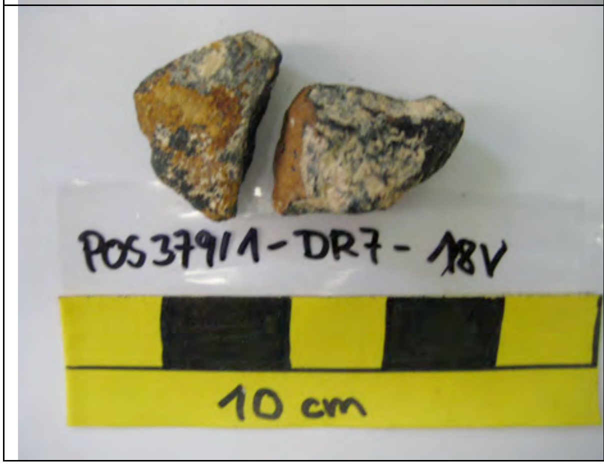
7 cm by 5 cm pillow lava fragment similar to **DR7-1V**. Alteration changes from the rim to the centre from strong (red-brown) to moderate inward greyish-brown. Two sections (one more and one less altered) were selected for thin section and geochemistry.

POS379/1-DR7-12V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

3 cm by 2 cm strongly altered (red-brownish) lava pebble.

	**POS379/1-DR7-13V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 4.5 cm by 4 cm strongly altered piece of lava pebble that otherwise is similar to **DR7-2V**. The sample shows an 8 mm rim of carbonate containing two angular, greenish altered lava fragments and microfossils. The sample was selected for thin section and geochemistry.
	**POS379/1-DR7-14V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 5 cm by 3 cm lava fragment similar to **DR7-2V** but more altered (red-brownish). The sample was selected for thin section and geochemistry.
	**POS379/1-DR7-15V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 5 cm by 4 cm piece of lava very similar to **DR7-14V**. The sample was selected for thin section and geochemistry.
	**POS379/1-DR7-16V** *Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.* 16 cm by 11 cm with lava indicating pillow lava texture with 2 cm manganese crust. The sample shows some 2-3 mm wide cracks that contain carbonate. The lava is similar to **DR7-2V**, but more altered. It is red-brown with only few small greyish, slightly less altered parts.

<table>
<tr>
<td>
</td>
<td>POS379/1-DR7-17V
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

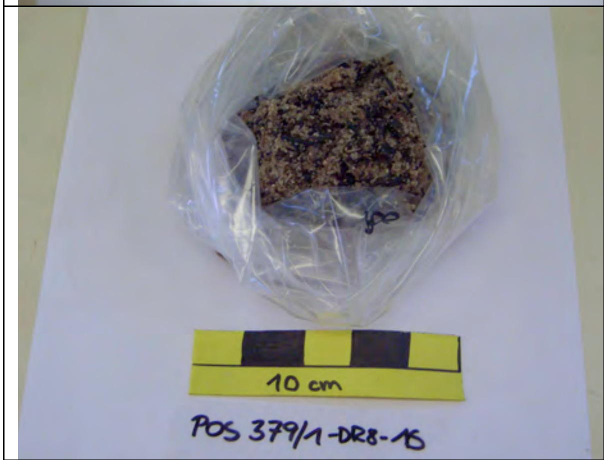
3 cm by 3 cm lava pebble, which is similar to DR7-1V, but more altered.</td>
</tr>
<tr>
<td>
</td>
<td>POS379/1-DR7-18
Southwestern flank of Tolkien seamount at ca. 2,900 mbsl.

Several pieces of lava, similar to DR7-1V, but more altered.</td>
</tr>
</table>

7.3. Samples recovered from Krylov Seamount and Krylov Ridge

POS379/1-DR8-1C
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

Several pieces of corals covered by manganese crust, similar to **DR1-1C**.



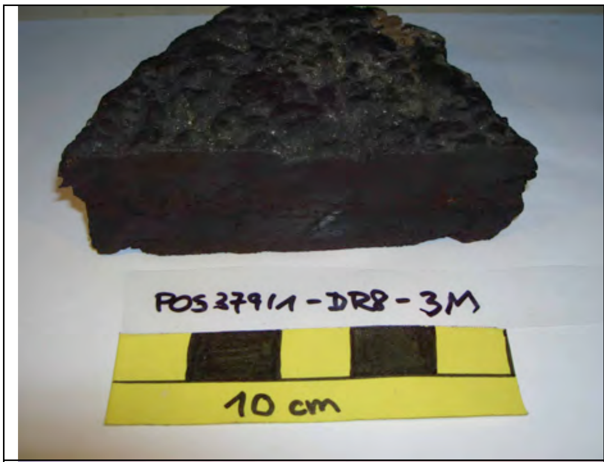
POS379/1-DR8-1S
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

Foraminifera sand from the sediment traps.

POS379/1-DR8-2S
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

6 cm by 4 cm pebble of limestone coated by 1 cm to 3 cm manganese crust.

	**POS379/1-DR8-3S** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* Limestone covered by 3 cm to 4 cm manganese crust. The sample was selected for thin section and geochemistry.
	**POS379/1-DR8-4S** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 60 cm by 25 cm bioclastic limestone with thick porous manganese crust. A 20 cm by 10 cm subsample was taken for the archive.
	**POS379/1-DR8-1M** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 8.5 cm piece of 3.5 cm thick, relatively dense and laminated manganese crust with some brown Fe-oxide.
	**POS379/1-DR8-2M** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 6 cm fragment of 5 cm thick, black and relatively dense, laminated manganese crust with some brown Fe-oxide.

	**POS379/1-DR8-3M** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 13 cm piece of 4 cm thick, relatively dense and laminated manganese crust with some brown Fe-oxide.
	**POS379/1-DR8-4M** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 8 cm thick manganese crust of which the upper 4 cm are well laminated containing some Fe-oxide layers. The lamination of the lower part is much less pronounced.
	**POS379/1-DR8-5M** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* Several pieces of manganese crust stored in the archive.
	**POS379/1-DR8-1V** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 4 cm by 5 cm cobble of non-vesicular, aphyric, grey-brown, probably basaltic lava. The moderately altered sample has feldspar in the matrix and contains Fe-Mn-oxides along cracks. The sample was chosen for thin section and geochemistry.

POS379/1-DR8-2V
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

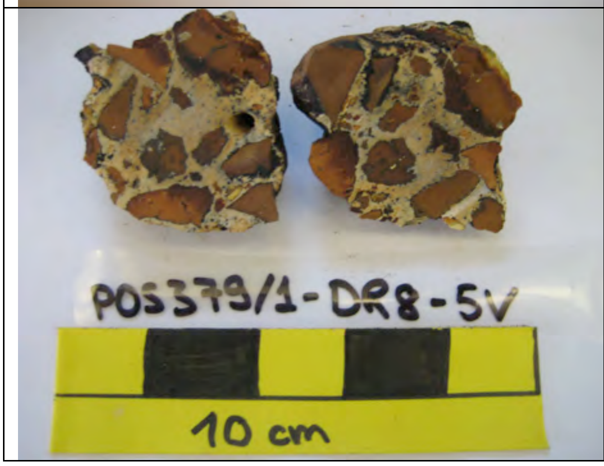
3 cm by 2 cm pebble of nearly aphyric and slightly vesicular, probably basaltic lava. The strongly altered sample is dominated by rare plagioclase phenocrysts (1 mm) and vesicles filled with secondary minerals. The pebble shows some impregnation with Fe-Mn-oxides and a thin (1 mm) manganese crust. The sample was selected for geochemistry.

POS379/1-DR8-3V
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

Brown, strongly altered lava with palagonite rim, which is probably a former glass rind of pillow lava. This sample is aphyric and slightly vesicular with secondary mineral filling. Cracks are healed with secondary minerals. The lava is partly covered with corals. The sample was selected for thin section and geochemistry.

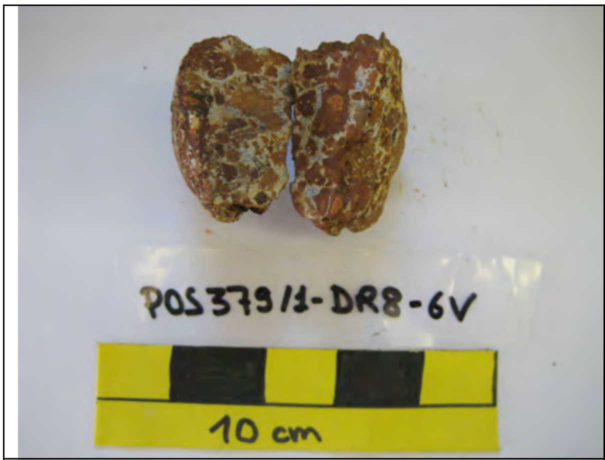
POS379/1-DR8-4V
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

3 cm by 2 cm pebble of hydrothermally altered, yellowish, pale brown lava (presumably basaltic). The sample is aphyric and non-vesicular and is covered by thin manganese crust. Cracks are filled with Fe-Mn-oxides. It was selected for thin section and geochemistry.



POS379/1-DR8-5V
Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.

4 cm by 4 cm cobble of hyaloclastite with 0.5-1.5 cm fragments of altered brown basaltic lava, partly with palagonite rims. The lava fragments are embedded in a pale brownish to whitish carbonate-rich matrix and are matrix supported.

	**POS379/1-DR8-6V** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* 6 cm by 5 cm cobble of hyaloclastite similar to **DR8-5V** but fragments are more clast supported.
	**POS379/1-DR8-7V** *Southwestern flank of Krylov Seamount at ca. 1,950 mbsl.* Several altered lava pebbles similar to the **DR8-2V** and **-3V**.
	**POS379/1-DR9-1C** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Red soft corals (4 cm) growing on remnants of other corals.
	**POS379/1-DR9-2C** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Piece of tree-shaped coral about 19 cm long.

	**POS379/1-DR9-3C** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Corals (5 cm) and sponge.
	**POS379/1-DR9-4C** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Stony coral, 4 cm – 7 cm.
	**POS379/1-DR9-5C** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Several pieces of corals up to ~ 50 cm long.
	**POS379/1-DR9-1S** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Foraminifera sand from the sediment traps.

	**POS379/1-DR9-2S** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* 6 cm by 7 cm yellowish-pale greyish rounded carbonaceous (foraminifera) sandstone.
	**POS379/1-DR9-1M** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* 5 cm thick manganese crust that is laminated, dense and black, except for a 0.5 cm thick layer of brown Fe-oxide in the middle.
	**POS379/1-DR9-2M** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* 5 cm thick manganese crust, similar to **DR9-1M**.
	**POS379/1-DR9-3M** *Western flank of Krylov Seamount at ca. 1,700 mbsl.* Several 1 cm to 10 cm pieces of manganese crust.

<table>
<tr><td>
</td><td>POS379/1-DR9-4M
Western flank of Krylov Seamount at ca. 1,700 mbsl.

4.5 cm thick laminated manganese crust on carbonate and palagonite.</td></tr>
<tr><td>
</td><td>POS379/1-DR9-1SM
Western flank of Krylov seamount at ca. 1,700 mbsl.

30 cm by 20 cm boulder of strongly hydrothermally altered hyaloclastite with 2 cm of dense black manganese crust.</td></tr>
<tr><td>
</td><td>POS379/1-DR9-1V
Western flank of Krylov Seamount at ca. 1,700 mbsl.

5 cm by 3 cm grey-reddish, plagioclase-phyric, vesicular lava cobble with dense, moderately altered matrix. The plagioclase content is high (~30%), with mostly altered phenocrysts 2-8 mm long. Vesicles are irregular and up to 1 cm and filled with white-yellowish secondary minerals and Fe-Mn-oxides. The rim of the cobble is more altered and brown and covered by a 1 mm thick manganese crust. The sample was selected for thin section and geochemistry.</td></tr>
<tr><td>
</td><td>POS379/1-DR9-2V
Western flank of Krylov Seamount at ca. 1,700 mbsl.

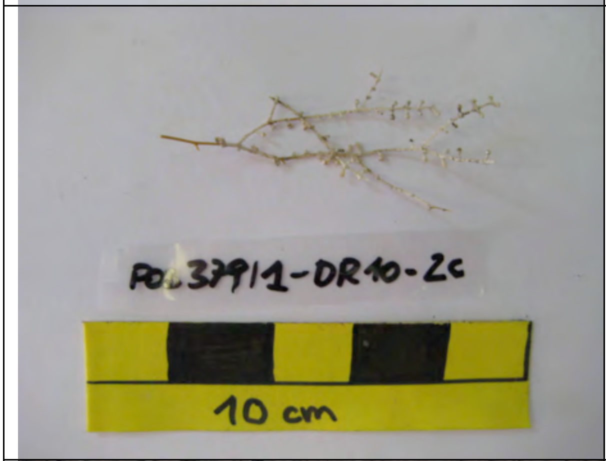
30 cm by 20 cm rounded boulder of hydrothermally altered greenish hyaloclastite with brown-blackish fragments of palagonitised glass. The sample was selected for thin section (with focus on the black domains, which represent former glass and may eventually still may contain some relatively fresh tiny domains) and geochemistry.</td></tr>
</table>

POS379/1-DR9-3V
Western flank of Krylov Seamount at ca. 1,700 mbsl.

13 cm by 10 cm greyish-greenish, (hydrothermally) altered fragment of pillow lava with palagonitised former 0.8 cm glass rind below which is a 3 cm section of dense, barely vesicular, aphyric lava. The centre consists of vesicular, more altered lava. Vesicles are entirely filled with white-yellowish secondary minerals. The sample was selected for thin section and geochemistry.

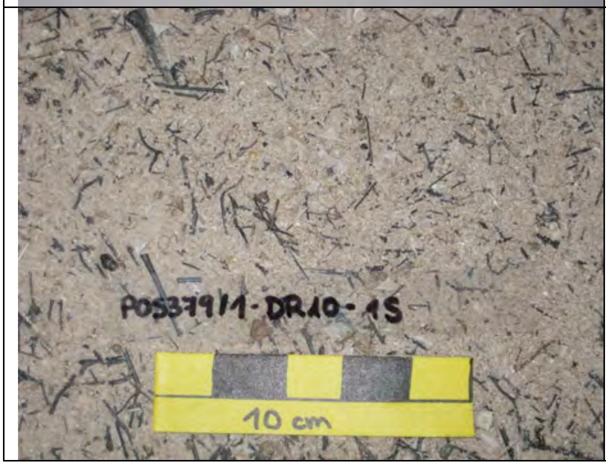
POS379/1-DR10-1C
Western flank of Krylov Seamount at ca. 1,800 mbsl.

Several fragments of corals ranging from 7 cm – 25 cm.



POS379/1-DR10-2C
Western flank of Krylov Seamount at ca. 1,800 mbsl.

Tiny pieces of coral.



POS379/1-DR10-1S
Western flank of Krylov Seamount at ca. 1,800 mbsl.

Foraminifera sand from the sediment traps.

	**POS379/1-DR10-1M** *Western flank of Krylov Seamount at ca. 1,800 mbsl.* 38 cm by 27 cm altered hyaloclastite with 1 cm manganese crust. The sample is stored in the archive.
	**POS379/1-DR10-1SM** *Western flank of Krylov Seamount at ca. 1,800 mbsl.* Several cobbles and boulders of variably lithified bioclastic limestone containing highly altered ~0.5 cm to 1 cm clasts of lava. The pieces are overgrown with 1.5 cm black, not so well layered manganese crust.
	**POS379/1-DR10-1V** *Western flank of Krylov Seamount at ca. 1,800 mbsl.* 8 cm by 6 cm cobble of angular lava with subrounded edges. Colour varies from greyish to brown depending on degree of alteration. A clear alteration front is visible penetrating 0.5-1.5 cm into the lava. The rock is almost aphyric and vesicular (10%, up to 1mm). Vesicles in the centre seem to be still open, whereas those in the altered outer part are filled with white secondary minerals. A relict of an altered phenocryst could have been plagioclase. The sample is coated by 1 mm thin manganese crust. Selected for thin section and geochemistry.
	**POS379/1-DR10-2V** *Western flank of Krylov Seamount at ca. 1,800 mbsl.* 4 cm by 2.5 cm angular brown pebble of plagioclase-phyric lava that is slightly vesicular (<5%, up to 2 mm). The plagioclase (5 – 10%, < 1 mm) and groundmass are moderately altered. Vesicles are filled by secondary minerals. The sample was selected for thin section and geochemistry.

POS379/1-DR10-3V
Western flank of Krylov Seamount at ca. 1,800 mbsl.

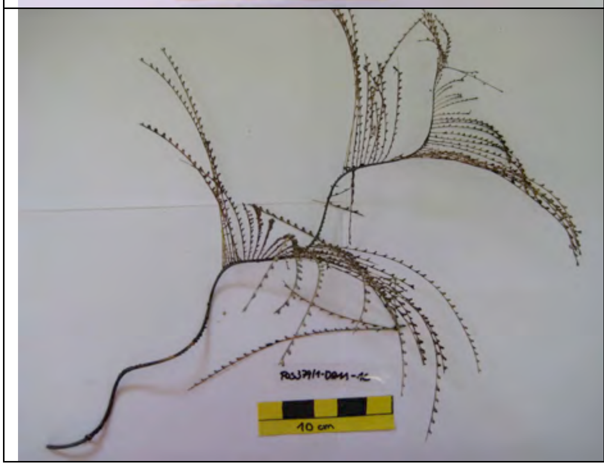
5 cm by 4 cm cobble of subrounded, moderately to strongly altered, brown-reddish lava similar to **DR10-2V** but is much more vesicular (30%, up to 0.5 mm). The vesicles are filled with secondary white, brown and green minerals, partly with black Fe-Mn-oxides. The manganese crust is 0.5 mm thin. The sample was selected for thin section and geochemistry.

POS379/1-DR10-4V
Western flank of Krylov Seamount at ca. 1,800 mbsl.

7 cm by 4 cm pale grey lava cobble with 0.5 mm rim of brownish alteration. The lava is basically aphyric except for rare altered plagioclase phenocrysts (1 mm). Vesicularity is low (1%, 1 mm). The subangular cobble shows cracks typical for pillow lava. It is covered by 1 mm manganese crust that is lacking at edges and corners. The sample was selected for thin section and geochemistry.

POS379/1-DR10-5V
Western flank of Krylov Seamount at ca. 1,800 mbsl.

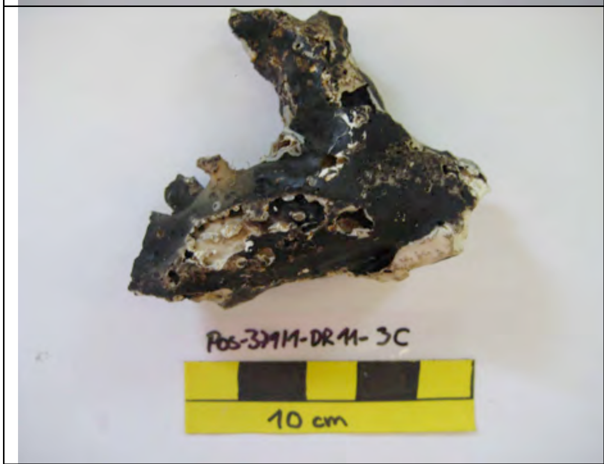
6 cm x 5 cm x 1 cm piece of strongly altered hyaloclastite with former glass turned into palagonite.

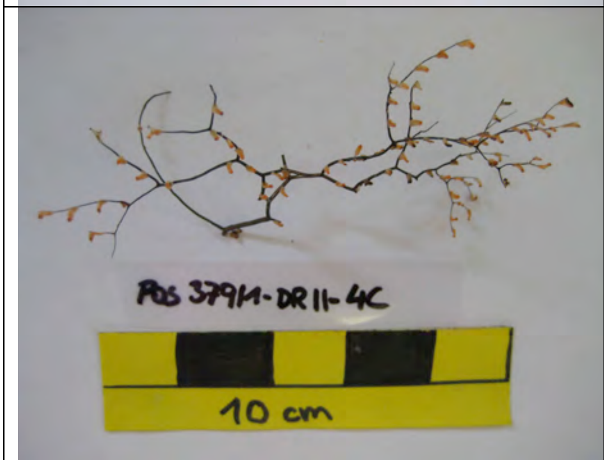


POS379/1-DR11-1C
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Golden coral, ~ 40 cm long.

<table>
<tr><td>
</td><td>POS379/1-DR11-2C
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Pale brown, 6 cm piece of a coral.</td></tr>
<tr><td>
</td><td>POS379/1-DR11-3C
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Five dm-scale pieces of coral.</td></tr>
<tr><td>
</td><td>POS379/1-DR11-4C
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Fan shaped coral with dark skeleton and pink knobby polymers.</td></tr>
<tr><td>
</td><td>POS379/1-DR11-1S
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Foraminifera sand with some broken shells and manganese crust-covered coral pieces.</td></tr>
</table>

POS379/1-DR11-1MV
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

10 cm by 9 cm pillow lava fragment similar to **DR11-1V** with 2 cm manganese crust. The sample was selected for geochemistry.

POS379/1-DR11-2MV
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

8 cm by 5 cm yellow-brownish, highly altered rounded lava cobble.

POS379/1-DR11-3M
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Fragment of 3 cm thick manganese crust.

POS379/1-DR11-4M
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

4 cm by 3 cm fragment of 2 cm thick black manganese crust which is moderately dense and well layered.

POS379/1-DR11-5M
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

4 cm by 5 cm manganese crust similar to **DR11-4M**.

POS379/1-DR11-6M
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

Several boulders of strongly altered hyaloclastite and pillow fragments with 2-3 cm thick manganese crust.

POS379/1-DR11-8M
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

40 cm boulder of manganese crust.

POS379/1-DR11-1V
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

11 cm by 10 cm cobble of grey-reddish basically aphyric and moderately altered lava with rare plagioclase phenocrysts (2 mm). Vesicularity is moderate (ca. 15%, with vesicles mostly 1-2 mm across, but occasionally up to 1 cm and stretched). The vesicles are filled with white and brown secondary minerals. The sample most likely is a pillow lava fragment and is covered by thin (1 mm) manganese crust. The sample was selected for thin section and geochemistry.

POS379/1-DR11-2V
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

9 cm by 7 cm, pillow lava fragement similar to **DR11-1V**. The sample has pale brown secondary minerals and black Fe-Mn-oxides along cracks and palagonitised former glass.

POS379/1-DR11-3V
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

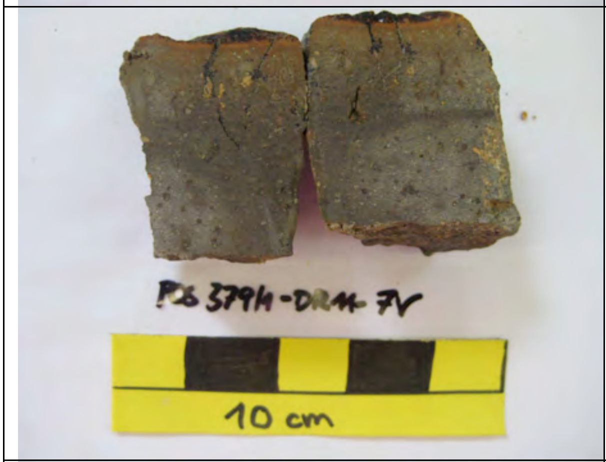
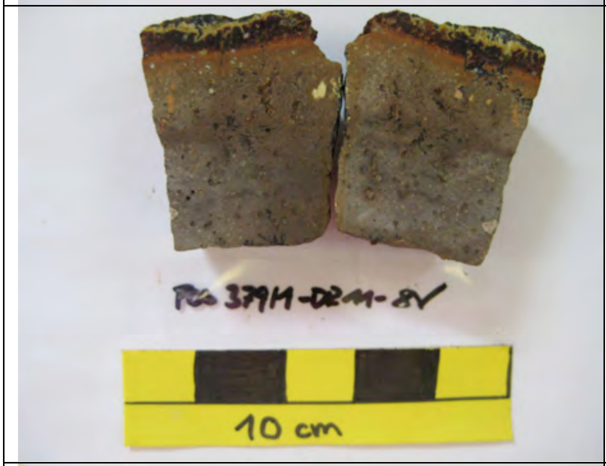
10 cm by 6 cm piece of pillow lava similar to **DR-11-2V**. The former glass rind more pronounced and the sample exhibits columnar jointing. The sample is used for thin section and geochemistry.

POS379/1-DR11-4V
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

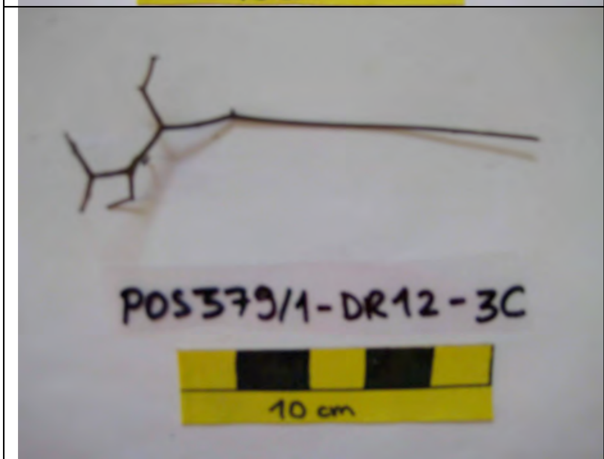
8 cm by 6 cm lava piece, similar to **DR11-2V**.

POS379/1-DR11-5V
Eastern section of Krylov Ridge at ca. 2,100 mbsl.

7 cm by 6 cm lava piece, similar to **DR11-1V**. The sample was selected for thin section and geochemistry.

	**POS379/1-DR11-6V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* 6 cm by 4 cm pillow lava fragement, similar to **DR11-2V**.
	**POS379/1-DR11-7V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* 5 cm by 4 cm pillow lava fragement, similar to **DR11-2V**.
	**POS379/1-DR11-8V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* 5 cm by 4 cm pillow lava fragement, similar to **DR11-2V**.
	**POS379/1-DR11-9V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* 19 cm by 12 cm pillow lava fragment, similar to **DR11-2V** but more altered amd with thicker manganese crust.

	**POS379/1-DR11-10V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* 20 cm by 13 cm lava fragment, similar to **DR11-2V** but more altered.
	**POS379/1-DR11-11V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* 18 cm by 11 cm lava fragment, similar to **DR11-10V**.
	**POS379/1-DR11-12V** *Eastern section of Krylov Ridge at ca. 2,100 mbsl.* Several cm- to dm-size cobbles and fragments of pillow lava similar to **DR11-1V** and **DR11-2V**.
	**POS379/1-DR12-1B** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Sea star (discarded).

	**POS379/1-DR12-1C** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Several pieces of corals (decimeter-size) with black thin Mn-crust coating.
	**POS379/1-DR12-2C** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Fragment of silicate sponge (discarded).
	**POS379/1-DR12-3C** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Tiny fragment of golden (?) coral.
	**POS379/1-DR12-4C** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Three decimeter-size pieces of coral largely without manganes crust coating. The white one turned into yellow within a few minutes when on deck.

POS379/1-DR12-1S
Central part of Krylov Ridge at ca. 2,030 mbsl.

Foraminifera sand with fragments of fossils from the sediment traps.

POS379/1-DR12-2S
Central part of Krylov Ridge at ca. 2,030 mbsl.

Two cobbles of bioclastic limestone with tiny altered clasts of lava similar to **DR12-1V**.

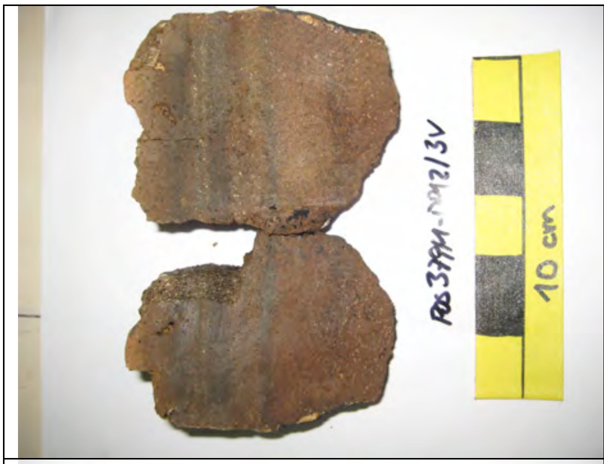
POS379/1-DR12-1M
Central part of Krylov Ridge at ca. 2,030 mbsl.

3 x 5 cm manganese crust. The upper 1 cm is dense and black while the rest less dense with brown Fe-oxides. Some pieces of basalt are found underneath.

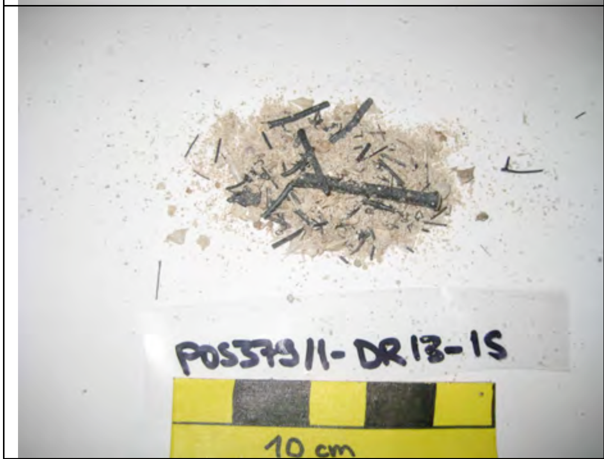
POS379/1-DR12-2M
Central part of Krylov Ridge at ca. 2,030 mbsl.

4.5 x 4.5 cm fragment of 2.5 cm thick manganese crust on 2 cm vesicular basalt.

	**POS379/1-DR12-3M** *Central part of Krylov Ridge at ca. 2,030 mbsl.* 8 cm x 13 cm and 4 cm thick and relatively dense manganese crust on altered lava.
	**POS379/1-DR12-4M** *Central part of Krylov Ridge at ca. 2,030 mbsl.* 1.5 cm thick dense black manganese crust.
	**POS379/1-DR12-1V** *Central part of Krylov Ridge at ca. 2,030 mbsl.* 18 x 13 x 6 cm boulder of lava. Alteration is variable ranging from dark grayish, less altered parts to reddish brown, more altered sections. Vesicles (ca. 15% up to 3 mm) are unevenly distributed in the sample and filled with brown secondary minerals and partly with Fe-Mn oxides. The sample is almost aphyric with rare plagioclase phenocryst. Many plag needles are found in the groundmass. The manganese crust is thin (< 1 mm) and lacking at the edges. Sample selected for geochemistry and thin section. A subsample is found in the archive.
	**POS379/1-DR12-2V** *Central part of Krylov Ridge at ca. 2,030 mbsl.* 12 x 7 cm cobble of pillow lava fragment. The sample is mostly brown with few more greyish, less altered areas. Alteration ranges from moderate to strong. Vesicularity is high (ca. 20%, and vesicles (mostly 1-2 mm, up to 1 cm) are partly or entirely filled with white and brown secondary minerals, especially in most of the areas at the rim with impregnation of Fe-Mn-oxides. Plag needles are frequent in the groundmass, some form tiny 1 mm phenocrysts. The manganese crust is thin (< 1 mm). Selected for geochemistry and thin section.

	**POS379/1-DR12-3V** *Central part of Krylov Ridge at ca. 2,030 mbsl.* 9 cm x 7 cm cobble of pillow lava fragment with layered texture parallel to the former (cooling) surface. Vesicles are frequent (ca. 10-15%) and small (ca. 1 mm) and partly filled with white and brown secondary minerals. Alteration varies from moderate in greyish areas to strong in brownish areas. The lava is aphyric but the matrix contains plag needles and completely altered relicts of ferro-magnesian minerals, probably former ol and/or cpx. The upper 2-3 cm close to the former glass rind (now palagonite) shows Fe-Mn-oxide impregnation. The manganese crust is thin (1 mm). The sample was selected for geochemistry and thin section.
	**POS379/1-DR12-4V** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Several cobbles similar to **DR12-1V** but more altered. The manganese crust is thin (< 1 mm). The sample was selected for geochemistry and thin section. A subsample is stored in the archive.
	**POS379/1-DR12-5V** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Several cobbles similar to **DR12-2V**. Samples are stored in the archive.
	**POS379/1-DR12-6VM** *Central part of Krylov Ridge at ca. 2,030 mbsl.* Several cobbles with hyaloclastites and lava fragments and 1 cm manganese crust. The samples are stored in the archive.

	**POS379/1-DR13-1B** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Decimeter-size silica sponge (discarded).
	**POS379/1-DR13-1C** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Several decimetre-size corals with thin black manganese crust coating.
	**POS379/1-DR13-2C** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Decimetre-size fragments of corals without Mn-crust coating.
	**POS379/1-DR13-3C** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Fragments of golden coral with a sea star.

	**POS379/1-DR13-4C** *Western section of Krylov Ridge at ca. 2,020 mbsl.* A ca. 5 cm red soft coral.
	**POS379/1-DR13-1S** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Foraminifera sand with fragments of fossils from the sediment trap. Stored in the archive.
	**POS379/1-DR13-3S** *Western section of Krylov Ridge at ca. 2,020 mbsl.* 7 cm x 7 cm rounded cobble of well-lithified carbonaceous sandstone. It may be a hydrothermally altered analogue of **DR-1S**. Stored in the archive.
	**POS379/1-DR13-1M** *Western section of Krylov Ridge at ca. 2,020 mbsl.* 3 cm x 7 cm x 2 cm non-laminated Mn-crust attached to altered hyaloclastite.

	**POS379/1-DR13-2M** *Western section of Krylov Ridge at ca. 2,020 mbsl.* 1.5 cm x 7 cm, well laminated and relatively dense manganese crust.
	**POS379/1-DR13-3M** *Western section of Krylov Ridge at ca. 2,020 mbsl.* 4 cm x 12 cm, relatively well laminated manganese crust with brown Fe-oxide layers on altered hyaloclastite.
	**POS379/1-DR13-4M** *Western section of Krylov Ridge at ca. 2,020 mbsl.* 3.5 cm x 7 cm relatively dense manganese crust. No clear lamination visible.
	**POS379/1-DR13-5M** *Western section of Krylov Ridge at ca. 2,020 mbsl.* 2 cm x 6 cm manganese crust that is not so well laminated and contains some domains with brown Fe-oxide.

POS379/1-DR13-1V
Western section of Krylov Ridge at ca. 2,020 mbsl.
10 cm x 9 cm cobble of pillow lava with columnar jointing and vesicularity decreasing from the former cooling front towards the centre. Outer 1/3 is highly vesicular, central 2/3 less vesicular. Vesicles are filled with white, brown and black secondary minerals and partly Fe-Mn-oxides. Micro-phenocrysts are plag (20%, up to 2 mm) and a greenish altered, probably former ferromagnesian mineral (cpx?). The plag is altered. The manganese crust is thin (< 1 mm). The sample was selected for geochemistry and thin section.

POS379/1-DR13-2V
Western section of Krylov Ridge at ca. 2,020 mbsl.

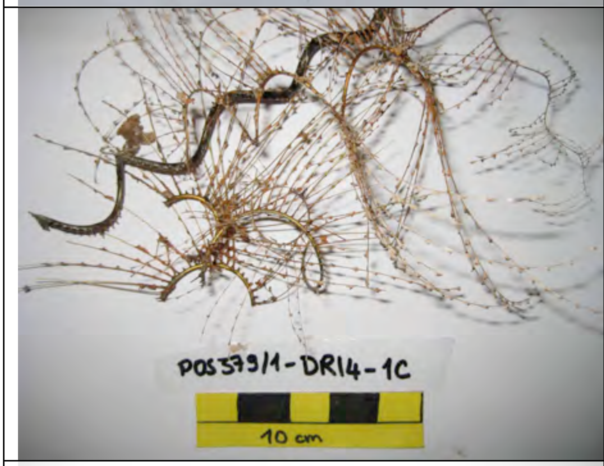
8 cm x 6 cm cobble of lava with high vesicularity (ca. 25%, 1-3 mm). Colour is mainly red-brown with numerous grey less altered small dots. Vesicles are filled with white, brown and black secondary minerals. The lava is aphyric but many plagioclase needles are visible in the groundmass. The manganese crust is thin on surfaces but lacking At edges and corners. The sample was chosen for geochemistry and thin section.

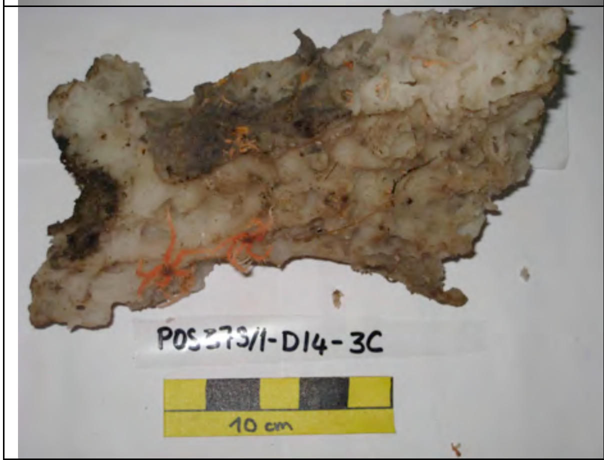
POS379/1-DR13-3V
Western section of Krylov Ridge at ca. 2,020 mbsl.

11 cm x 7 cm cobble of lava similar to **DR13-2V** but much more vesicular and somewhat more altered. Vesicles are partly filled with green, brown yellow and black secondary minerals. In a zone of the sample vesicles are entirely filled with white secondary minerals. Stored in the archive.

POS379/1-DR13-4V
Western section of Krylov Ridge at ca. 2,020 mbsl.

13 cm x 14 cm boulder of highly vesicular and moderately to strongly altered aphyric pillow lava fragment similar to **DR13-2V**. A 1-1.5 cm band across the sample is almost non-vesicular and greyish. Alteration is only moderate and the domain was cut for geochemistry and thin section.

	**POS379/1-DR13-5V** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Several cobbles and boulders of highly vesicular and moderately to strongly altered lava with 1 cm manganese crust. The sample was stored in the archive.
	**POS379/1-DR13-6V** *Western section of Krylov Ridge at ca. 2,020 mbsl.* Several decimetre-size fragments of strongly altered green hyaloclastites and brown lava pebbles with relatively thick manganese crust. Stored in the archive.
	**POS379/1-DR14-1C** *Hill on central Krylov Ridge at ca. 1,900 mbsl.* Several pieces of decimeter-size golden corals.
	**POS379/1-DR14-2C** *Hill on central Krylov Ridge at ca. 1,900 mbsl.* A ca. 5 cm soft red coral.

	**POS379/1-DR14-3C** *Hill on central Krylov Ridge at ca. 1,900 mbsl.* Several pieces of decimeter-size fragments of corals with brown and white surfaces. Much of the white turned into yellow within minutes once on deck.
	**POS379/1-DR14-4C** *Hill on central Krylov Ridge at ca. 1,900 mbsl.* A ca. 20 cm x 14 cm piece of silica sponge, probably living when sampled. Several small sea stars were sitting on it and in cavities.
	**POS379/1-DR14-1S** *Hill on central Krylov Ridge at ca. 1,900 mbsl.* Foraminifera sand with fragments of fossils from the sediment trap.
	**POS379/1-DR14-2S** *Hill on central Krylov Ridge at ca. 1,900 mbsl.* Two decimeter-size pieces of moderately lithified foraminifera sandstone with fragments of fossils. It may be the lithified analogue of the foraminifera sand found in the sediment traps (DR14-1S).

POS379/1-DR14-1M
Hill on central Krylov Ridge at ca. 1,900 mbsl.

6 cm by 10 cm manganese crust grown on altered basalt. The upper 1 cm of the crust is dense and black and overlies a 2.5 cm layer of brown Fe-oxides.

POS379/1-DR14-2M
Hill on central Krylov Ridge at ca. 1,900 mbsl.

8 cm by 14 cm manganese crust grown on an altered basalt. The upper centimeter is dense and black and overlies less well laminated layers with Fe-oxide.

POS379/1-DR14-3M
Hill on central Krylov Ridge at ca. 1,900 mbsl.

Several 3 cm to 12 cm pieces of manganese crust.

POS379/1-DR14-1VA
Hill on central Krylov Ridge at ca. 1,900 mbsl.

17 cm by 13 cm rounded boulder of altered lava similar to **DR-12-1V** and **DR-12-2V**. Stored in archive.

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