IFM-GEOMAR REPORT

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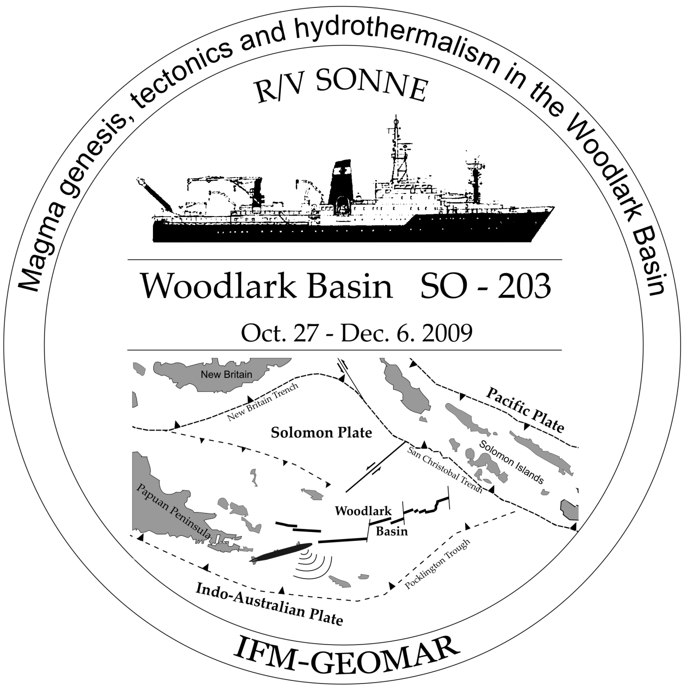
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

FS Sonne
Fahrtbericht / Cruise Report SO203

WOODLARK
Magma genesis, tectonics and hydrothermalism in the Woodlark Basin

Townsville, Australia - Auckland, New Zealand
27.10. - 06.12.2009



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Christian-Albrechts-Universität zu Kiel

Nr. 33
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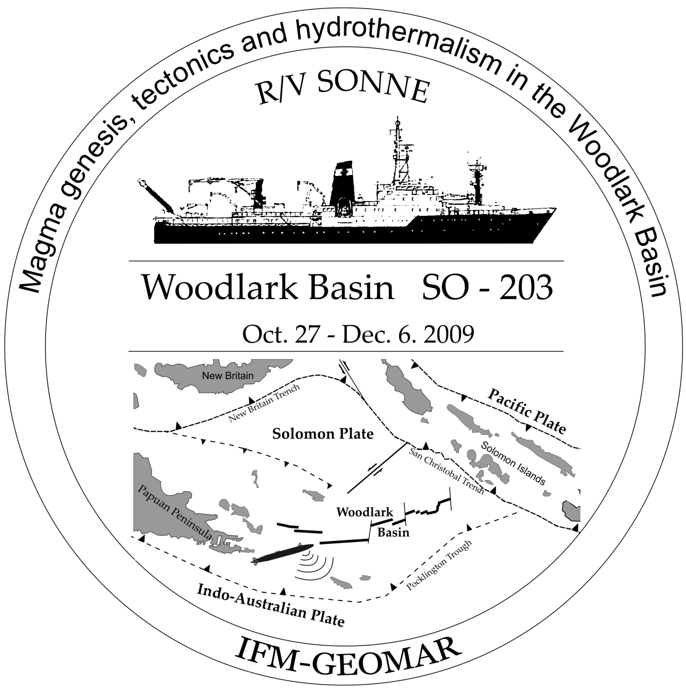

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ISSN Nr.: 1614-6298

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Das Leibniz-Institut für Meereswissenschaften ist ein Institut der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)

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Herausgeber / Editor:
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IFM-GEOMAR Report
ISSN Nr.: 1614-6298

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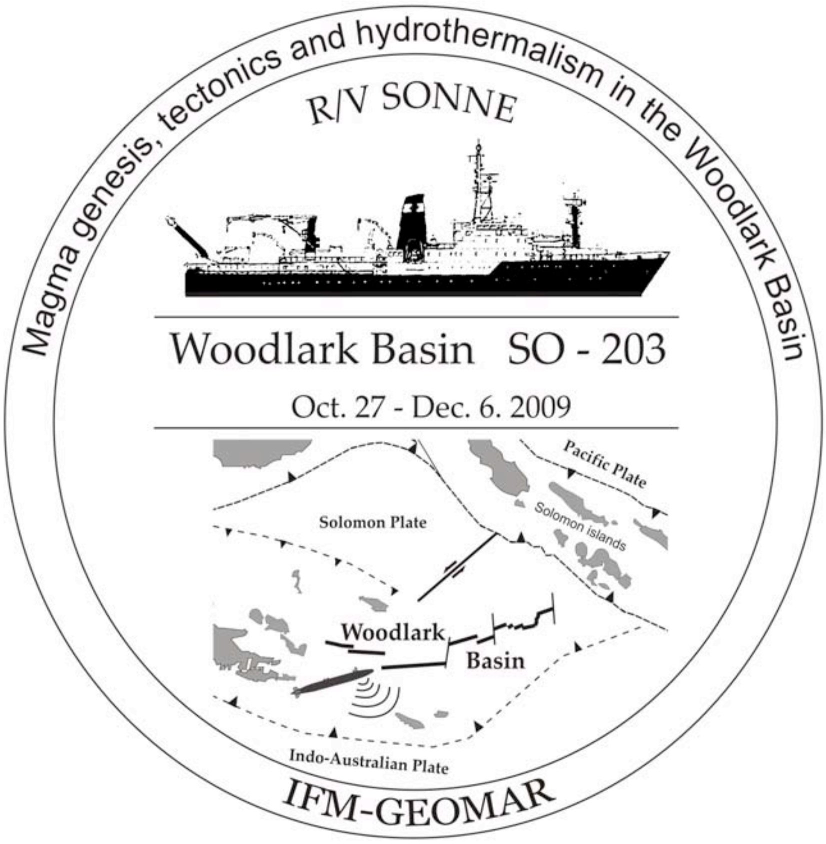
Cruise Report SO-203

"Woodlark"



27.10.2009 (Townsville) - 6.12.2009 (Auckland)

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1 Introduction and Overview (Devey)

1.1 Introduction

The Woodlark Basin is probably the only place in the world where the transition from continental splitting to oceanic spreading can be directly observed on the seafloor, effectively devoid of overburden. The spreading axis is propagating westward into the Papua New Guinean basement [*Taylor et al.*, 1995]. The axis itself has been divided into 5 segments [*Martinez et al.*, 1999] separated by major lateral offsets associated with large-dispacement overlapping spreading centres or transform-like features (Figure 1.1).

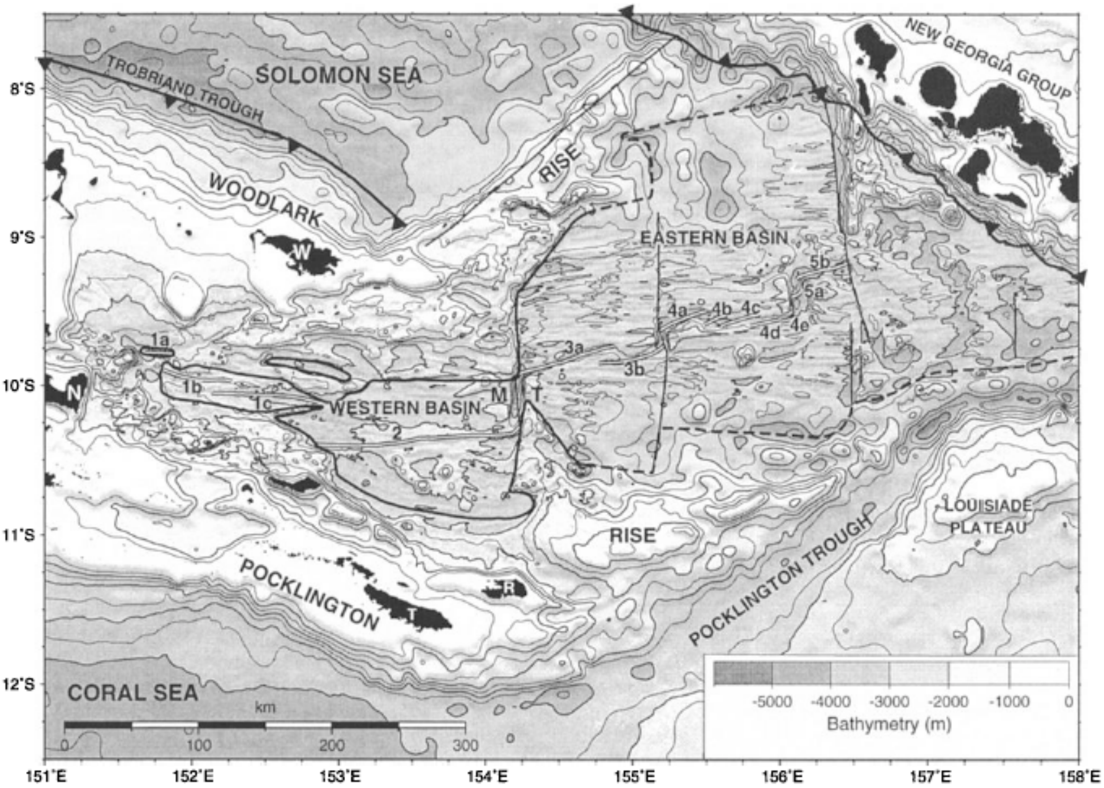


Figure 1.1: Bathymetric map (from Martinez et al., 1999) showing the position of the Woodlark spreading centre (double line) within the basin and the segment numbers given by these authors. This numbering style will be used throughout this report.

Although the basin has been extensively studied for its tectonic and geophysical characteristics [*Benes et al.*, 1997; *Ferris et al.*, 2006; *Goodliffe et al.*, 1997; *Kington and Goodliffe*, 2008; *Little et al.*, 2007; *Martinez et al.*, 1999; *Westaway*, 2005; 2007] and the site of active continental extension at Moresby Seamount was the focus of ODP Leg 180, very little work had been, up to present, been done on the rocks of the spreading axis and adjacent areas themselves. Samples had been collected from Franklin, Cheshire and Dobu Seamounts in the westernmost Woodlark area[*Bogdanov et al.*, 1997a; *Bogdanov et al.*, 1997b; *Dril et al.*, 1997], and some from around segment 4. A comprehensive sampling of the axis had not been carried out, however.

The aim of the SO-203 cruise was to sample the magmatic rocks of the neovolcanic zone up to segment 4 and also the perform a flow-line sampling of the off-axis region perpendicular to segment 4. Structural geology investigations and ground-truthing sampling were aimed at investigating how continental crust splits and whether it becomes incorporated into the newly-formed ocean floor in any volume. The occurrence of hydrothermal activity in the newly-split continental crust was a further focus. The cruise can be roughly divided into two halves - West Woodlark, focussing primarily on the continental splitting problems and East Woodlark which dealt with the sampling of the maturing spreading centre.

1.2 West Woodlark

After three days transit from Townsville, Australia, the Sonne arrived to begin working on Segment 1 and the Moresby Seamount area. The stations occupied are shown in Figure 1.2.

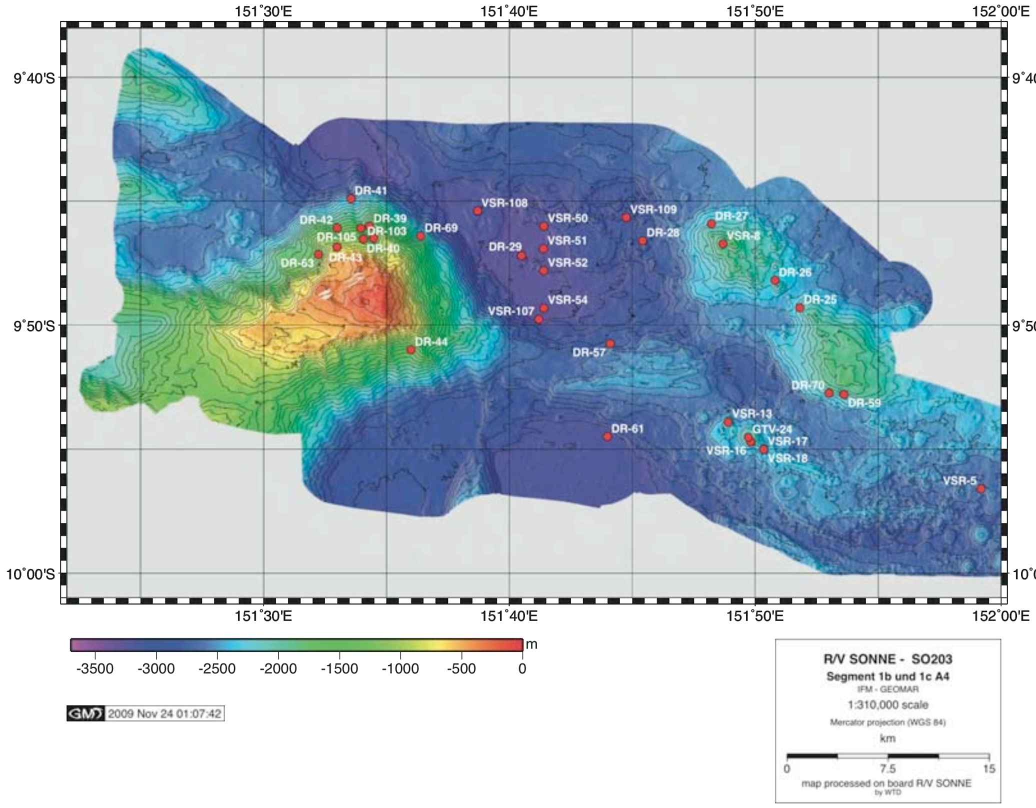


Figure 1.2: Bathymetry and sample locations in the Moresby Seamount/Segment1A&B region. For feature names see Fig. 1.3

The youngest spreading axis segment (Segment 1A) lies immediately east of Moresby Seamount. We sampled the segment, Moresby, and the neighbouring area extensively. Particular focus was placed on the continent/ocean transition at the base of Moresby and the detachment surface on Moresby itself (both of which were extensively mapped using the AUV, see reports Behrmann et al. and Klauke et al.). On Segment 1B we made detailed studies of two small volcanoes, one of which (Franklin Smt.) was known before the cruise to show low-temperature hydrothermal activity [*Bogdanov et al.*, 1997b].

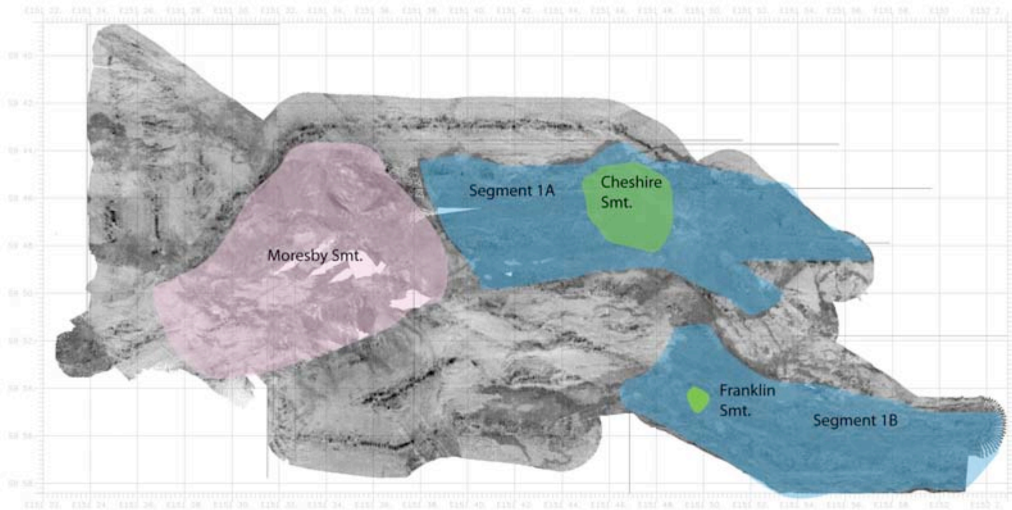


Figure 1.3: Backscatter image derived from ship-based EM-120 echosounder data of the area mapped in Figure 1.2. Dark backscatter denotes hard, reflective seafloor.

Following the Moresby/Segment 1 A&B work we worked slowly eastward, sampling segments 1B and 1C and fragments of older crust between them (Figure 1.4) before beginning on Segment 2.

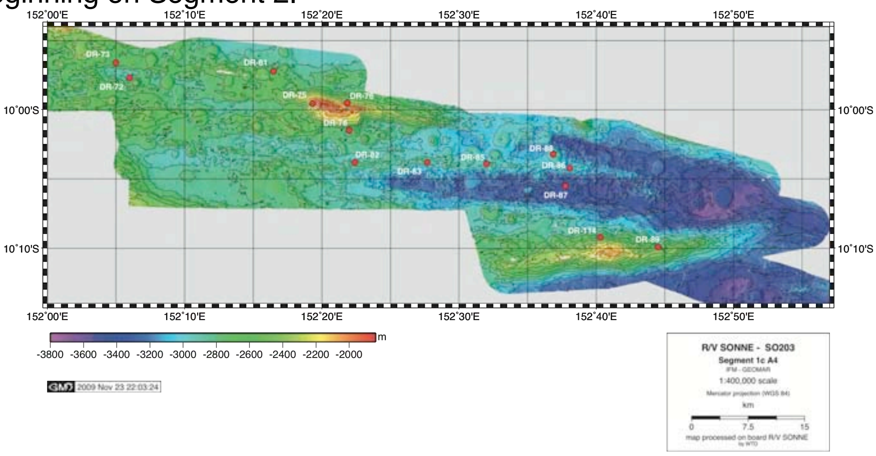
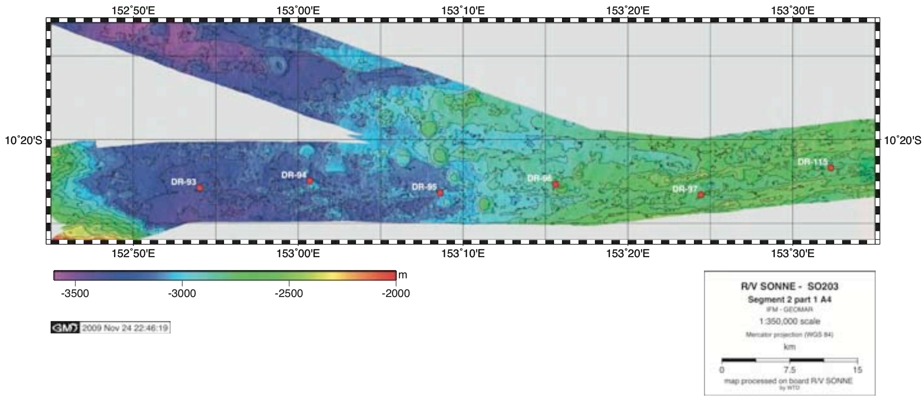


Figure 1.4: Bathymetry of Segments 1b & 1C. Note the two massifs which bound them.

Segment 2 has, along with most of the other segments, recently (ca. 80 ka) re-orientated its spreading direction and is cutting newly-formed crust [*Goodliffe et al.*, 1997]. This made the axis difficult to find using either bathymetric or backscatter



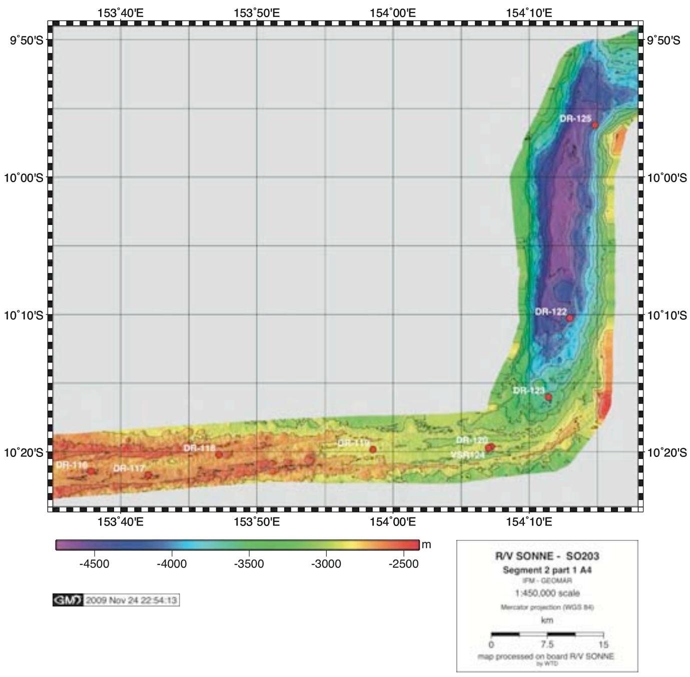


Figure 1.5: Bathymetry and sampling stations on Segment 2 west (upper) and east (lower). Also shown on the lower figure is the extensional basin forming in the fracture zone between segments 2 & 3.

information. Some of the sampling yielded somewhat older-looking rocks, particularly at the western end of the axis.

The reorientation of the axis has brought the former transform faults into an extensional stress field, resulting in wide deep basins in these areas. In the basin between Segments 2 & 3 we found clear evidence for recent volcanism, confirming their extensional nature.

1.3 East Woodlark

Segment 3 proved to be the most difficult to sample, with dredges getting stuck several times. But it also yielded some of the freshest samples from stations on the high of the hour-glass-shaped segment 3A (Figure 1.6).

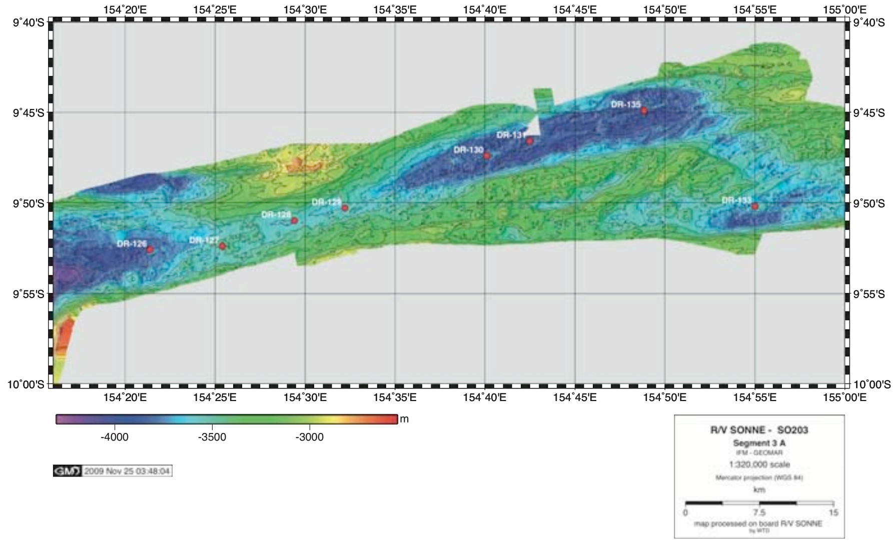


Figure 1.6: Bathymetry and sampling stations of the western part of Segment 3, showing 3A with its hour-glass type morphology and the western end of 3B.

This segment also yielded, in its eastern most part, the only hydrothermal plume found on the entire cruise (Figure 1.7).

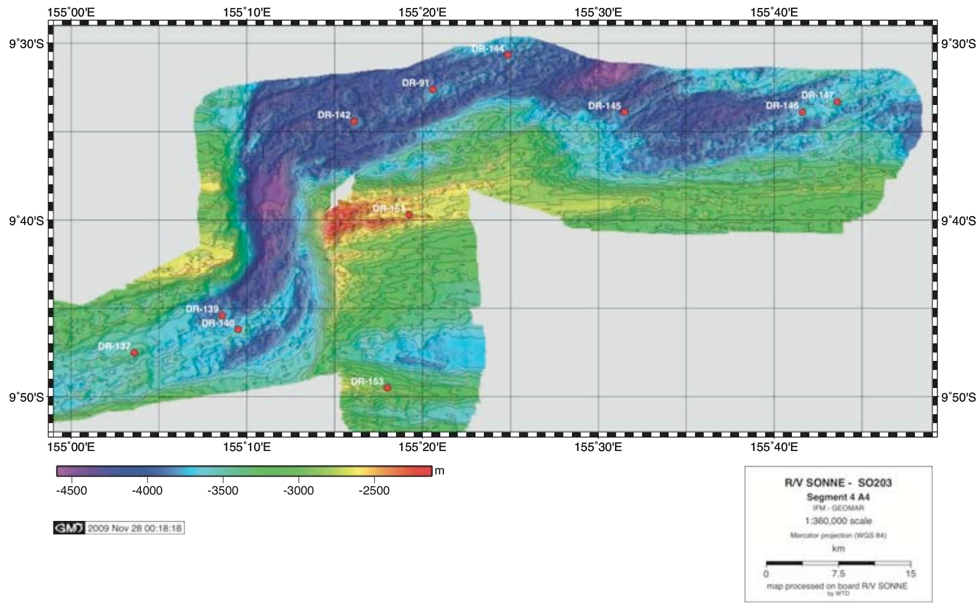


Figure 1.7: Bathymetric map of Segment 4 showing sampling stations. Note, as with the transition from Segment 2 to 3, that the transform fault zone is marked by an extensional basin.

1.4 North-South transect

In addition to sampling along the spreading axis itself to look at how the magma compositions change as the ridge matures and true oceanic spreading begins, we also made a sampling profile perpendicualr to the ridge, to try and access any compositional variations which have occurred through time at one point on the spreading axis. Although in some cases it was difficult to find a slope free of sediment to sample and as a consequence the sampling is biased toward tectonic highs, we succeeded in acquiring samples from

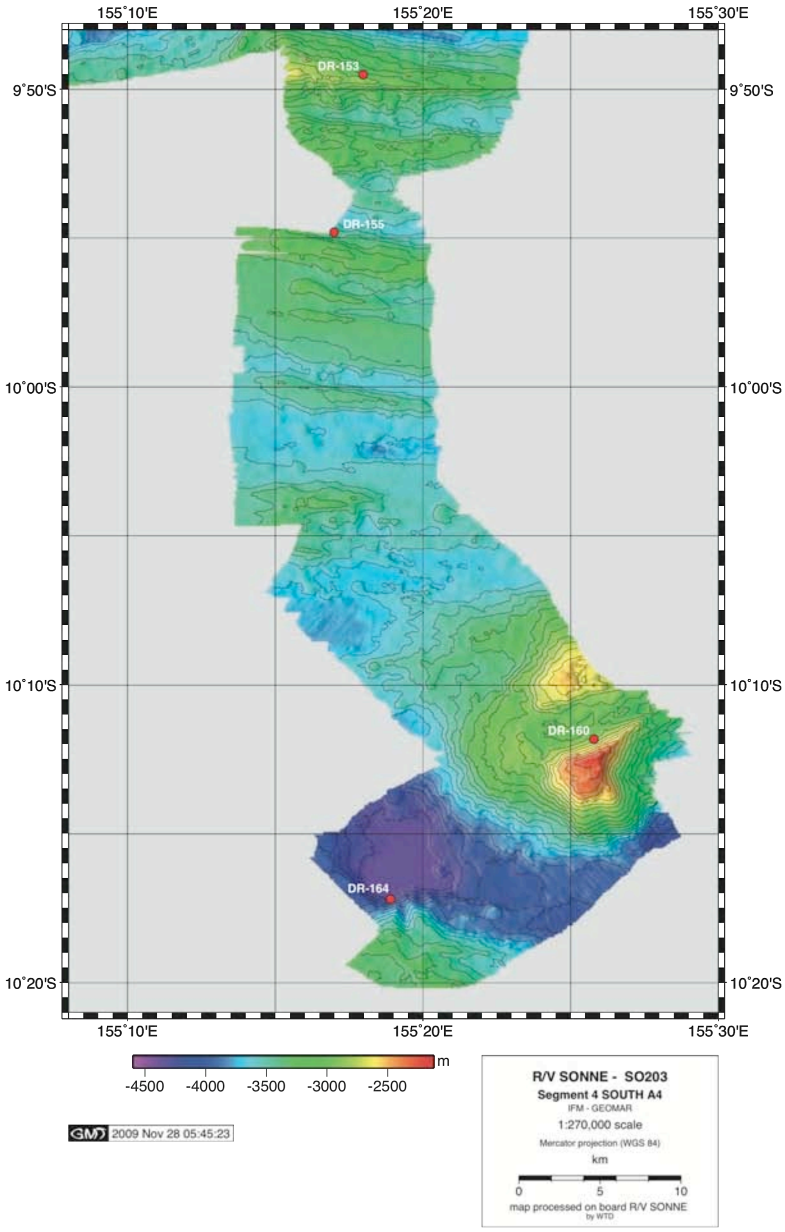


Figure 1.8: Sampling along the north-south profile adjacent to segment 4A

1.5 Literature

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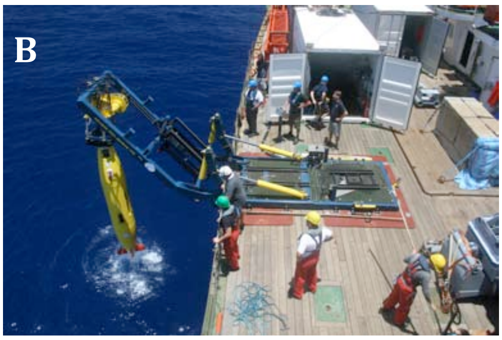
2 AUV dives (K. Lackschewitz, S. Petersen, M. Rothenbeck, J. Sticklus)

2.1 Technical description

The Autonomous Underwater Vehicle (AUV) ABYSS (built by HYDROID) from IFM-GEOMAR can be operated in water depth of up to 6000 m.

The ABYSS system comprises the AUV itself, a control and workshop container, and a mobile Launch and Recovery System (LARS) with a deployment frame that was installed at the starboard side on the afterdeck of R/V SONNE. The LARS was developed by WHOI to support ship-based operations so that no Zodiac is required to launch and recover the AUV. The LARS is mounted on steel plates which are screwed on the deck of the ship. The LARS is configured in a way that the AUV can also be deployed over the port or starboard side of the German medium- and large-size research vessels. The LARS is stored in a 20 ft. container during transport.

We can deploy and recover the AUV at weather conditions with a swell of up to 2.5 m and wind speeds of up to 6 beaufort. For the recovery the nose float pops off when triggered through an acoustic command. The float and the 20 m long recovery line drift away from the vehicle so that a grappnel hook can snag the line (Fig. 2.1A). The line is then connected to the LARS winch, and the vehicle is pulled up (Fig. 2.1B). Finally, the AUV is brought up on deck and safely secured in the LARS (Fig. 2.1C). During SO 203 no problems were encountered during any deployment or recovery with the LARS system.



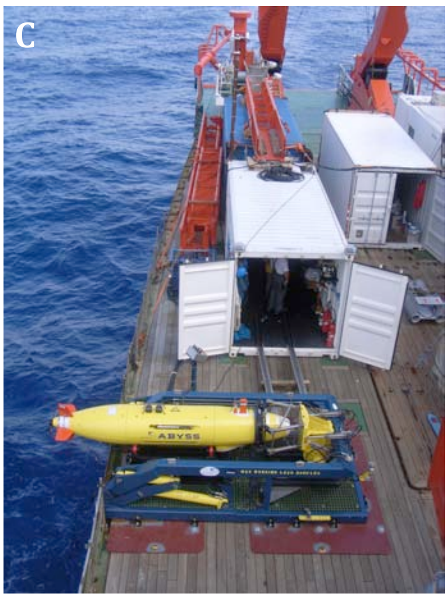


Fig. 2.1: A) A grappnel hook snags the recovery line of the AUV. B) The vehicle is pulled up in the LARS. C) The deployment frame of the LARS is brought in and the AUV is safely secured.

The vehicle consists of a tapered forward section, a cylindrical midsection and a tapered tail section. An internal titanium strongback, which extends through much of the vehicle length, provides the structural integrity and acts as a mounting platform for syntactic foam, equipment housings, sensors and release mechanisms. The maximum vehicle diameter is 0.66 meters and the overall length is 4 meters. Vehicle weight is approximately 880 kilograms, but is depending on the payload configuration. A rectangular compartment in the midsection of the vehicle contains three pressure housings and an oil-filled junction box. Two pressure housings each contain one 5.6 kWh 29-Volt lithium-ion battery pack. The third pressure housing contains the vehicle and sidescan sonar electronics. The vehicle's inertial measurement unit and acoustic Doppler current profiler are housed in two other independent housings that are mounted forward of the 3 main pressure housings. The propulsion and control systems are located in the tail assembly, which is bolted to the aft face of the vehicle strongback. The tail assembly consists of a pressure housing with motor controller electronics and an oil-compensated motor housing. Propulsion is generated with a 24 VDC brushless motor driving a two-bladed propeller. Control is achieved with horizontal and vertical fins driven by another 24 VDC brushless gear motors. The vehicle velocity range is 1.2 to 2.0 m/s, although best control is achieved at velocities above 1.5 m/s. The AUV descents with about 0.9 m/s whereas the ascent speed is about 0.5 m/s or 1m/s if the ascent weight is dropped. Together with the deployment/recovery procedure the descent to the seafloor and the ascent back to the vessel take approximately 2.5 hours at a water depth of 3000 m.

Sensors of the base vehicle include pressure, temperature, conductivity, optical backscatter and Eh-sensor (in cooperation with Dr. Koichi Nakamura, Japan); and an inertial navigation system that is aided by an Acoustic Doppler Current Profiler (ADCP) with bottom lock capabilities.
In addition, the vehicle can be reconfigured for three different modes of operation as follows
1. Base vehicle plus RESON Seabat 7125 Multi-Beam (200/400 kHz), or
2. Base vehicle plus Electronic Still Camera & Strobe (not used during SO 203), or
3. Base vehicle plus Sub-Bottom Profiler (not used during SO 203) and EdgeTech Dual Frequency (110/420 kHz) Side Scan Sonar.

2.2 Multibeam survey

The multibeam sonar was the main sensor during the AUV dives at SO203. We have operated the system at 200 kHz with 256 equi-angular beams and at 400 kHz with 512 equi-angular beams. The RESON firmware allows selecting single data files from a record of several files which can be acquired during a survey. Beam data (snippets), sidescan data, backscatter data, data for maintenance and of course the bathymetric data are a few examples of the entire record. Besides the mandatory records as sonar settings, beam geometry data and bathymetric data we also recorded the backscatter imagery data. However, for processing the backscatter data also the snippets are needed because of their amplitude informations.
A single transmission from the projector unit illuminates a 128° swath on the sea floor. The seabed return signal is received by the receiver unit, digitized, and stored as s7k-files, a proprietary RESON format, on a hard drive.

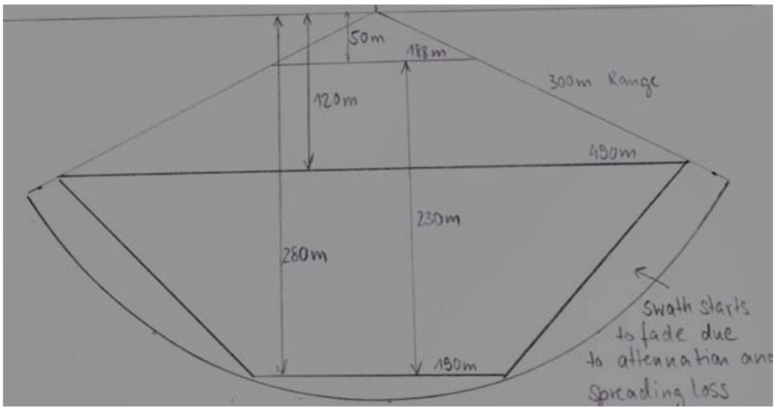


Fig. 2.2: Geometric relation between vehicle altitude and beam range using the dual frequency R*ESON multibeam system.*

The amount of data increases by approximately 10 MB per minute during a high frequency survey and by approximately 8.5 MBytes per minute during a 200 kHz survey. This rate depends of course on the ping rate. During SO203 we have achieved ping rates of 4-5 pings per second at the high frequency survey (altitude 50 m) and 2-3 pings per second at the low frequency survey (altitude 120 m), respectively. After a file reaches a size of 980 MByte the system creates a new file. A 20 hour mission will generate about twelve 1 GB files. The change from one file to the next happens without noticeable delay and cannot be seen in the merged grid model. Using altitudes of 50 m and 120 m the swath width is ~ 200 meters for 400 kHz and ~ 280 meters for 200 kHz (Fig. 2.2). In general, the dive missions are planned by using a line spacing of 80 meters and 150 meters, respectively. For steeper slopes the line spacing has to be decreased. The multibeam surveys are usually operated in the depth mode that means the vehicle dives in a constant water depth which can be changed during a mission due to a rough topography. In such a case a lower limit for the altitude has to be chosen for safety reasons during the mission planning.

2.3 Sidescan survey

Two side-scan surveys were accomplished during SO203. The 120 kHz survey has recorded high resolution data from an area of 9.72 km^2, whereas the 410 kHz survey was aborted shortly after starting the mission due to a leak in the tail section. The results of the aborted mission are neglectable and will not be mentioned below. In general, a side-scan survey is planned in altitude mode where the vehicle follows the topography.

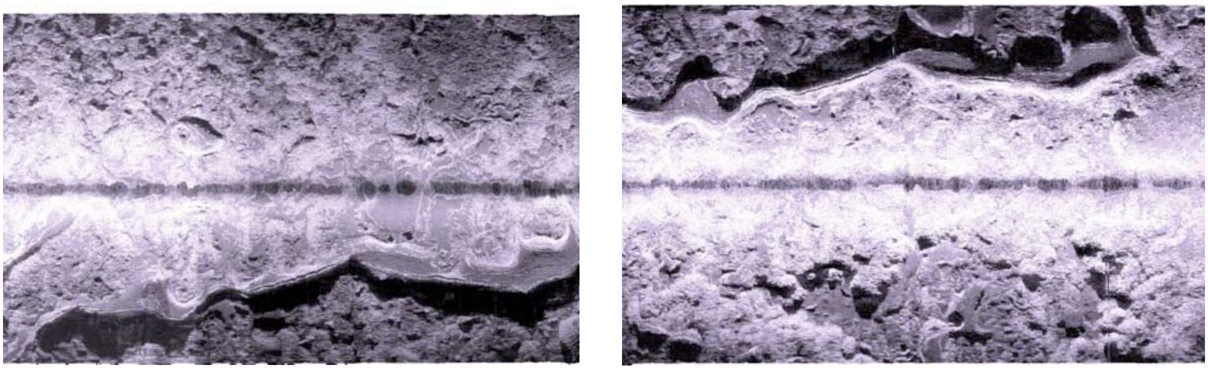


Fig. 2.3: Two sidescan profiles showing the same elongated volcanic feature with an illumination from each side.

A swath of 400 meters to both sides of the vehicle is the maximum range for the low side-scan frequency which requires an altitude of 40 meters. The line spacing of a side-scan pattern differs from the multibeam in two ways. At first the line spacing is larger due to the wider range. Thus, the resulting swath width provides a coverage of almost 2 km² per hour. In addition, the line spacing should be chosen to provide wider and narrower line spacing in an alternating way resulting in an overlap of 100 % and providing two side-scan maps with opposite illuminations (see Fig. 2.3A and B). In our case we chose a line spacing of 200 / 600 meters. The side-scan settings that can be adjusted during the survey are limited to the frequency (low or high) and the range. The side-scan data are acquired in form of JSF files. The French program CARAIBES (IFREMER) was used to create a mosaic from the recorded files.

All sensor information collected by the vehicle is marked with time, depth and latitude/ longitude as it is collected, facilitating the rapid and highly automated generation of maps and HTML based reports. An acoustic communication system permits the vehicle to send status messages to the surface ship containing information about the vehicle's status, its location, and some sensor data while it is performing a mission at up to 6 km below the surface. The acoustic communication system is also used to send data and redirection commands to the vehicle. The AUV utilizes electronics, control software, and the laptop based operator interface software.

The vehicle navigates autonomously using a combination of navigation methods:
• **GPS** - Works only on the surface, GPS determines the vehicle's location on Earth. GPS determines the "initial position" before the vehicle submerges, and verifies or corrects the vehicle's position when it surfaces during the mission. GPS also plays a critical role during INS alignment.
• **Inertial Navigation System (INS)** - After alignment on the surface, INS continuously integrates acceleration in 3 axes to calculate the vehicle's position. It uses input from the DVL and the GPS to maintain its alignment.
• **Doppler Velocity Log (DVL)** - Continuously measures altitude and speed over ground whenever the vehicle can maintain bottom-lock. The DVL receives temperature and salinity data from the CTD Probe to calculate sound speed. The DVL must be within range of the bottom to measure altitude and provide bottom-lock for the INS.
• **Long Baseline Acoustic Navigation (LBL)** - The vehicle can navigate using LBL navigation by computing its range to two (or more) moored acoustic transponders.
• **Ultra Short Baseline Acoustic Navigation (USBL)** – An additional navigation is realized by a IXSEA mini transponder which can be triggered by a ship's IXSEA

Posidonia USBL positioning system, if available.

2.4 Navigation behaviour of the AUV during SO203

The vehicle showed some navigational errors, especially during dive 13 and 15. Currently, we don't know the reason, but there are a few indications which points to the DVL (RDI Workhorse Navigator) as one possible reason. The navigational errors can be divided in 3 groups:
1. LBL fixes which have been accepted by the vehicle software (indicated as green arrows in the VIP) but not considered.
2. Jumps of the vehicle during the track without recognizable reason.
3. Virtual across track shift of the vehicle and a real reaction of it afterwards

1. During a mission using two transponders the vehicle monitors continuously the range to both of them. After it recognizes a useful series of transponder ranges than it marks the position as an accepted LBL (Long Baseline) fix. It will be indicated in the navigational display as a green arrow. The vehicle position jumps to this LBL fix immediately and corrects its position to the planned track. During the mentioned missions either the vehicle ignored the LBL fixes completely or it corrects its position wrongly, which means the jump does not end exactly on the LBL fix. Sometimes a constant shift of a certain direction and distance of several meters to a series of LBL fixes can be seen. The reason of that error is unknown and has to be discussed with the manufacturer.

2. The log file shows a lot of jumps over distances of up to 50 meters and in various directions. The cause is unknown. The Kearfott display shows that the INS position as well as the state position jumps suddenly and without a shown trigger. There were no LBL fixes or anomalies in the log file, which could cause these jumps.

3. The last error looks like a virtual, short-time shift from the side of the vehicle. Afterwards the vehicle corrects its track accordingly. At this time the forward velocity decreased apparently but the thruster revolution showed no anomalies. The Kearfott x-y residual reflects this behaviour in form of large peaks. The ADCP display showed these shifts in the current north/east announcement sometimes with realistic values but often with huge values up to 45 m/s. In the last case the vehicle position remains at the same point for some seconds instead of shifting.
It is important to mention that all of these errors in this group occurred while transiting above steep slopes mostly upwards slopes. The altitudes had values between app. 60 and 80 meters.
It seems to be a problem of the DVL or the ADCP (a function of the DVL) respectively due to the fact that the velocity and the altitude information are supplied by the DVL. That is an assumption and has to be determined by the manufacturer.

A Vehicle Interface Program (VIP), a Windows program that manages every aspect of AUV operation, include the following tasks:

• Mission planning on electronic navigation charts (customizable, multi-format)
• Real-time mission monitoring through the acoustic modem
• Real-time support-vessel position and heading through GPS and compass feeds
• Pre-mission system checkout

• Post-mission data analysis, mission play-back, and side-scan review

Navigation charts show missions during planning, operation, and review. A graphic Mission Planner lets users build mission files using drag-and-drop to position waypoints and mission objectives on the chart window, and fine-tune missions using editable text fields. Automatic error checking verifies all aspects of planned missions, and warns operators if any mission parameters are incorrect. Communication between the vehicle and the computer runs through a standard Ethernet connection, or wirelessly, using the WiFi connection.

The following technical problems occurred during SO 203:

During the ascent of dive 16 the AUV has aborted the mission because it has reached the safety limit of battery power. At the same time the VIP has indicated a ground fault (GFI) which came from the ADCP. We couldn't solve the GFI, however, because the GFI caused only a current of < 1mA, we were still able to dive. On deck the propeller of the vehicle started to spin after a shutdown of the vehicle which was related to a failure on the motor-controller board. We were able to fix the problem by changing the board. In addition, a current overflow occurred after we restarted the RESON multibeam which was caused by a failure on the guest board. We solved the problem by also changing this board. However, it seems that there was a direct correlation to that event of reaching the battery power limit. When the batteries reach a low capacity condition and the vehicle aborts, it turns off the high power sensors to save power. It is possible that the multibeam sensor was transmitting at this time causing problems on the guest port card.
In the following we experienced a number of problems which may or may not be related to this incident. It turned out that the flash card on the CPU PCB didn't work properly and the vehicle was not able to load the entire software from the card. Also, the battery bus 2 did not respond via the VIP because of a failure on a serial board. However, the battery charger indicates that the battery was still working with full power.

Several times the VIP has indicated a leak in the tail electronic bottle. A few water droplets inside the bottle most likely have caused this failure. Besides the GFI in the ADCP bottle a second GFI occurred which we couldn't localize. At this point, we stopped further diving for safety reasons.

However, we were able to carry out 10 scientific dives, summing up to almost 60 h bottom time (Tab.2.1)

Tab. 2.1: Summary of AUV dives during SO 203

Station # SO 203	Dive No.	Date	Time Start (UTC)	At Bottom (UTC)	Off Bottom (UTC)	Time End (UTC)	AUV Bottom Time	% Bottom Time	Distance Travelled (km)	Location
4-AUV	11	30.10.09	05:54	-	-	09:18	-	-	10,8	Volcanic ridge Segment 1B
4B-AUV	12	30.10.09	10:22	11:07	19:00	21:18	7,9 h	72,1 %	57,7	Volcanic ridge Segment 1B
12-AUV	13	01.11.09	05:04	06:05	09:52	11:01	3,8 h	63,9 %	34,3	Franklin Seamount
15-AUV	14	01.11.09	13:05	13:58	22:23	23:37	8,7 h	82,5 %	58,7	Franklin Seamount
34-AUV	15	04.11.09 - 05.11.09	08:02	08:47	00:33	01:30	15,8 h	90,3 %	97,1	Moresby Seamount
49-AUV	16	06.11.09	02:53	03:43	21:02	22:35	17.3 h	87.8 %	108.0	Western End of Segment 1A / Eastern foot of Moresby
79-AUV	17	11.11.09	20:23	21.18	22:04	23:30	0.8 h	25.6 %	18.2	Segment 1C
102-AUV	18	17.11.09	22:06	-	-	22:15	-	-	0.9	Western End of Segment 1A / Eastern foot of Moresby
102-AUV	19	18.11.09	00:55	02:02	06:53	08:31	4.9 h	64.5 %	43.4	Western End of Segment 1A / Eastern foot of Moresby
106-AUV	20	18.11.09	14:29	15:18	15:35	16:40	0.3 h	13.6 %	7.4	Western End of Segment 1A / Eastern foot of Moresby
Total:		**10 scientific dives**					**59.5 h**	**62.5 %**	**436.5**	

2.5 First results

In total, 10 dives were completed in the western Woodlark Basin, ABYSS dives 11-20 were dedicated to hydrothermal exploration and high-resolution mapping.

ABYSS 11 (SO 203-4) had to be aborted after 30 min due to a failure in the mission plan.

ABYSS 12 (SO 203-4B) was a dive to explore and map an area on the spreading segment 1B. Dive 12 was conducted at a height of average 120 m above a seamount and ridge crest, respectively, with a line spacing of 150 m and 100 m, respectively. The dive recorded no significant Eh and turbidity signals (Fig. 2.4). ABYSS flew a survey distance of 57.7 km.

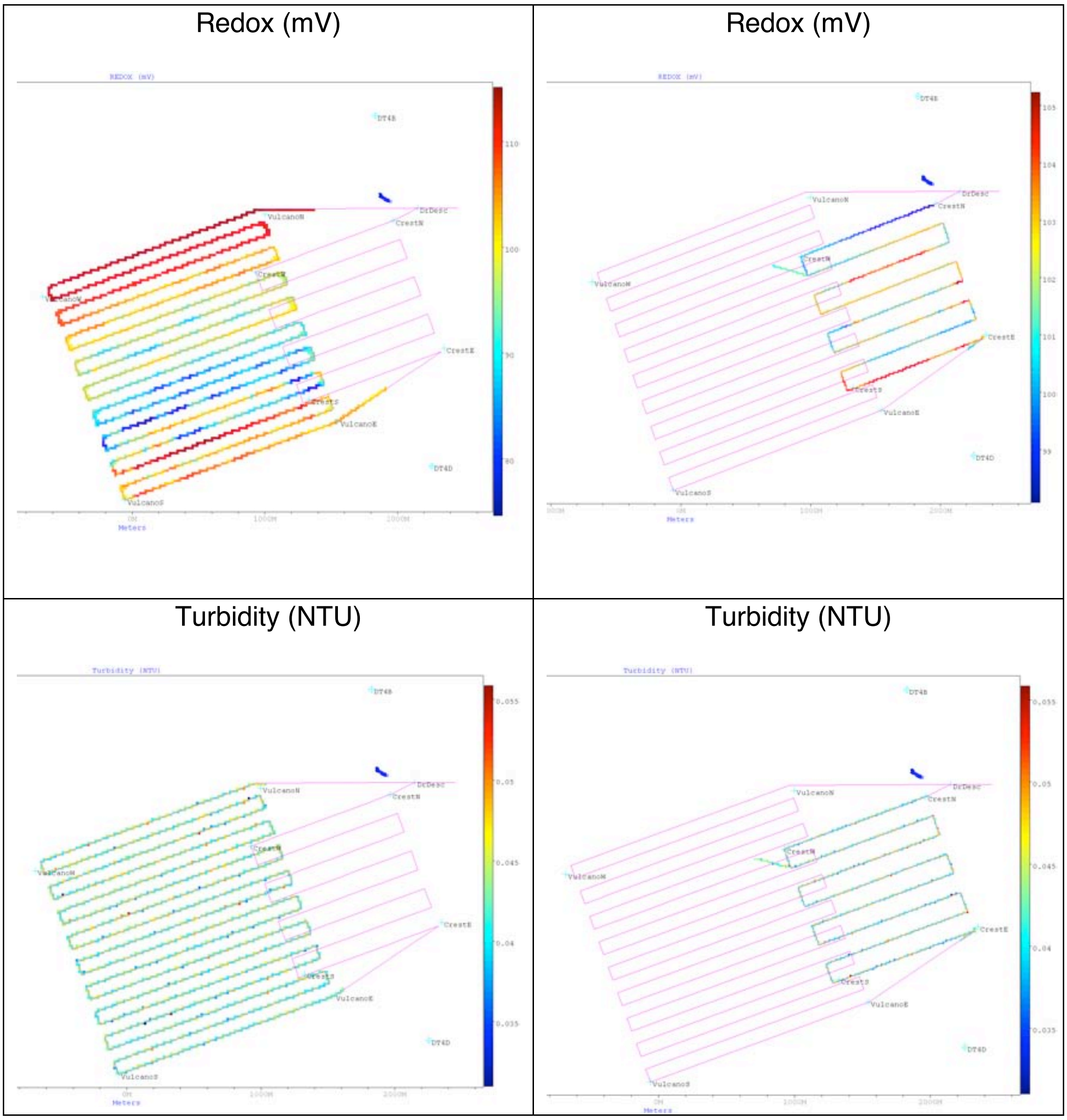


Fig. 2.4: Eh and turbidity data for dive ABYSS 12.

Dives ABYSS 13 and 14 (SO203-12AUV and -15AUV) were chosen to map the area of „Franklin Seamount“. Dive 13 mapped Franklin Seamount using the 400 kHz RESON multibeam and was planned with two water depth levels of 2100 m and 2130 m by using a 80 m line-spacing over the seamount crater. In addition, we used the 200 kHz multibeam sonar for detailed bathymetric mapping of the area west of the Franklin Seamount during dive 14. Both dives did not record significant Eh and turbidity anomalies (Figs. 2.5A and B). The change in color in the Eh line of both maps is a result of a general sensor drift from lower to higher values during time.

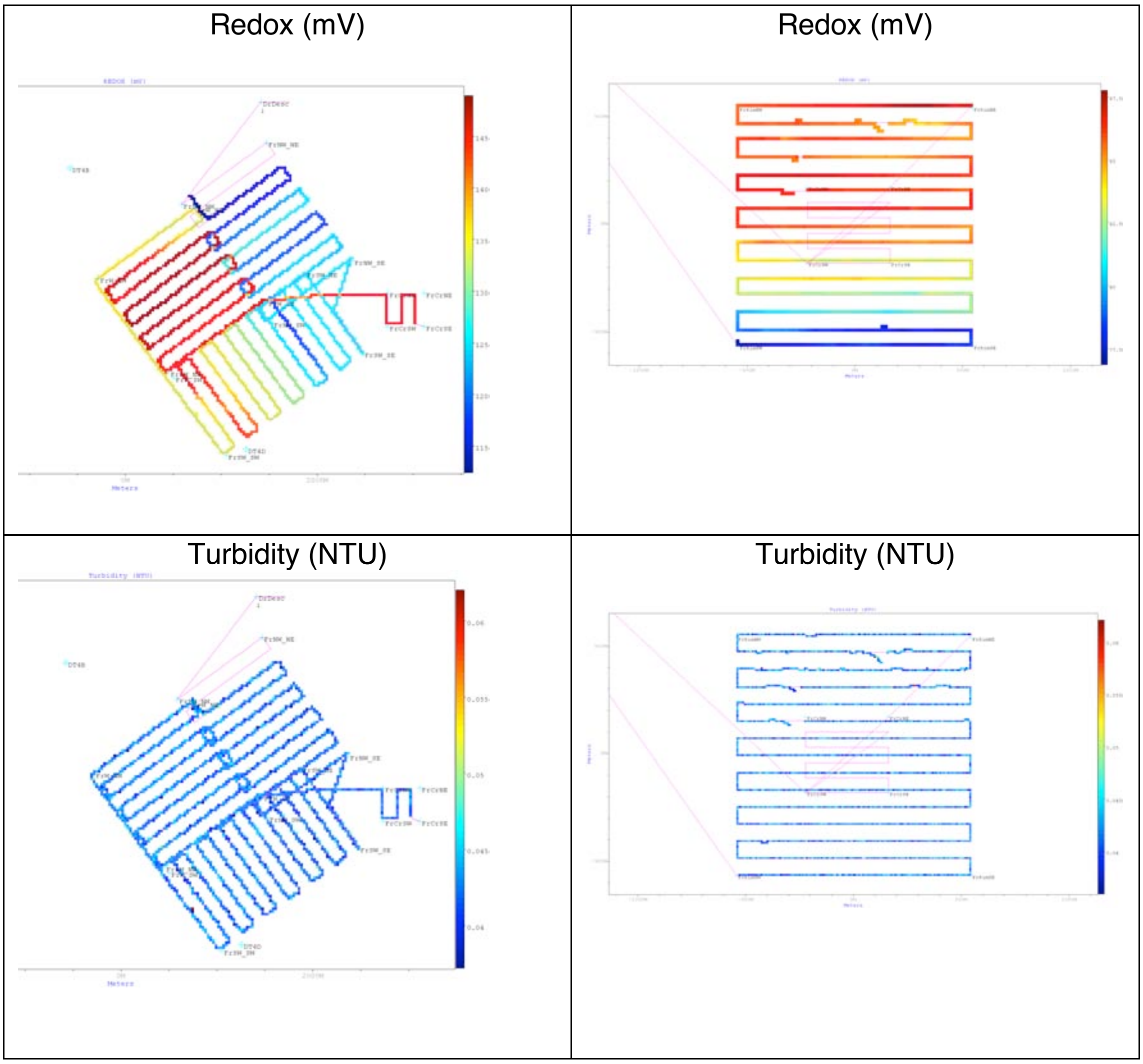


Fig. 2.5: Eh and turbidity data for dives ABYSS 14 (left) and 13 (right).

ABYSS 15 (SO203-34AUV) was conducted to carry out high-resolution bathymetric mapping (200 kHz multibeam sonar) of the Moresby Seamount detachment fault from 500m to 2700m water depth with average 100 m line-spacing.

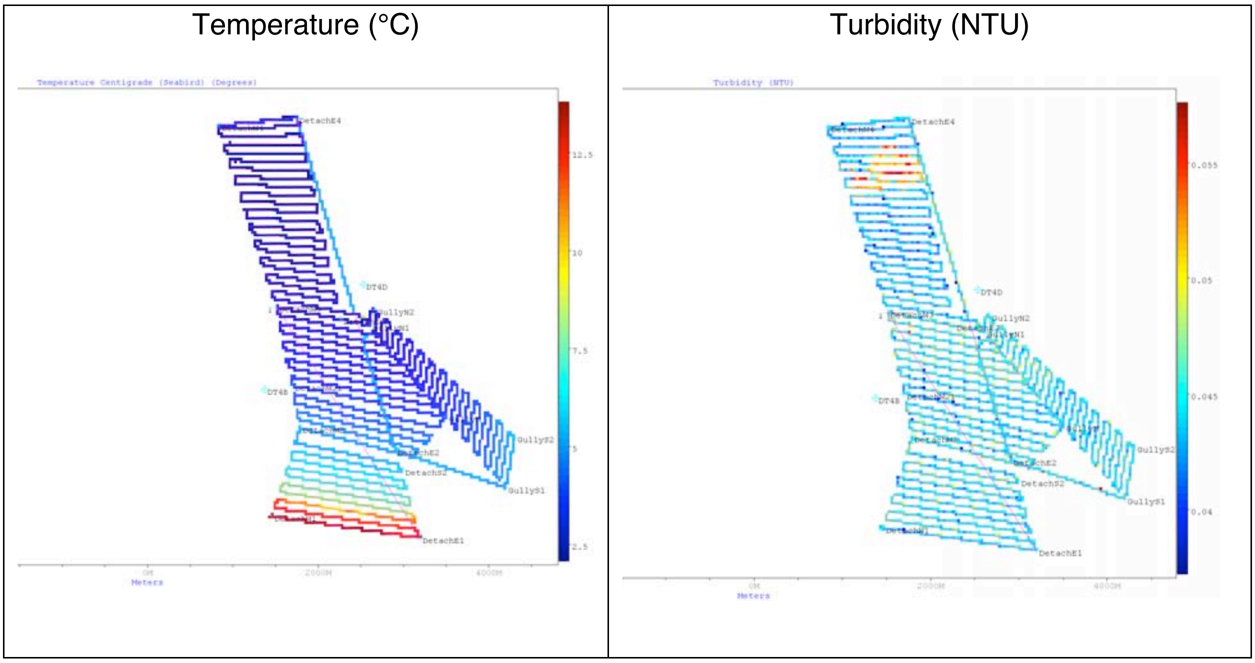


Fig. 2.6: Temperature and turbidity data for dive ABYSS 15.

A significant hit was recorded in the turbidity record at the foot wall of the detachment fault in 2600 m water depth (Fig. 2.6). However, because we had to disconnect the Eh-Sensor to connect the pencil beam it is not clear whether the turbidity anomaly is based on a higher particle load of a bottom current or if it is a hydrothermal signal. ABYSS surveyed 97 km on track during ~ 16 hours. A detailed bathymetric map of the Moresby Seamount detachment fault from the ABYSS Reson multibeam is shown in Chapter 5.

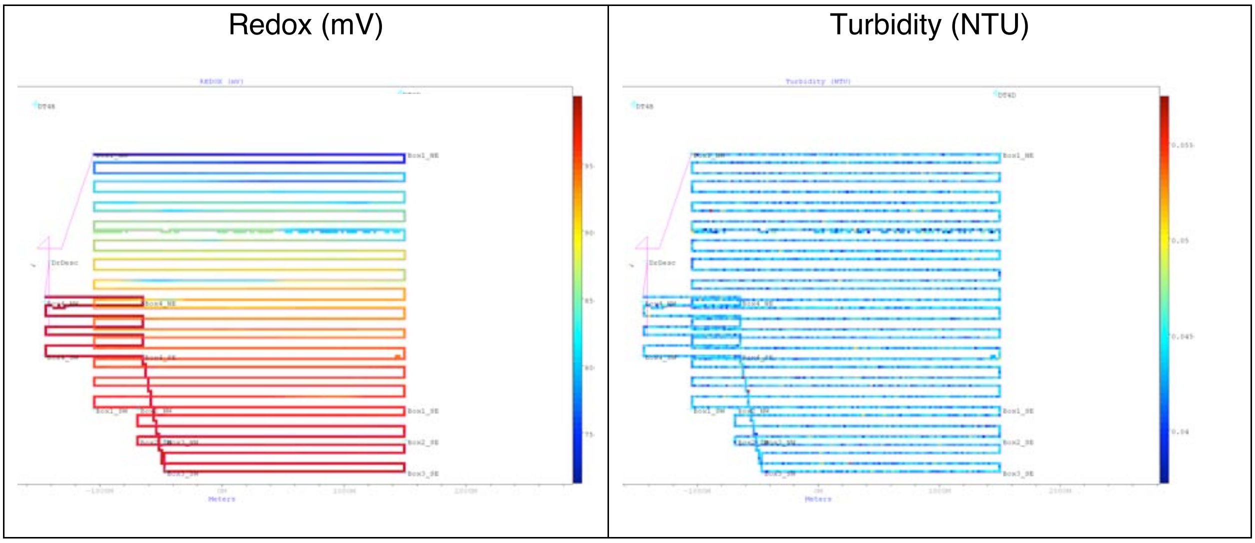


Fig. 2.7: Eh and turbidity data for dive ABYSS 16.

ABYSS 16 (SO 203-49AUV) was a dive to map (400 kHz) an area directly east of Moresby Seamount where a transition from continental crust to young oceanic crust occurs. Dive 16 was conducted at a height of ~ 50 m above the ocean floor with 80 m line spacing. The dive recorded no significant Eh and turbidity signals (Fig. 2.7). ABYSS flew a survey distance of 107 km.

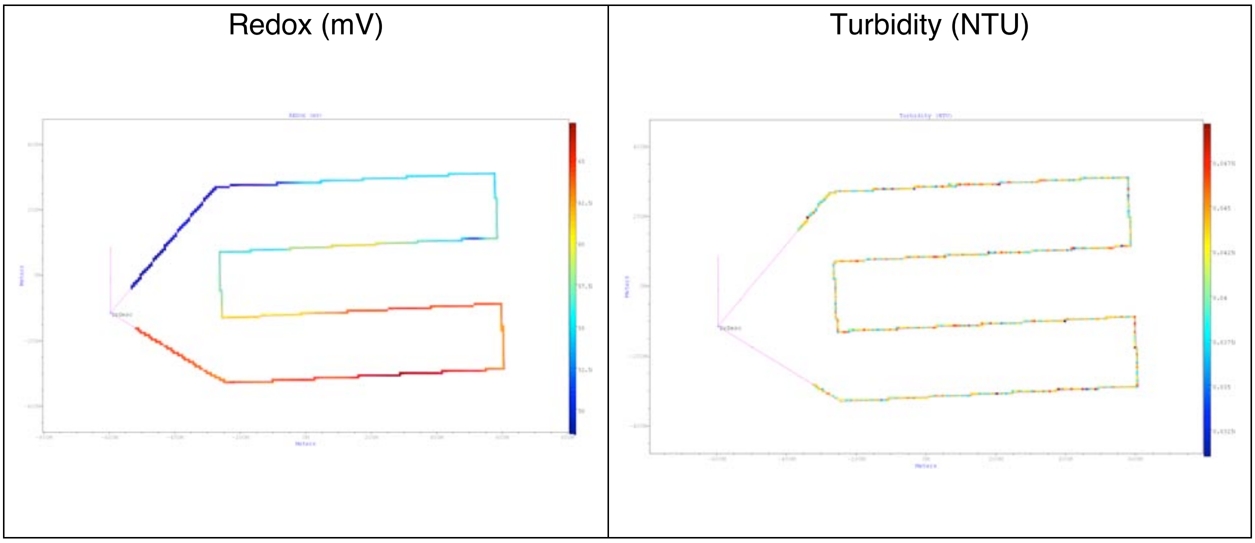


Fig. 2.8: Eh and turbidity data for dive ABYSS 17.

ABYSS 17 (SO203-79AUV) was a test dive and terminated after we have changed two defect electronic boards. During the dive we have monitored a non-repairable ground fault in the ADCP causing < 1mA at the housing. During the entire dive the ground fault kept stable which gave us the possibility for further dives. The survey lines were conducted 150 m above the seafloor in a water depth of ~ 2700 m. The dive recorded no Eh and turbidity anomalies (Fig. 2.8).

Dive ABYSS 18 (SO203-102AUV) aborted shortly after launching due to a sudden reset of the vehicle.

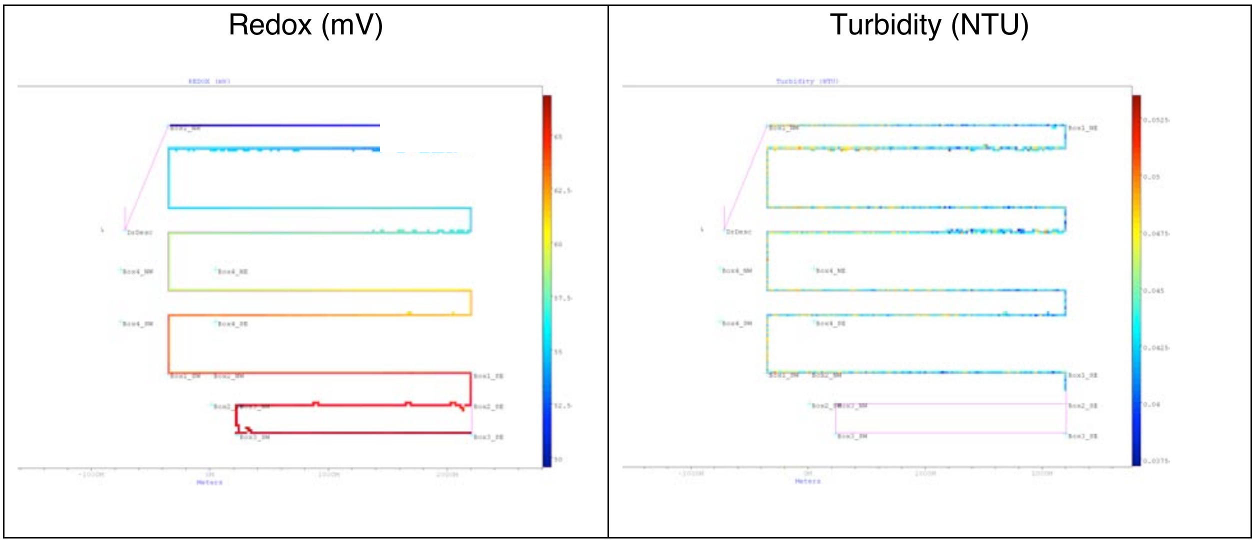


Fig. 2.9: Eh and turbidity data for dive ABYSS 19.

ABYSS 19 (SO203-102AUV) dive was designed to repeat the survey we made on ABYSS 16 dive at the eastern foot of Moresby Seamount for side scan mapping. The dive went well and the low-frequency sidescan sonar (110 kHz) recorded properly. The vehicle flew an altitude of 40 m above seafloor with an alternate line spacing of 600 and 200 m which gave us a full coverage by a swath of 400m on each side. We had two collisions along the lower wall of Moresby Seamount without any damage.

Fig. 2.9 shows the Eh and turbidity data and, hence, the lines from which side-scan data have been obtained (see chapter 3).

The dive ABYSS 20 aborted shortly after the AUV has reached its mission track, however, the high-frequency side scan sonar (410 kHz) recorded properly for a few minutes.

3 AUV mapping – techniques and results (I. Klaucke, S. Petersen, M. Rothenbeck)

Four AUV dives collected bathymetric data and one additional dive collected sidescan sonar data. The data have been processed onboard using different software packages. Low frequency (200 kHz) bathymetry data and sidescan sonar data have been processed using the package CARAIBES from IFREMER, while high-frequency (400 kHz) bathymetric data was processed using PDS2000 by RESON, because processing the 512 beams provided by the 400 kHz sensor is not yet implemented in CARAIBES.

3.1 Dive 012

The target of dive 012 was a small volcano near the ridge axis of segment 1B (Fig. 3.1), where previous data suggested a turbidity anomaly in the water column. The highly variable topography resulted in a two-part mission design. The first part of the mission consisted of 8 parallel profile lines over the eastern ridge crest. The tracks were 150 meter apart and laid in a staircase fashion over the topography in order to assure ideal mapping conditions in terms of range and vehicle safety. The remainder of the mission ABYSS flew 120 metres above the submarine volcano with 100 meter line spacing for a total of 18 profiles. Bathymetric data were recorded during the entire mission using the 200 kHz option of the RESON 7125.

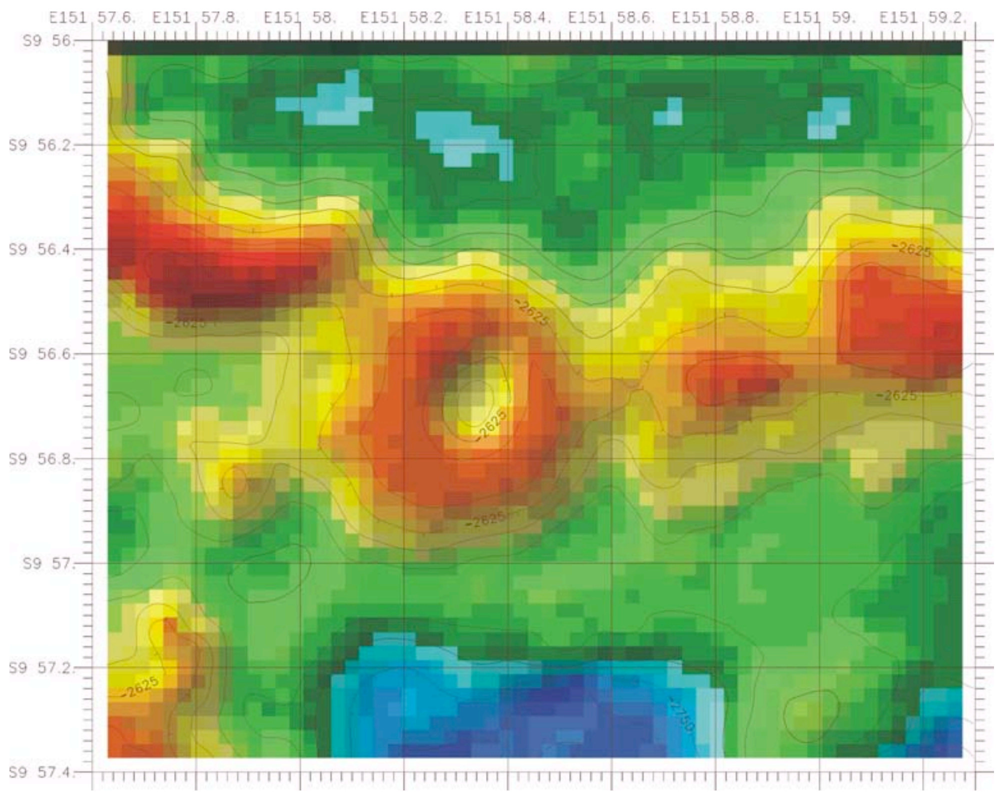


Figure 3.1: Ship-borne EM120 bathymetry of a small volcano on ridge segment 1B.

Two transponders were deployed during the dive at S9°55.772, E151°59.024 and S9°57.201, E151°59.258 resulting in good transponder coverage over almost the entire mission (Fig. 3.2) and yielding good navigation data. Although the data are recorded in the fish in RESON'S open access format s7k, the raw data can not be imported directly into CARAIBES. Importing the data first into PDS2000 and then directly exporting the data again as *.s7k, however, results in readable s7k-data for CARAIBES and probably other processing packages. In the case of dive 012 prior to exportation, the navigation data has been cleaned and quality filtering applied in PDS2000. In CARAIBES, the soundings have been georeferenced and manually edited. Out of a total of 12 million soundings some 16% have been invalidated and the remaining soundings gridded to 5 metres cell size with 80-100 soundings per cell (Fig. 3.3). Gridding to a 2 metres grid (10 soundings per cell) is also possible and shows more detail but also highlights the imperfections due to varying pitch of the vehicle and improper editing (Fig. 3.4).

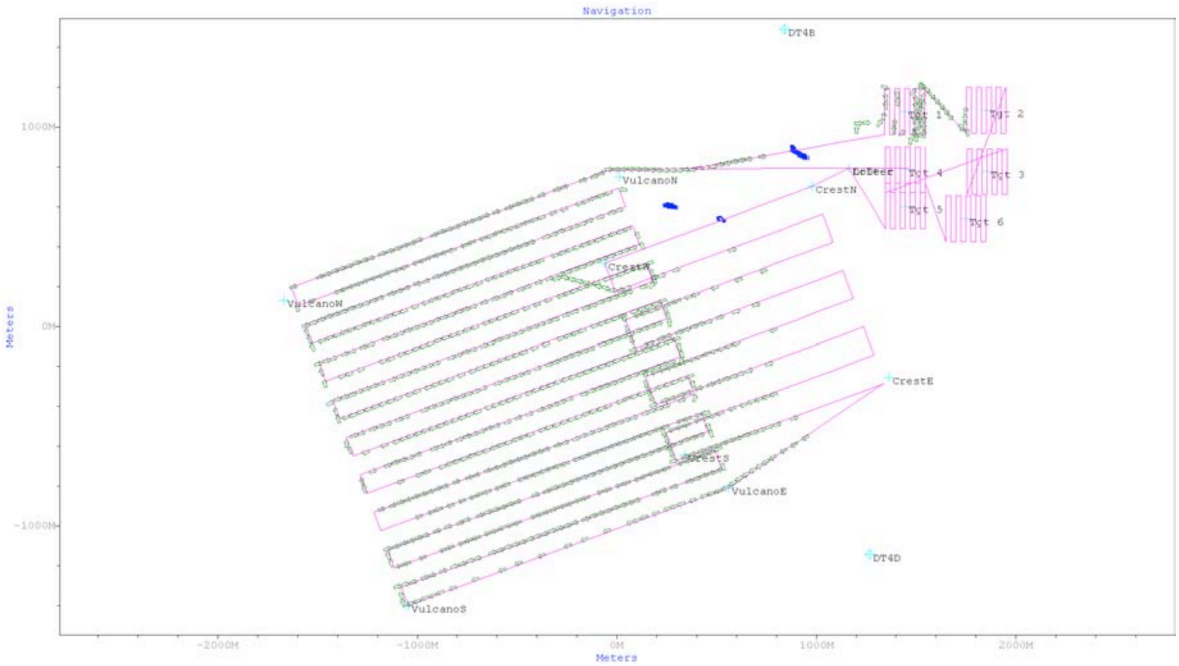


Figure 3.2: Mission layout and transponder fixes for dive 012. DT4B and DT4D indicate the transponder positions.

The detailed AUV bathymetry reveals unprecedented detail of submarine volcanic morphology, such as magmatic pillows, small magmatic overflow channels, a large fissured plateau, and collapse structures. The most remarkable features are situated at the rim of the central caldera of the large volcano centred at E151° 58.3/S9° 56.7, where small scale collapses are visible (Fig. 3.4). Mass wasting is also present at the southern edge of the volcanic plateau in the Northwest of the study area, where a more than 200 meter long portion of the plateau has slid down the flanks of the structure (Fig. 3.3), but has neither disintegrated nor reached the bottom of the slope.

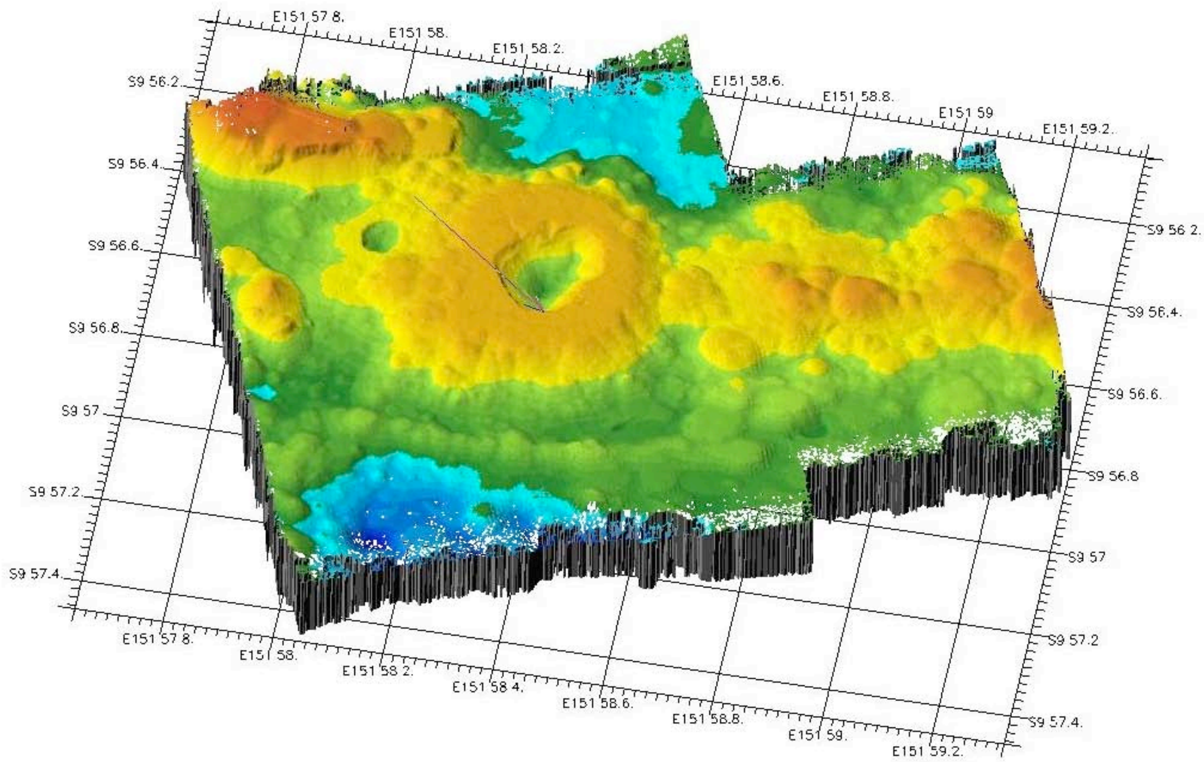


Figure 3.3: 3D view of 200 kHz bathymetry recovered from dive 012.

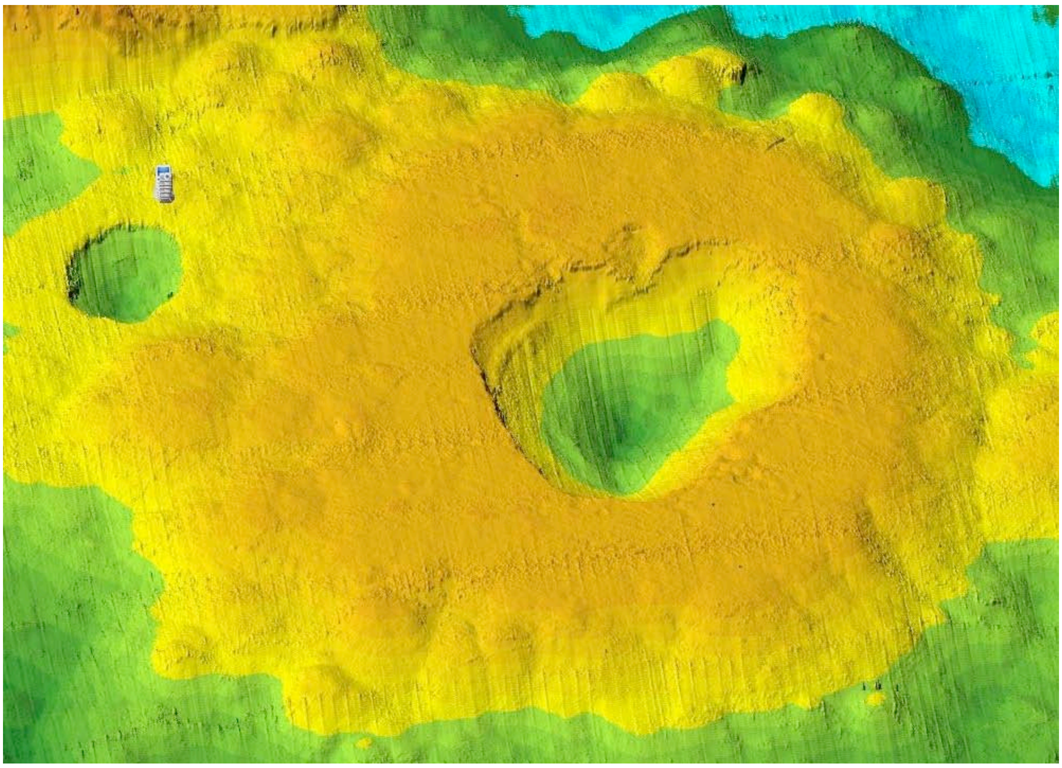


Figure 3.4: Detail of 3D view display of high-resolution (2m grid cell size) bathymetry.

3.2 Dives 013 and 014

These two dives were targeted at mapping Franklin Seamount and its immediate surroundings (Fig. 3.5). Franklin Seamount is known to contain barite chimneys and Fe-oxyhydroxide deposits; one of the few indications of hydrothermal activity in the West Woodlark Basin. Dive 013 was designed to map the inner crater and the rim of Franklin Seamount with 400 kHz bathymetry, while dive 014 mapped four additional volcanic edifices to the Northwest of Franklin Seamount (Fig. 3.5) and again the crater of the latter for comparison with the 400 kHz map.

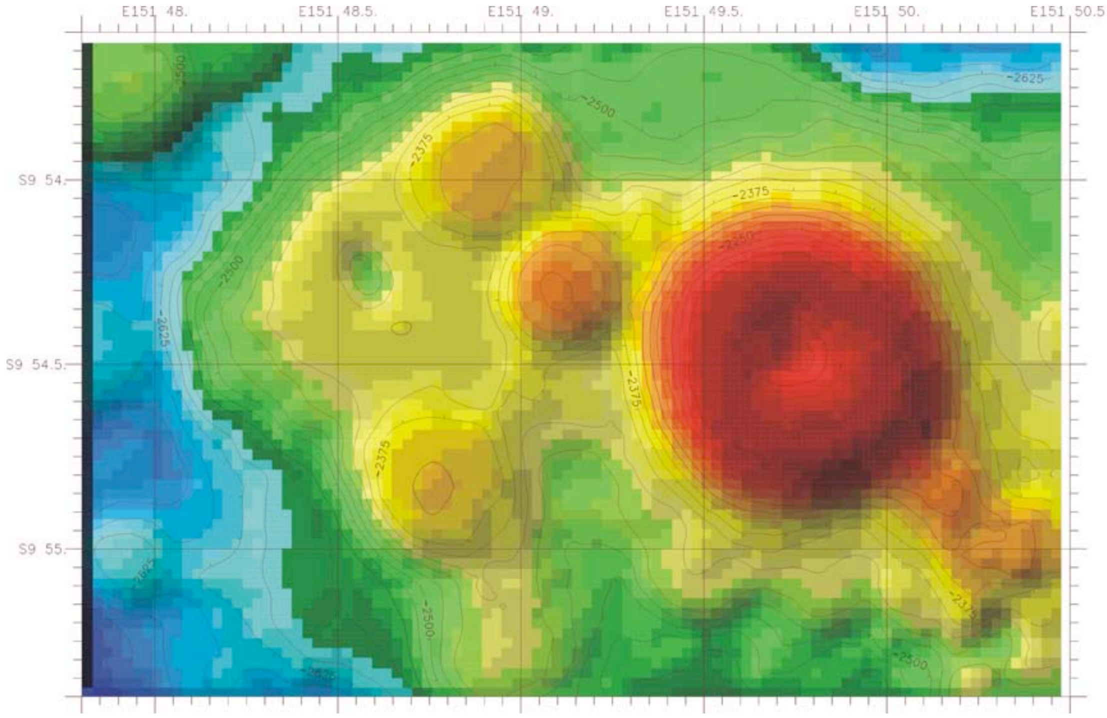


Figure 3.5: Ship-borne EM120 bathymetry of Franklin Seamount and its immediate vicinity.

Mission layout of dive 013 consisted of 15 parallel tracks with 80 m track spacing and where the vehicle was flying in constant water depth of 2100 m, i.e. 40-50 m above the seafloor (Fig. 3.6). In addition, five shorter, parallel tracks aimed at mapping the interior of the crater and were run right after the initial tracks in 2130 m water depth. Two transponders were deployed at S9°53.684 / E151°47.839 and S9°55.274 / E151°48.842 resulting in good coverage in the western portion of the mission but only poor transponder coverage in the east (Fig. 3.6). Still, navigation data proved to be of reasonable quality. Data processing was carried out with PDS2000 and consisted of navigation editing (cutting out the turns and editing navigational errors observed during the dive), application of various filters (level 3 quality filter: beams with good colinearity and good brightness used; beam reject filter: 1-25 and 487-512 beams rejected; range filter: only beams between 5 and 150 m used) and manually editing the remaining soundings. Due to the steep slopes of the area the ping reject was set to 100% (for details see dive 016 below). The valid soundings were subsequently gridded with 1 m grid spacing resulting in a bathymetric map revealing spectacular detail (Fig. 3.7). The outer rim of Franklin Seamount is not entirely featureless but shows a number of small elevations with small tricorne cracks of just a few tens of metres in diameter indicating small eruption centres (Fig. 3.8). The interior of the seamount also shows a morphology that is very different from the volcano mapped by dive 012. While the crater of the latter is featureless, the crater of Franklin Seamount shows the presence of several domes indicating renewed volcanic activity after collapse of the initial volcanic edifice (Fig. 3.7). Large talus fans are apparent and have been confirmed during TV-grab station 24TVG.

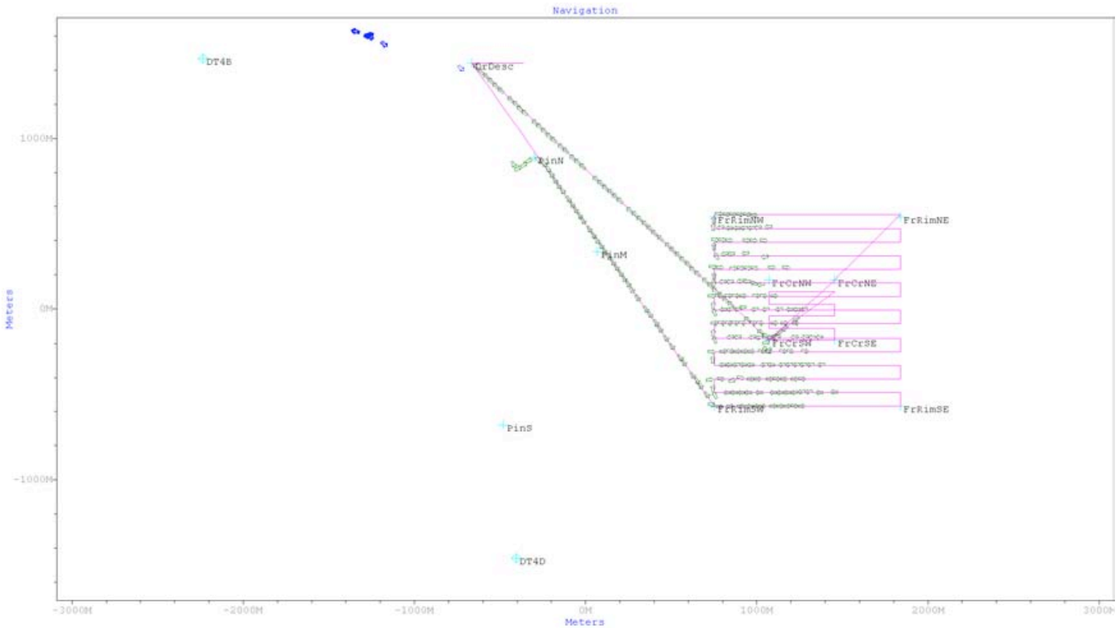


Figure 3.6: Mission layout and transponder fixes for dive 013. DT4B and DT4D indicate the transponder positions.

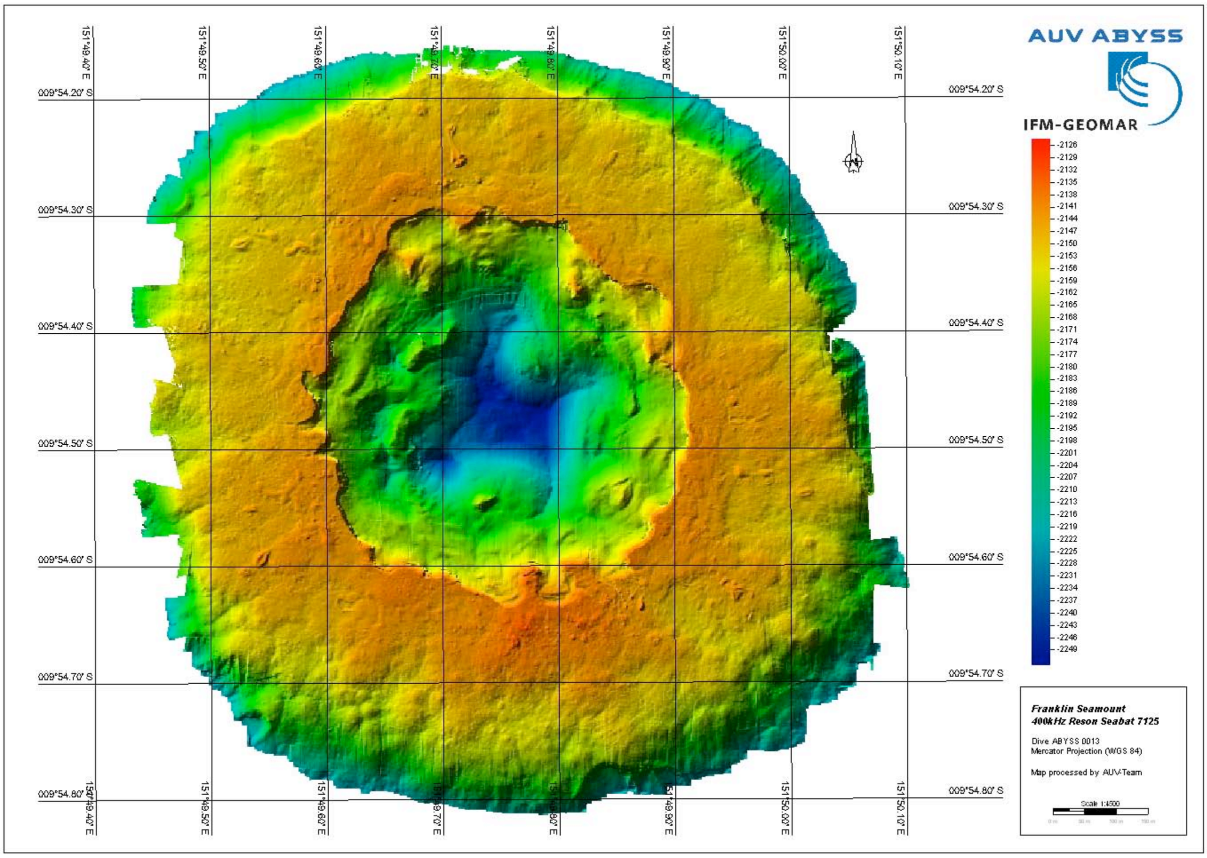


Figure 3.7: 400 kHz bathymetric map of Franklin Seamount rim and crater (1m grid-cell size).

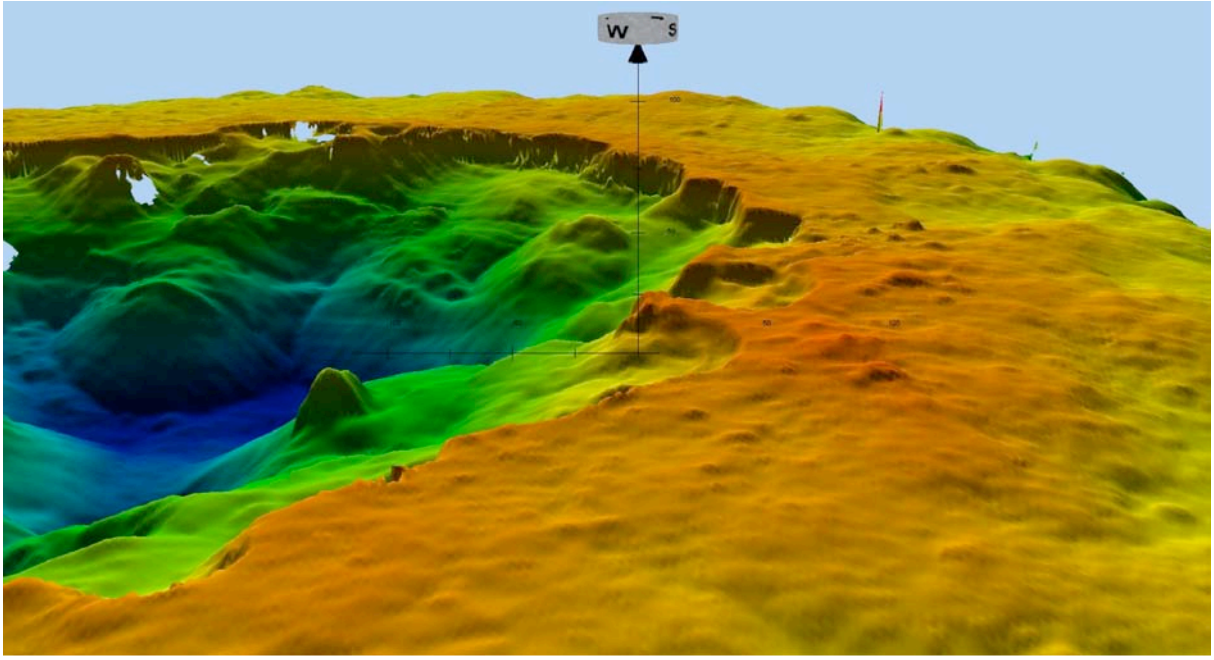


Figure 3.8: Detailed 3D view of 400 kHz bathymetric map of Franklin Seamount.

Mission layout of dive 014 consisted of 33 parallel tracks of 1200 m length and 150 m track spacing. The entire mission was divided into four subsets, each subset flown in a different water depth in order to compensate for different height of the structures that were mapped. The same transponder positions as for dive 013 were used, resulting in good coverage for the eastern part of the mission, but poor coverage in the western part that was located directly between the transponders (Fig. 3.9).

Figure 3.9: Mission layout and transponder fixes for dive 014. DT4B and DT4D indicate the transponder positions.

The 200 kHz bathymetric data of this dive were processed onboard using CARAIBES. After importing the data several filters were applied including a RESON brilliance and colinearity filter and invalidating the 30 outermost beams on both the port and starboard side. Subsequent manual editing of the soundings resulted in good data quality for the eastern half of the survey, but poor navigation data for the western half that translated into mismatches between overlapping beams (Fig. 3.10). A different approach for processing the data was also tested. The original data were gridded at 50 m grid spacing. Then the original data were filtered against this grid and all soundings falling 60 m outside of the grid were invalidated. The resulting bathymetry data were then gridded at 20 m, filtered with 30 m, finally gridded at 5 m and filtered at 8 metres in order to have a final grid of 2 m cell size. The resulting grid still contained more erroneous soundings (especially along steep slopes) but allows quickly generating a complete and detailed bathymetric map. Comparing dive 014 and dive 013 it should be noted that dive 013 has better navigation data and subsequently better bathymetric data than dive 014 although transponder fixes for dive 013 were only available for half the length of each track. During dive 014, on the other hand, entire tracks had to be run without transponder fixes and the navigation error could accumulate. The cumulative error should be on the order of 4 m per hour, but navigational mismatch is much larger and reaches 60 m for adjacent tracks in the northwestern part of dive 014. The reason for the large navigational errors despite Kearfott's inertial navigation sensor remains unknown.

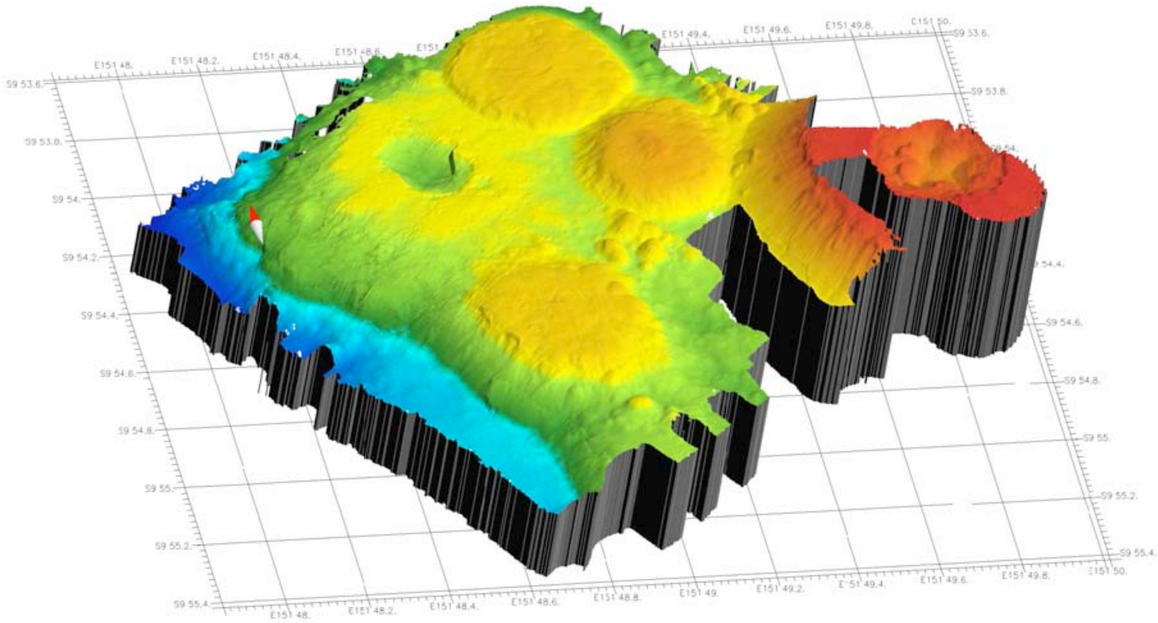


Figure 3.10: 3D view of Franklin Seamount crater and volcanoes to the northwest of it. The northwestern quadrant is problematic because of navigation shifts between adjacent survey lines.

The CARAIBES software package has routines that allow realignment of erroneous navigation for bathymetric data. Using the tool RegBat allows compensating for bad navigation between adjoining tracks (Fig. 3.11). Using this tool for several adjoining tracks in a row, however, results in cumulative errors and distortion.

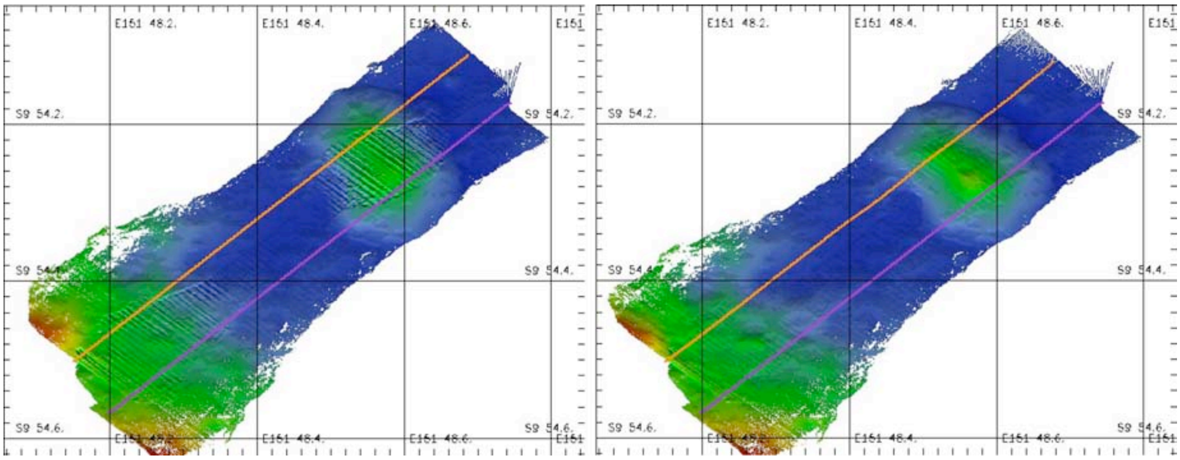


Figure 3.11: Example of recalculating navigation data for two adjacent survey lines.

3.3 Dive 015

The 15th dive of AUV Abyss was designed to map a 3 km wide stretch of the northern flank of Moresby Seamount. This flank of the seamount is believed to represent the surface of an active detachment and signs of faulting on the seafloor could give insight into detachment mechanics. Mapping this area with AUV was quite challenging, because more than 2000 metres of relief had to be covered by the two trans-ponders at S9°46.376 / E151°33.394 and S9°45.708 / E151°34.029, and the AUV had to map a steeply inclined slope. The 200 kHz option of the RESON multi-beam was, of course, chosen for this task. Still, for large portions of the dive, especially in the upper, southern part transponder fixes were not available (Fig. 3.11) resulting in insufficient alignment of adjacent survey lines. Individual tracks consequently generate edges running across the slope and are still visible in the final map (Fig. 3.13). In addition, an entire segment of one track at S9°45 is shifted northwards by several metres. Fore more details on Moresby Seamount see section 3.1.

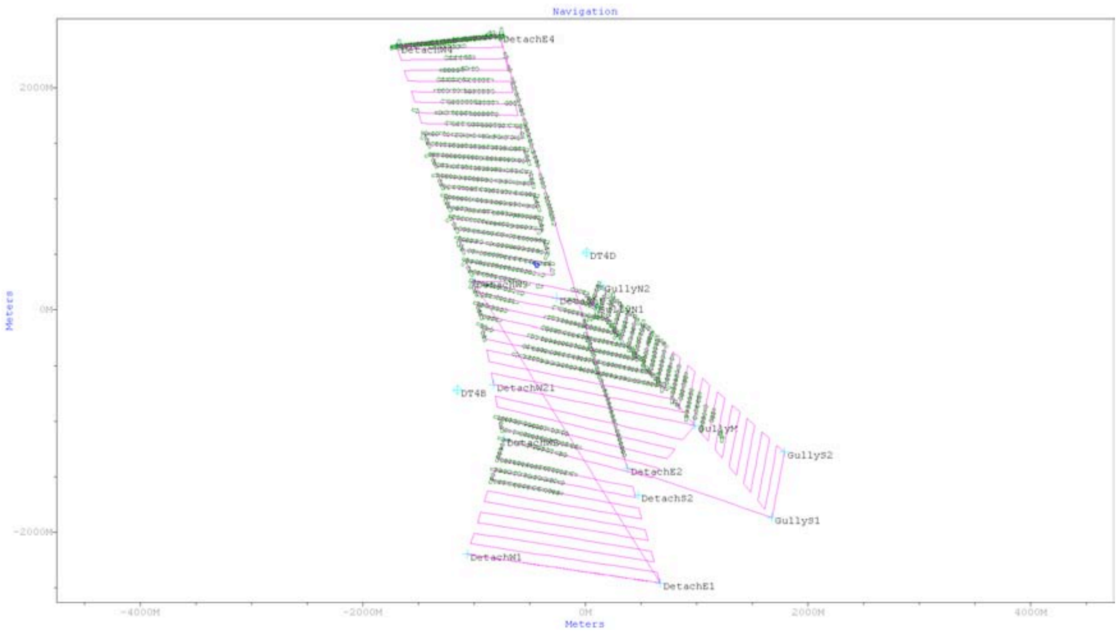


Figure 3.12: Mission layout and transponder fixes for dive 015 in relative coordinates. DT4B and DT4D indicate the transponder positions.

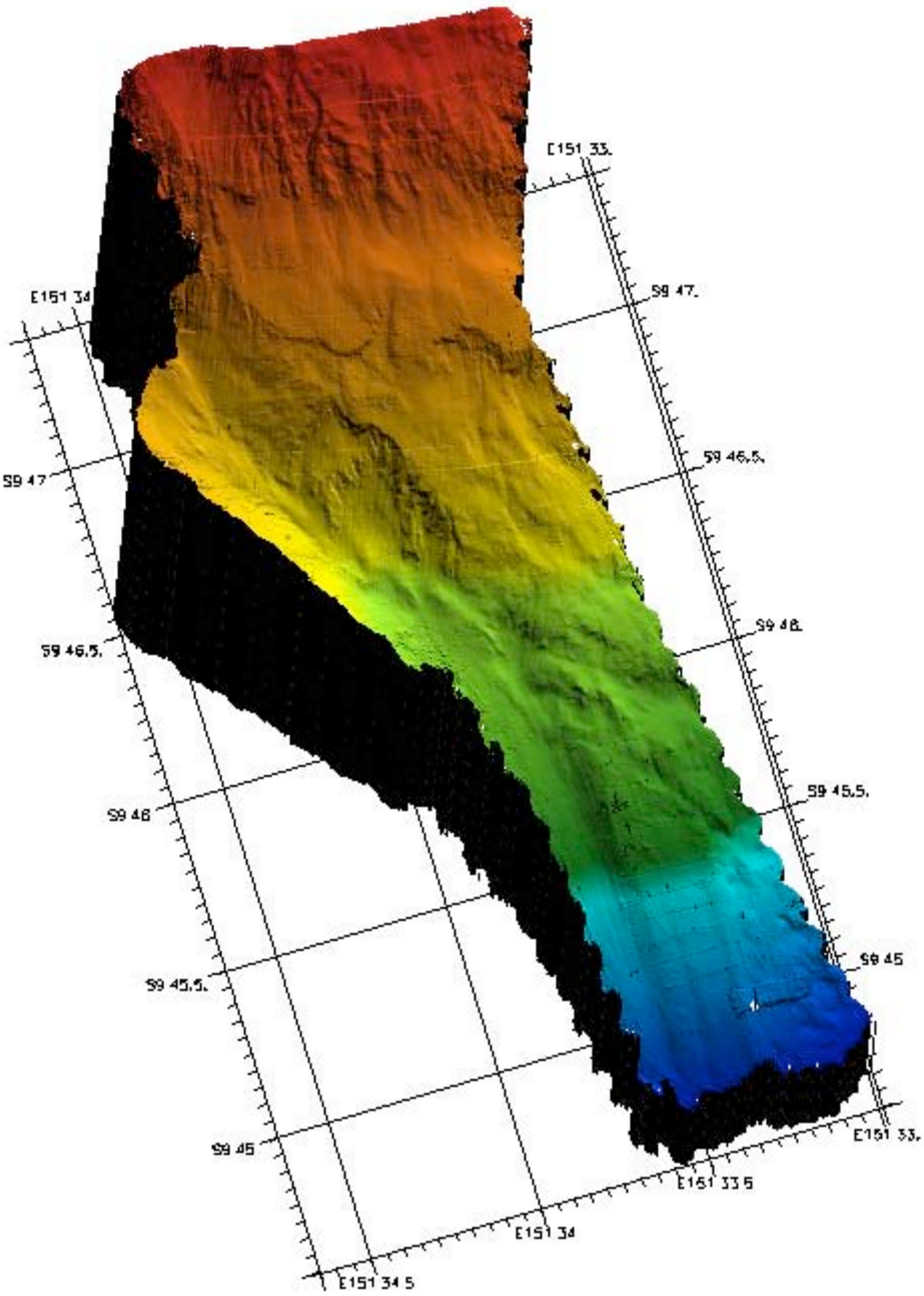


Figure 3.13: 3D bathymetric view of the northeastern flank of Moresby Seamount using 200 kHz bathymetric data. Soundings have been filtered but not edited.

3.4 Dive 016

This dive was designed to map the foot of Moresby Seamount, i.e. the contact between fresh oceanic crust and the old continental crust (Fig. 3.14). Ship-borne backscatter data indicate a very sharp contact between the two domains, but 400 kHz bathymetry data should reveal the details of this contact and possibly the processes involved. Two transponders were deployed at E151°40.339 / S9°48.301 and E151°41.978 / S9°48.251, i.e. outside of the surveyed area. This resulted in good navigation data for almost the entire area (Fig. 3.15).

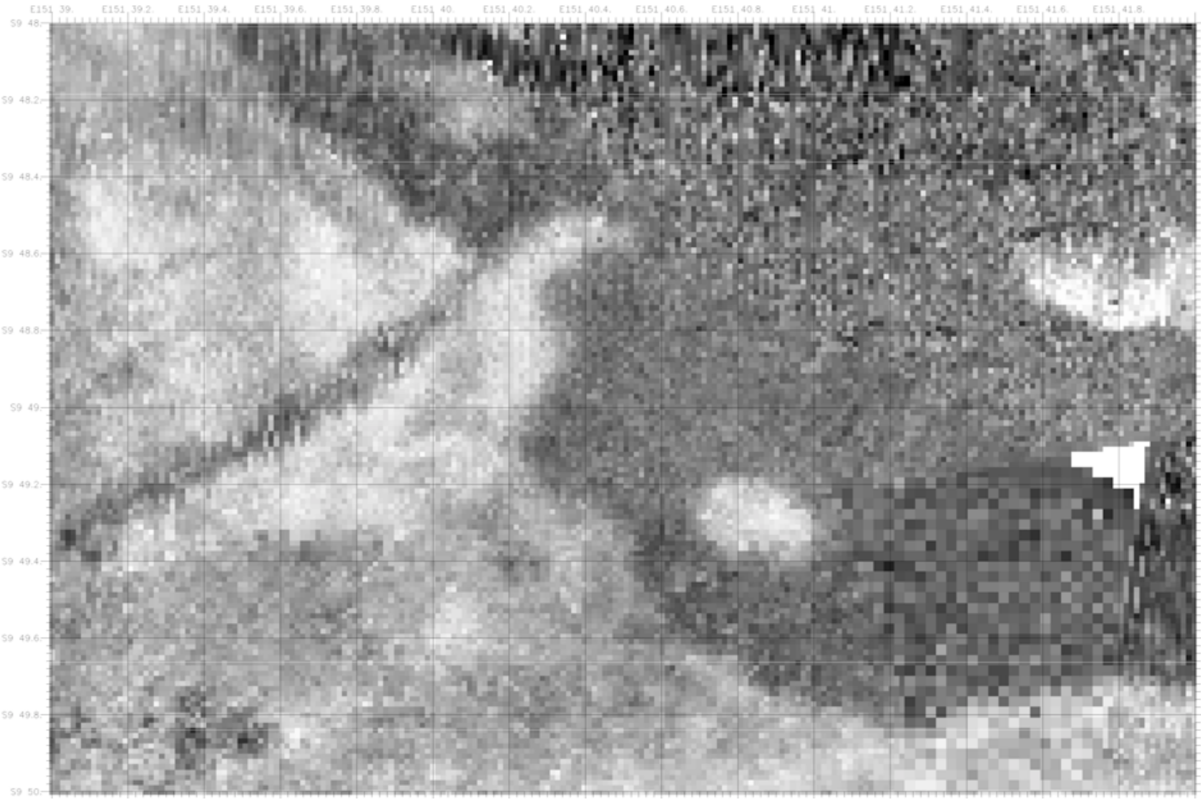


Figure 3.14: Simrad EM120 backscatter map of the foot of Moresby Seamount showing the contact between high backscatter recent volcanics (in dark) and low backscatter old continental basement or recent sediment cover (in white).

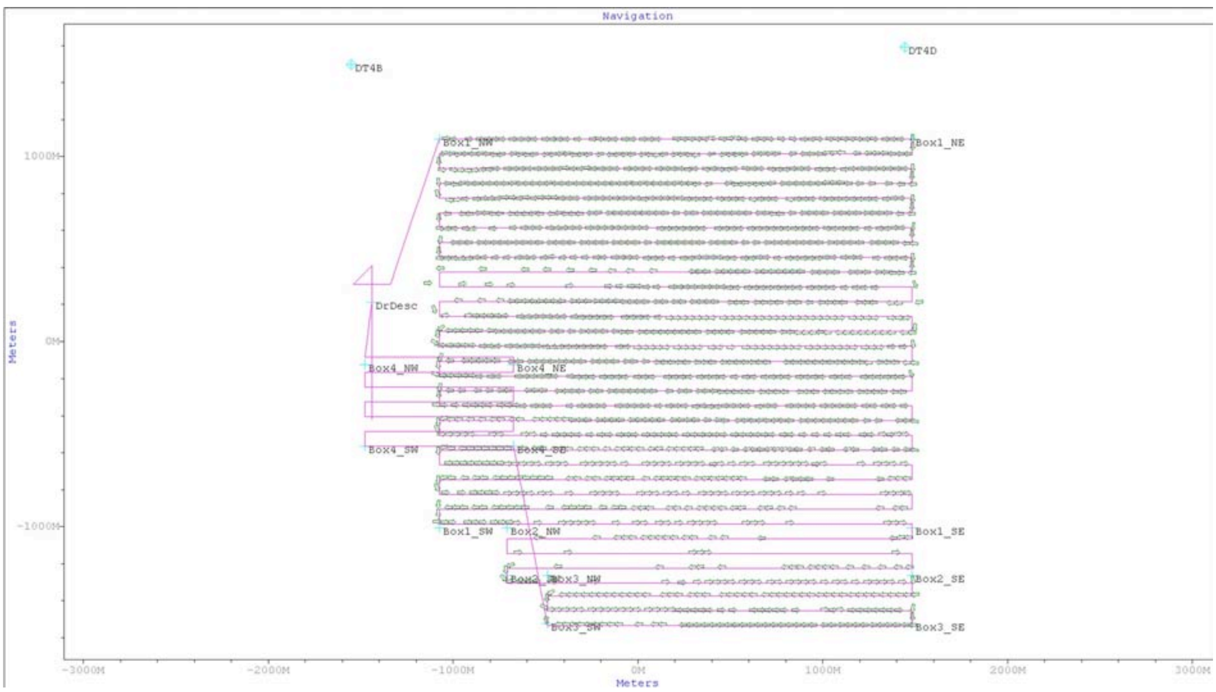


Figure 3.15: Mission layout and transponder fixes for dive 016 in relative coordinates. DT4B and DT4D indicate the transponder positions.

Dive 016 was run with settings that differed slightly from those of dive 013 in that power output of the RESON transducer was reduced. Processing of the 400 kHz bathymetry data was done with PDS2000 using RESON'S quality filters, a range filter of 200 m and subsequent crude manual editing. It turned out that this procedure produced many holes in the final grid (Fig. 3.16) although close inspection of the raw indicated significantly more good soundings than appeared in the final map. In addition, the data were of significantly lower quality than those of dive 013, i.e. many soundings were rejected by the original quality filter. One possible explanation is the reduced output power that should result in lower amplitudes of the return signal. The Reson quality filter was consequently set to 2, which means also beams with good colinearity but poor brightness are included.

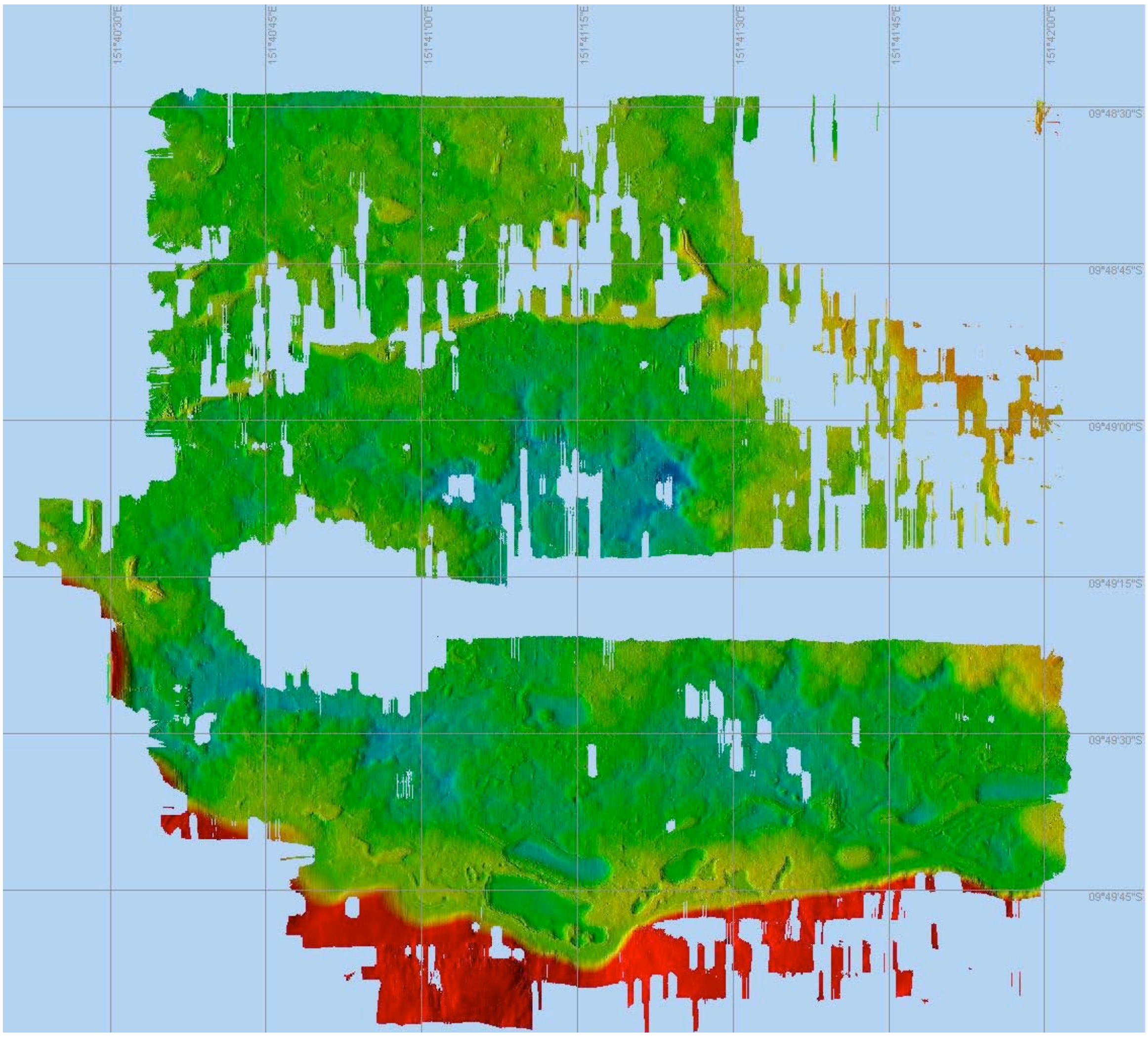


Figure 3.16: 400 kHz backscatter map with original settings. Much of the missing data has been taken out by the PDS2000 quality filter. One survey line is missing in the centre of the map.

It is apparent from Figure 3.16 that entire ping blocks are missing in the dataset. This actually resulted from a default parameter setting for editing in PDS2000. The default value for ping rejection is set to 30%, i.e. if more than 30% of the soundings of a given ping are invalidated because the soundings are, for instance, out of range, the entire ping including the good values will be rejected. The value was consequently set to 100% which proofed also valuable for editing the data in the steep morphology around Franklin Seamount (dive 013). Additionally, the 30 outer beams were rejected and a range filter of 5-120 was applied, i.e. rejecting all values that are closer than 5 m and more than 120 m away.

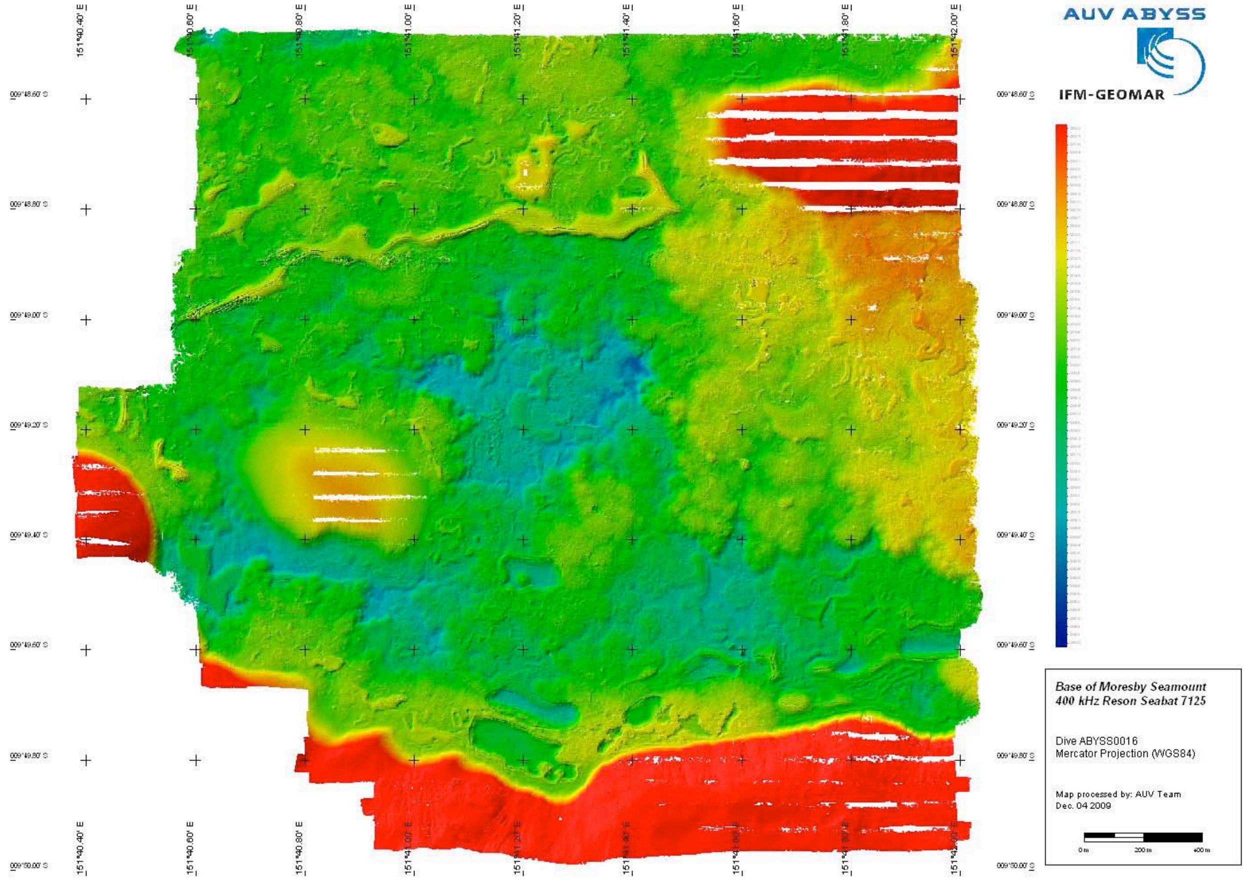


Figure 3.17: 400 kHz bathymetric map with no beam reject and manual editing.

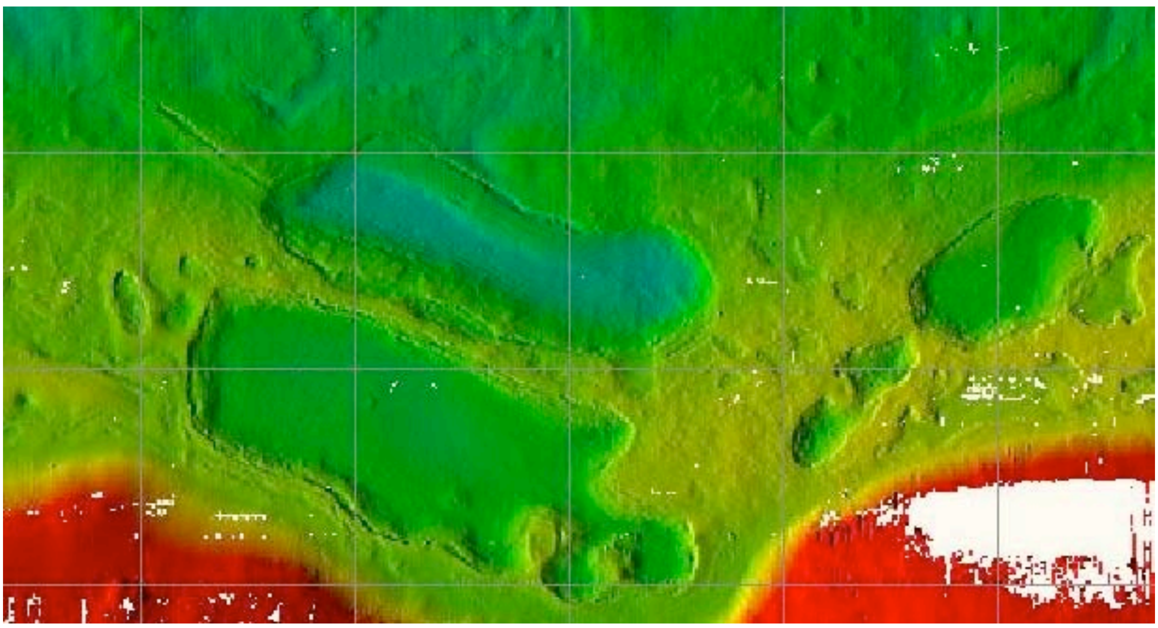


Figure 3.18: Detail of 400 kHz multibeam map of the foot of Moresby seamount.

3.5 Dive 019

The aim of dive 019 was to map a portion of the foot of Moresby Seamount (an area already mapped with 400 kHz bathymetry, dive 016) with 120 kHz sidescan sonar and 4-16 kHz subbottom profiler. As the subbottom profiler was not working properly (dive 018, see section 2.1) only the 120 kHz sidescan was used during this dive. Mission layout consisted of seven parallel tracks that were spaced alternatively 200 and 600 metres in order to ensure complete overlap. Two additional, shorter profiles were spaced 300 m and are located to the south, which corresponds to the lowermost flank of Moresby Seamount. Transponders for this dive were placed at S9°48.266 / E151°40.239 and S9°48.202 / E151°41.974. Surprisingly, the vehicle drifted quite frequently off course despite recurrent transponder fixes. This resulted in readjustments of the vehicle's course and heading that are problematic for processing the sidescan sonar data.

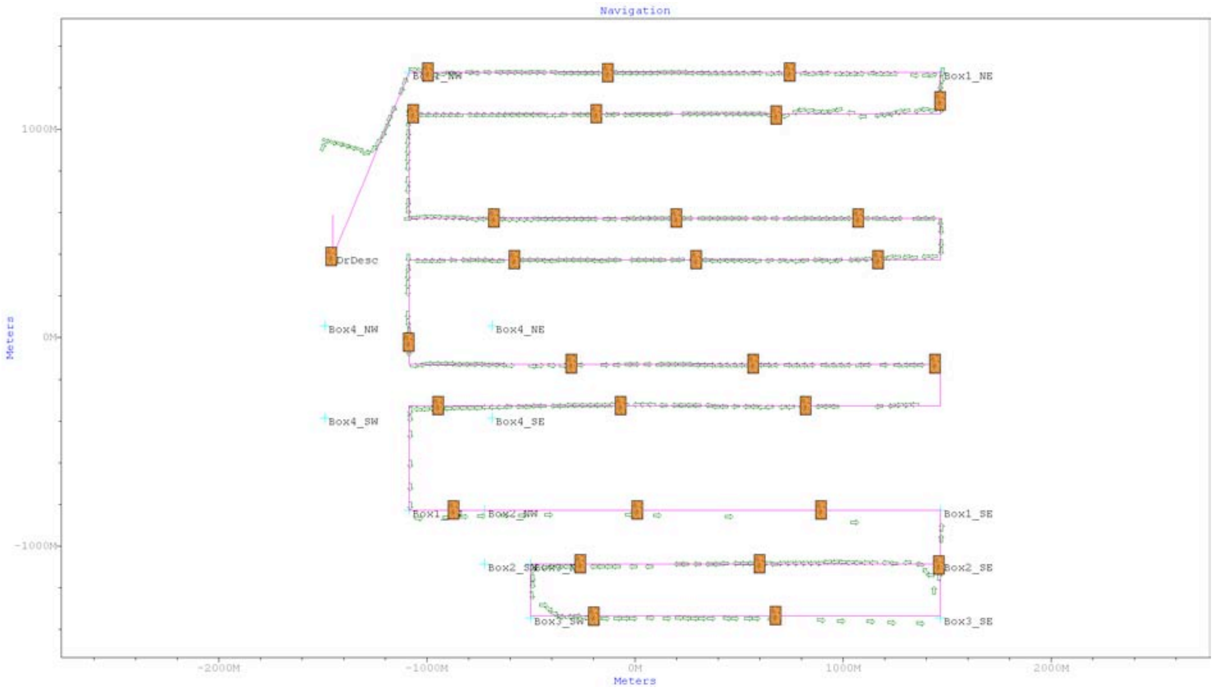


Figure 3.19: Mission layout and transponder fixes for dive 019 in relative coordinates. DT4B and DT4D indicate the transponder positions and the orange square indicate the beginning of a new raw data file.

The raw sidescan sonar data were recorded in EDGETECH's own open access data format jsf and then displayed in and exported from the software package DOLPHIN 4400 as *.xtf, that can be imported into CARAIBES. During importation the original across-track resolution of 0.03 m was reduced to 0.2 m, the fish altitude was corrected and a slant-range correction was applied assuming a flat bottom. Georeferencing of the pings was carried out based on the vehicle's header information and was previously smoothed. Lost transponders resulted in the vehicle drifting away from its original course. A new transponder fix then results in strong jumps in the navigation data that have been manually edited and then smoothed. At the same time, the vehicle adjusted its course by strong heading variations that are problematic for georefrencing the data (Fig. 3.20). As the AUV has more freedom in variation of heading than a towed sonar system, using course instead of heading for plotting the pings is no option, because this would result in very blocky sonar images.

In order to overcome this problem in future dives using sidescan sonar, more gradual corrections to the vehicle's trajectory should be programmed. Each profile has then been processed to 0.75 m pixel size and all nine profiles have been mosaicked together (Fig. 3.21).

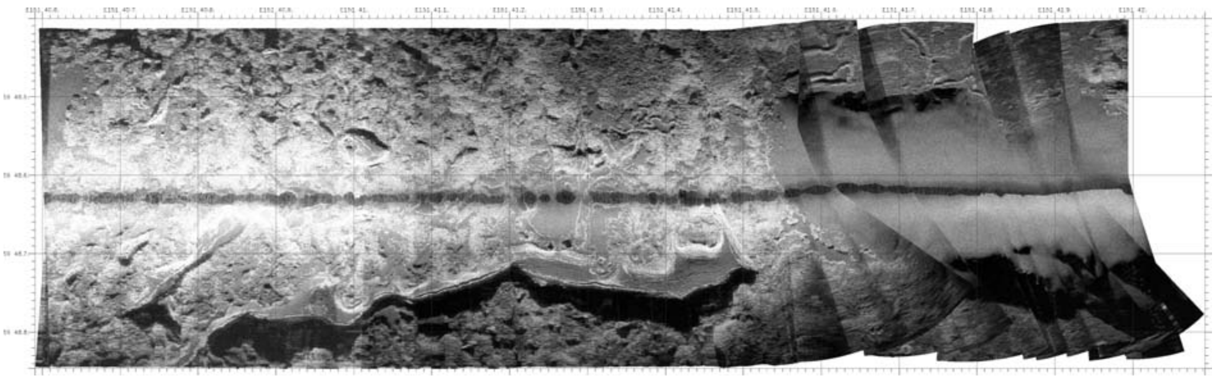


Figure 3.20: Unedited 120 kHz sidescan sonar profile. High backscatter intensity is white.

The 120 kHz sidescan sonar data show details of the seafloor that are comparable to 400 kHz bathymetric data (Fig. 3.17). All bathymetric features are also visible on the sidescan sonar mosaic, but additional information about the texture of the seafloor is available (Fig. 3.21). The shallow areas in the northeast and the west of the surveyed area show a smooth surface resulting in low backscatter intensity compared to the lower lying areas that also show a more rugged topography evidenced by widespread shadows. The rugged terrain most likely corresponds to recent lava flows that abut against sediment covered high grounds. The northern part of the survey area at S9°48.8 also shows irregular, elongated ridges of variable width and having a fissured crest. Similar ridges are found at S9°49.6 and E151°41.8 while at the foot of Moresby Seamount comparable ridges form small, enclosed basins. These basins might correspond to drained lava ponds and one could speculate that the large ridge at S9°48.8 corresponds to the southern border of a much larger of these lava ponds, whose northern edge has been covered by a more recent lava flow. In such a scenario, the fissures on the crest of the ridges should correspond to cooling cracks instead of eruption-related openings. Alternatively, the ridges themselves may have been active eruption centres.

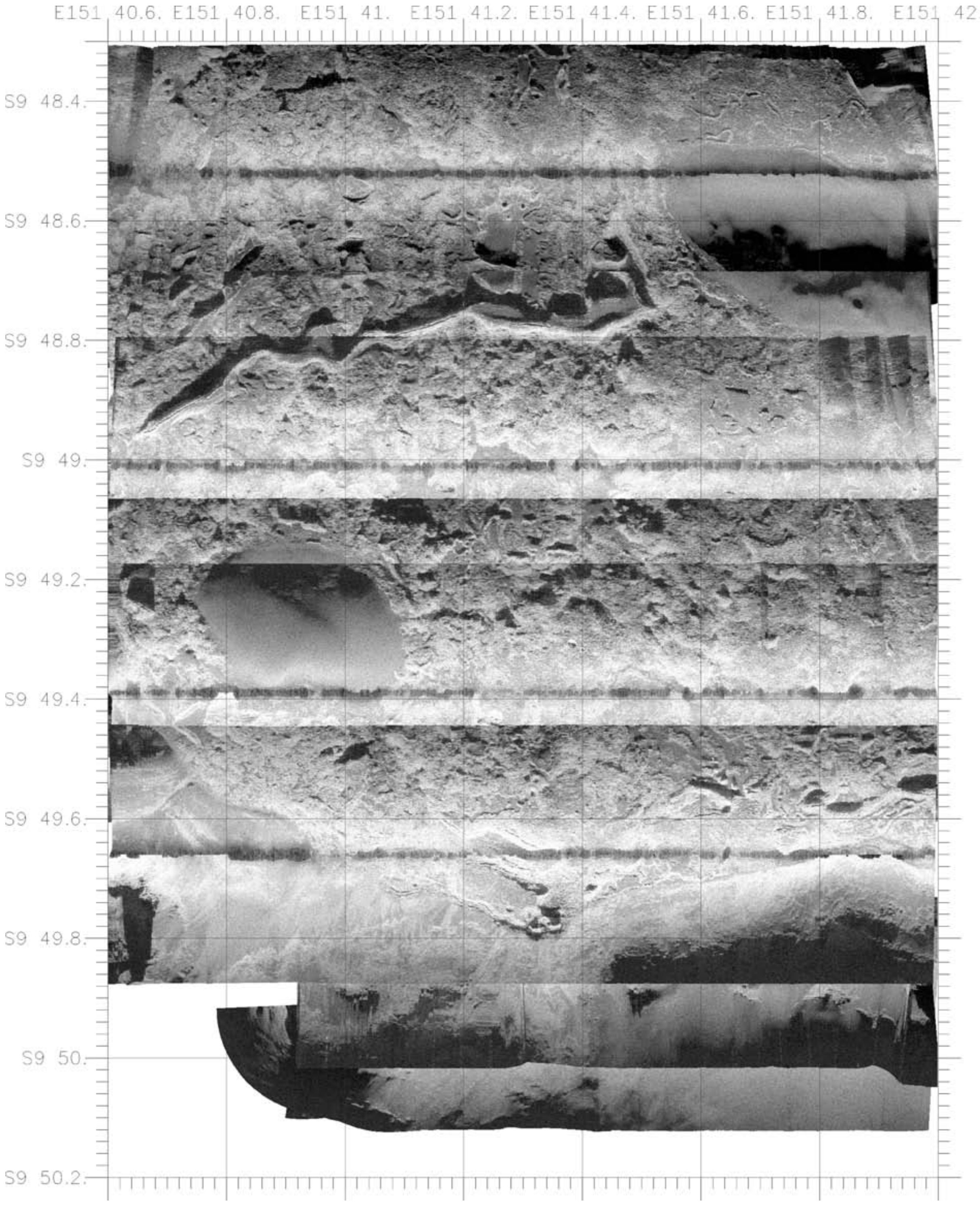


Figure 3.21: Edited 120 kHz sidescan sonar mosaic over the foot of Moresby Seamount (in the south). High backscatter intensity is white.

3.6 Dive 020

Dive 020 was designed for 410 kHz sidescan sonar and camera mapping of a small portion of the area covered by dive 019. Unfortunately the camera failed immediately and the 410 kHz sidescan sonar mission was quickly aborted by the vehicle (see section 2.1. for details). Only a short section of 410 kHz sidescan sonar data was recorded at the beginning of the mission (Fig. 3.22). These data have a raw across-track pixel size of just 0.01 m for 100 m of range. The data have been processed in the same way as for dive 019, with the difference that the final mosaic has a pixel size of 0.25 m.

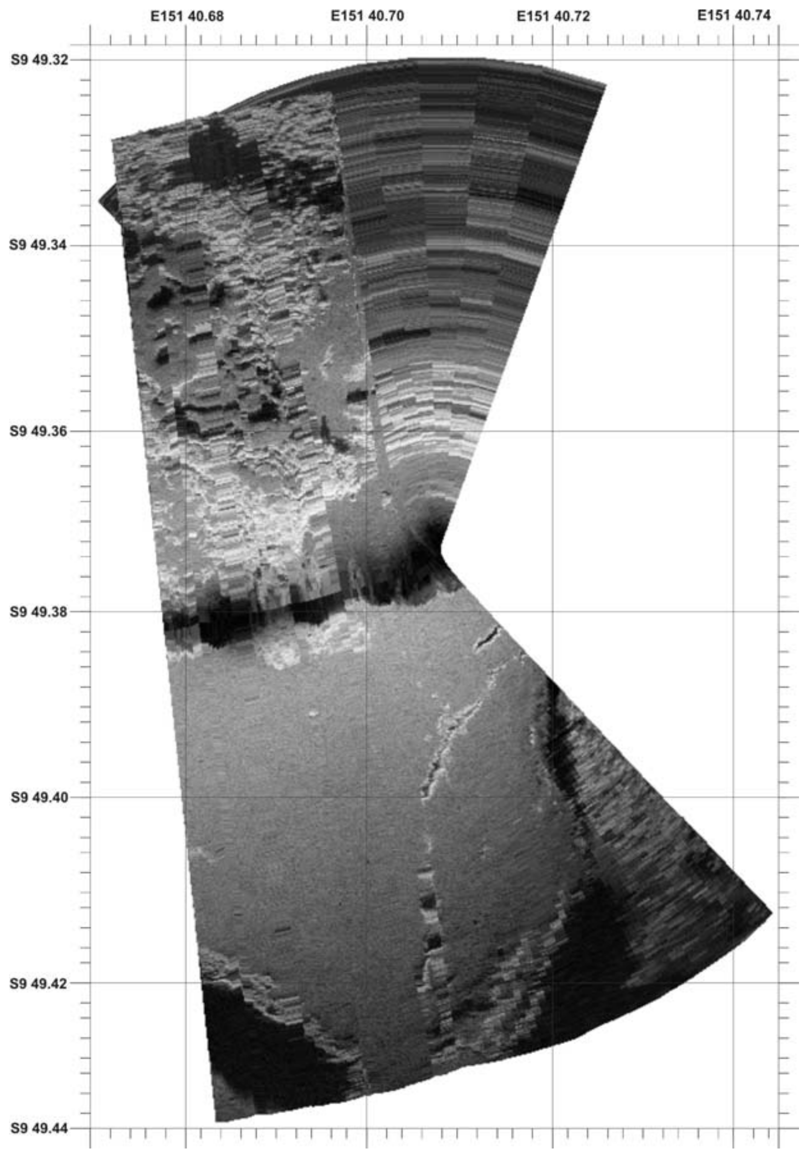


Figure 3.22: 410 kHz sidescan sonar profile over at the foot of Moresby Seamount. High backscatter intensity is white.

4 EM 120 bathymetric and backscatter mapping (I. Klaucke, S. Theißen)

The bathymetric mapping has been carried out with the multibeam echo sounder system EM 120 (Kongsberg) onboard the RV Sonne (Fig.4.1). The echo sounder system consists of a transceiver and transmitter unit fixed below the keel of the vessel. The average operating sonar frequency is 12 kHz with 191 beams per ping. The beam spacing is either equidistant or equiangle with a maximal angular coverage of up to 150°. The ping rate is only limited by the round trip travel time in the water. The transmit fan is split into separate sectors (11.25-12.75 kHz) depending on the water depth. In deep waters it is split into nine sectors transmitting sequentially. Each sector takes into account the vessel´s roll, pitch and yaw.

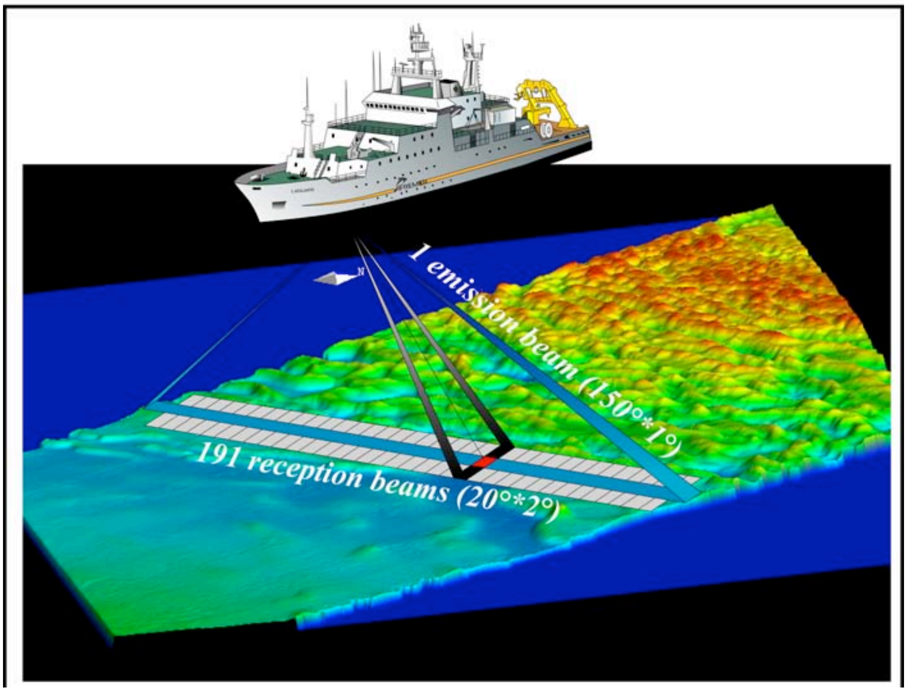


Fig. 4.1: SIMRAD EM 120 Multibeam System

The objective of the bathymetric mapping was to improve the existing maps on the basis of hydrosweep data (Martinez et al., 1999). The echo sounder data have been used to generate bathymetric and backscatter maps to define dredge and wax corer positions.

During the cruise the echo sounder system operated in the equiangle modus. The angles have been defined depending on the objectives of the individual surveys, to obtain a good balance between area coverage and resolution. For detailed mapping of the segments 1 to 3 the system operated with an angular coverage of 2 x 40° and a vessel speed of 5 or 8 knots. The settings have been changed during the mapping survey of Moresby seamount. According to the water depth the angle has been varied manually between 40° and 60°.

The bathymetric mapping of segment 4, parts of segment 3 and the across axis profile south of segment 4A were carried out with a vessel speed of 10 knots due to time constraints.

The post processing of the raw data was performed with the software packages Neptune (Kongsberg) or Caraibes (Ifremer). The data edited with Neptune were exported into GMT (Wessel and Smith, 1995) for final gridding and production of bathymetric maps. This work has been done by the system operators of the RV Sonne. The post processing with the software Caraibes was mainly performed to produce backscatter maps in addition to the bathymetric maps. The EM 120 also records reflectivity data of the received acoustic signal. The intensity of the reflected signal varies depending on the properties of the seafloor. The velocity profile derived from the CTD measurement at segment 1B (09°56.31'S 151°58.24'E) is used to correct the data (Fig.4.2).

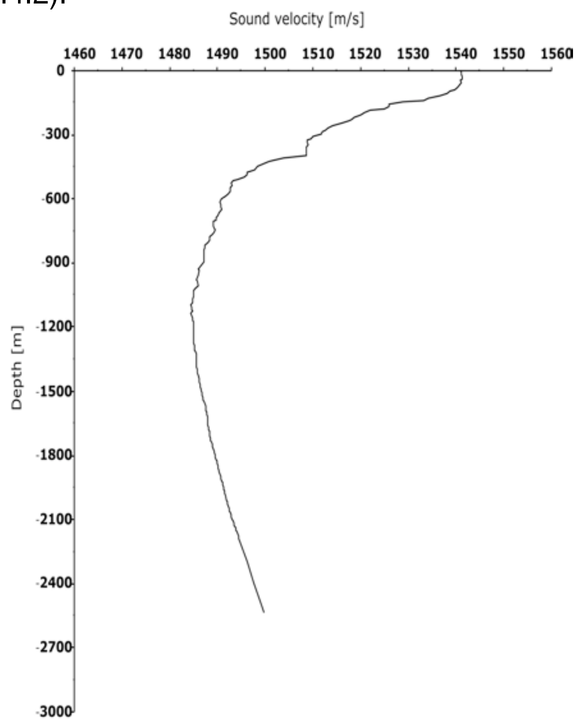


Fig. 4.2: Sound velocity profile at 09°56.31'S 151°58.24'E

All backscatter maps (Figs. 4.3-10) are gridded with a cell size of 25 m and subsequently interpolated, except the across axis profile of segment 4A. In this case a 50 m grid is used because of poor data set due to the speed of the vessel (10kn) and heavy seas. As the EM 120 system operates with a low frequency (12 kHz), the beams consequently penetrate through soft sediments and deeper structures are shown on the backscatter maps. This possible penetration and resulting volume backscatter has to be considered when interpreting backscatter maps. Together with already taken rock samples it was possible to distinguish between ridge axis and continental fragments and to define sample locations for dredging and wax corer. High backscatter intensity is illustrated by the light tones and low backscatter intensity by darker tones. The areas of low reflectivity resemble areas covered with magmatic material, mainly sheet flows and pillows, whereas areas of low backscatter are interpreted as continental fragments with sedimentary cover.

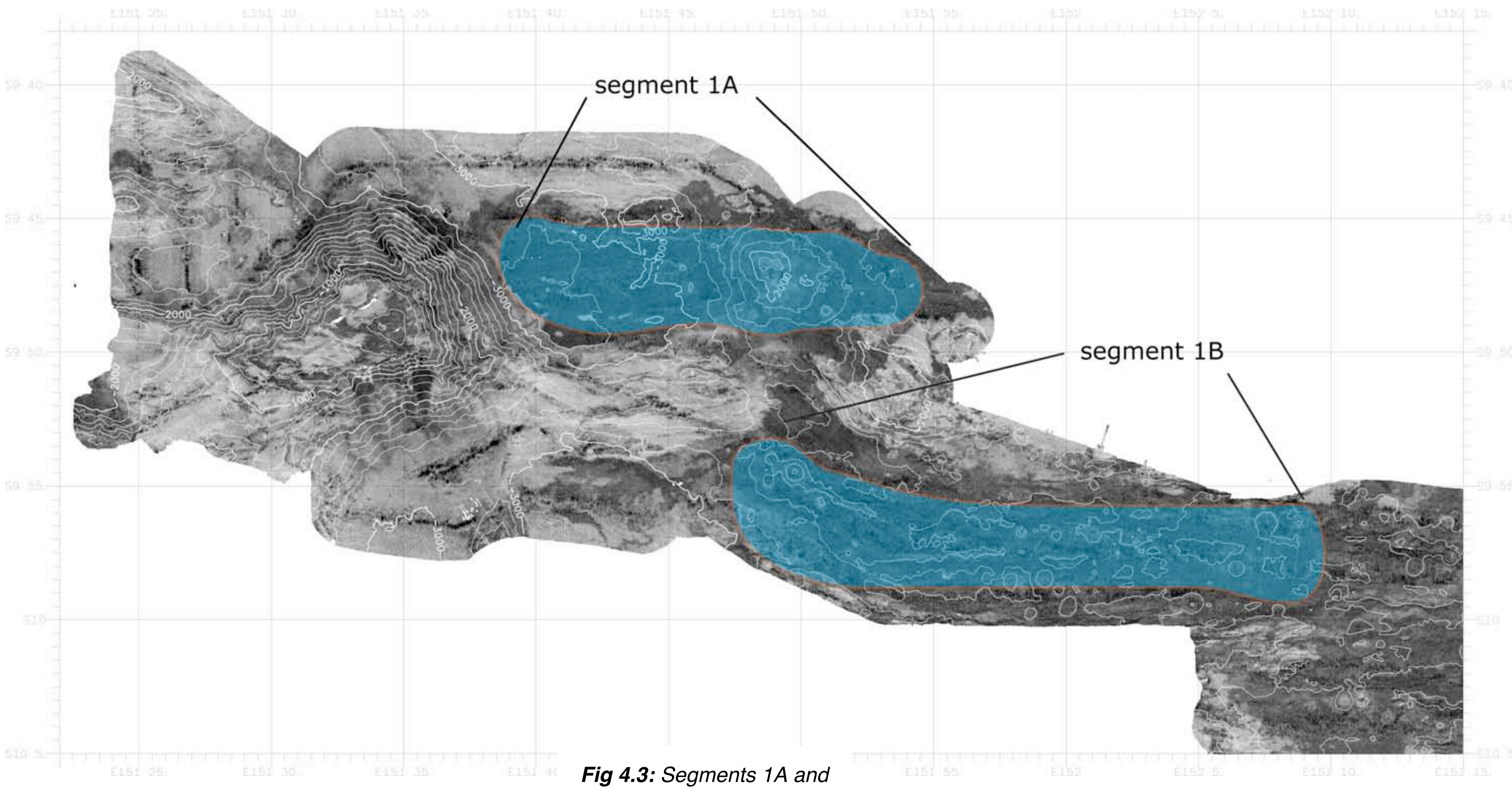


Fig 4.3: *Segments 1A and 1B*

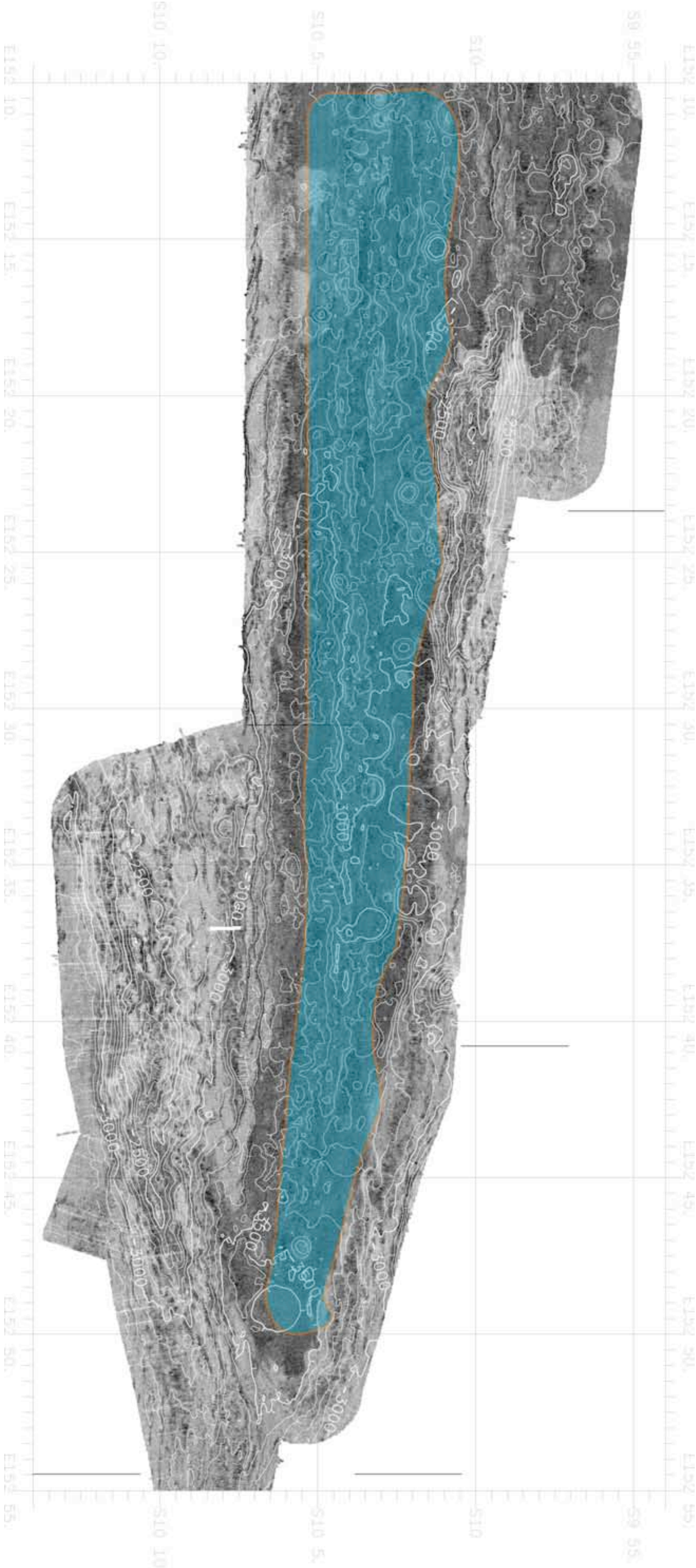


Fig 4.4: *Segment 1C*

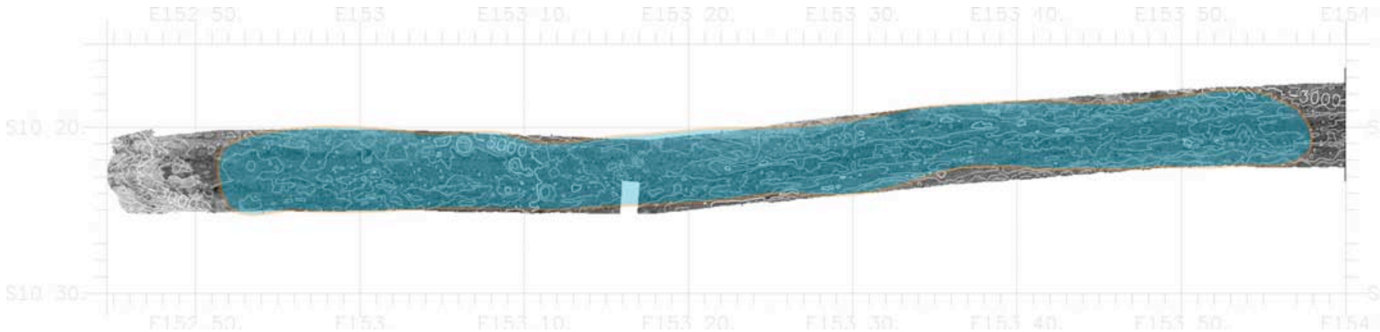


Fig. 4.5: Western part of segment 2

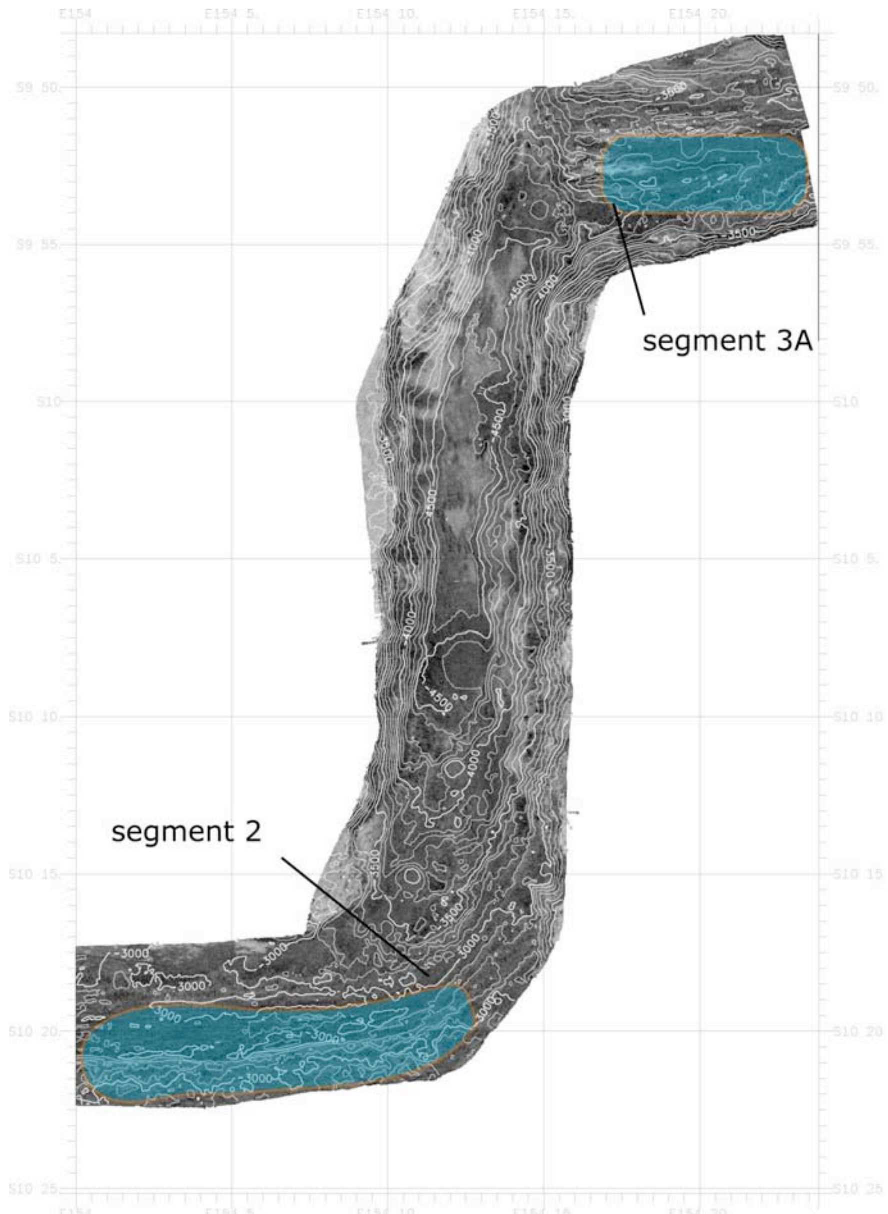


Fig. 4.6: Fracture Zone between segments 2 and 3A

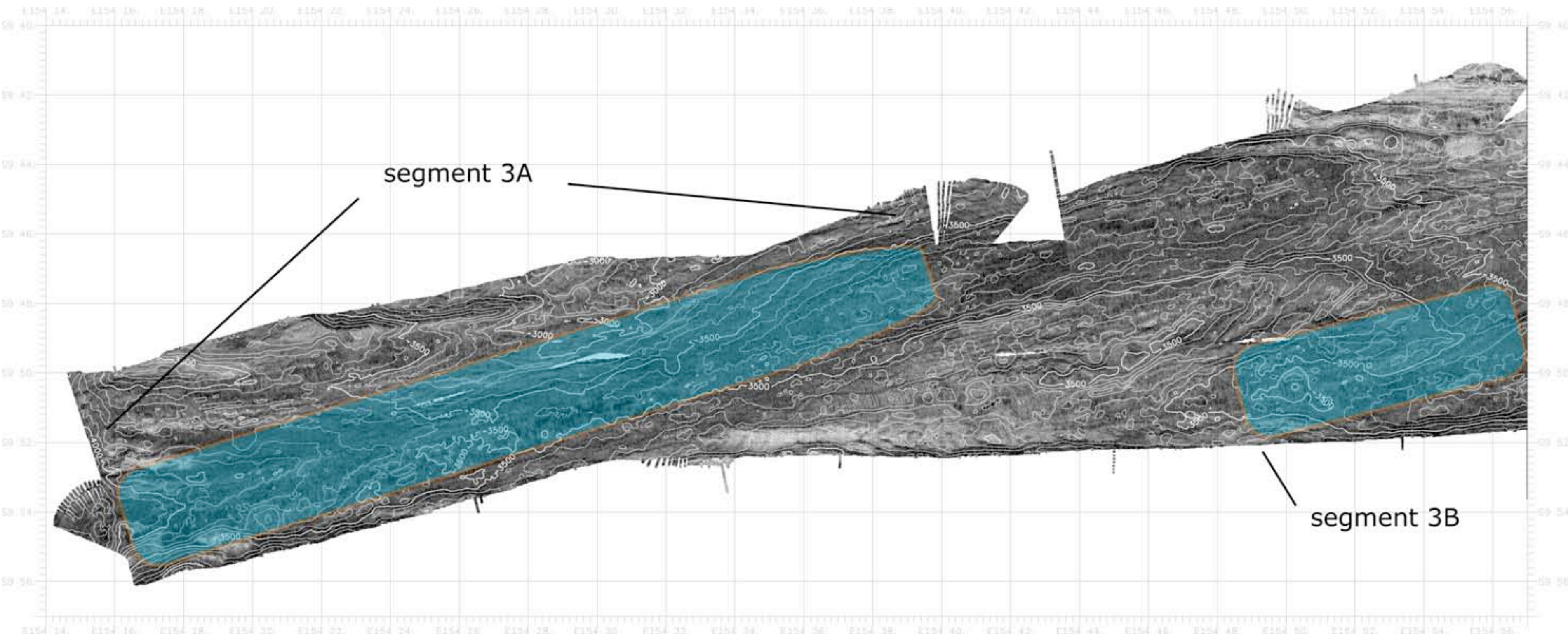


Fig 4.7: *Segment 3A*

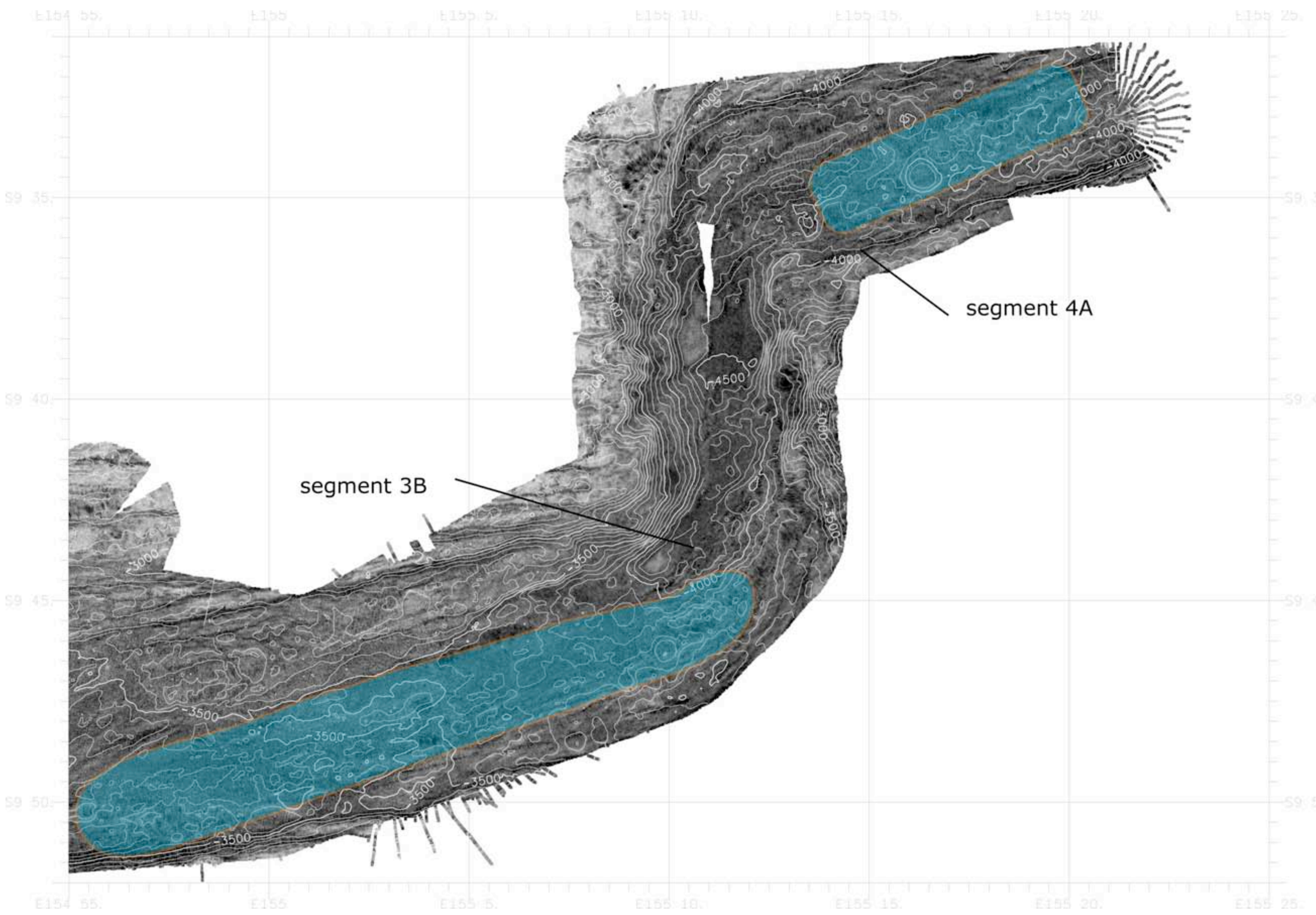


Fig 4.8: *Segment 3B and fracture zone between segments 3 and 4*

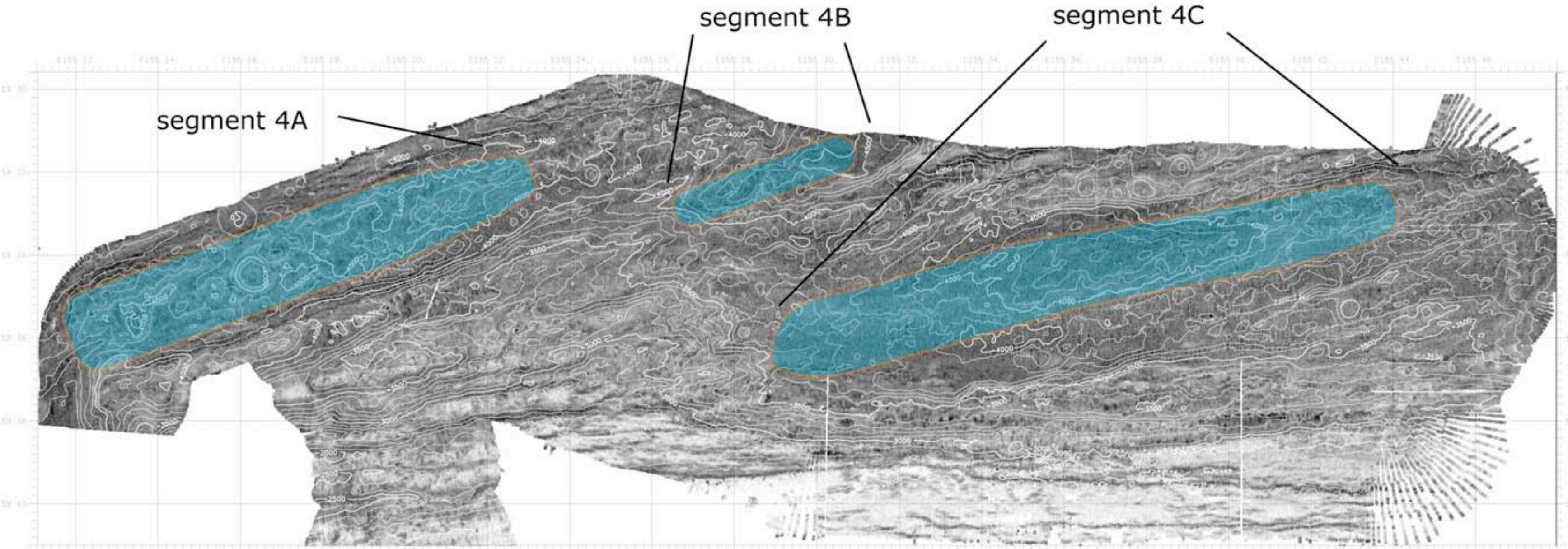


Fig 4.9: Segments 4A - 4C

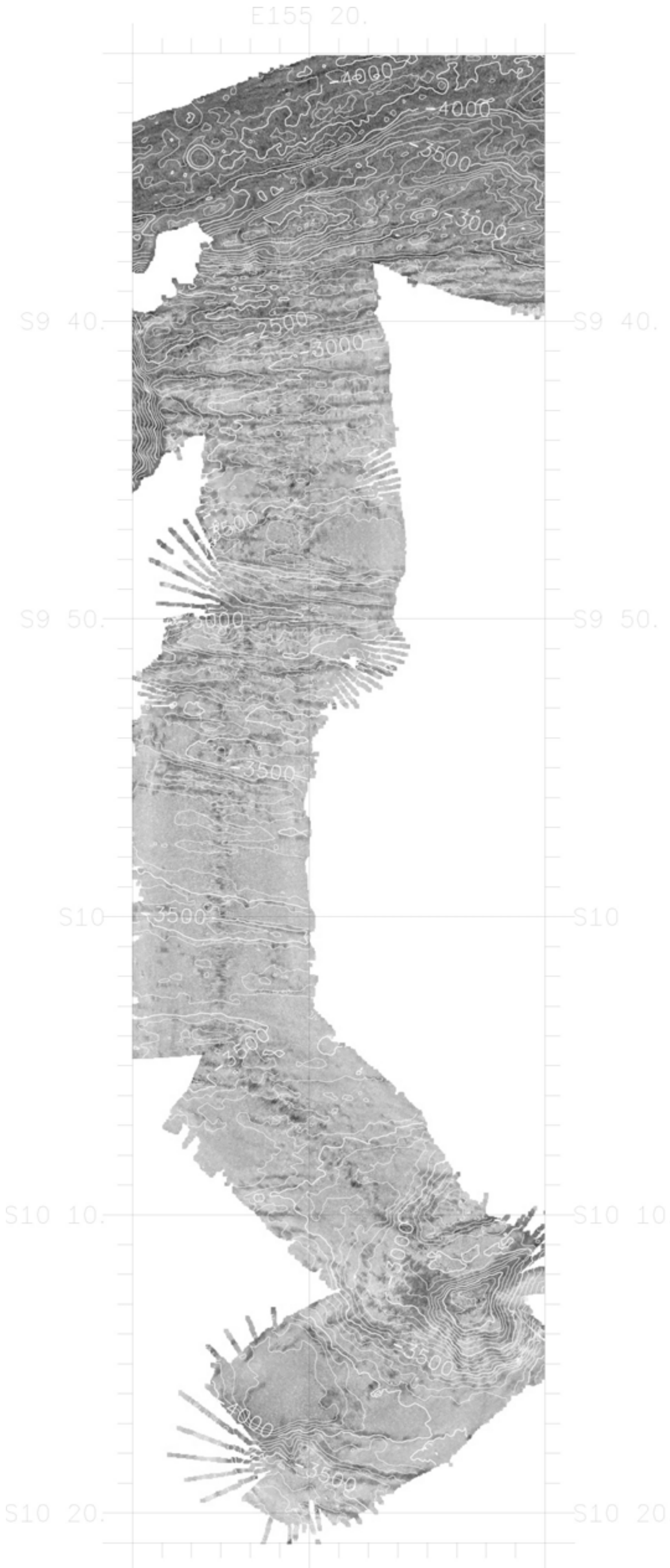


Fig. 4.10: *Profile south of 4A*

5 Moresby Seamount - Mapping and sampling (J. Behrmann, T. Nagel, R. Speckbacher)

5.1 Physiography and Geology

Moresby Seamount (Figure 5.1) at 9°49´S/155°35´E is located east of the D´Entrecasteaux Islands, a series of physiographic highs off the eastern coast of the Papuan Peninsula, that form metamorphic core complexes of Neogene age (e.g. Little et al., 2007; Baldwin et al., 1993; 2008). Formation of the core complexes can be directly related to crustal and lithospheric extension west of the propagating Woodlark rift zone, leading to the oceanic Woodlark Basin (Weissel et al., 1982; Taylor & Exon, 1987; Taylor et al., 1999). In this sense Moresby Seamount may be considered a metamorphic core complex *in statu nascendi*, forming the lower plate to a crustal-detachment fault (e.g. Taylor & Huchon, 2002; Kington & Goodliffe, 2008). Alternatively, Moresby Seamount could be a major fault-bounded horst in the hangingwall of a sub-horizontal detachment fault at depth, as suggested by Little et al. (2007). Moresby Seamount is located just south of the deep basin situated above the local maximum of upper crustal extension (Kington & Goodliffe, 2008), which will likely host the future oceanic spreading axis, and north of another, west-closing basin of uncertain origin. East of Moresby Seamount is the basin that hosts spreading axis segment 1b, and is floored by young basaltic crust.

The peak of Moresby Seamount is just 110 meters below sea level, and its base sits on seafloor more than 3000 meters deep (Figure 5.1). Along its ENE trending physiographic axis the seamount is about 15 km long and has a basal width of 10-12 km. The northern, eastern and southern slopes are inclined about 30°, and the almost flat, 3 km wide crestal area is gently inclined to the WSW. The bathymetric data created with a multibeam echosounder during this expedition, form the base of the map in Fig. x1, with an average grid spacing of about 25 m. This is a substantial improvement a the older bathymetric data (Taylor et al., 1995), which define a grid size of about 220 m. Thus, topographic features of sub-100m size can be clearly identified, forming an excellent base for site selection regarding the dredging and for of high-resolution mapping using the Autonomous Underwater Vehicle (AUV). Dredging stations DR-39 to DR-43, DR-103 and DR-105 (Fig. x1) were chosen to optimally sample the extensional detachment fault zone exposed on the northern side of Moresby Seamount (Taylor & Huchon; 2002), to complement the geological evidence from ODP Sites 1114 and 1117, and talus Sites 1110 to 1113. Dredging stations DR-44 and DR-63 were required to verify the nature and extent of the Plio-Quaternary sedimentary cover of the metamorphic rocks forming the basement of Moresby Seamount.

Important information regarding the basement and sediment units outcropping at the seafloor at and around Moresby Seamount can be inferred from the map of backscatter intensity of the of the multibeam echosounder survey (Figure 5.2). However, it has to be noted that this information on seabed geology is qualitative, and cannot be extracted in a quantitative way. The dark area (i.e. high backscatter intensity) to the east of Moresby Seamount likely are young basalts of the oceanic crust flooring the basin. This is corroborated by the results of dredging in the basin. The two basins north and south of the seamount seem to reflect the sedimentary fill by showing light gray color (i.e. low backscatter intensity). This is verified by the findings from ODP Sites 1108, and 1110-1113, which penetrated the the coarse

Quaternary sedimentary talus of the seamount. The eastern, northeastern and northern flanks of the seamount show medium gray coloring, reflecting the outcrop of basement rocks, and mylonites and cataclasites at the seafloor, without thick cover of young sediments. This is in line with the findings of the dredging survey (see below). The crestal area and the southern slope of Moresby Seamount have a mottled appearance on the backscatter map, likely reflecting different thickness of the Quaternary sediment cover. On the southern and the northwestern sides, the dark patches near the upper termination of the slope are probably the expression of fairly recent submarine mass wasting into both, the southern and northern basins, with a cover of non-indurated sediment missing (see description and interpretation below).

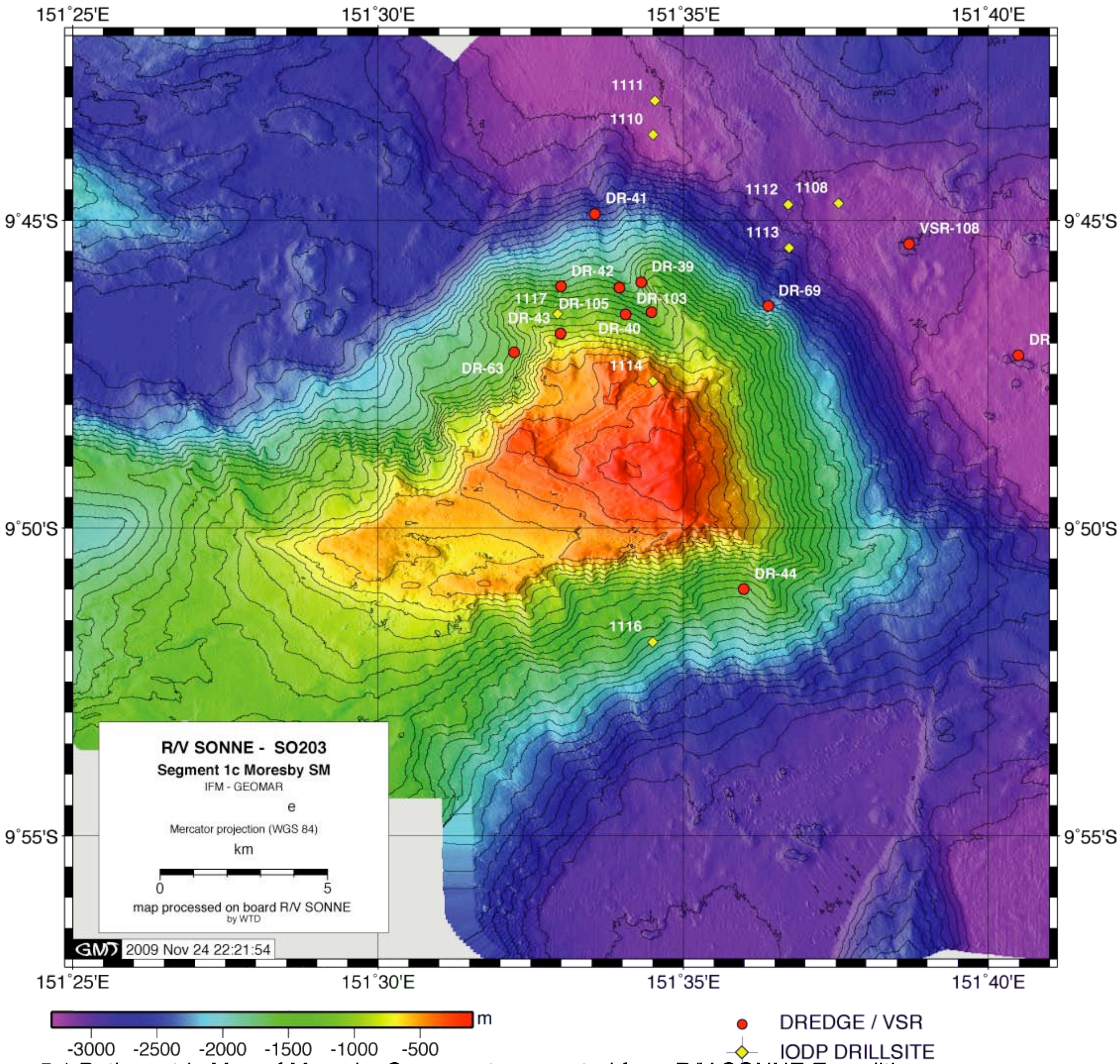


Figure 5.1 Bathymetric Map of Moresby Seamount, generated from R/V SONNE Expedition 203 multibeam echosounder data. Dark gray: high backscatter intensity; light gray: low backscatter intensity.

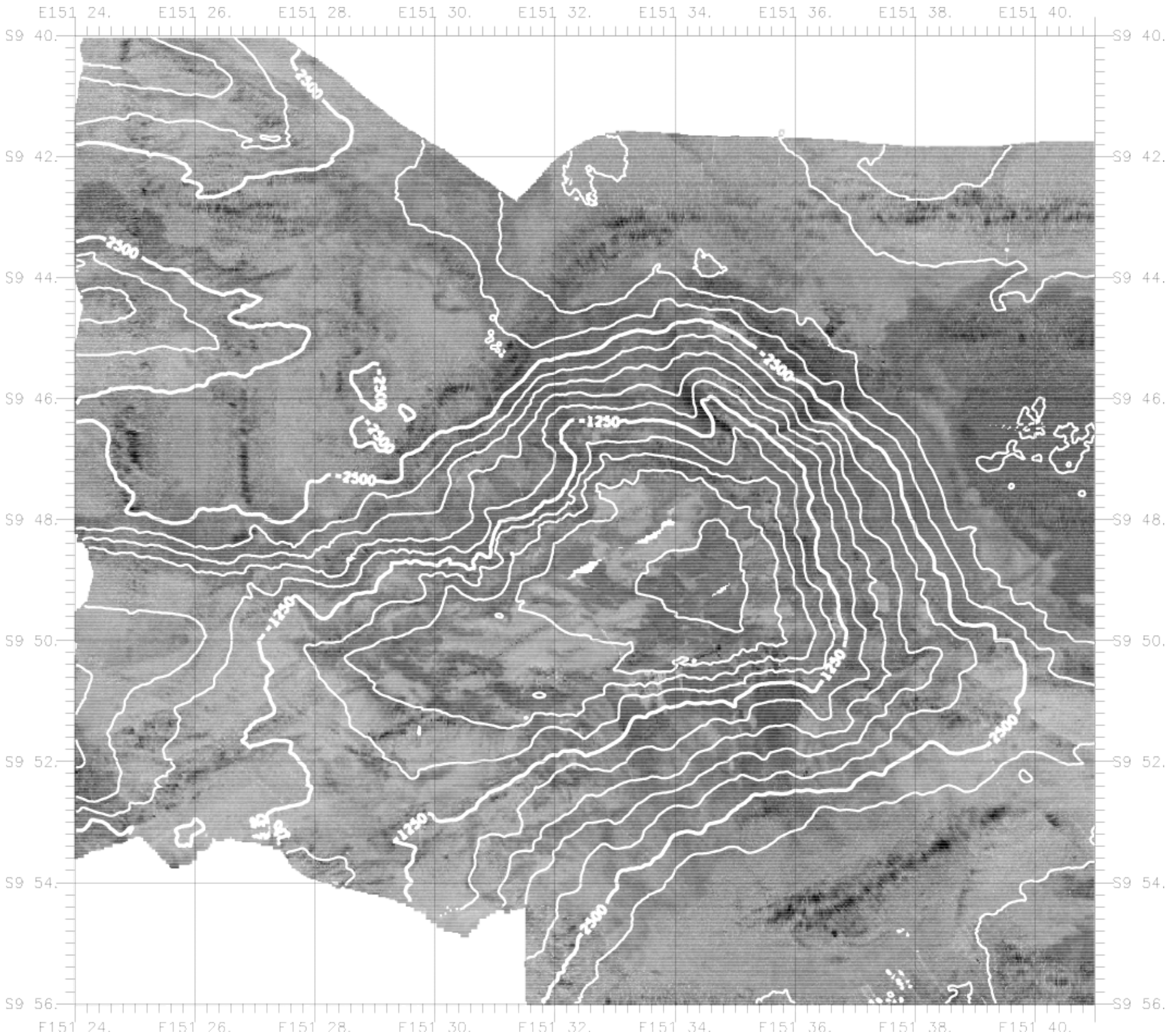


Figure 5.2 Map of backscatter intensity of seabed around Moresby Seamount, generated from R/V SONNE Expedition 203 multibeam echosounder data.

5.2 Geological map and principal rock types

The results of the dredging, information from the ODP drillholes (Taylor & Huchon, 2002), and the R/V SONNE Expedition 203 bathymetric mapping was integrated to produce a geological map of Moresby Seamount and its immediate surroundings (Figure 5.3). Geological units will be described in the following from top (youngest) to bottom (oldest). There are three types of Quaternary sediments covering Moresby Seamount itself, the slopes, and the surrounding basins.

A thin (up to 6.6 m) Pleistocene cover of foraminer-bearing ooze and clay, containing calc-alkaline volcanic silt-sized components was recovered above an unconformity at ODP Site 1114 (Taylor & Huchon, 2002; Roller, 2007). This Pleistocene cover has not been mapped out in Figure 5.3 as an independent lithological unit, but is represented as the thin Pleistocene cover of Pliocene clastic sediments.

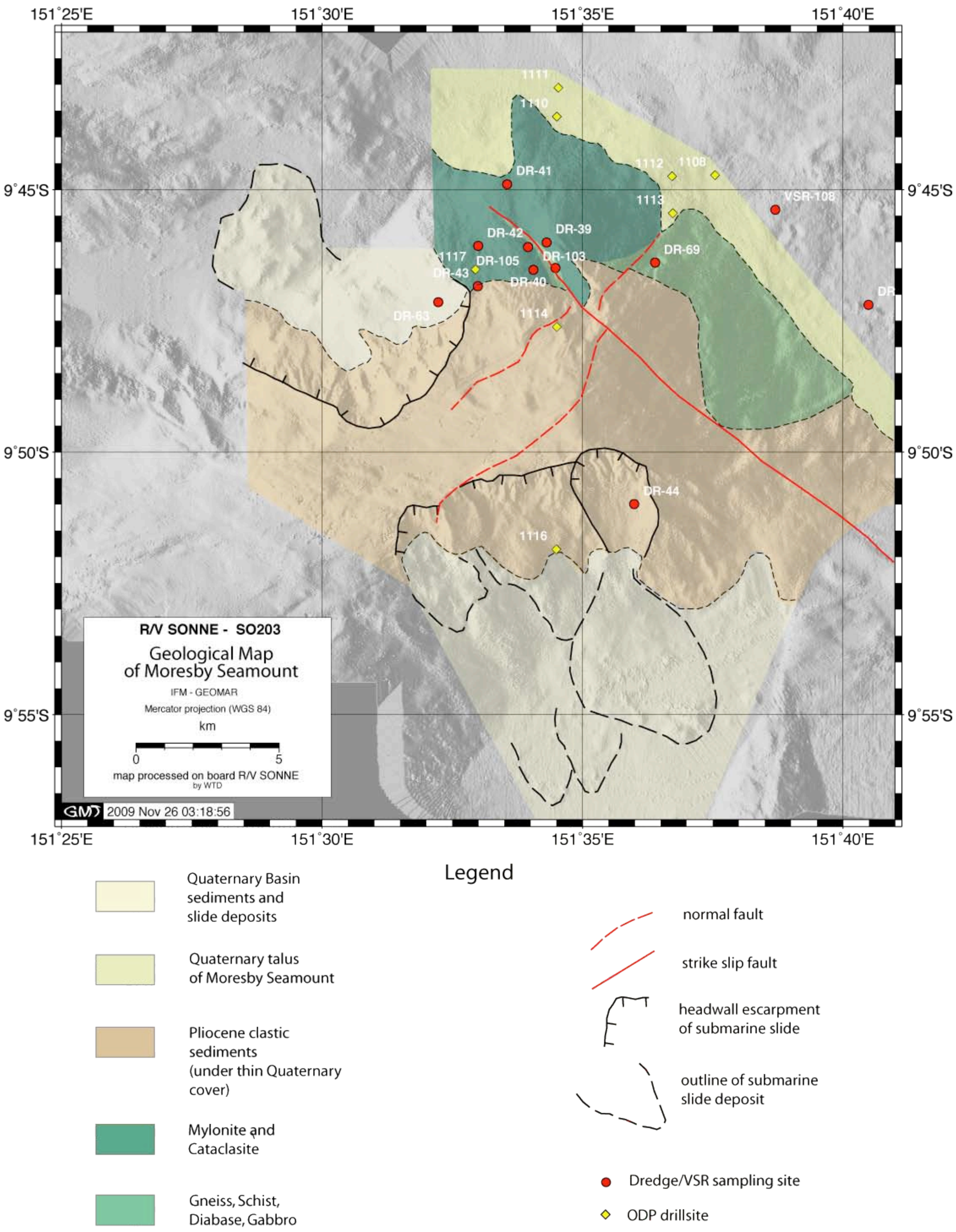


Figure 5.3: Geological map of Moresby Seamount and immediate surroundings.

The Quaternary talus to the NE of Moresby Seamount (Figure 5.3) is mainly defined by the descriptions of ODP Sites 1108, and 1110-1113, the so-called „Talus Sites“ (cf. Roller, 2002). At Site 1108, coarse grained Pleistocene gravels and conglomerates, interbedded with finer-grained clastic sediments are about 62 m thick. Closer to the foot of the seamount, at Sites 1111 and 1112 the Pleistocene talus is generally more coarse grained and at least 174 m and 122 m thick, respectively (Roller, 2002). Site 1113 penetrated a 25m long section consisting almost exclusively of matrix-poor fanglomerates. All talus sites contain gravels of mylonites and other faulted and fractured basement rocks in the uppermost 20 m of section, indicating that the detachment fault surface was being progressively exhumed during the Upper Pleistocene, and covers not only the northern, but also the NNE slope of Moresby Seamount.

The Quaternary basin sediments and slide deposits north and south of Moresby Seamount lack characterization by drilling or dredging, but are mainly defined by areas of low backscatter intensity (Figure 5.2). Areas if hummocky topography on the lower slopes and the basin floors (see Figure 5.1 and Figure 5.3) are interpreted to be the result of submarine mass wasting (see description below).

The unit comprising Pliocene clastic sediments has extensive outcrops along the crest and on the upper flanks of Moresby Seamount (Figure 5.3). These are variably lithified siltstones and mudstones with interbedded volcaniclastics and andesitic extrusives (Taylor & Huchon, 2002; Roller, 2007). Towards the lower part, sandy, compositionally immature proximal turbidites occur frequently at ODP Site 1114, and, to a lesser extent, at Site 1116.

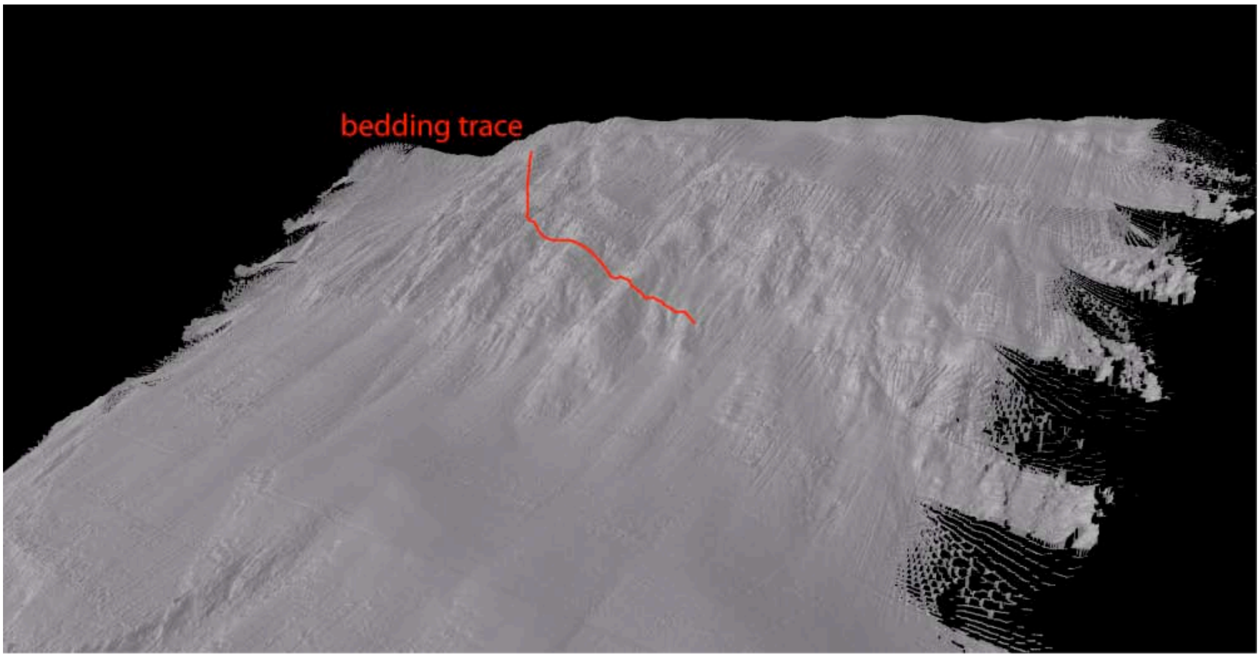


Figure 5.4: Oblique view of the northern crestal area of Moresby Seamount, as imaged by the high-resolution bathymetric AUV data. View from NW, illumination from NE. Imaged area is about 1500 meters wide. Note traces of bedding inclined to the right (south).

Both types of sediment were deposited at mid-bathyal depths (< 900 m below sea level; cf. Taylor & Huchon, 2002). Similar samples were recovered along with basement rocks in dredging stations DR-39, Dr-40, DR-42 (only few samples) and DR-43. These findings attest to the fact that a fairly thick layer of gray to olive green Pliocene clastics is exposed near the crest if the north slope of Moresby Seamount, as imaged by Figure 5.4, an oblique view of the high-resolution bathymetric mapping above the detachment surface. Judging by the dredge contents these are mostly sandstones, some of them coarse-grained with graded bedding (Fig. x5f) and bioturbation. Second lithology are mudstones. From the oblique view of the upper part of the AUV multibeam mapping survey (Figure 5.4) it is evident that thick beds are concentrated in the lower part of the cliff, and are tilted southward. Dredge DR-44, taken on the southern slope of the seamount, exclusively contained coarse clastic Pliocene sandstones and microconglomerates, the latter containing detrital plagioclase and basaltic rock fragments. Dredge DR-63 from the northwestern slope recovered mainly sandstones and microconglomerates, but also mudstones, which locally contain a schistose fabric developed discordantly to the sedimentary layering (Figure 5.5e) and provide evidence of near-surface and very young tectonic deformation.

The principal fault rocks found on the detachment surface exposed on the N and NNW slopes of Moresby Seamount are cataclasites and mylonites. They were sampled in great compositional and structural variety in Dredges DR39 - DR-43, DR-103 and DR-105. Representative examples are shown in Figure 5.6. Mylonites and very fine grained ultramylonites specimens with excellently developed planar foliation (Figure 5.6b), stretching lineation, tailed porphyroclast and asymmetric boudinage fabrics. In places the foliation is folded into drag structures (Figure 5.6a) with fold axes at high angles with the stretching lineation. Transitions to semi-ductile fabrics are observed in so-called phyllonites, as seen in Figure 5.6c. The mylonitic fabric is cut by multistage shear bands, and porphyroclasts show less well developed recrystallization tails. Fig. x6d shows an example of hydrothemally altered, foliated cataclasite with intense fracturing and veining. This is indicative of cohesive cataclastic flow, thought to be concentrated in the upper part of the detachment zone. Massive to weakly foliated cataclasites, as shown in Figure 5.6e bear greenschist-grade to sub-greenschist-grade brittle deformation fabrics consisting of multistage extensional fractures filled with epidote, quartz and carbonates. Rocks that form strain enclaves due to their rigidity, like the fine-grained metagabbro in Figure 5.6f, often show pervasive silicification and mineralization by disseminated pyrite (see below). A prelininary structural model of the detachment zone on the basis of dredge sampling and high-resolution AUV mapping is described and discussed below.

Basement rocks away from the extensional detachment zone, i.e. structurally below it, consist of two groups of rock types (Figure 5.3), which were mainly found in dredge DR-69 at the eastern slope of Moresby Seamount . First, there are quartzo-feldspathic gneisses and schists (Figure 5.5a), which are tightly folded and foliated, and have a well-developed stretching lineation. More mica-rich varieties exist as well (Figure 5.5b), with intense foliation fabric, often overprinted by extensional and compressional dilatant shear zones. These, however, do not show the retrogressive alteration associated with the mylonites from the detachment (see above). Likely protoliths are psammitic to pelitic sediments, and the metamorphic grade according to preliminary visual petrographic description is upper greenschist facies. Second lithology are greenschists and meta-gabbros. The latter are fine grained, and undeformed (Figure 5.5c) or slightly foliated (Figure 5.5d), with slight or more pervasive retrogressive alteration of primary minerals to albite, epidote and chlorite.

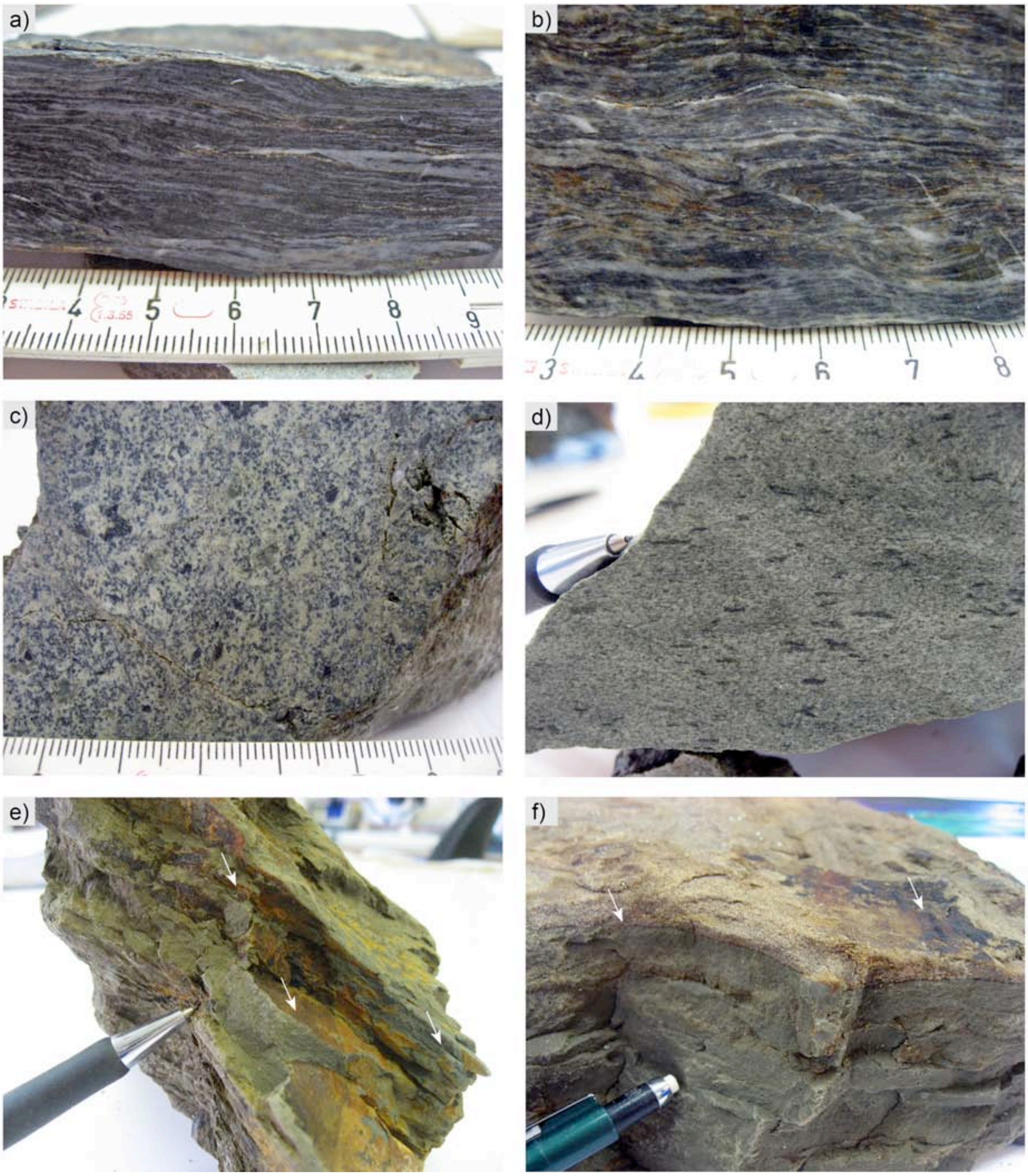


Figure 5.5: Photographs of principal rock types dredged at Moresby Seamount (a) DR69-5B: tightly foliated, quartz-rich Metapsammite/Metapelite recovered from the footwall of the low angle normal fault with intrafolial folds and well developed stretching lineation. (b) DR69-3A: banded metapelitic schist with quartz filled -extensional fractures crosscutting the foliation at 30°–60° angle (c) DR39-7B: medium-coarse grained (grainsize 1-3mm) epidote-altered gabbro with subhedral feldspar and pyroxene. d) DR41-3B: fine-grained gabbroic rock (grain size 0.2-1mm) with larger elongated chlorite patches and weak foliation. (e) DR63-1C deformed siltstone from the northwest flank of Moresby Seamount; white arrows mark some of the shear planes. Strain is concentrated in fine grained clayey-silty layers. (f) DR63-1B: deformed turbidite: left arrow marks the sharp boundary from siltstone to sandstone; right arrow accentuates slickensides on sliding surface.

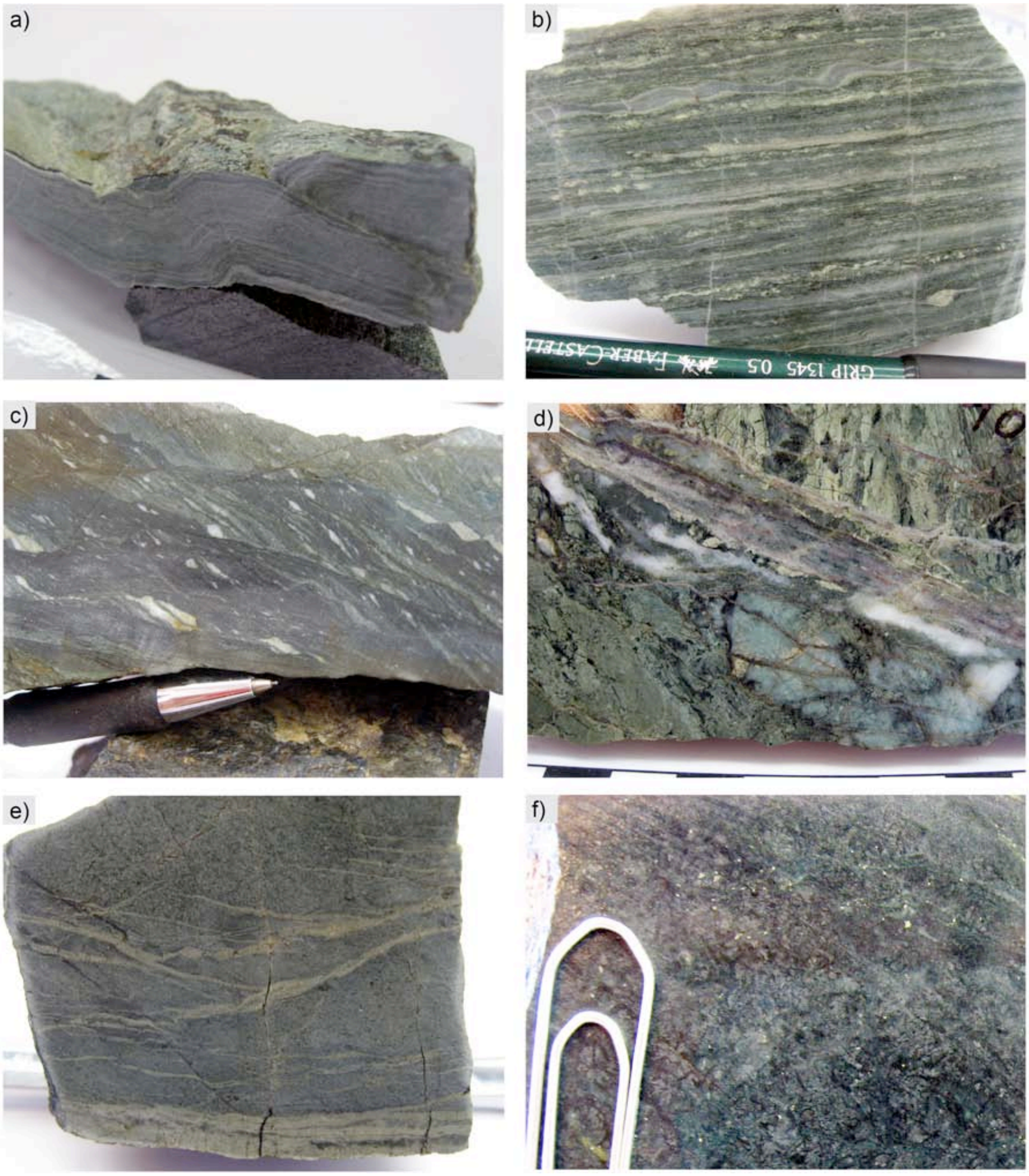


Figure 5.6: Photographs of cut surfaces of principal rock types dredged on Moresby Seamount detachment. (a) DR39-4D: mylonite, stretching lineation-parallel face with obliquely striking fold axes (angle between SL and FA is 70°) and top-to-the left thrust fault cross-cutting the hinge of an antiform. (b) DR40-2A: ultramylonite, stretching lineation-parallel face with bouniaged quartz layer, sigma-type quartz-winged porphyroclast and late stage extensional fractures perpendicular to foliation. (c) DR105-8A: shear band fabric in phyllonite representing transition from mylonitic to cataclastic fabrics. (d) DR103-1D: cohesive, altered cataclasite (chlorite-breccia). Angular components are highly fractured diabase with abundant quartz and epidote veins. Alteration minerals are quartz, epidote and chlorite. (e) DR 41-4A: fine-grained, green-grey, massive cataclasite with at least two generations of healed fractures. (f) DR43-1A: black microgabbro with cataclastic overprint, silicified, and containing abundant disseminated pyrite.

5.3 Mass wasting structures

One obvious physiographic feature on the bathymetric map of Moresby Seamount (Figure 5.1) are two segments of very steep upper upper slope (up to 800 meters high) on the southern and northwestern sides, with crest-like cavities up to 3 km wide. The crest-shaped slope breaks are probably headwall scarps of submarine slides. Downslope from these features are areas of high backscatter intensity (Figure 5.2), indicative of indurated rock outcropping at the seafloor, not covered by substantial amounts of young sediments of Quaternary age. On the basin floor south of Moresby Seamount are areas of rugged topography, made of up to 0.5 km-sized displaced blocks, with three well developed frontal, south-facing walls (Figure 5.3). This is interpreted as the runout area of three major slides, which must have occurred fairly recently, i.e. in the Upper Quaternary. Supporting evidence comes from the fact that drilling at ODP Site 1116 did not intersect any Quarternary sediments in the upper part of the hole (Taylor & Huchon, 2002). Also, Dredge DR-44, located in the upper feeder area of the easternmost slide (Figure 5.3) did only recover indurated sediment of probable Pliocene age. On the NW side of the seamount a similar, NW-facing set of structures exist, defining a large, 6 km-wide headwall scarp and an extensive area of deposition on the basin plain. Here, Dredge DR-63 exclusively recovered indurated sandstones and mudstones. Runout lengths of the slides are up to 10 km, and the structurally best-defined individual slide, located at the eastern end of the southern set of headwall scarps, has a an estimated volume of two cubic kilometers of displaced material. Whatever the causes of individual slides, their location on both sides of the morphological axis of the seamount bears a relation to differential uplift, arching and oversteepening of both slopes as Moresby Seamount was deformed and uplifted.

5.4 Tectonic structure of Moresby Seamount Detachment

AUV Dive 015 yielded a high-resolution bathymetric map of the detachment surface on the northern slope of the seamount (Figure 5.7). The main area covers about five square kilometers and a depth range from 500 to 2800 meters below sea level (mbsl). The surveyed part of the detachment is located west of a pronounced valley, which strikes NW-SE above and N-S below 2000 m depth. A smaller survey area to the east of the upper portion of this valley had navigation problems, and is not included into this description. The AUV data allows recognizing four sectors with distinct topographic features. From top to bottom, we refer to these as *Upper Rugged Area*, *Upper Smooth Area*, *Lower Rugged Area*, and *Lower Smooth Area* (Figure 5.8). Four dredge surveys (DR40, DR41, DR103, DR105) were carried out within the mapped area and three in the immediate vicinity (DR42, DR43, DR39).

The *Upper Rugged Area* ranges from about 500 meters down to about 950 mbsl. A network of small erosional channels characterizes steep topography between 500 and 800 mbsl. At several places, there are thin tabular bodies discernible, which appear to represent bedding. This interpretation is in line with the results from dredging (DR40, DR43), which recovered clastic sedimentary rocks of presumably Pliocene age. In the lower portion (800-950 mbsl), the slope is much gentler and exhibits depositional fans forming at the channel exists.

The *Upper Smooth Area* is a relatively small, steep and extremely flat surface between about 950 and 1100 mbsl. Dredge DR103 from this site and DR43 from a location slightly to the west recovered no other basement rocks than cataclasites, and we interpret this surface as the top of the *Moresby Seamount Detachment*.

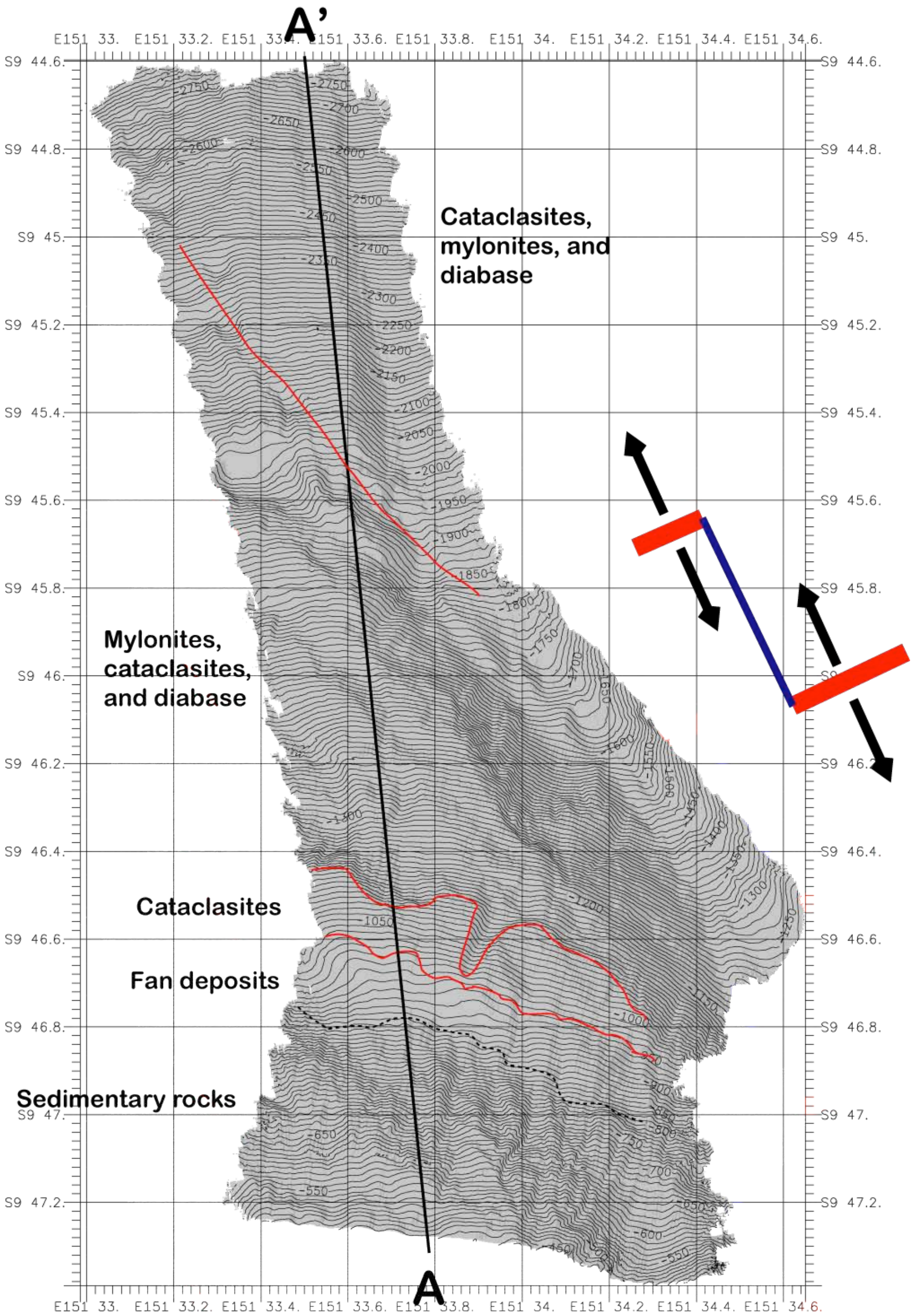


Figure 5.7: Topographic map of AUV-Dive 015 processed with software package "Caraibes". Red lines indicate boundaries between domains discussed in the text. The black line labeled A-A' indicates trace of the cross section in Figure x10. The schematic sketch on the left shows the orientations of spreading axes and transforms faults as defined by present day Euler pole between the Australian and the Woodlark Plate (Bird 2003).

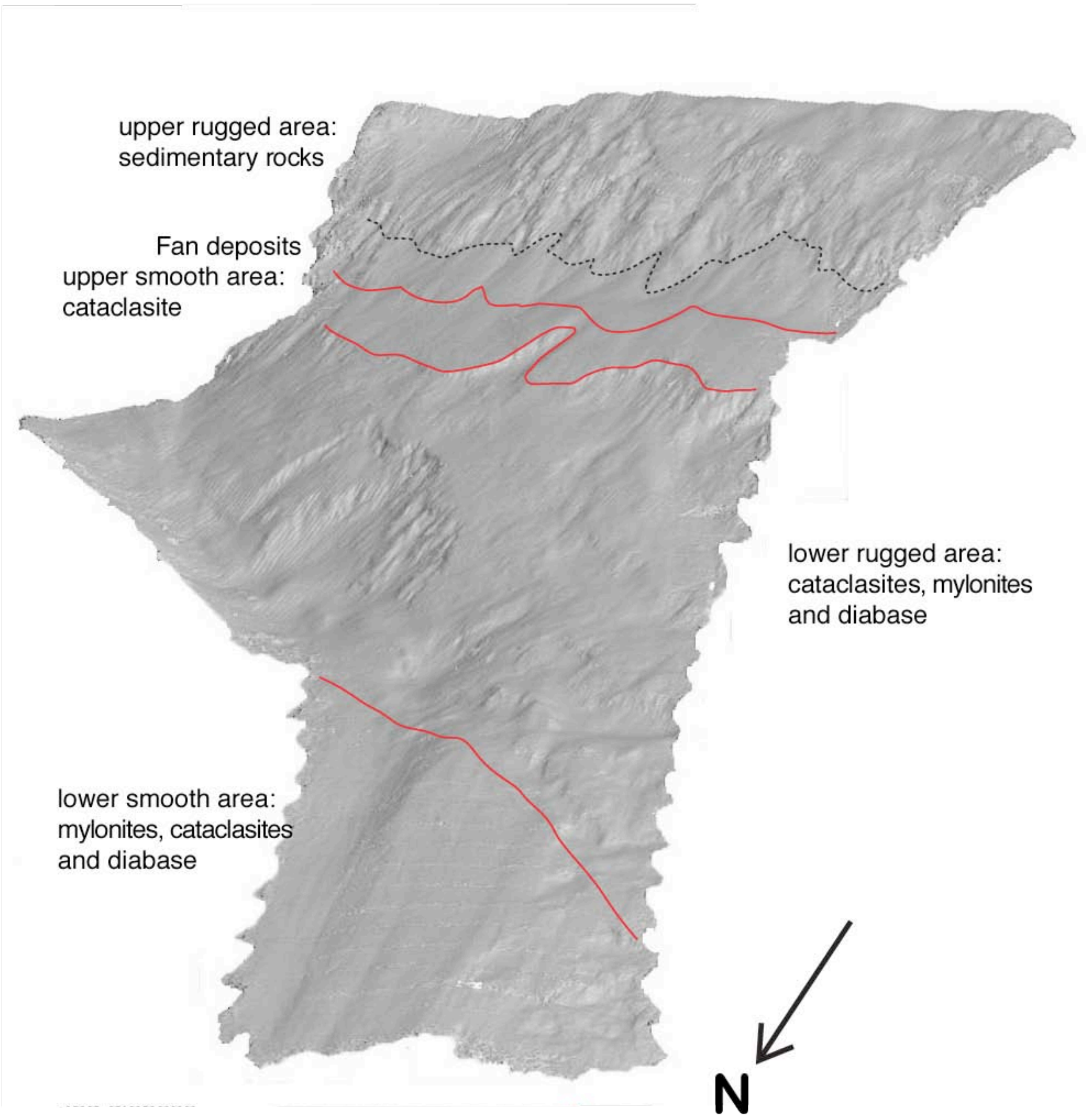


Figure 5.8: "Aerial" view onto the area of AUV-Dive 015. Bathymetric data is processed with software package "Caraibes". Red lines indicate boundaries between domains discussed in the text.

The upper boundary of the *Lower Rugged area* is a steep erosional cliff, which cuts a few tens of meters into the cataclastic surface above. Between 1100 and about 2000 mbsl, a rough topography is defined by several erosional scarps. Structurally, this area is a window into the footwall of the cataclastic surface described above. Dredges DR42 and DR105 from that level recovered a mix of cataclasites, mylonites and undeformed mafic intrusives.

The *Lower Smooth Area* down to the bottom of the surveyed area at 2800 mbsl is again a flat and seemingly polished surface. The upper boundary strikes NW-SE and runs uphill into the main valley on the eastern side of the surveyed area suggesting a fault. The surface displays several north-south-oriented, extremely straight grooves

(Figure 5.8), which are hundreds of meters long, and may be megascopic slickensides. Dredge DR41 recovered mainly mylonites and cataclasites. Hence, the surface is at least partly formed by mylonitized rocks.

These findings are interpreted as follows. The two smooth areas are very likely tectonically created surfaces parallel to the Moresby Seamount Detachment that have experienced neither erosion nor sedimentation since their appearance at the seafloor. The *Lower Rugged Area* displays erosional topography cut into the footwall of the fault plane, while sedimentary rocks deposited on top of the basement form the Upper Rugged Area. The observed structures and the results from dredging allow a few preliminary conclusions.

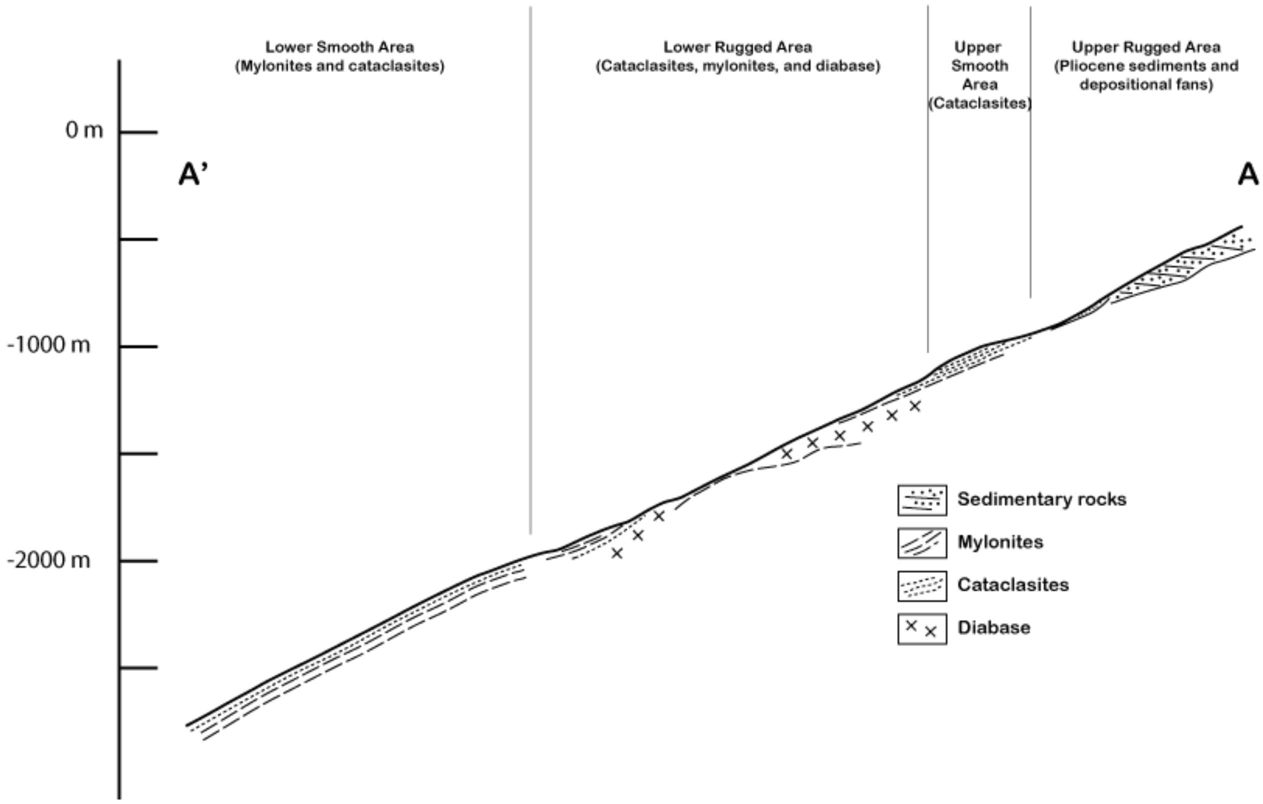


Figure 5.9: Interpretative downdip cross section through the area of AUV-Dive 015 with boundaries between domains, as discussed in the text. Trace of cross section is shown in Figure x8.

Relation between cataclastic and mylonitic deformation. Exposures of normal faults with large offsets usually show a transition from cataclastic deformation at the top of the fault zone to distributed mylonitization below. This stratification in space reflects progressive localization of deformation in time, i.e. with decreasing metamorphic grade. Along the Moresby Seamount Detachment, this relationship is not immediately evident: Cataclastic and mylonitic rocks were recovered from all dredges except for the uppermost discrete surface, the *Upper Smooth Area*, which yielded only cataclasites, as shown in Figure 5.9. This observation might be due to the limited spatial resolution of dredging, however, ODP Leg 180 also recovered mylonites structurally above cataclasites (Taylor & Huchon, 2002; Roller, 2002). A possible explanation is that ductile and brittle deformation along the fault zone are caused by differences in bulk composition rather than differences in metamorphic grade during deformation. Most mylonites appear to contain significant amounts of quartz while most cataclasites and the undeformed host rocks are mafic in composition. Many cataclasites display greenschist facies minerals like chlorite and epidote and their formation implies temperatures sufficient to allow for ductile deformation in quartz. Hydrothermal precipitation of quartz in the shear zone might cause a transition from cataclastic to ductile deformation even in an extensional setting.

Age of deformation. The presence of clastic sediments of Mid-Pliocene age on top of the Seamount indicates that greenschist grade metamorphism and high-temperature deformation must be older than 3.5 Ma. Whether this applies to cataclastic and mylonitic deformation on the detachment is not clear. Also, the same sedimentary rocks have been drilled in the basin north of the seamount (ODP Leg180; Taylor & Huchon, 2002) limiting the total horizontal offset along the detachment to less than 8 kilometers since Mid-Pliocene times. However, in a thermal regime with a 100°C/km geothermal gradient (Taylor & Huchon, 2002), 8 km displacement on a dtachment fault dipping 30° will exhume rocks at the surface that have resided at 4 km depth, and 400°C when shearing began. This way ductile mylonites, as sampled from the lower rugged and lower smooth areas may indeed owe their existence to syn-extensional shearing.

Extension along the Moresby Seamount detachment fault is only a fraction of the total extension in the rift system, which amounts to more than 50 kilometers in the past 3.5 Ma, based on Eulerpol rotation between the Australian and the Woodlark Plates (Bird 2003, Kington and Goodliffe 2007). Greenschist grade deformation may even be related to Paleogene thrusting, or earlier phases of extensional tectonics. However, undeformed diabase was dominantly recovered from the *Lower Rugged Area*, hence, from the deepest structural position with respect to the detachment. This suggests that the mylonites are indeed related to deformation along the detachment surface.

Possible transform fault and implications. The straight boundary between the *Lower Rugged* and *Lower Smooth Area* in continuation of the steep valley on the east side of the surveyed area suggests a structural discontinuity (Figure 5.3, Figure 5.8). The orientation of this boundary is very similar to the orientation of transform faults predicted for present day plate motion between the Australian and the Woodlark Plates (inset in Figure 5.7), which underwent a considerable reorientation about 500000 years ago (Goodliffe et al. 1997), and again 80000 years ago (cf. Little et al., 2007). If extension in the Moresby-Seamount area is indeed parallel to the present day plate motion, this boundary could now be a sinistral strike-slip fault (Figure 5.3, Figure 5.8). In that case, the north-south-striking grooves on the *Lower Smooth Area* would have at least to be older than 80000 years. This is in line with the observation from dredging that the rocks carrying grooves are predominantly mylonites presenting a deeply exhumed part of the fault system.

5.5 Mineralized veins and fractures on Moresby Seamount

Faults and shear zones are major fluid conduits in crustal basement and sedimentary rocks (e.g. Knipe, 1993). The detachment fault on the north side of Moresby Seamount exposes intensely deformed lithologies. The rocks involved in faulting are sedimentary rocks of Pliocene-Pleistocene age unconformably overlying Paleocene-Maastrichian (Taylor & Huchon, 2002) metabasites, the latter showing greenschist-grade metamorphism (Taylor et al., 1999).

Figure 5.10: (a) DR69-2A: syntectonically, folded, foliation-parallel quartz veins overprinted by later extensional -quartz filled-fractures. (b) DR42-5C: multistage veins mostly filled with epidote-quartz and quartz. Crosscutting relations reflect the folded epidote-quartz veins to be the oldest, the second generation (quartz filled) cuts diagonally across the sample with slightly older veins along their rims. Finally these vein structures get crosscut again (black veins). (c) DR42-4: crosscutting relations between first stage epidote-quartz vein and second stage quartz vein. (d) DR42-3C: pervasive network of crosscutting vein generations of early quartz, or combined quartz and epidote, overprinted by later extensional fractures filled with calcite. (e) DR105-1A: tightly foliated mylonite sample with foliation-parallel antitaxial crack-seal vein fabrics. (f) DR105-5B: multistage network of quartz veins with segregations of pyrite and disseminated hematite.

Deformation of turbididtic sediments in several fault zones in the hanging wall is dominated by brittle mechanisms, and sometimes accompanied by veining (e.g. Roller et al., 2001). The metabasic and metasedimentary rocks of the footwall on or immediately below the detachment show a transition from ductile to brittle

deformation fabrics (see above). Many fracture systems show evidence of repeated opening and healing during multistage hydrothermal mineralization.
The crosscutting relationships and deformation fabrics of the veins and their infill locally allow the reconstruction of the relative timing of deformation and precipitation events. Four different types of mineralized veins and fracture zones can be characterized on Moresby Seamount. From old to young these are:

(1) Epidote-quartz veins in highly sheared greenschist facies rocks.
(2) Pure quartz veins, sheared and/or extensional.
(3) Sheared and/or extensional veins filled with calcite.
(4) Quartz veins with sulfides, and disseminated sulfide mineralization of silicified host rock

Silicification is the most obvious alteration feature associated with the veins and is responsible for the older mineralization. Crosscutting relationships define epidote-quartz veins as first generation, followed by a second generation of pure quartz veins. Vein geometries are complex and affected by both, ductile and brittle deformation. Older veins are folded and the younger veins are disrupted and sheared. Many of the older veins are oriented parallel to the foliation, because they were generated syntectonically, therefore shearing was assisted by hydraulic fracturing under relatively high pore pressure. For example, Figure x10a shows syntectonic, foliation-parallel and folded quartz veins overprinted by later, multi-generation extensional fractures again filled with quartz.

Some of the extensional fissures in the faulted rocks of the detachment contain infills of calcite; these carbonate-bearing fluids were responsible for a third generation of veins, crosscutting quartz veins. Most of the calcite veins were later affected by shearing. Mineralization is dominated by coarse blocky calcite (Figure 5.10d). The youngest calcite-veins are very fine, undeformed and crosscut the foliation at high angles.

Cohesive cataclasites from DR 105 (Figure 5.10f) and DR 41 show silicifaction and a pervasive network of quartz-filled extensional fractures with segregation of hydrothermally remobilised sulfides, and disseminated hematite. As there are no crosscutting relationships with the vein types described before, the temporal relationship of these veins is presently unclear. However, this generation of veins is also a product of brittle (cataclastic) deformation and might therefore be of similar age as the other generations (e.g. Figure 5.10c).

The temporal relationship of veining and detachment faulting is described and derived as follows. The highest frequency of mineralized fractures and faults is concentrated in the cataclastically overprinted rocks of the upper smooth area of the detachment (Figure 5.8). These rocks recorded an early metamorphic overprint, then followed by retrogression with ductile/brittle extensional deformation and hydrothermal alteration (Roller et al., 2001). The latter processes have been related to normal faulting of Moresby Seamount, and the unroofing of its basement. Evidence for enhanced porosities and fluid flow along the low angle normal fault has been provided from geophysical observations (Floyd et al., 2001).

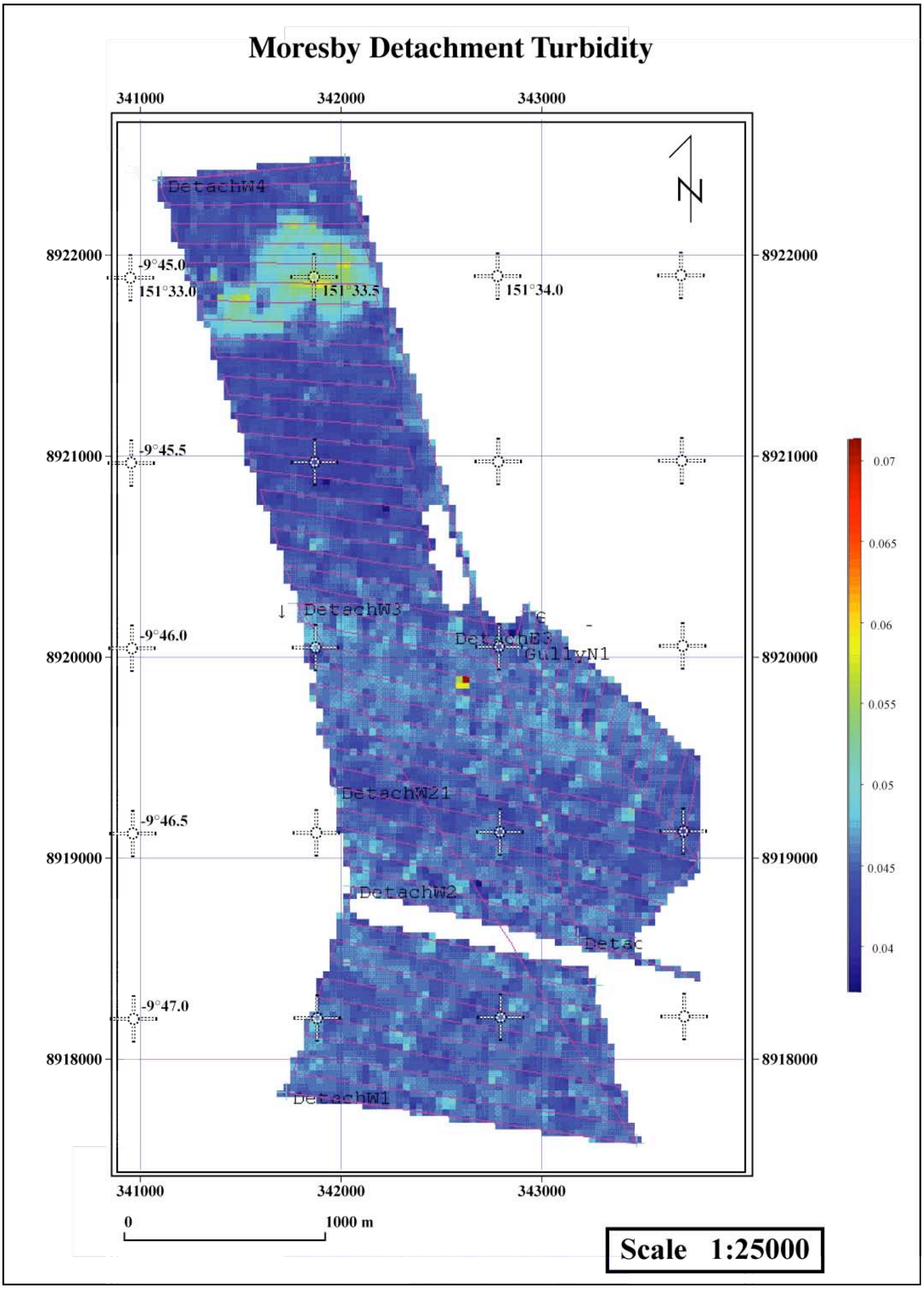


Figure 5.11: Map of turbidity in ocean bottom water, AUV-Dive 015, northern end of Moresby Seamount Detachment.

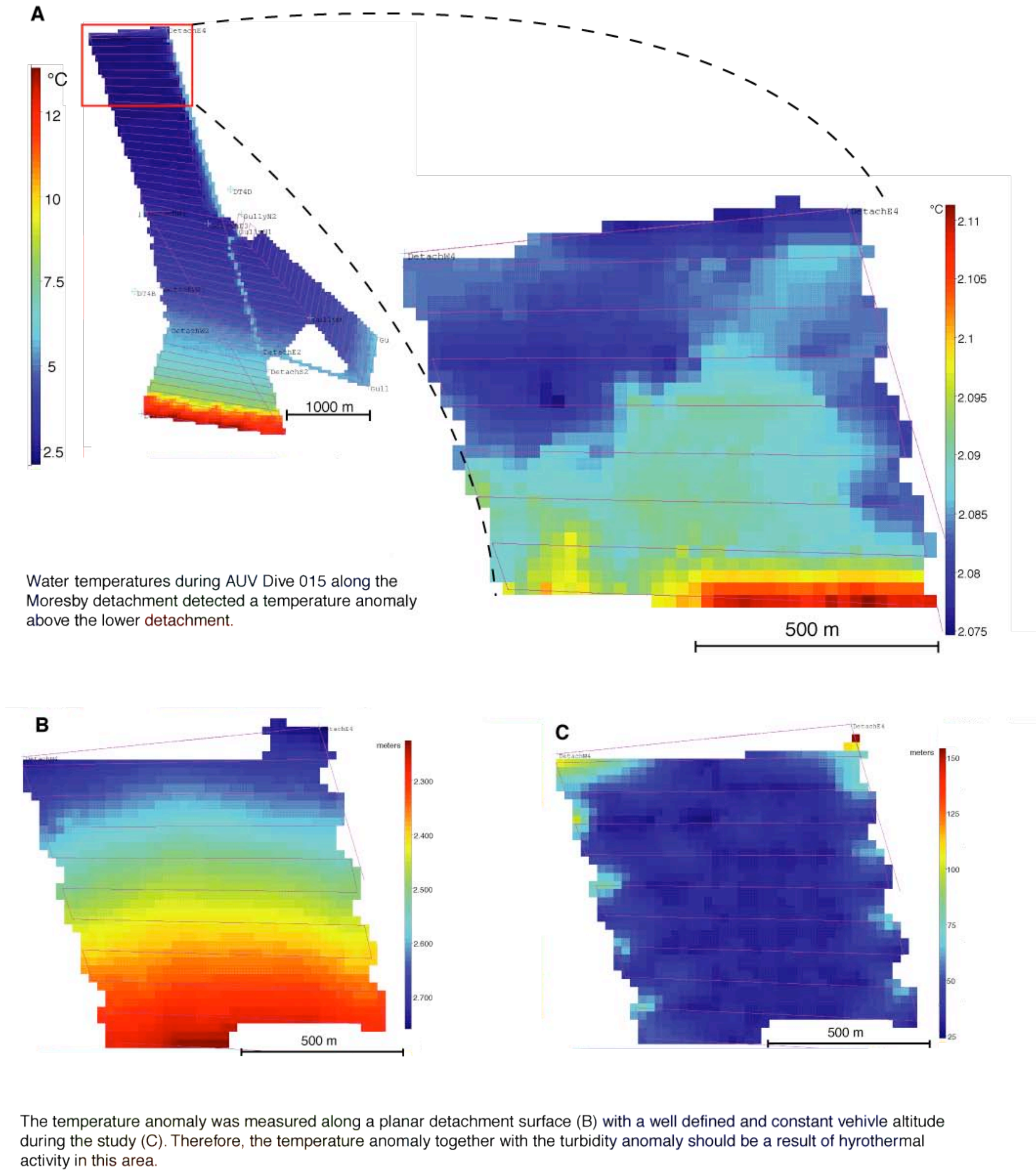


Figure 5.12: Map of temperature anomaly in ocean bottom water, northern end of Moresby Seamount Detachment, AUV-Dive 015

Thus a temporal relationship of mineralized fracture systems to detachment faulting is plausible. Abundant mineralized veins in the mylonites (Figure 5.10e) indicate that ductile deformation was interrupted by episodic stress build-up and the veins are interpreted as syntectonic with respect to detachment faulting (Kopf et al., 2003). The brecciated fault contact is marked by an abrupt increase in the degree of extensional fractures. Hydrothermal mineralization sealed the predominately tensional fractures (Figure 5.10b). So far our account to the fabrics of deformed rocks comprises samples from the detachment surface itself (e.g. Figure 5.10b, c), but also involves samples from deeper parts of the footwall (Figure 5.10a). All dredged positions in the adjacent area of the detachment surface (Figure 5.3) contain samples with more or less penetrative fracture systems.

5.6 Temperature and turbidity anomaly in the water column

AUV Dive No. 015 yielded one unexpected result. The recordings of the CTD and the turbidity sensor were evaluated, and a spatially coincident anomaly in the records of water turbidity (Figure 5.11) and the water temperature (Figure 5.12) was detected in the water column above the detachment in the constant travelling altitude of the AUV relative to the detachment surface. This is where the detachment fault dips beneath the overlying sediment cover of the hangingwall block. Water turbidity there is increased about 50% above the background value recorded at this depth in the surrounding area (Figure 5.11). The turbidity anomaly is about 800-1000 meters in diameter. The record of bottom water temperatures shows the expected stratification with depth (Figure 5.12a). However, when spreading scales to show small differences of temperature over an area 500m by 1000m relative to the surrounding bottom water (inset right in Figure 5.12a). Figure 5.12a and b demonstrate that vehicle altitude above the slightly convex detachment surface was held approximately constant. We thus conclude that the temperature perturbation, which is on the scale of 0.01°C, is real and may be due to the same process as the anomaly ot turbidity. A straightforward interpretation would bet that the turbidity and temperature anomaly reflects the seeping of temperate or warm fluids from the detachment zone. These fluids may be responsible for the fault-controlled mineralizations described from the detachment fault system at depth (e.g. Kopf et al., 2003, Famin & Nakashima, 2005) and point out an active hydrothermal system of the detachment fault.

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6 Woodlark spreading center investigations and petrographic rock sampling (P. Brandl and J. Mahlke)

6.1 Methods

6.1.1 Chain bag dredges:

Dredging using chain bag dredges is the most common way to sample the ocean floor. Chain bag dredges are similar to large buckets with steel teeth at their opening and a chain bag similar to a fishing net attached to their bottom. To recover rock samples with this method, the dredge is lowered to the seafloor and dragged slowly over the ocean floor by the ship's winch. As the dredge bounces along the seafloor, pieces of rocks are scooped into it. After the dredge is pulled back up to the ship, the rocks are emptied onto deck and sorted. If large amounts of samples are recovered, only some representative ones for the whole dredge are kept.

If no rocks could be recovered at a dredge station, the importance of obtaining samples was most often weighted against the available time. A dredge was then either repeated at the same station or a dredge site nearby had to be found.

On SO203 a small chain bag dredge type I K/MT9000 produced by KUM – Kieler Umwelt- und Meerestechnik was used. It has an opening of 100x50cm and a chain bag net size of about 5cm. One dredge haul usually takes – depending on the water depth – between 2-6 hours. The benefit of dredging is that large pieces of the rock are obtained.

The selection of dredge sites was done according to detailed SIMRAD EM120 mapping. Bathymetric maps as well as backscatter images of the seafloor were used to set dredging positions in order to sample only relatively fresh rocks on or at least close to the actual spreading axis of the Woodlark Basin. A number of existing datasets was also used for the selection of dredge sites, especially during across-axis sampling. These datasets include:

1. Swath bathymetry data and maps provided by Martinez
2. Magnetic data provided by Goodliffe
3. Swath bathymetry data and maps provided by Nautilus Minerals

6.1.2 Volcanic rock corer

A volcanic rock corer is similar to a small gravity corer with a lead weight on top of it. There are different kinds of wax corers, some looking exactly like very small gravity corers with one large tube that is about 50cm long. During SO203 a new kind of volcanic rock corer was used, featuring a round steel plate at its bottom with seven steel pipe-fittings that are about 3cm deep and 4cm in diameter (internal), attached to it. For coring the steel cups were loaded with plastic cups filled with Vaseline. The wax corer with Vaseline-filled cups and the weight then travelled down to the seafloor. About 50-80m above the approximate seafloor the winch was stopped for a few minutes to let the rope with the wax corer to come to rest. It was then again further lowered with 1m/s until definite bottom contact was distinguished by a clear decrease of the rope tension. This decrease marks the moment when the volcanic rock corer hit the seafloor. The device was then heaved slowly until it was definitely free from the bottom and finally pulled back on board with 1m/s. Vaseline turned out to be a good fabric for embedding rock or glass chips when the corer strikes the bottom and shatters the rocks of the ocean floor. The rock chips stick to the Vaseline and can later be recovered by pouring hot water over the sample or heating everything up in a microwave, melting the Vaseline and therefore separating the sample from the Vaseline. The small size of the cups and the larger number of cups rise the chances of recovering small rock fragments when hitting the bottom.

Although only small amounts of samples can be taken with this method, it still turned out to be a good sampling method when only trying to obtain e.g. glass, since modern analysis techniques only need small sample sizes. Therefore only a few fine-grained glass chips are still enough material for e.g. Electron Microprobe Analysis and/or Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry.

6.1.3 TV-grab

A TV guided grab basically looks like a large bulldozer shovel with steel teeth at the opening of its set of steel jaws. It has a video camera mounted between the jaws that transmits pictures of the seafloor, allowing to search for objects of interest on the ocean floor with the jaws open. In that way it also provides the opportunity to identify suitable objects prior to sampling and look at the actual sampling location on a monitor on board the research vessel. If a suitable sampling location has been found, the jaws can be closed by a hydraulic motor and thus grab the sample/s.
The selection of TV-grab stations was done just like for the according to SIMRAD EM120 mapping, recorded MAPR data during dredging and at geologically and morphologically interesting targets. During SO203 three dives have been done with the ship-owned guided grab “Bodo” and only one sample could actually be recovered altogether.

6.2 Shipboard Procedures

All rock samples from the wax corer and the TV-grab were kept, due to their small sample sizes and amounts. Samples taken with the wax corer were then treated as described above. For rocks sampled by dredging, only a representative selection of samples was kept. Once recovered through dredging or the TV-grab, the samples were then cleaned and cut using a chain saw type “Grünheim”. They were then examined using a hand lens and/or a microscope and grouped according to their lithologies and degree of submarine alteration. Once sorted, a selection of samples was cut for thin sections. Glass was chopped of with a lump hammer and stored separately for Electron Microprobe Analysis. For rocks that did not feature a glassy crust, all e.g. Manganese coating or crust or other alteration products were removed completely with the saw to produce a relatively uncontaminated piece of rock for geochemistry analysis. Samples were further described, labelled, wrapped in bubble wrap or sealed in plastic bags and finally stored in boxes for transportation to IFM-GEOMAR.

6.3 Segment 1

6.3.1 Axis 1A, East Basin and Cheshire Seamount (plate 1: a, b)

Freshest looking pieces of lava or glass were sampled at dredge sites DR-28 (East Basin; many, very large plag-phenocrysts) and DR-27 (Cheshire Smt.) and from wax corer station VSR-50 (East Basin). Sampling stations north and south of these stations recovered older looking lava or glass fragments with sediment. Therefore, we suppose therefore, that axis 1A extends somewhere in the northern East Basin, presumably along stations VSR-50 to DR-28 and DR-27 (Figure 6.1). The westward continuation of axis 1A could not precisely determined. The sample taken at wax corer station VSR-108 is represented by fresh glass which was covered by sediment and is hence not an evidence for a magmatic stage of spreading. At another dredge site in the northern of the two remarkable rift valleye northwest of Moresby Seamount

(Figure 6.1) no rocks were recovered. Due to the behaviour of the tension during dredging we suppose that there, the ocean floor is covered by muddy sediments.

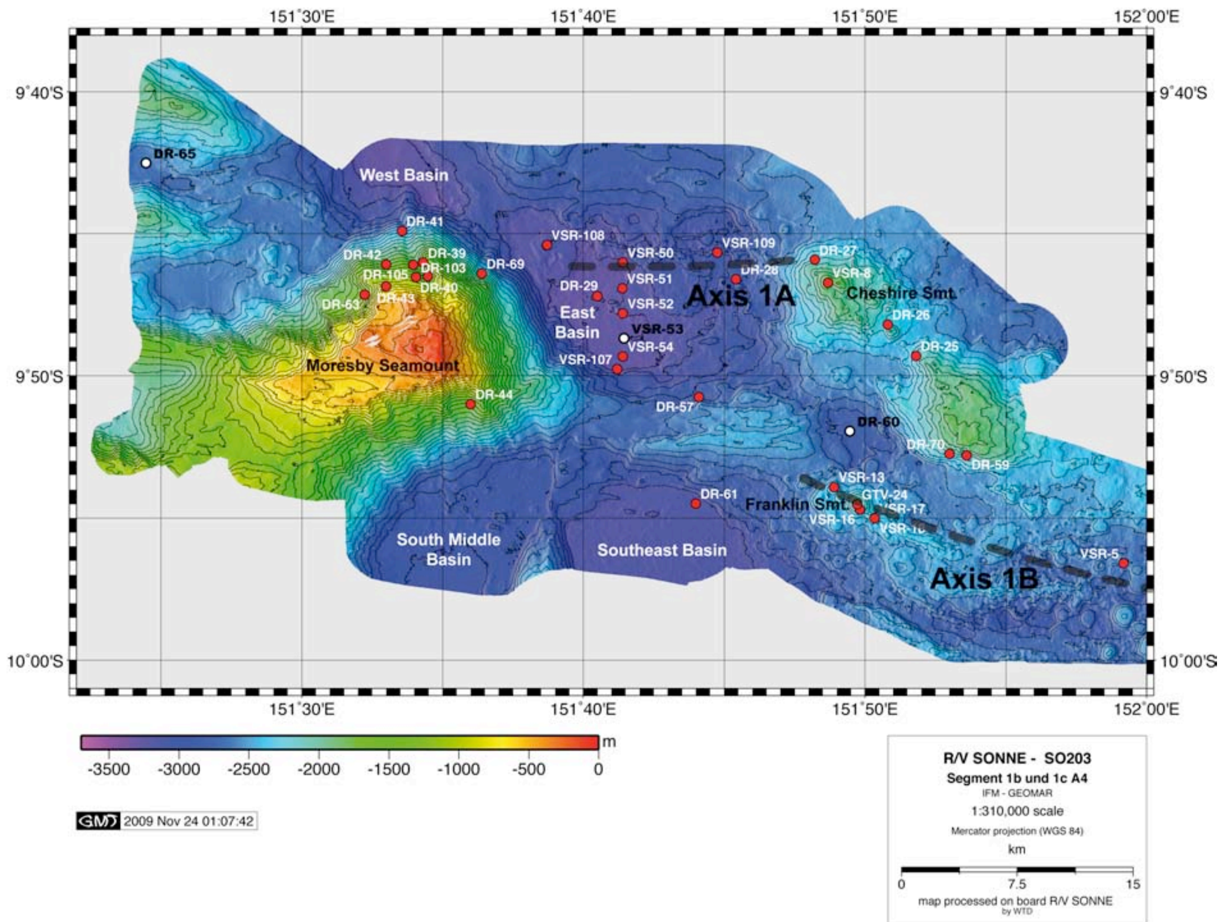

Figure 6.1: Bathymetry of the continent-ocean transition east of Moresby Seamount. Successful sampling station (recover of rock material) are shown by red dots, failed sampling stations by white dots with black circles. Failed stations which were successfully repeated are not shown The supposed locations of axes 1A and 1B are marked with dashed grey lines. Locations after Binns et al. (1987), ridge axes after Goodliffe et al. (1997).

Two dredge stations at Cheshire Seamount (DR-26 on the southeastern and DR-27 at the northwestern slope) and one wax corer station (VSR-8 on top of the seamount) recovered rocks. At station DR-25 at the northwestern slope of the seamount southeast of Cheshire Smt. pillow lava was sampled and hence is genetically more related to Cheshire Smt. than to the southern part of this yet unnamed seamount, which will further be discussed below (DR-59 and DR-70). VSR-8 recovered strongly weathered glass chips with filled vesicle cavities and also rocks from stations 25 to 27 were relatively old. Nevertheless, a progradation from older rocks to younger rocks from the southeast (DR-25) to the northwest (DR-27) can be observed.

6.3.2 Continental fragment between East Basin and Southeast Basin and seamount southeast of Cheshire Smt. (plate 1: c-f)

At one dredge site from the bathymetric high between East Basin and Southeast Basin (DR-57, Figure 6.1) subaerial extruded volcanic rocks were recovered. Samples were represented by basaltic lava flows (pahoehoe lava and highly-

vesicular basalt columns). Also, silica-rich pumices occur, but their origin must be questioned as they must have formed on land and probably do not represent in-situ samples. All recovered rocks were strongly altered and coated with manganese.
The unnamed seamount southeast of Cheshire Smt. (Figure 6.1) provides a complex geological structure. From the northern end, strongly altered pillows lava were sampled by dredge site DR-25 (see Cheshire Smt.), whereas two dredges from the southern slope recovered arc crustal rocks. DR-59 is characterized by strongly altered basalts, hyaloclastites, volcaniclastic breccias, intensely altered dacites, and quartz breccias with highly altered dacite fragments. DR-70 brought pieces of SiO_2-rich lava flows (probably rhyolite), again pumice (allochtonous?), hyaloclastic rocks, volcanic glass, and devitrified rhyolitic glass to the surface. We suppose that at least the southern part of this ‚seamount' is build up of crustal rocks of the former volcanic arc related to the northward subduction of the Coral Sea along the Pocklington Trough. Strongly weathered pillows to the north are related to subaqueatous extrusion of basaltic lava probably in an early stage of spreading.

6.3.3 Axis 1B, Southeast Basin and Franklin Seamount

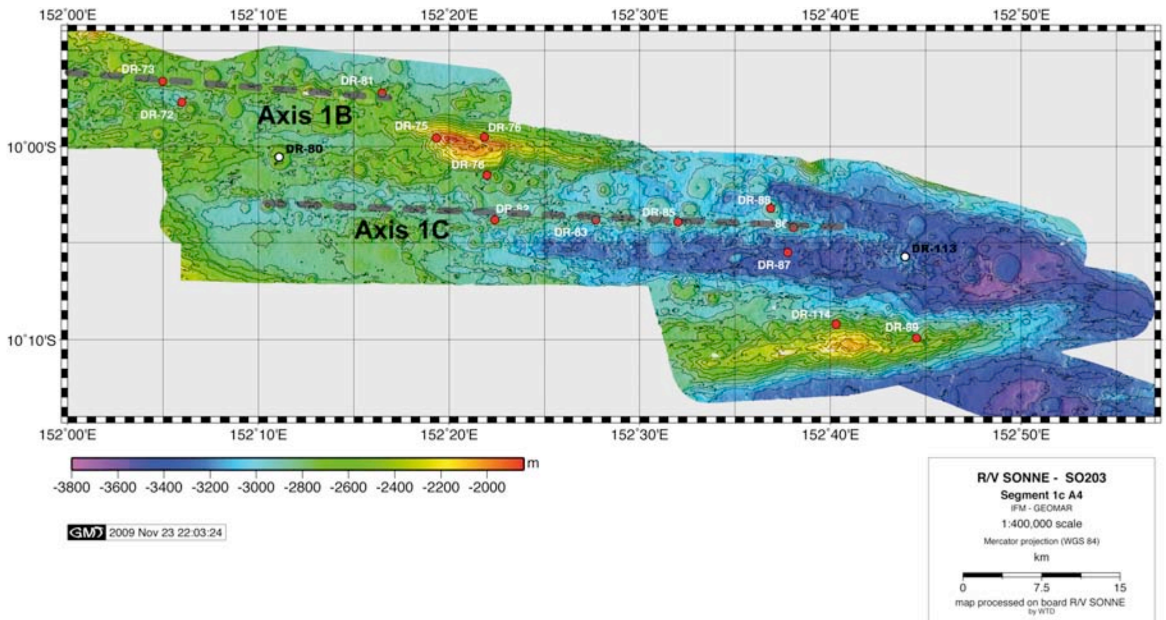

*Figure 6.2**:** Eastern part of axis 1B and axis 1C. We found fresh rocks only on a few locations at the eastern ends of axes 1B and 1C and their exact position must therefore be further discussed. For further explanations see Fig. 3-1.*

One dredge site (DR-61) from the Southeast Basin (Figure 6.1) recovered one piece of fairly fresh basalt with glass crust and minor palagonite. Hence, we suspect that the Southeast Basin is composed of oceanic crust. In which context those oceanic crustal rocks are regarding their petrogenesis (prolongation of axis 1B?) remains yet unclear. No bathymetric hint for a northwest or westward continuation of axis 1B further west than Franklin Seamount (Figure 6.1) could be recognised
From Franklin Seamount and the surrounding smaller volcanic cones, a row of 4 wax corers was impacted onto the ocean floor trending from northwest to southeast (VSR-13 and VSR-16 to -18). Nevertheless, only station VSR-16 on the southeastern crater rim of Franklin Seamount itself recovered fresh glass chips (phyric with plag- and ol-phenocrysts). Other stations were sediment-covered (VSR-13) or recovered altered glass (VSR-17: oxidised rims, VSR-18: moderately fresh). Hydrothermal

precipitates (low-T Fe-oxihydroxides) recovered by usage of the shipboard TV-Grab ‚Bodo' (GTV-24) were described in the hydrothermal chapter of this cruise report and a high resolution bathymetric map of Franklin Seamount can be found in the AUV-chapter.
Axis 1B can only hardly be defined. We sampled along the volcanic cones that were easily be distinguished by bathymetric data and morphology (Figure 6.1 and Figure 6.2) and we also suppose to be on-axis of what Goodliffe et al. (1997) defined as axis 1B, as we recovered freshest looking basalts at station DR-81 at the eastern tip of the ridge axis, while stations DR-72, DR-73 and VSR-5 did recover pillows with sediment-filled fractures and Fe-Mn-staining or palagonitized glass respectively.
One dredge site (DR-80) on a probably rifted volcanic cone between axes 1B and 1C did not recover any rocks. The absence of any rope tension while dredging could be caused by a thick sediment layer on the ocean floor and hence an older age.

6.3.4 Bathymetric high between axes 1B and 1C (plate 2: a, b)

The bathymetric high between axes 1B and 1C (Figure 6.2) was first supposed to be a fragment of continental crust comparable to arc crust fragments between axes 1A and 1B. Three dredge sites (DR-75, -76, and -78) brought basaltic rocks and pillows to the surface. Some of them were strongly altered with thick Fe-Mn-crust, while others were quite fresh looking, almost unaltered with large Plag- and Ol-phenocrysts. Hence there is hence no doubt that this bathymetric high is composed of oceanic crustal rocks not significantly older than basalts recovered from ridge axes north and south of this high. The smooth texture of the northern slope (Figure 6.2) is probably the result of a normal fault scarp and the bathymetric high probably represents an uplifted rift shoulder. Detailed geochemical studies are necessary to prove whether this high is composed of basalts of an early stage rifting event or it is composed of MORB similar to the surrounding ridges.

6.3.5 Axis 1C (plate 2: c-e)

After mapping this segment with the shipboard Simrad EM-120 echo sounder, we thought to be quite sure where axis 1C must be located. Although stations DR-82 and DR-83 recovered only slightly altered pillows with distinct cooling columns and high vesicularity and DR-85 (repetition of empty dredge DR-84) recovered moderately fresh pillows, we definitely dismatched the axis by station DR-86 (direct eastward continuation of a virtual line between DR-82, -83, and -85; Figure 6.2). Station DR-87 just south of DR-86 did not recover significantly younger rocks. From the eastern end of the axis no rocks at all could be recovered from a cone by dredge DR-113 (no distinct rope tension -> sediment cover?). Freshest looking rocks of axis 1C were recovered at station DR-88 from a volcanic cone just north of the presumed ridge axis. Therefore, dredge site DR-88 at which pieces of sheet flows with only slight alteration were sampled is probably the location of most recent volcanic activity along axis 1C.

6.3.6 Continental fragment south of eastern end of axis 1C (plate 2: f and plate 3: c)

At dredge site DR-89 diorites, granodiorites, andesites and fault breccias were sampled. All of them were strongly altered and epidote-bearing. A second dredge site (DR-114) recovered on the one hand strongly altered diabase, dolerite, and pumice, and on the other hand, less altered basalts with many flow-elongated vesicles. It represents the dredge with the largest variety of samples taken during cruise SO-203. Rocks of DR-89 probably represents rocks of the old island arc crust, whereas samples of DR-114 represents rocks of an early stage of rifting. Further geochemical investigations are necessary to explain the detailed petrogenetic history of this continental fragment. The bathymetric map indicates a major normal fault scarp to the south of the fragment (see Figure 6.2).

6.4 Segment 2 and Moresby Transform

6.4.1 Axis 2 (plate 3: a, b, d, e)

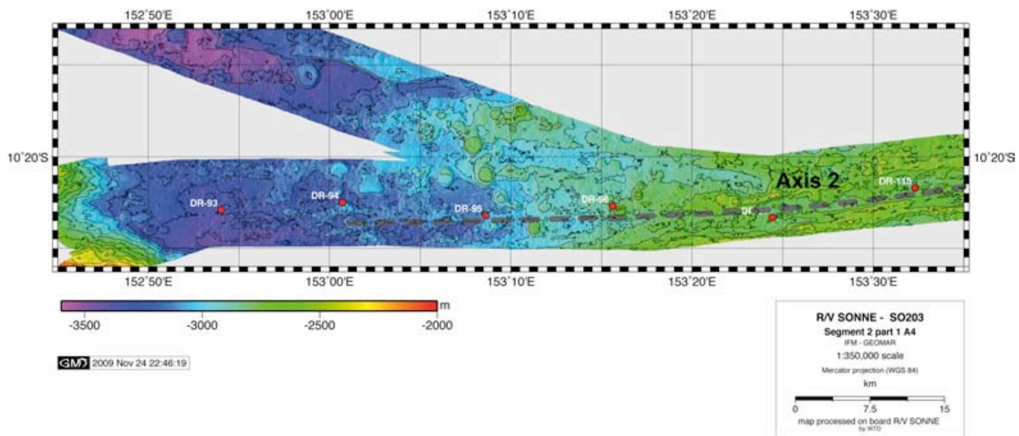

*Figure 6.3**:** Western part of segment 2 with sampling points (red) and the position of the ridge axis (dashed grey line) after Goodliffe et al. (1997), modified from recent observations.*

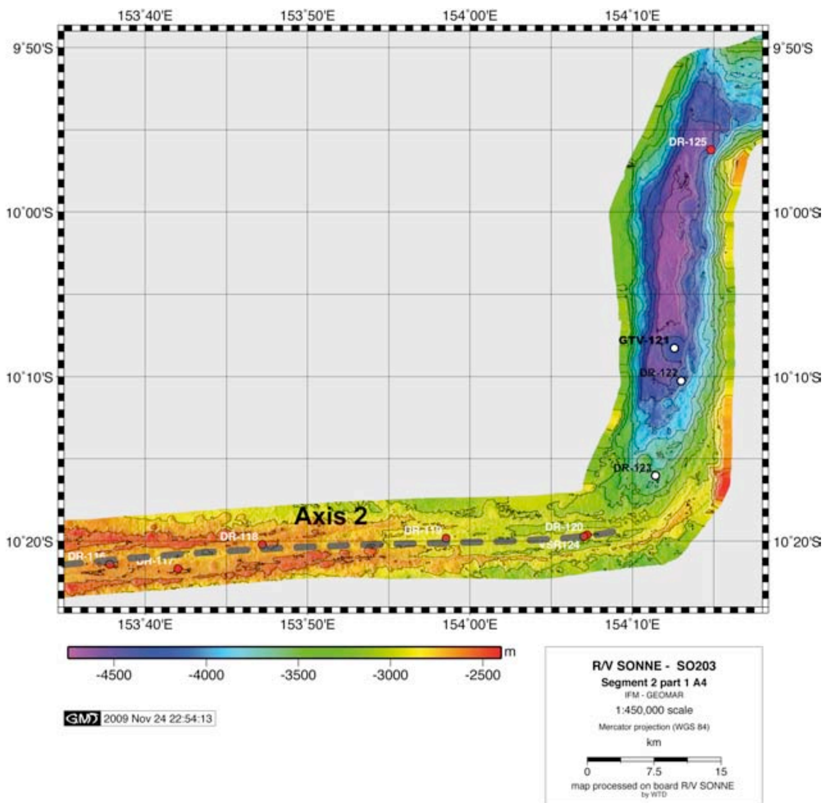

*Figure 6.4**:** Eastern part of axis 2 and the Moresby pull-apart basin. Note the clearly visible volcanic cones extending from the eastern end of axis 2 northwards into the basin. Further explanation see Figure 6.1 and Figure 6.3.*

Eleven dredge sites and one wax corer were used to sample axis 2. While DR-93 and DR-94 at the western end of the segment definitely do not belong to the youngest parts of the ridge axis, we got quite fresh samples at the other stations. Rocks from DR-93 and DR-94 were strongly altered on the surface with a fresh interior. DR-96 and DR-117 were similar but probably less altered (moderately to strongly altered, with large amounts of Fe-oxides on their surfaces). All other dredge sites are represented at least in parts by fairly fresh looking pillows. It is worth to mention station DR-95, where some very unusual samples were recovered: fresh pieces of sheet flows with large Plag-phenocrysts and extremely large vesicles (up to a few cm) at a water depth of more than 3000 m. Freshest looking samples so far were recovered at station DR-120. Therefore, we decided to also use a wax corer (VSR-124) equipped with a MAPR to look for recent hydrothermal activity, but even in this area we could not discover any plume.

6.4.2 Moresby ‚Transform' (pull-apart basin; plate 3: f)

In consequence of the reorientation of the Woodlark Spreading Center (Goodliffe et al., 1997), the tectonic setting of the Moresby ‚Transform' changed from a basin along a transform fault to a pull-apart basin. Therefore, we had the idea of possible occuring (ultra-)slow-spreading within the basin based on our bathymetric survey. We recognised some volcanic cones up to 2 Nm in diameter extending from axis 2 northwards along the eastern side of the basin. Nevertheless, no rocks were obtained at stations DR-122 and DR-123. On station GTV-121 the new TV-grab of the IFM-GEOMAR was first used for testing but transmitted only pictures of a thick sedimented bottom. Sampling was not allowed at this station as no rock sampling activities have been granted by the government of Papua New Guinea.
DR-125 was brought out on the inside corner high at the northeastern end of the basin. Deformed altered gabbros with epidote veins, (proto-)cataclastites and brecciated quartz-veins were recovered. They indicate faulting of deeper crustal rocks along the Moresby Transform.

6.5 Segment 3

6.5.1 Axis 3A (plate 4: a-d)

Axis 3A was quite well matched by rock sampling (Figure 6.5). Seven dredge sites recovered rocks of variable degree of alteration but most of them were quite fresh or only less hydrothermally altered. On stations DR-126 and DR-127 we dredged quite fresh pillows which were partly devitrified. DR-128 was stucked at the bottom and the ship had to return to point were this dredge site started to get the dredge free. In addition with moderate to strongly altered pillows we suspect this part of the ridge is presently in a tectonic stage rather than a magmatic stage of spreading. DR-129 again recovered fresh looking pillow lava. Dredging at station DR-130 behaved similar to DR-128 and the dredge got stucked for a while. DR-130 and DR-131 recovered moderate to strongly hydrothermally altered pillow and sheet flow lava with maybe slightly fresher looking rocks from DR-131. DR-135, at the eastern tip of axis 3A (Figure 6.5), brought relatively fresh looking pillow lava to the surface.

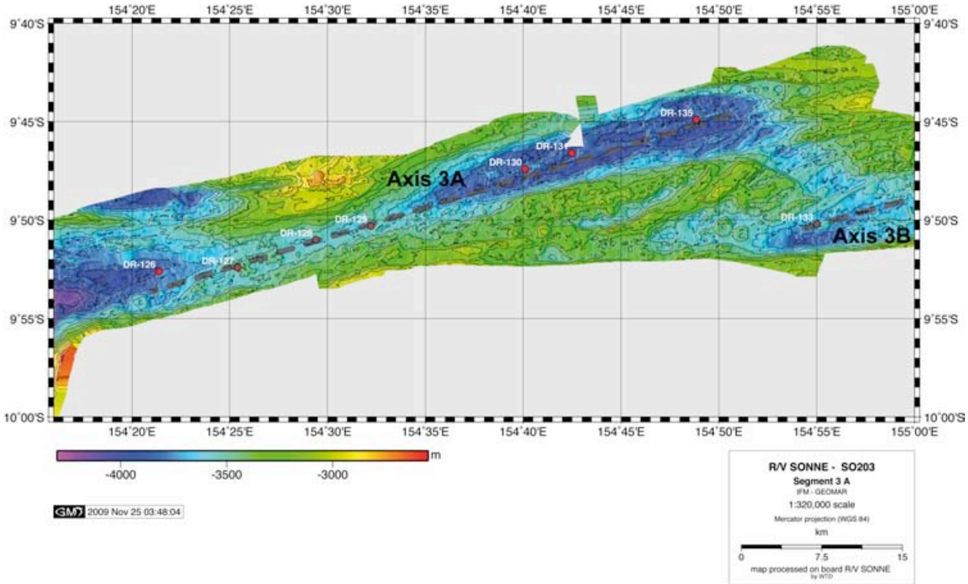

Figure 6.5: Axis 3A and western part of axis 3B. Symbols as in Figure 6.1 and Figure 6.3.

6.5.2 Axis 3B (plate 4: e, f)

Four dredge sites were brought out along axis 3B (Figure 6.5 and Figure 6.6). The ridge axis was matched by sampling at stations DR-137 and DR-140 from which fresh pillow and sheet flow lava with only minor hydrothermal alteration were recovered. From DR-133 on the western tip of axis 3B (Figure 6.5) and DR-140 on a volcanic cone south of the present spreading axis (Fig. 3-6) slightly to moderate altered pillow lava and some sheet flow fragments were dredged (rocks from DR-140 with Mn-coating).
On station DR-137 a MAPR installed 400 m above the dredge recorded the only evidence for a plume during this cruise (Figure 6.6). With two Tow-Yo's (stations 141 and 149) we tried to distinguish the source of this plume, but additional search at the suspected ridge area with the shipboard TV-grab ‚Bodo' (GTV-150) remained without success.

6.5.3 Pull-apart basin between segments 3 and 4

This basin probably developed similar to the Moresby Transform, which is supposably nowadays a pull-apart basin. On the bathymetric map it looks like adjacent axes (3B to the southwest and 4A to the northeast) are turning into this basin (Figure 6.6). No samples were recovered from this structure.

6.6 Segments 4 and 5

Segment 4 is composed of 5 distinct axes from which axes 4A to 4C were sampled during cruise SO-203 (Figure 6.6). Axes 4D, 4E and segment 5 (2 more ridge axes: 5A and 5B) were either mapped nor sampled during this cruise.

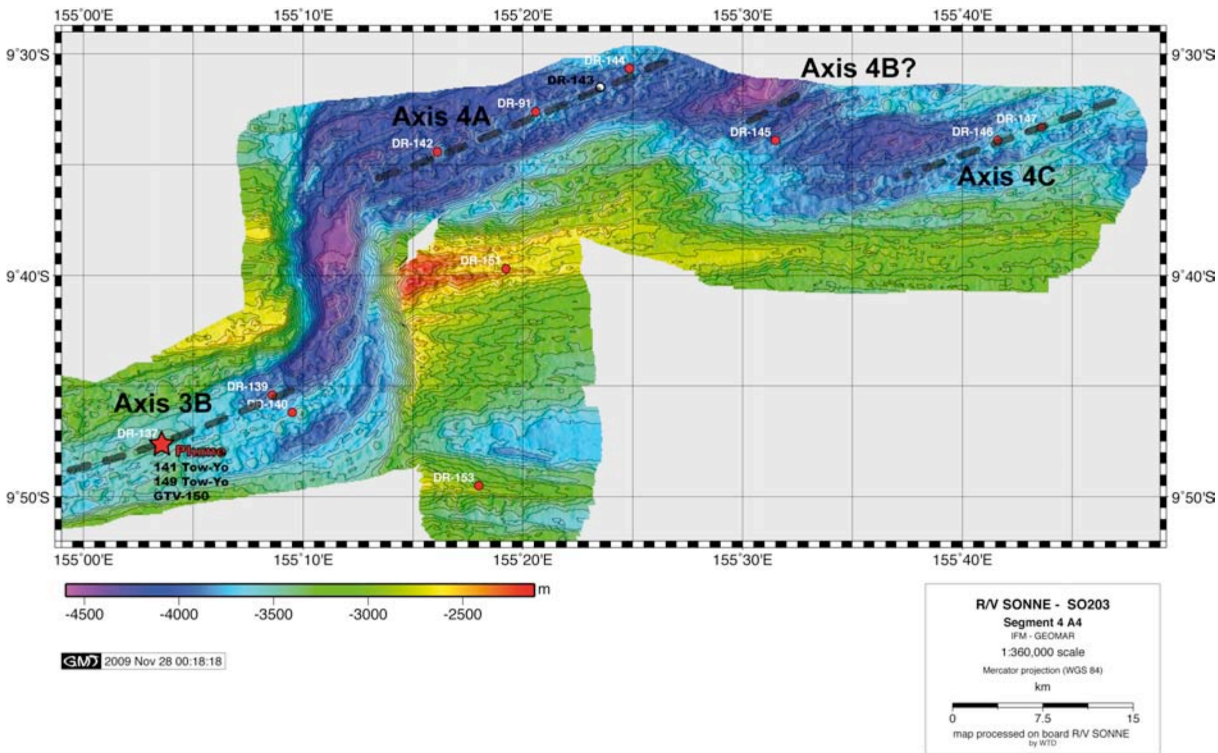

Figure 6.6: Eastern tip of axis 3B, possible extensional basin at the former transform fault between segments 3 and 4, axes 4A to 4C of segment 4 and the northern part of the transect across the Woodlark Basin from ridge axis southwards to the Pocklington Rise. Symbols as in Figure 6.1 and Figure 6.3.

6.6.1 Axis 4A (plate 5: a)

Even though we did not obtain any samples at dredge site DR-143, we recovered rocks of axis 4A at three other dredge stations (Figure 6.6). At DR-142 some very fresh pieces of glass crust were sampled, while at DR-91 basalts with slight hydrothermally altered surfaces but fresh interior and at DR-144 a mixture of blocky lava, sheet flows and pillows was recovered. The grade of alteration of rocks of station DR-144 varied from strongly altered to fresh. We generally managed to sample the youngest and freshest rocks of ridge axis 4A quite well.

6.6.2 Axis 4B (plate 5: b)

We probably mismatched axis 4B with dredge site DR-145, as we only got old pillows, which were sedimented and strongly hydrothermally altered. We suppose that ridge axis 4B must be positioned on one of the two bathymetric higher ridge-like features north and south of the structure we sampled (Figure 6.6).

6.6.3 Axis 4C (plate 5: c)

We matched axis 4C quite well with two dredge stations (Figure 6.6). For station DR-146 very fresh looking pieces of sheet flows were obtained, whereas at DR-147 fresh looking pieces of sheet flows and pillow lava were recovered.

6.6.4 N-S transect from axis 4A southwards (along E 155° 20’; plate 5: d-f)

Sampling along the entire Woodlark spreading center worked quite well, whereas sampling towards the southern boundary of the Woodlark Basin near the Pocklington Rise turned out to be more difficult. South of S 10° we got no samples at the first try of dredging. Therefore, stations DR-159 and DR-162 had to be repeated, then successfully as station DR-160, DR-164 respectively (Figure 6.7).
We sampled basalts at station DR-151. Those had a fresh interior even if they were already strongly altered at their surfaces. Further south, at station DR-153 moderately altered basalts with a thick Mn-crust (up to 5 mm) were recovered. At DR-155 strongly altered blocky basalts with a thick Mn-crust were obtained. Dredge site DR-157 was empty and was also not repeated due to the absence of any bites. DR-160 (repetition of DR-159) was located on top of a prominent seamount and strongly altered basalts with Mn-crust and a remarkably alteration rim were recovered. DR-164 (repetition of DR-162) was located at the southern slope of a deep basin (> 4300 m water depth) and represent a mixture of micrograbbros, sandstones (?), altered basalt with hematite and breccias with veins and hematite.

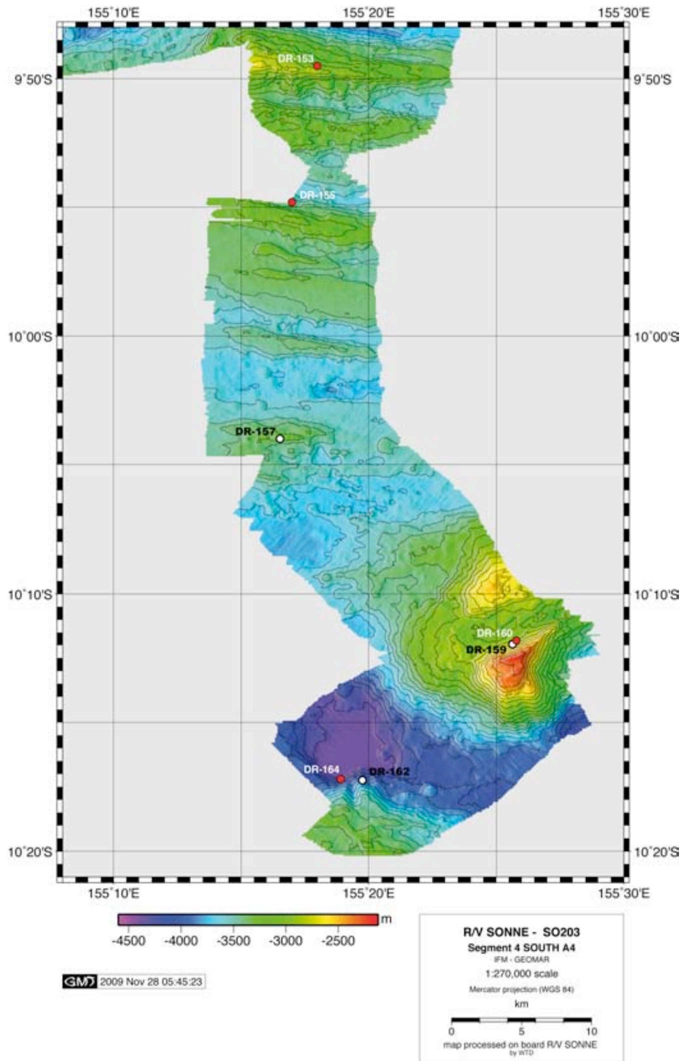

Figure 6.7: N-S transect from axis 4A southwards to the transition from Woodlark Basin to Pocklington Rise chosen in order to sample an age-progressive transect perpendicular to the ridge axis (along ~ E 155° 20’). Symbols as in Figure 6.1.

6.7 References

Binns, R. A. and Whitford, D. J. (1987): Volcanic rocks from the western Woodlark Basin, Papua New Guinea. Pacific Rim Congress 87, Cold Coast, Australia.

Goodliffe, A., Taylor, B., Martinez, F., Hey, R., Maeda, K., and Ohno, K. (1997): Synchronous reorientation of the Woodlark Basin spreading center. Earth and Planetary Science Letters, Vol. 146 (1-2): 233-242.

6.8 Plates

Plate 1: East Basin and adjacent areas (scale: 1 cm)

a) DR 27-1: piece of high vesicular sheet flow lava from the northern toe-of slope of seamount southeast of Cheshire Smt..

b) DR 28-1: highly plagioclase-phyric basalt from the northeastern East Basin, probably from close to ridge axis 1A.

c) DR 57-1: Possibly not in-situ pumice (on land?) from the continental fragment between East Basin and Southeast Basin.

d) DR 57-3: Subaerial extruded pahoehoe lava from the continental fragment between East Basin and Southeast Basin.

e) DR 70-2: Piece of lava flow with elongated vesicles and flow banding, dredged from the southern slope of the seamount southeast of Cheshire Smt..

f) DR 70-8: Large piece of devitrified rhyolitic glass from the seamount southeast of Cheshire Smt..

Plate 2: Axes 1B and 1C (scale: 1 cm)

a) DR 76-4-B: Strongly altered pillow lava from the bathymetric high between axes 1B and 1C.

b) DR 78-6: Almost fresh pieces of pillow lava, recovered just south of the bathymetric high between axes 1B and 1C.

c) DR 82-3: Pieces of sheet flow lava with glass crust and some Mn-coating. Recovered from axis 1C.

d) DR 83-3: Large pillow basalt with glass crust from axis 1C.

e) DR 88-1: Piece of fresh sheet flow lava from a volcanic cone, slightly north of the eastern tip of axis 1C.

f) DR 114-3-A und 114-3-B: Volcanic rock with large vesicles and flow-orientated small vesicles from the continental fragment south of axis 1C.

Plate 3: Axis 2 and Moresby Basin

a) DR 94-2: Strongly hydrothermally altered pieces of pillow lava from the western axis 2.

b) DR 95-1: Fresh pieces of sheet flow lava (scoria?) recovered from the western axis 2.

c) DR 114-3: Epidote-bearing diabase and veined dolerite and recovered at the continental fragment south of axis 1C.

d) DR 117-2: Strongly hydrothermally altered pillow basalt recovered from axis 2.

e) DR 120-4: Jumbled sheet flow with minor hydrothermal alteration on surfaces recovered from the eastern axis 2.

f) DR 125-1: Slightly deformed gabbros with epidote-veins dredged at the northeastern inner corner high of the former Moresby Transform.

Plate 4: Axes 3A and 3B

a) DR 127-3: Very fresh piece of pillow lava with remarkable glass crust from axis 3A.

b) DR 128-1: Hydrothermally altered piece of pillow lava with fresh glass crust from axis 3A.

c) DR 129-1: Fresh pieces of pillow lava with large plagioclase-phenocrysts from axis 3A.

d) DR 135-1: Altered pieces of pillow lava from the eastern tip of axis 3A.

e) DR 137-1: Very fresh piece of a sheet flow with minor alteration from the eastern axis 3B, where a plume was recorded.

f) DR 139-2: Quite fresh piece of sheet lava flow with fresh glass crust on top and bottom. Recovered from a volcanic cone slightly north of the eastern tip of axis 3B.

6.8.1 Plate 5: Axes 4A to 4C and N-S transect

a) DR 142-1: Very fresh pieces of glass crust recovered from a volcanic cone of western axis 4A.

b) DR 145-1: Strongly altered pillow lava recovered off-axis south of axis 4B.

c) DR 146-1-B: Pieces of phyric sheet flow lava with fresh glass crust on the one side and thick Mn-coating on the other. Dredged on axis 4C.

d) DR 151-5: Strongly altered basalt recovered from the bathymetric high south of axis 4A.

e) DR 153-3: Strongly weathered piece of basaltic lava with thick Mn-crust further south than DR 151.

f) DR 160-2: Strongly weathered piece of basaltic lava with thick Mn-crust recovered from the southern slope of the remarkable basin at about S 10° 17', E 155° 20'.

7 Hydrothermal Activity and Mineralization (M. Hannington, S. Petersen)

7.1 Segment 1

Four completely different types of hydrothermal alteration and mineralization were found on segment 1:

- (i) mesothermal quartz veins in highly sheared greenschist facies rocks exposed on the Moresby detachment fault,
- (ii) low-temperature Fe-Si-Mn oxyhydroxide crusts in the crater of Franklin Seamount,
- (iii) epithermal-style alteration and mineralization in dacite breccias form a submarine diatreme complex SE of Cheshire Seamount,
- (iv) quartz-epidote alteration in granodiorite and diorite intrusive rocks from a structural high south of segment 1C.

Although there is an abundance of small-scale basaltic volcanoes along this segment of the Woodlark basin, there does not appear to be a clearly defined spreading center. Segment 1 is apparently dominated by tectonic extension rather than focused seafloor spreading, and magmatic activity is characterized by abundant small pillow volcanoes and ridges distributed over a wide area, typical of slow-spreading mid-ocean ridges. Recent magmatic activity includes both basaltic volcanism and small volumes of more silicic lavas erupted along extensional faults cutting fragments of older arc crust. The latter suggest that the late stages of intra-arc rifting and associated felsic magmatism locally overlap with seafloor spreading along parts of Segment 1. This complexity is reflected in the different styles of hydrothermal alteration and mineralization recovered.

Despite the abundance of small basaltic volcanoes, there appear to be no major hydrothermal plumes associated with this magmatic activity. Eleven deployments of the MAPRs failed to detect any significant anomalies, except for a small near-bottom particle plume above a volcanic ridge on the southeast flank of Franklin Seamount. Fresh, glassy basalt was recovered from several of the high-reflectivity areas of East Basin and Southeast Basin, but no evidence of hydrothermal activity was found to be associated with these lavas. Although broad heat flow anomalies are known to exist in these basins, the lack of hydrothermal venting may reflect that spreading is not yet organized to the point where the focused rise of mantle material can drive high-temperature hydrothermal circulation near the seafloor.

The arc-like lavas and older crust exposed along this segment show evidence of hydrothermal alteration and mineralization more typical of intra-arc rifting. These include the intensely altered and mineralized dacite breccias associated with a felsic center on the SE flank of Cheshire Seamount and quartz-epidote alteration in plutonic rocks dredged from a structural high on the south side of segment 1C. The dacite breccias host epithermal-style mineralization that may have formed in a submarine diatreme. The altered plutonic rocks likely reflect older (Cretaceous?) hydrothermal activity that occurred on PNG. Both types of alteration and mineralization are represented on the nearby islands (Misima and Woodlark) and in the easternmost portion of the Papuan Peninsula (Morobe gold district).

7.2 Moresby Seamount (Segment 1A):

The detachment fault on the north side of Moresby Seamount exposes intensely deformed greenschist facies metavolcanic rocks of the lower plate that host abundant syntectonic quartz veins. The abundant quartz veining of the chlorite schists and mylonite in DR-39 (Figure 7.1) is typical of shear zone-hosted mesothermal quartz vein systems developed at the brittle-ductile transition in ancient greenstone belts. Although they are now exposed by the detachment fault, these shear-hosted quartz veins are likely related to the much earlier deformation during subduction of the Australian margin in the Cretaceous. Similar lower plate rocks comprising altered mafic volcanics cut by quartz+hematite shear veins and tectonic breccia were recovered in DR-103.

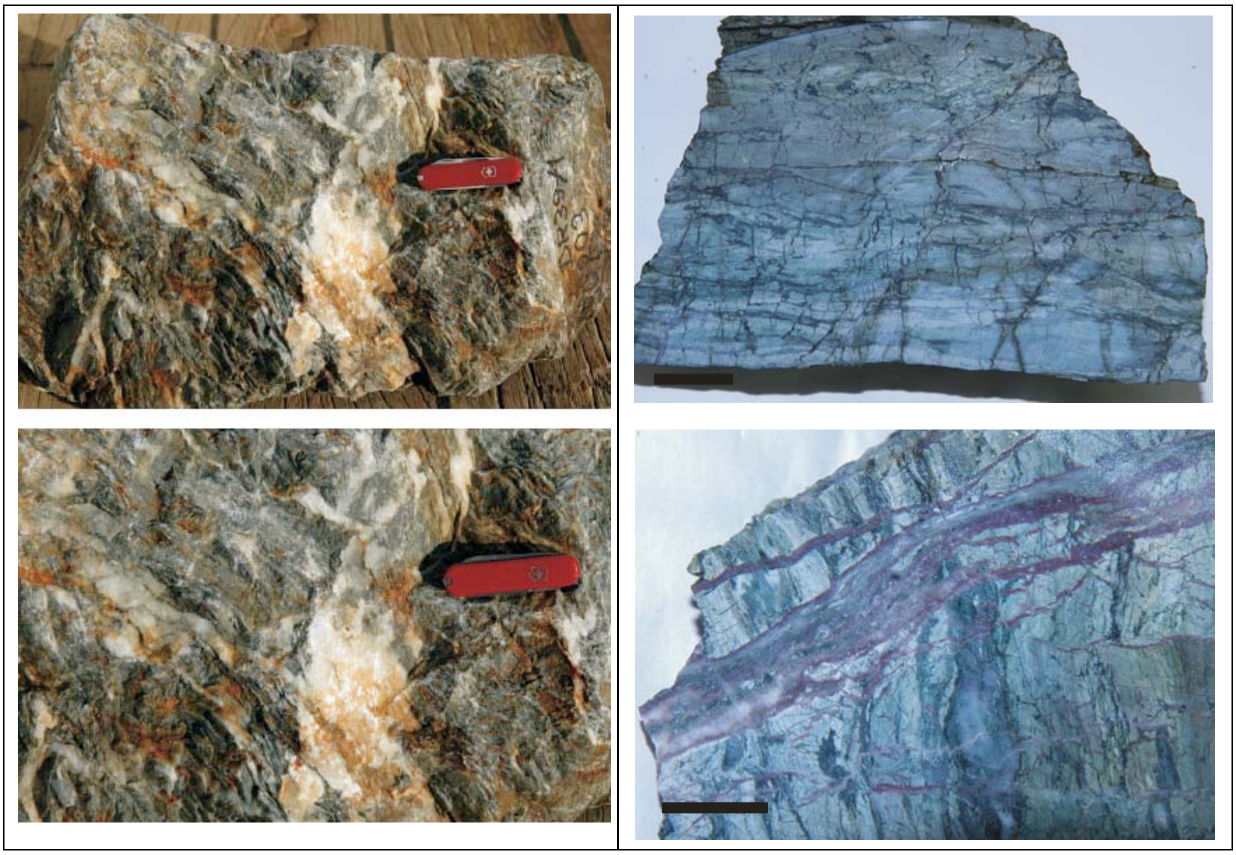

Figure 7.1:Left: DR39-1 Grey-black quartz-chlorite-muscovite schist with up to 50% ribbon quartz, cut by at least one generation of later quartz veins. No sulfides were observed in the quartz veins, but Fe-oxide staining visible in these photographs indicates that disseminated pyrite is likely present. Minor disseminated pyrite was observed in other greenstone samples from the dredge. Right: top DR103-1 - Altered and sheared mafic volcanic rock from lower plate of the Moresby Detachment. Alteration appears to consist mainly of quartz, epidote and chlorite, with quartz occupying shear-related(?) fractures. Bottom; Quartz-hematite veins in tectonic breccia cutting altered mafic volcanic rocks. At least two generations of quartz veining are evident, with a component of shear on the youngest veins. Scale bar is approximately 1 cm.

A small temperature anomaly at the foot of Moresby Seamount and clay-rich fault gouge recovered in DR-39 may represent leakage of present-day "metamorphic" fluids along the detachment. Such fluids have been documented in studies of aqueous-carbonic fluid inclusions in quartz veins recovered by drilling during Leg 180 (Famin et al., 2005), and they likely represent deep crustal fluids on the detachment.

At Wapolu on nearby Ferguson Island, quartz veins in a low-angle normal fault (also considered to be a detachment structure) host significant gold mineralization. The veins are hosted by rocks of the metamorphic core complex that are being exhumed by uplift and rifting associated with the opening of the Woodlark Basin (<5 Ma). Whereas most of the quartz veining in samples from DR-39 and DR-103 are much older (associated with the greenschist metamorphism and deformation), a number of cross-cutting extensional veins are present in the samples that may be similar in age to the quartz veining in the low-angle normal faults at Wapolu.

7.3 Franklin Seamount (Segment 1B)

Franklin Seamount is a large circular volcanic edifice, similar to many of the volcanoes that characterize the Western Woodlark Basin. An AUV survey of the summit of Franklin Seamount showed a flat-topped circular plateau, about 150 m wide. The topography of the summit plateau appears to be punctuated by small (10 m) pillow mounds but otherwise is featureless. A 60-m deep crater occurs in the center of the volcano. The scalloped rim of the crater has nearly vertical walls in the first 10-20 m, which give way to steep talus slopes leading to the crater floor. The morphology of the summit resembles a collapse caused by drainback of a central feeder for the volcanic edifice. A lava lake may have formerly occupied the area of the crater floor. Banks of talus now surround the flat area of sheet flows at the bottom of the crater. Pillow ridges or possibly dikes locally protrude through the talus surrounding the bottom of the crater.

Low-temperature hydrothermal deposits were located at the southwest corner of the crater floor, close to a linear feature (pillow ridge or partially buried dike?) at the edge of the talus slope covering the crater floor. The ridge is about 30 m high (2245-2215 m), with coherent lava partly exposed beneath the talus. An area of <20 m diameter of Fe-stained sediment was located, with grey crusts that are probably the barite-rich material originally observed from the MIR submersible. Sample GTV-24 recovered Fe-Si and Mn-oxide material from a flat surface at the edge of this feature. The second field on the southeast side of the crater floor was not observed, and no obvious chimney-like structures or shimmering water were found in the southwest field.

GTV-24 sampled Fe-Si crusts in the small crater of Franklin Seamount, at a depth of 2215 m. The hydrothermal deposits sampled consist of weakly indurated, orange-brown Fe-Si-Mn oxyhydroxide crusts that appear to have been deposited directly on (or through) talus. This may account for the bulbous or knobby surface texture of the crusts observed in the TV grab. The steep slopes of the sampled deposit (from 2245 to 2215 m) may be part of the mound-like feature reported by Lisistyn et al. (1991) to be in the area. The recovered material ranges from irregular growths and laminated crusts (1-5 cm thick) to more massive structureless Fe oxides. The darker outer surfaces of the samples are due to a thin mm-scale coating of black Mn oxides. These are presumably the exposed surfaces, although the undersides of some crusts also are coated by Mn oxides and some have fractures that are lined by Mn oxides. The soft, porous and friable, light orange-colored material is most likely Fe-stained amorphous silica.

Some harder, dark brown, semi-lusterous layers may be goethite.

The TV grab recovered 3 main rock types: (i) Fe-Si-oxyhydroxide crusts with minor Mn-oxide staining, (ii) massive Fe-Mn oxyhydroxides, and (iii) highly vesicular basalt. The sampled material closely resembles the Fe-Si-Mn oxide crusts previously described by Lisitsyn et al. (1991) and Binns et al. (1997).

GTV24-1 – large, 5 cm pieces of bright orange to yellow, layered Fe-oxide crust
GTV24-2 – 3-4 cm pieces of darker brown massive Fe-oxide with minor Mn oxide coating
GTV24-3 – 5-10 cm piece of massive brown-black Fe-oxides with a black Mn coating
GTV24-4 – smaller pieces of layered orange-brown Fe-oxide crust, similar to 1
GTV24-5 – small pieces of more silica-rich material; several pieces of whiter amorphous silica
GTV24-6 – highly vesicular basalt with well-developed glassy rim

(including one larger archive sample of massive brown Fe-oxide, 15 cm, and two bags of miscellaneous pieces of broken Fe-oxide crust)

Interpretation:
The sampled crusts appear to correspond to similar material originally sampled from MIR by Lisitsyn et al. (1991) and described in detail by Binns et al. (1997). During those dives two sites of barite crusts were observed: one at 2245 m depth in the southwest corner of the crater floor and one at 2241 m depth on the southeast corner. The recovered samples are from a shallower depth (2215 m) above the southwestern site.

Both sites are located about 10 m above the deepest part of the crater, where the talus aprons flatten and cover the lavas on the crater floor. Both sites are surrounded by angular basaltic talus coated by black manganiferous oxides. The MIR dives located multiple spires of barite with mound-like bases at the southwestern site; however, these spires were not observed in GTV-24. The sampled crusts are from a slope on top of blocky talus, and a grey interior was observed where they were disrupted, but barite was not found in the samples.

Volcanic activity in the crater has ceased, as indicated by the uniform light sediment cover, and the observed mineralization is likely a product of cooling of the most recent lava at the margins of the crater floor following its collapse. Although the TV grab appears to have passed over the location of the 7-m- high mound described by Lisitsyn et al. (1991), the extent of mineralization in the crater appears to be much less than has been suggested in the literature. Certainly, the entire crater floor is not part of a major hydrothermal system as depicted in Lisitsyn et al. (1991). Rather, the low-temperature hydrothermal activity appears to be localized by the edge of the central flow and may be simply products of the cooling of these lavas. A large hydrothermal system is not present in the crater.

These deposits are reported to be widespread within the crater, on the summit plateau, on the northwestern flank of the volcano, and on the small pillow volcano northwest of Franklin Seamount (Lisitsyn et al., 1991; Binns et al., 1993). Most of the deposits were inactive in 1990, but seven different areas with shimmering water were reported. No shimmering water was observed during GTV station 24.

A breach in the crater previously reported in the literature does not appear to exist. The steep outer flanks of Franklin Seamount have an irregular surface in the high-resolution bathymetry and likely represent pillows or lava tubes, previously described from the MIR dives. Two separate 50-100 m high pillow volcanoes occur on the flat area west and northwest of the main volcano. The narrow ridge extending southeast of Franklin Seamount is composed of fresh basalt (DR-25) and appears to be a product of fissure eruptions subparallel to the curving axis of the OSC in segment 1B. This was the location of the only near-bottom MAPR anomaly recorded in the area, suggesting that the lavas are very young and possibly associated with diffuse low-temperature venting. Similar glassy lavas were observed at this location during the 1990 MIR dives, nearly 20 years ago. The presence of sediment everywhere else on the volcano is consistent with the very high sedimentation rates (estimated to be on the order of 9 cm/1,000 yr based on C-14 dating of sediment cores: Binns et al., 1993).

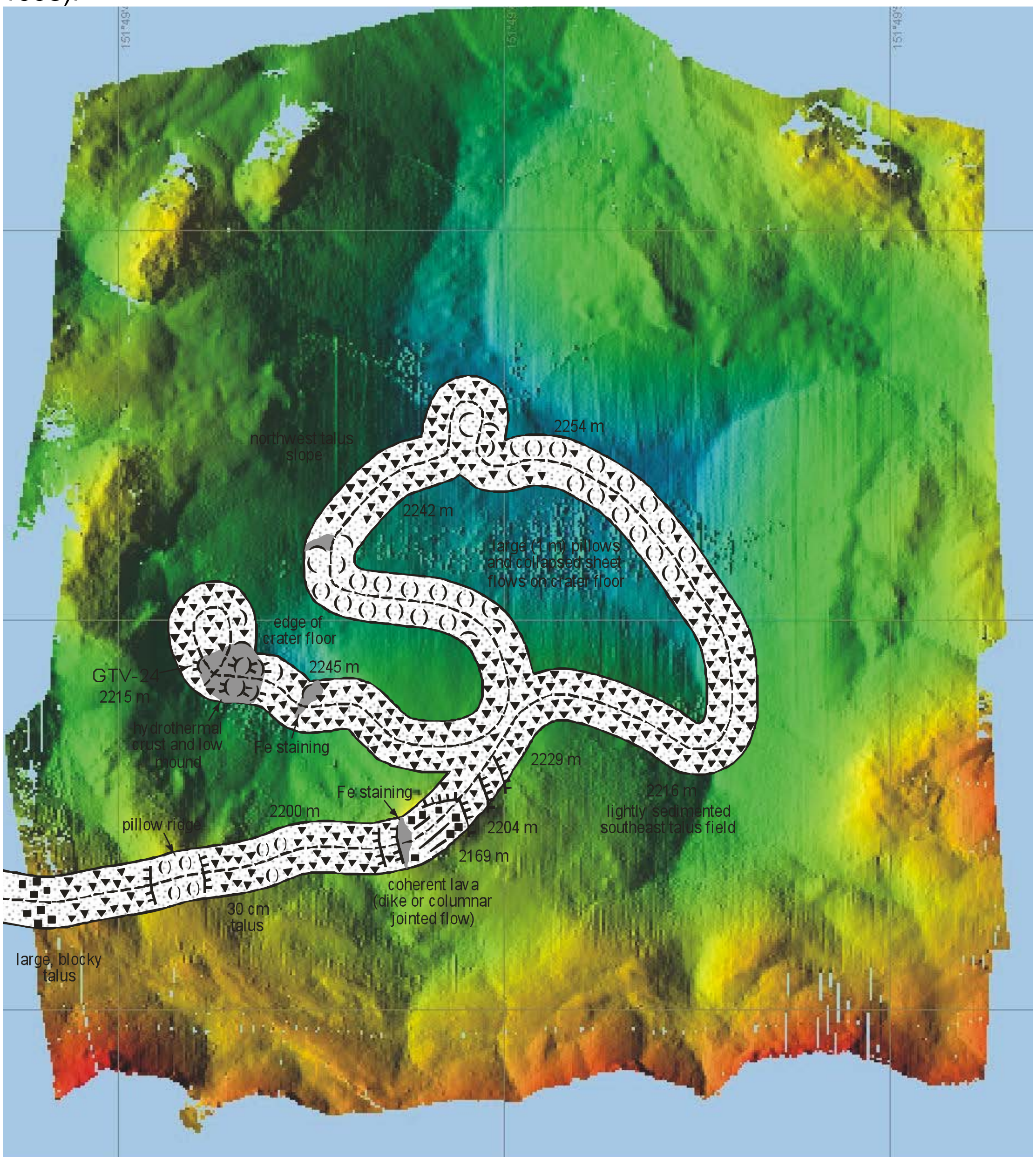

Figure 7.2: Geological interpretation of the geology of Franklin Seamount draped over the detailed bathymetric map provided by the AUV Abyss.

7.4 SE of Cheshire Seamount (Segment 1B)

A large volcanic high SE of Cheshire Seamount was thought to be a block of "continental" crust caught in the OSC between segment 1A and 1B. However, a narrow ridge of basalt was found on the northwest side of this structure suggesting that it is mainly "oceanic" crust. Basalt hyaloclastite was recovered in DR-59 on the south side (Figure 7.3). The seamount is dissected by large, east-west-trending normal faults that record ongoing extension between segment 1A and 1B. Fresh dacite(?) and intensely altered dacite breccias (Figure 7.4 and Figure 7.5) are exposed along these faults, suggesting that small felsic volcanic centers are still active in the extending crust. The breccias closely resemble those generated in diatremes (breccia-filled volcanic pipes that are formed by gaseous eruptions). The most intensely clay-altered breccias are cemented by several stages of dark chalcedonic and reddish hematitic quartz with disseminated and stringer polymetallic sulfides (Figure 7.6).

Figure 7.3: DR59-2 - Block of basalt hyaloclastite, partly cemented by pale yellow clay±amorphous silica with an upper surface coated by Mn oxides. The right photo shows a close-up of the basalt clasts in the yellow matrix (nontronite?). Scale on right photo is approximately 1 cm.

The only other felsic lavas in the Western Woodlark (apart from the ubiquitous pumice of uncertain derivation) are small rhyolite cones and lava domes in actively extending arc crust on Goodenough and Ferguson Islands and on Dobu Seamount (Davies and Smith, 1971). Dacite domes and diatreme breccias are also found on Misima and Woodlark islands, associated with earlier phases of intra-arc rifting. The intensely altered dacite breccias in DR-59 closely resemble rocks from diatreme breccia complexes on Misima and Woodlark islands, which host significant low- to intermediate-sulfidation epithermal gold deposits. This suggests that a similar style of mineralization may still be occurring in the now submarine part of the rift.

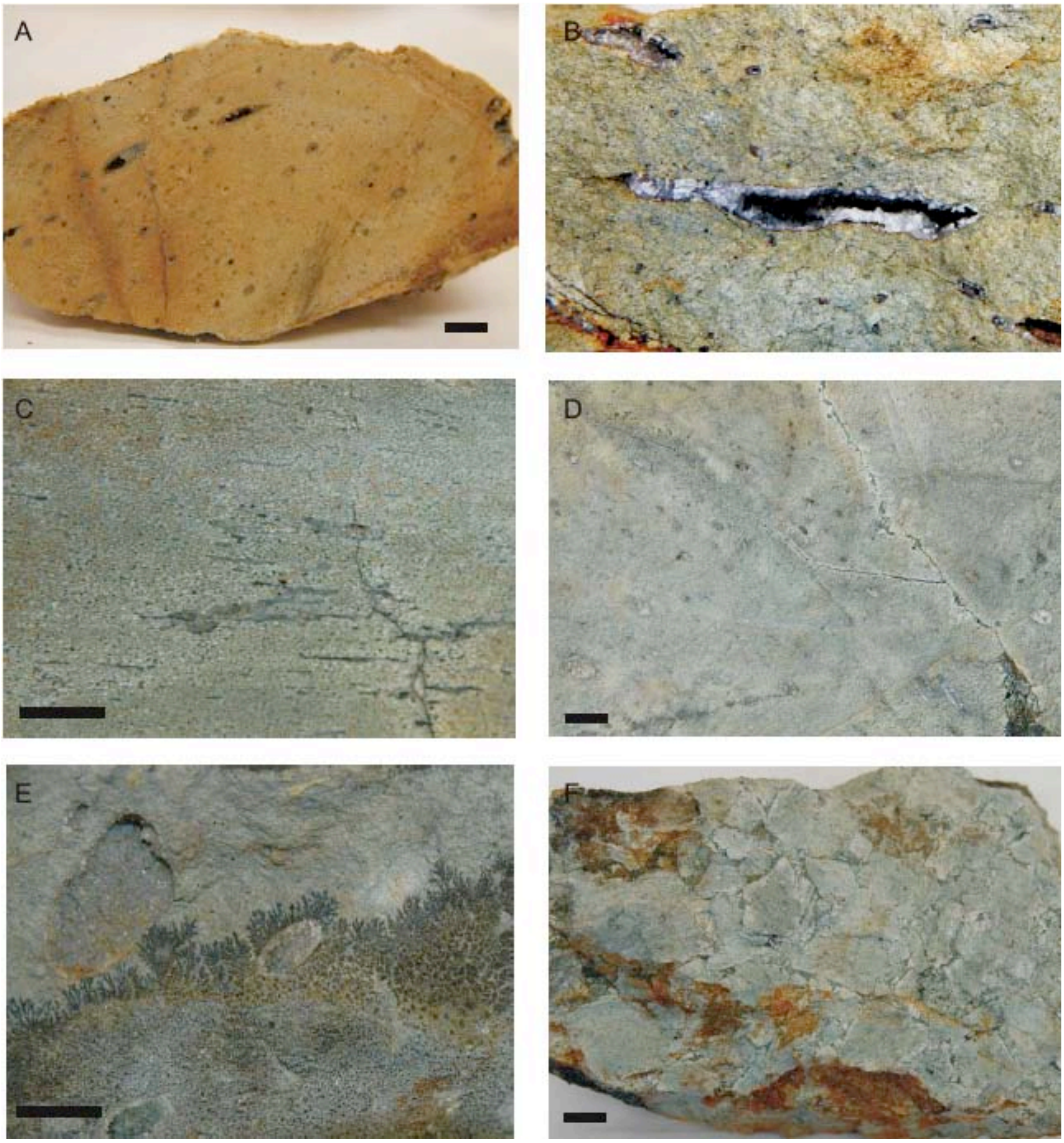

Figure 7.4: ***A****. DR59-12 - Massive propylitically altered dacite with 0.5 cm vesicles lined by drusy quartz. Weathered equivalent of DR-4.* ***B****. DR59-4 - Altered dacite with 0.5 cm vesicles lined by drusy quartz.* ***C.*** *DR59-4 - Massive propylitically altered dacite showing cooling cracks lined by quartz and rimmed by clay and/or silica alteration.* ***D.*** *DR59-4 - Massive propylitically altered dacite with bleached fractures.* ***E.*** *DR59-4 - Fracture lined by arborescent Mn-oxide in altered dacite.* ***F.*** *DR59-6 - In situ dacite breccia. Monomictic, clast-supported breccia with minor quartz stockwork veining.*
Scale is approximately 1 cm.

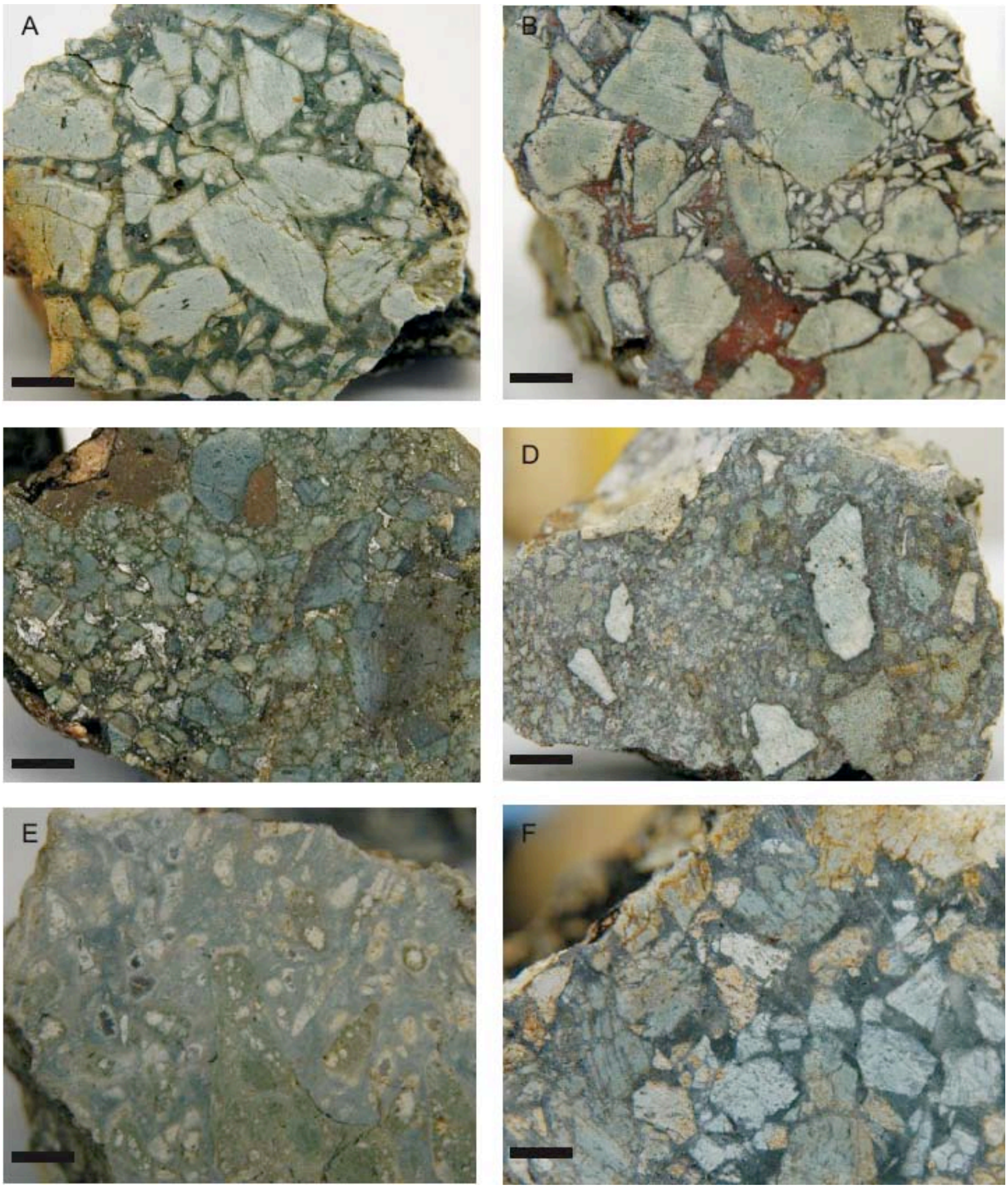

Figure 7.5: ***A.*** *DR59-7- Moderately clay-altered dacite clasts with silica rims in a fine-grained, dark grey chalcedonic quartz matrix. Matrix-supported textures are typical of a "fluidized breccia".* ***B****. DR59-10 - Monomictic, matrix-supported dacite breccia with a red hematitic quartz (jasper) matrix and distinctive shard-like clasts, possibly resulting from explosive brecciation.* ***C.*** *DR59-3 - Polymictic breccia comprising clasts of variably altered (and weathered) dacite, 0.5-2 cm. The matrix comprises a mixture of clay and white amorphous silica.* ***D.*** *DR59-11 - Intensely clay-altered, quartz-rich breccia with a fine-grained, dark grey chalcedonic matrix. The clasts in this breccia sample are variably altered, indicating some transport prior to cementation.* ***E.*** *DR59-9 - Polymictic breccia with clasts of a porphyritic host rock (possibly from a subvolcanic source).* ***F.*** *DR59-7 - Intensely clay-altered, matrix-supported dacite breccia with a dark grey quartz matrix. Scale is approximately 1 cm.*

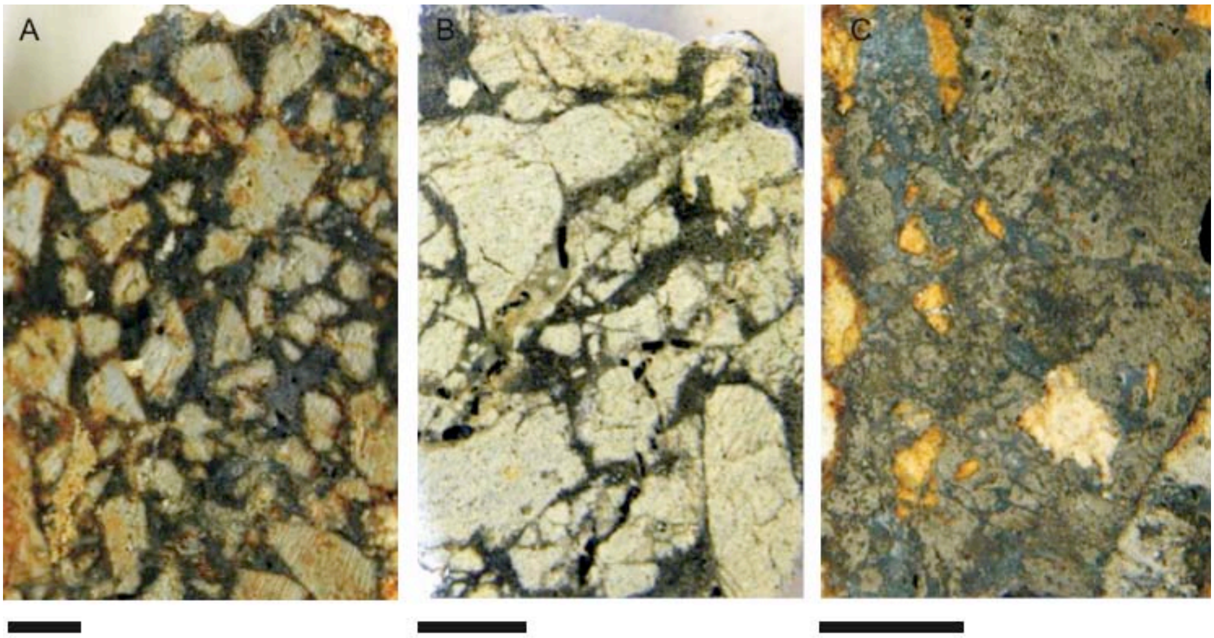

*Figure 7.6: **A.** DR59-7 - Intensely clay-altered, quartz-rich matrix-supported dacite breccia with a fine-grained, dark grey chalcedonic quartz matrix containing abundant disseminated pyrite. **B.** DR59-11 - Intensely clay-altered, quartz-rich breccia with abundant disseminated sulfide in the finegrained, dark grey chalcedonic matrix. The clay-altered dacite clasts and the grey quartz matrix are also cut by later quartz-sulfide microveinlets (black features in the veinlet are cavities left from dissolution of a bladed mineral, possibly calcite). **C.** DR59-11 - Semi-massive colloform pyrite in a dark siliceous matrix. Scale is approximately 1 cm.*

7.5 Highs Flanking Segment 1C

Two volcanic and structural highs occur on opposite sides of the interpreted southern spreading center of segment 1C. The large high on the north side of the segment appears to be entirely volcanic (possibly similar to the feature SE of Cheshire Seamount). DR-75 recovered glassy basalt as well as large 10-20 cm blocks of baked sediment. The weakly indurated beige-colored sediment contains abundant fluid escape structures that appear to have been silicified by low-temperature hydrothermal fluids. Cavities and open spaces in the sediment are infilled by white filamentous amorphous silica and hydrothermal Mn-oxides. The alteration of the sediment is most likely related to heat from the nearby basaltic lavas that may have recently flowed over or under the sediments. The presence of what appears to have been normal pelagic mud suggests that there have been long hiatuses in volcanic activity (on the order of several 1,000s of years), sufficient to accumulate many centimeters of sediment, and later eruptions have locally "baked" the sediment.

A second large high on the south side of segment 1C appears to be mainly "continental" crust rifted from nearby PNG. DR-89 recovered a range of high-level extrusive and plutonic igneous rocks (Figure 7.7 and Figure 7.8) from the lower part of this structure, including variably altered granodiorite, diorite, diabase and porphyritic lavas. Both the plutonic rocks and the lavas exhibit intense quartz-epidote alteration and silicification, with abundant epidote replacing plagioclase phenocrysts, lining fractures, and filling vesicles. This alteration is typical of the interaction of hydrothermal seawater or meteoric water with high-level subvolcanic intrusions in arc environments. Samples recovered in the dredge also included brecciated quartz veins in an apparent fault gouge and polymictic breccias containing clasts of the altered plutonic rocks with disseminated pyrite in both the clasts and the matrix (Figure 7.9).

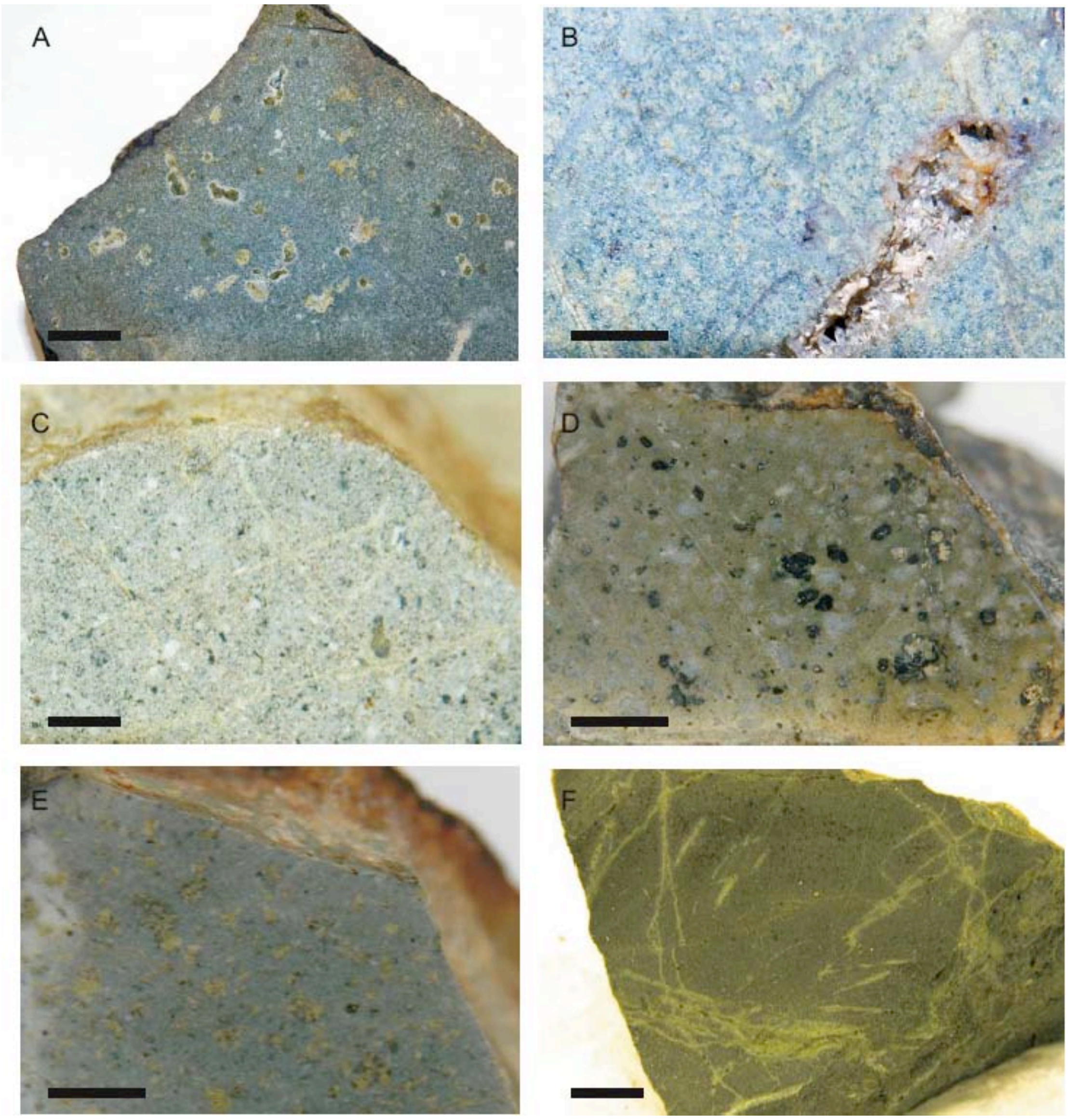

Figure 7.7: ***A.*** *DR89-5A - Fine to medium-grained mafic-intermediate volcanic rock (diabase) with 0.5 cm amygdules filled by epidote and rimmed by quartz.* ***B.*** *DR89-5A - Intensely altered fine to medium-grained, equigranular mafic-intermediate volcanic rock (diabase) cut by a fine network of quartz stringers. One large vesicle is lined by euhedral quartz.* ***C.*** *DR89-5B - Intensely altered, weakly porphyritic mafic-intermediate volcanic rock cut by a fine network of quartz and epidote-filled fractures. This rock locally contains small xenoliths (1 cm) of coarser-grained altered intrusive rock (diorite or granodiorite).* ***D.*** *DR89-5D - Intensely altered, porphyritic mafic-intermediate volcanic rock in which the matrix is completely replaced by fine-grained quartz and epidote.* ***E.*** *DR89-5C - Fine-grained mafic-intermediate volcanic rock in which the feldspar phenocrysts have been completely replaced by epidote.* ***F.*** *DR59-5B - Very fine mafic-intermediate volcanic rock cut by a network of epidote-filled fractures. Scale bar is approximately 1 cm.*

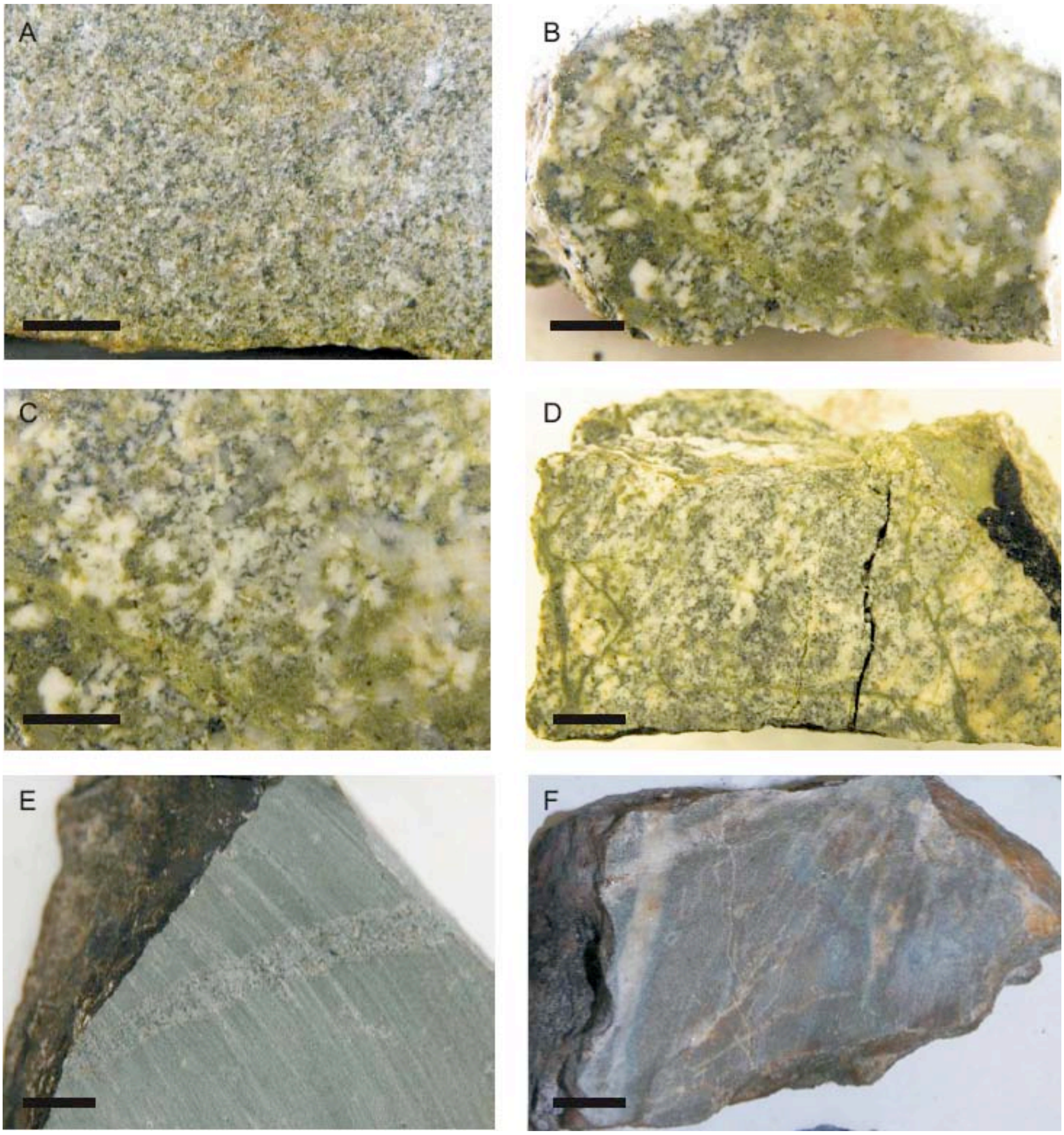

Figure 7.8: ***A.*** *DR89-2 - Medium-grained, equigranular intrusive rock of probable dioritic composition.* ***B.*** *DR89-1 - Coarse granodiorite with feldspars partially to completely replaced by coarse-grained epidote.* ***C.*** *DR89-1 - Close-up showing replacement of feldspar by epidote.* ***D.*** *DR89-1 - Coarse granodiorite with fracture-controlled epidote.* ***E.*** *DR89-3 - Fine-grained mafic-intermediate volcanic rock cut by a small igneous dike of intermediate composition.* ***F.*** *DR89-6 - Intensely silicified, fine-grained mafic-intermediate volcanic rock cut by multiple generations of quartz veins. Reddish brown color suggests possible hematitic alteration in the matrix. Scale bar is approximately 1 cm.*

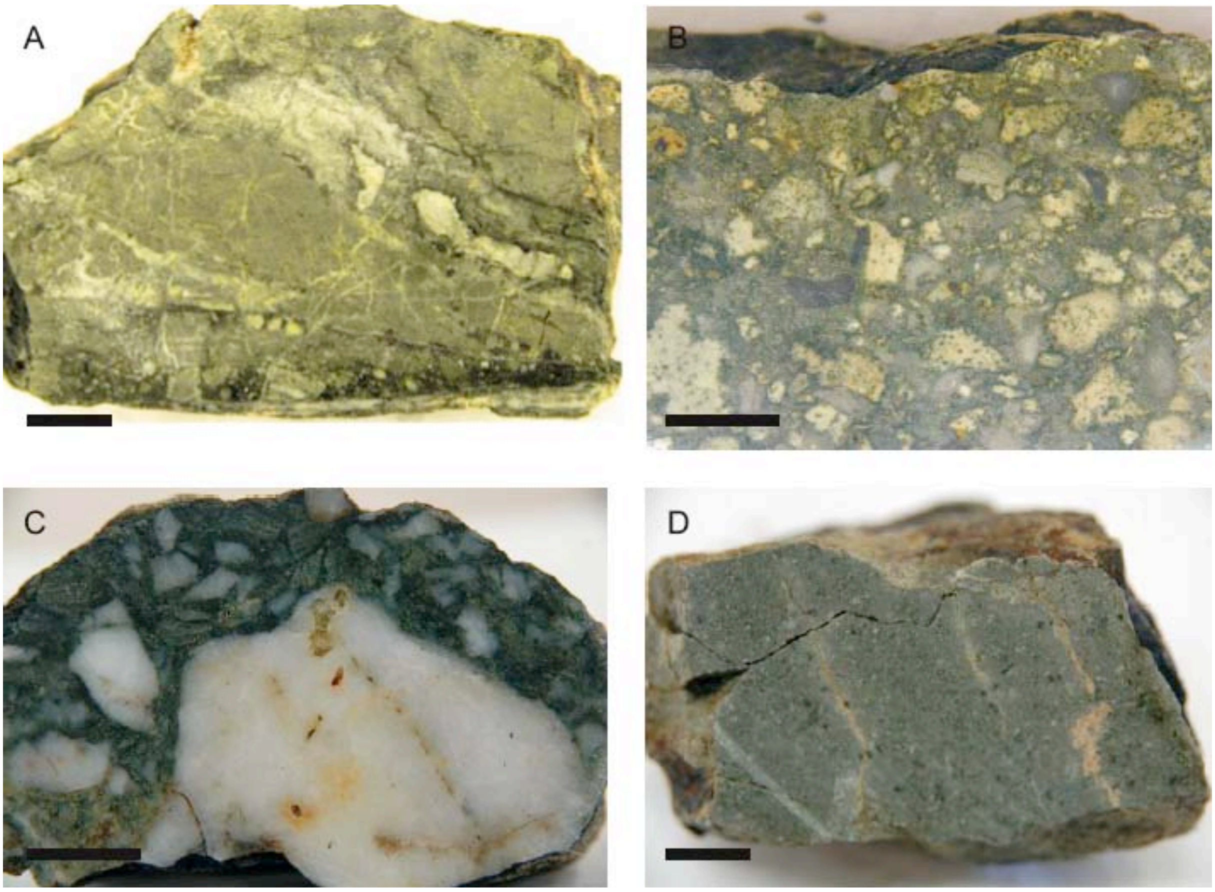

*Figure 7.9: **A**. DR89-7 - Tectonic breccia of fine-grained mafic-intermediate volcanic rock with a dark quartz-rich matrix. **B.** DR89-8 - Polymictic breccia with clasts of variably altered porphyritic (possibly intrusive) rock in a quartz-rich matrix. Minor euhedral pyrite is present as disseminations in the clasts and the matrix. **C.** DR89-7 - Tectonic breccia consisting of clasts of vein quartz in a dark siliceous and chloritic(?) matrix. **D.** DR89-5 - Moderately altered, weakly porphyritic mafic-intermediate volcanic rock cut by fine fractures filled by epidote and pink feldspar(?). Scale bar is approximately 1 cm.*

DR-114, higher up on the structure, recovered a suite of mafic-to-intermediate fine-grained intrusive rocks (diabase, diorite) exhibiting variable degrees of propylitic alteration, including epidotization, silicification, quartz veining, and brecciation (Figure 7.10**)**. The more mafic intrusive rock samples are uniformly coated by 2-3 mm of dense Mn crust and therefore appear to be old talus; the finer-grained and more intensely altered mafic-to-intermediate rocks do not have a Mn crust. These rocks were recovered together with a collection of relatively fresh, vesicular lavas that may represent a late-stage of volcanism that accompanied rifting of the arc.

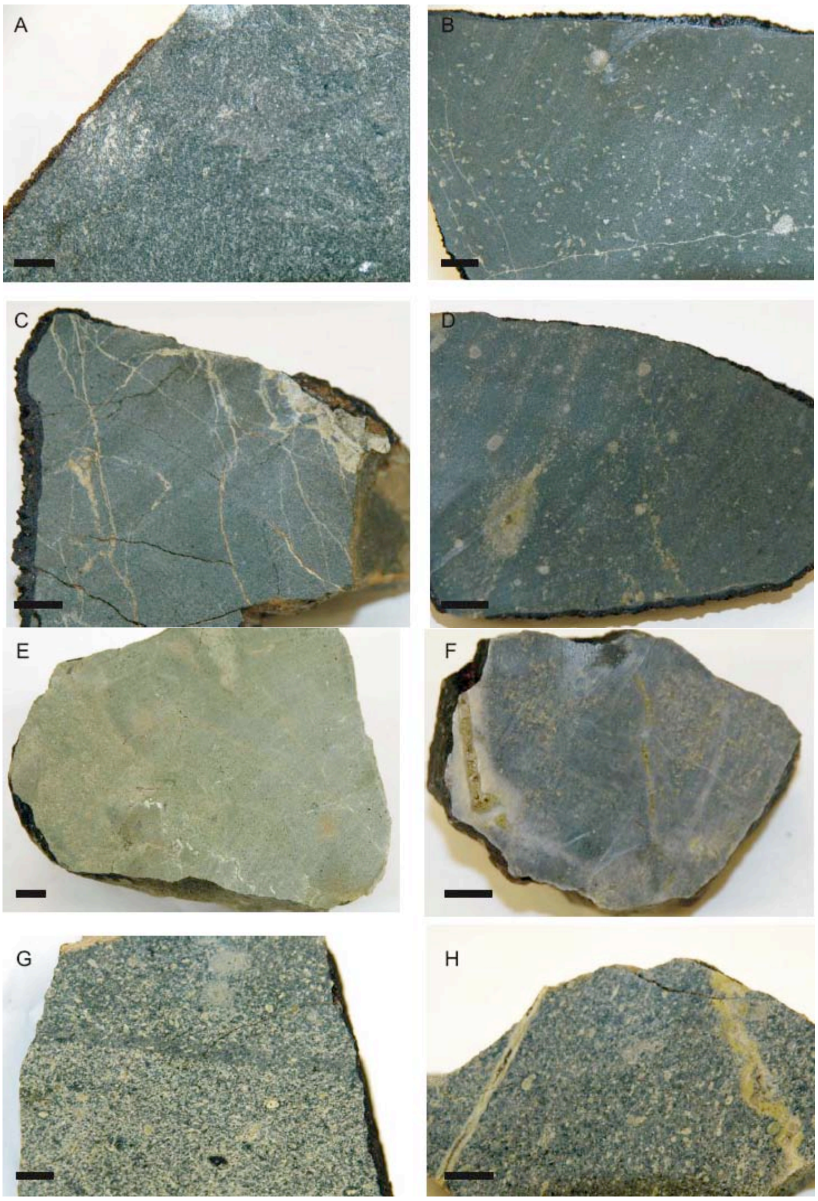

*Figure 7.10: **A.** DR114-1 - Fine-grained equigranular, mafic-to-intermediate intrusive rock (diabase) with minor disseminated pyrite + chalcopyrite but unaltered plagioclase crystals. **B.** DR114-2 - Very fine-grained mafic-to-intermediate volcanic rock with epidote-replaced feldpsar phenocrysts and epidote-filled fractures. **C.** DR114-3 - Strongly altered, fine-grained mafic-to-intermediate volcanic rock with epidote and quartz-filled fractures. **D.** DR114-3 - Strongly altered, fine-grained mafic-to-intermediate volcanic rock with epidote-filled hairline fractures and 0.5-1 cm epidote replacement patches. These samples (A-D) are talus pieces with 2-3 mm coating of dense Mn-oxide. **E.** DR114-5 - Pale green, propylitcally altered fine-grained mafic-to-intermediate volcanic rock (possible quartz phenocrysts) with minor disseminated fine-grained pyrite and chalcopyrite. **F.** DR114-4 - Intensely silicified mafic-to-intermediate intrusive rock cut by quartz- and epidote-filled fractures (2-5 mm wide) with quartz-rich rims. **G** and **H**. DR114-6 - Moderately-to-strongly altered medium-grained intermediate intrusive rock with epidote-replaced feldspars and quartz- and epidote-filled fractures and veins. These rocks do not have the coating of Mn-oxides and may represent a younger intrusive/extrusive suite and hydrothermal alteration events. Scale bar is approximately 1 cm.*

7.6 Segments 2 and 3

A single dredge near the base of the inner corner high between Segments 2 and 3 (DR-125) recovered both fresh and altered gabbro (Figure 7.11 and Figure 7.12). The unaltered gabbro contains abundant fine-grained disseminated sulfides, most likely immiscible sulfides and pyrrhotite(?). A number of samples are intensely brecciated and sheared, with fractures lined by epidote+quartz and rimmed by dark, possibly chloritic alteration. Epidote alteration of plagioclase appears to be part of the early post-crystallization alteration of the intrusive rocks, with late epidote+quartz filled (shear?) fractures likely related to deformation associated with the transform fault.

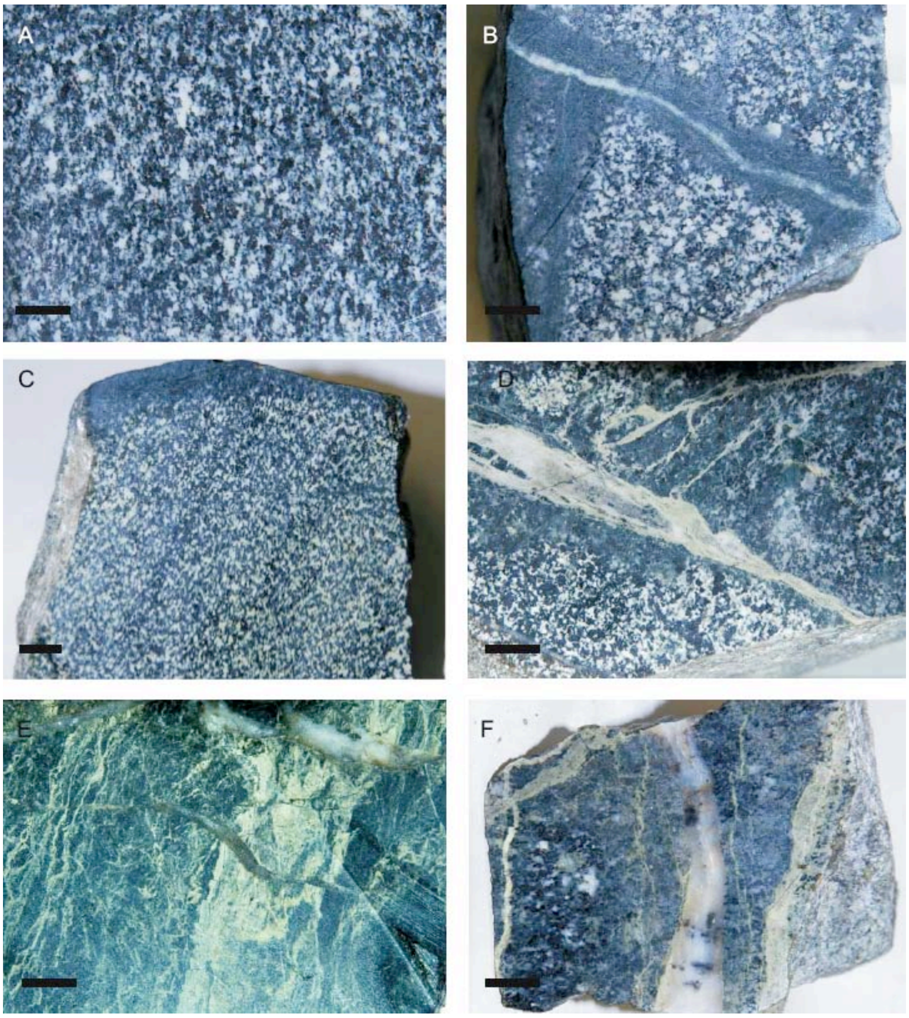

Figure 7.11: Gabbros exposed on the inner corner high of the transform fault between Segments 2 and 3. ***A.*** *DR125-1 - Unaltered gabbro with abundant disseminated sulfide (primary pyrrhotite).* ***B.*** *DR125-2 - Coarse-grained gabbro cut by epidote quartz filled fractures with alteration rims.* ***C.*** *DR125-4 - Epidote-altered gabbro with sheared margin.* ***D****. DR125-2 - Altered and fractured gabbro with quartz and epidote in shear(?) fractures.* ***E.*** *DR125-5 - Intensely sheared gabbro(?) with epidote-filled fractures* ***F.*** *DR125-3 - Late extensional quartz vein cutting altered and brecciated gabbro. Black mineral is Mn coating on quartz crystals. Scale bar is approximately 1 cm.*

Both the altered and, to a lesser extent, the unaltered gabbro samples are cut by late extensional quartz veins with distinctive open space-filling textures. The latter indicate that the veins likely were emplaced at a shallow level in the crust, probably during the recent phase of northwest-directed extension within the transform zone. One massive quartz vein, about 10 cm wide and containing partially replaced wallrock fragments, was recovered (Plate 13). However, most of the quartz veins do not contain wallrock and do not appear to have reacted with the host gabbros. Networks of quartz veins clearly cut the earlier epidote-filled shear fractures. Open spaces in the veins are lined by euhedral quartz crystals that are locally coated by black Mn oxides.

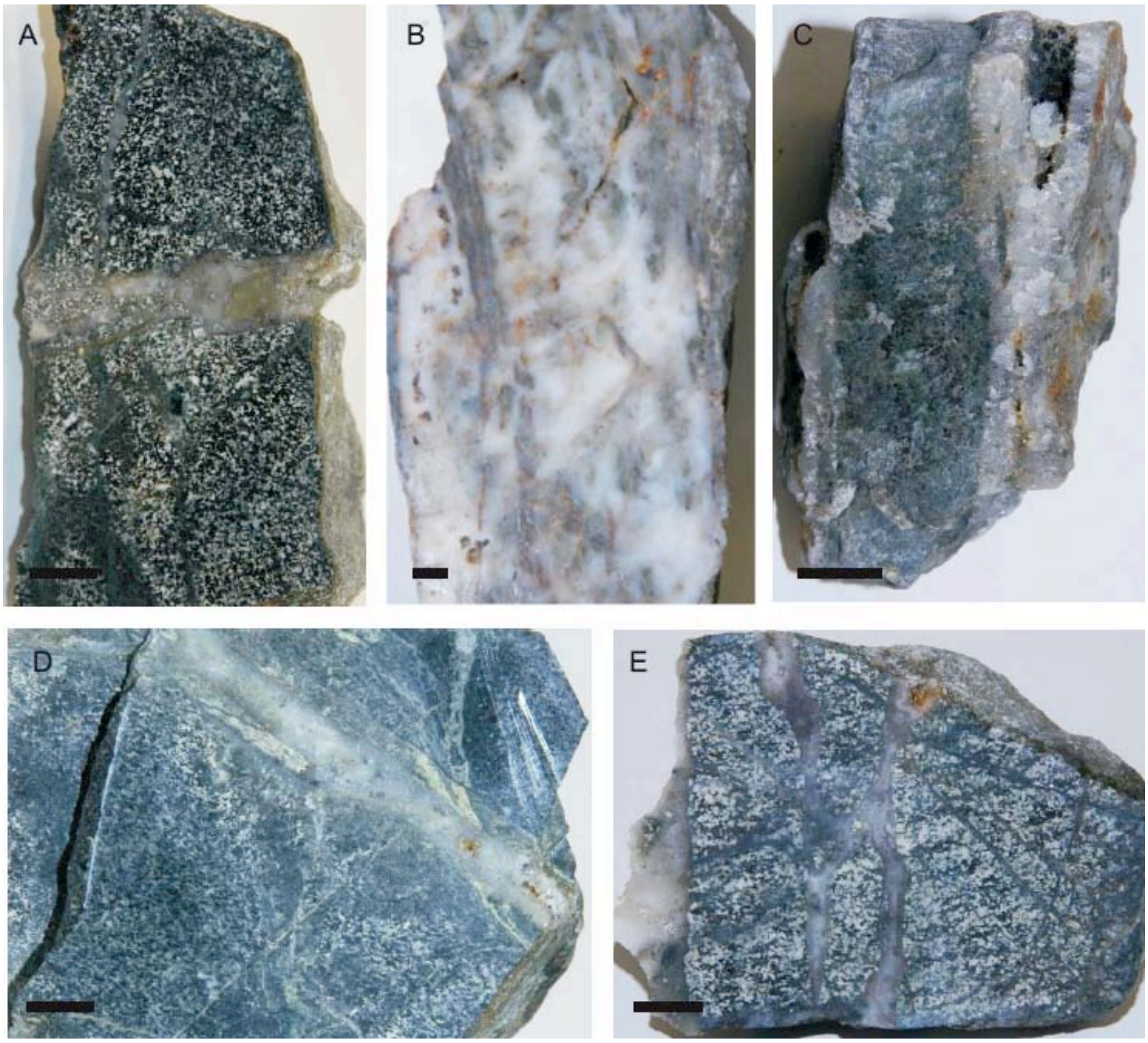

*Figure 7.12: Massive quartz veins with open space filling developed in gabbroic rocks during late-stage extension of the transform fault between Segments 2 and 3. **A.** DR125-3 - Extensional quartz vein with little or no alteration of the adjacent gabbro. **B.** DR25-3 - Massive, banded(?) 10 cm quartz vein with partially replaced wallrock fragments. **C.** DR125-3 - Open space-filling textures in late-stage extensional quartz vein. Black coating on quartz crystals is Mn oxide. **D.** DR125-3 - Extensional quartz vein cutting earlier epidote-filled fractures in gabbro. **E.** DR125-3 - Late-stage epithermal-style quartz vein network in altered gabbro. Scale bar is approximately 1 cm.*

7.7 Segment 3 plume source

A major hydrothermal plume detected above an axial valley volcanic feature during DR-137 was mapped with 5-MAPR "tow-yo" arrays during station 141 and 148. The plume, which measures 4.5 km in strike length, closely follows the volcanic ridge at the center of the segment, with nearly continuous nephels, Eh and temperature anomalies recorded at a height of 400-500 m above bottom. The unusual height of the plume indicates a large mass of heated and turbid water overlying the volcanic ridge, more typical of an "event" plume rather than a chronic plume produced by hydrothermal vents. However, the thickness of the plume is much less than normally expected for a volcanic eruption.

A TV grab station (GTV-150) attempted to map the central part of the ridge at the inferred location of the plume source (see Figure 7.13). The top of the ridge consists of low pillow mounds with up to 70% sediment cover, mainly in pockets and depressions. The northern flank of the ridge, leading onto a semicircular depression from which the plume appeared to emanate, is dissected by many large (2-5 m wide) and deep east-west trending fissures that expose thick pillow lava sequences on their walls. Two bathymetric features in the depression appear to be pillow mounds with abundant blocky talus. The survey ended back on top of the ridge to the southwest, on a large "haystack" pillow volcano. No evidence of hydrothermal or recent volcanic activity was found on the mapped portion of the ridge. Importantly, however, about 6 white squat lobsters (Monidopsis) were observed on the ridge at the beginning of the traverse and on the large "haystack" mound at the end. The presence of Monidopsis is a strong indicator of proximity to hydrothermal vents. The MAPR's on the rope of the TV-grab recorded strong anomalies in nephels and Eh during descent and ascent of the instrument confirming the measurement during the MAPR profiles, however, near bottom anomalies are missing.

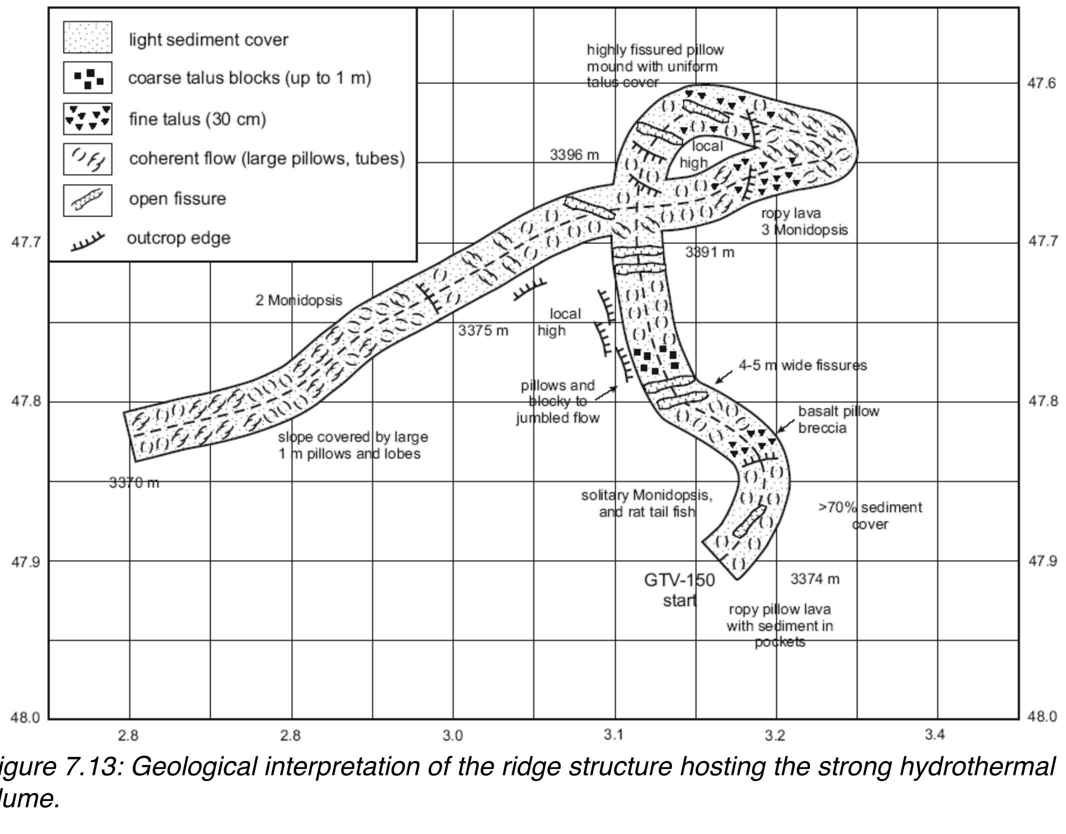

Figure 7.13: Geological interpretation of the ridge structure hosting the strong hydrothermal plume.

8 MAPR studies during cruise SO_203 in the Woodlark Basin, PNG (T. Laurila, M. Hannington

8.1 General information about the MAPR studies

Miniature Autonomous Plume Recorders (MAPR) are used for searching for evidence of hydrothermal activity in the water column. During SO-203 MAPRs were attached to wires during CTD deployment (1 time), rock (wax) coring (14 times) and dredging (23 times). A single MAPR was attached to the dredging wire only when the seabed was presumed to be reasonably flat. One small Eh anomaly was detected SE of Franklin Seamount (segment 1A) and one remarkable anomaly in Eh, Nephels and T profiles was found on segment 3. Detection of the significant anomaly led to two tow-yo and one TV-grab study with 5 MAPRs on the wire to better map the limits of the hydrothermal activity. A total of 41 deployments were done, of which one was unsuccessful. We had 5 MAPRs available. All of them were used at different times; however it was found that two of the MAPRs did not perform as well as the others (MAPR 53 and 54)

Technical information about MAPRs

The MAPRs are instruments that record temperature, pressure, light-backscatter and Eh. Data from the light-backscatter sensor (LBSS or nephelometer) is recorded in voltage. Conversion to nephelometric turbidity units (NTUs) could be done with equation 1. Raw data are used in this report (roughly 0,02V ≈ light attenuation of 0,01 m-1).

$$\Delta NTU = (V_r - V_b)/a_n$$

Equation 1. ΔNTU= LBSS anomaly in excess of ambient seawater
V_r = raw voltage reading from the sensor
V_b =background voltage of the ambient seawater (i.e. , V_r before the plume interference)
a_n= a factor unique to each LBSS, which is determined with laboratory calibration.

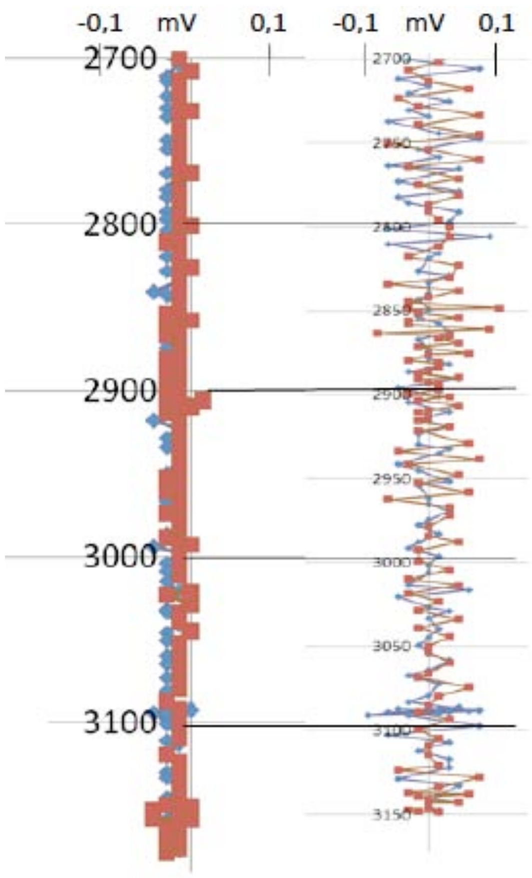

Figure 8.1: No anomaly was inferred from these Δ Eh profiles. On X-axis is Δ Eh in mV and on Y-axis is depth in meters.

Absolute temperature also was recorded. Temperature measurements could not be converted to temperature anomalies (Δθ), without information about the density profile.

Generally light attenuation anomalies define the plume better than temperature (or Δθ) anomalies, because local hydrography and low salinity vent fluids restrict the Δθ signal. Nephel anomaly vectors towards the vent site are generally better because nephels are rarely from diffuse sources.

The Eh sensor measures the seawater voltage with a Pt electrode. The absolute value of Eh varies significantly and drifts constantly during measuring. To eliminate this effect, Δ Eh values instead of absolute Eh were used in depth vs. Eh profiles.

The random scatter in Δ Eh values varied between the different MAPR units. The Eh data was interpret to show no anomalies if the profile was similar to either of the examples in Figure 8.1. The response of Eh sensor is roughly proportional to the age of the plume, as the reduced species in the plume are quickly oxidized by mixing and dilution with ambient seawater. Therefore, an Eh anomaly is usually only found close to the source. The data have not been converted to an absolute voltage against a standard hydrogen electrode.
Depth measurement is a function of pressure (db) and latitude; -10 was used for latitude at all locations, and depth calculated according to Fofonoff and Millard (1983).

8.2 Methods

A single MAPR was attached to the cable 50 m above the rock corer or CTD. During these deployments, the MAPR was expected to reach depth of ~50 m above bottom. A MAPR was attached 300-400 m above the dredge to prevent any damage. During dredging the MAPRs reached variable depths. As a result we might have missed small-scale near bottom chronic hydrothermal venting at stations where the MAPRs were too high. Depth of the MAPR during the first dredging with MAPR at station 73 is shown in Figure 8.2. At station 73 there was very few changes in the topography of the sea floor. Water depth was 2675 m in the beginning and end of dredging.
The longer bottom time for dredge deployments blurs the nephel vs. depth profile on the bottom leading to more(scattered) high values. Also the dredge might have mixed the bottom leading to higher nephel amounts. Details about tow-yo and TV grab studies are below.
A measurement interval of 5 seconds was used for all the measurements.
In the following diagrams measurements on the way down are marked in blue; measurements on way up are marked in red. Only the relevant depth range is presented in the following diagrams, as smaller scale, but reasonably stable, chronic plumes are expected to appear no more than a couple of hundred meters above the seabed. Event plumes are found higher in the water column.

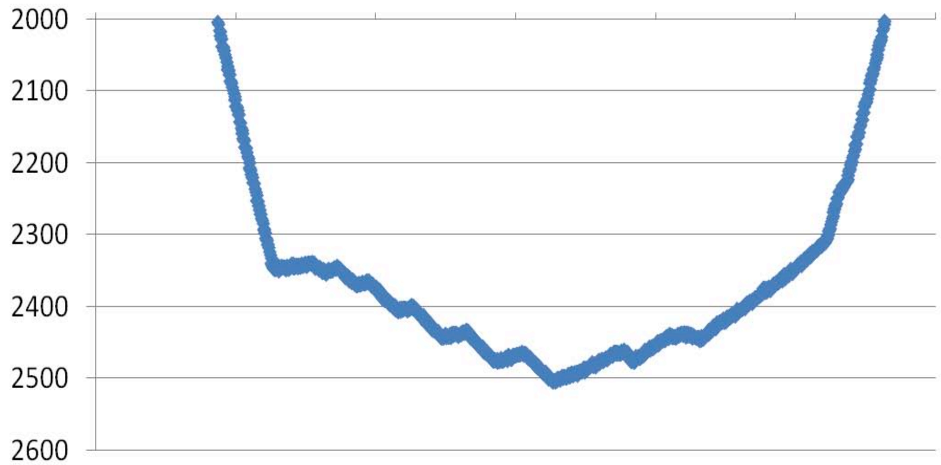

Figure 8.2 Depth of the MAPR during dredging at station 73. Sea bed topography was very flat at a constant 2675m.

8.3 Studies on segment 1

During studies on the 1st segment, no significant anomalies in Δ Eh or nephels were detected. During the first CTD deployment two MAPRs were used to learn how to use the apparatus and to be able to compare the results from two different sensors. At this stations MAPR50 reached a depth of ~50 m the above seafloor; second MAPR (51) was 10 m higher.

In Table 1 is represented basic information about the stations where MAPR were deployed. MAPR studies in segment 1 continued 10-13.11 and 18.11 (Table 2.).The corresponding locations are plotted on maps elsewhere. Stations 50-54 are on a north to south profile.

Technical problems with the date stamp were encountered at station 13; no MAPR data was recovered.

Table 1.Summary of the MAPR studies at segment 1A (+the very first station at segment 1B)

Stat. No.	Date and time	Location, instrument	GPS coordinates	Water depth
02	29.10.09 12:30-15:27	segment 1B, CTD	09°56.31'S 151°58.24'E	2699m
08	31.10.09/ 15:34-17:00	Cheshire Seamount, VSR	09°46.723'S 151°48.675'E	1686m
13	01.11.09/ 05:59-07:41	mound NW of Franklin Smt., VSR	09°53.904'S 151°48.898'E	2348m
16	01.11.09/ 15:10-16:49	SE rim of crater of Franklin Smt., VSR	09°54.685'S 151°49.815'E	2155m
17	01.11.09/ 17:16-18:53	ridge SE of Franklin Smt., VSR	09°55.001'S 151°50.333'E	2314m
18	01.11.09/ 19:06-__:__	ridge SE of Franklin Smt., VSR	09°55.00'S 151°50.34'E	2366m
50	06.11.09/ 05:23-07:37	western end of segment 1A, VSR	09°46.00'S 151°41.39'E	3195m
51	06.11.09/ 08:02-10:15	western end of segment 1A, VSR	09°46.91'S 151°41.39'E	3209m
52	06.11.09/ 10:40-12:46	western end of segment 1A, VSR	09°47.80'S 151°41.40'E	3201m
53	06.11.09/ 13:12-15:39	western end of segment 1A, VSR	09°48.68'S 151°41.38'E	3232m
54	06.11.09/ 16:02-18:25	western end of segment 1A, VSR	09°49.31'S 151°41.39'E	3235m

At stations 2-18, the amount of nephels vs. water depth and Δ Eh profiles did not show clear sign of plumes (Figure 8.3). Much more scatter in Eh measurements was recorded by MAPR 50 than 51.

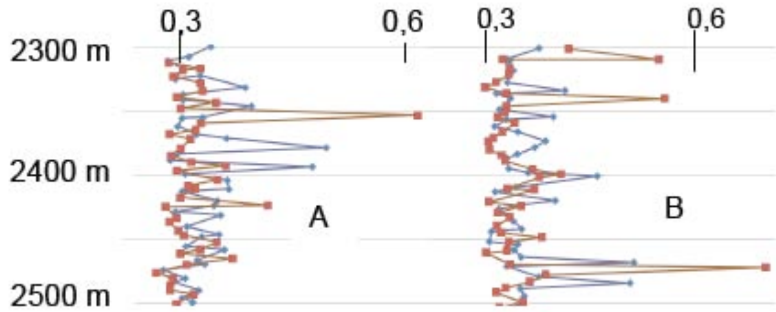

Figure 8.3: Amount of nephels at station 2. Measurements by MAPR 50 in A and by MAPR 51 in B

At station 16-18 no significant anomalies were found (Figure 8.4). A small Eh anomaly was found at station 17. SE of Franklin Seamount, at water depths of 2080-2260 m, but it was not accompanied by neph anomaly.

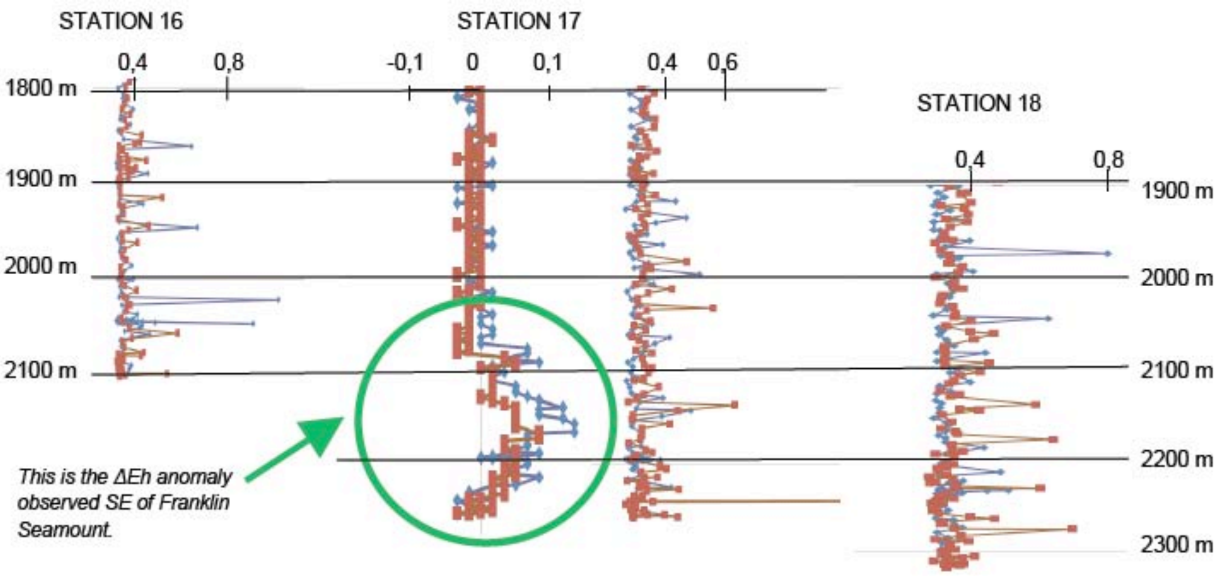

Figure 8.4: Amount of nephels from stations 16-18. No ΔEh values <-0.1 or >0,1 or constant higher values were observed at stations 16 and 18. An Eh anomaly at station 17, near Franklin Seamount is shown. Measurements done by MAPR50.

Stations 50-54 are on a straight line from north to south in the basin west of Cheshire Seamount. No significant anomalies were detected in either Eh or nephels (**Error! Reference source not found.**). Nephl profiles show a slight increase in concentration at water depths of approx. 2900 m to 3150 m. The water depth varied slightly from one station to another. The seabed is ≥50m below the deepest MAPR measurements. Water depths for each station are given in table 1.
No increases in ΔEh value were detected for stations 50-54. For measurements at stations 50 and 51 MAPR number 54 was used, which recorded a noisy signal, but no anomalies were detected (ΔEh remained under ±0,1 mV and no constant shift in the value was observed). ΔEh also remained constant during experiments at the stations 52-54 when MAPR number 51 was used (no changes of >0,05 mV were detected).

MAPR deployments continued at station 73, when the MAPR was attached to the dredge wire for the 1st time. In figure 5A. there is an example of a typical depth vs. neph profile from dredge deployment (station 73). More scattered high values on the bottom are caused by longer bottom time for the dredge than for the rock core.

Table 2. Summary of MAPR studies at stations 73-88 and 107-109, all are situated on segment 1.

Stat. No.	Date and Time	Location, instrument	GPS Coordinates	Water Depth
73	10.11.09/06:09-09:10	segment 1B, DR	09°56.61'S/152°04.99'E	2675m
80	12.11.09/01:15-04:40	segment 1C; flat part of axis, DR	10°01.69'S/152°11.99'E	2765m
83	12.11.09/14:29-17:14	segment 1C, DR	10°03.80'S/152°27.69'E	2910m
87	13.11.09/05:24-08:33	S of axis of segment 1C, DR	10°05.49'S/152°37.76'E	3371m
88	13.11.09/09:20-12:01	crater north of axis of 1C, DR	10°03.19'S/152°36.85'E	2950m
107	18.11.09/ 17:30-19:40	SE of Moresby Smt., VSR	09°49.77'S/151°41.20'E	3232m
108	18.11.09/ 20:31-22:38	NE of Moresby Smt., VSR	09°45.39'S/151°38.70'E	3094m
109	18.11.09/ 20:31-22:38	ENE of Moresby Smt., VSR	09°45.65'S/151°44.75'E	2871m

At stations 107-109 Eh profiles were peculiar. All the deployments were rock coring with MAPR53, which showed large scatter in Eh values. (e.g. Figure 8.5B from station 109 and Figure 8.5C from station 108). Stabilizing rock core before seabed might cause the shift in profile at station 108 (the blue measurements are done on the way down); a similar pattern was seen at station 107. No accompanying neph anomalies were detected.

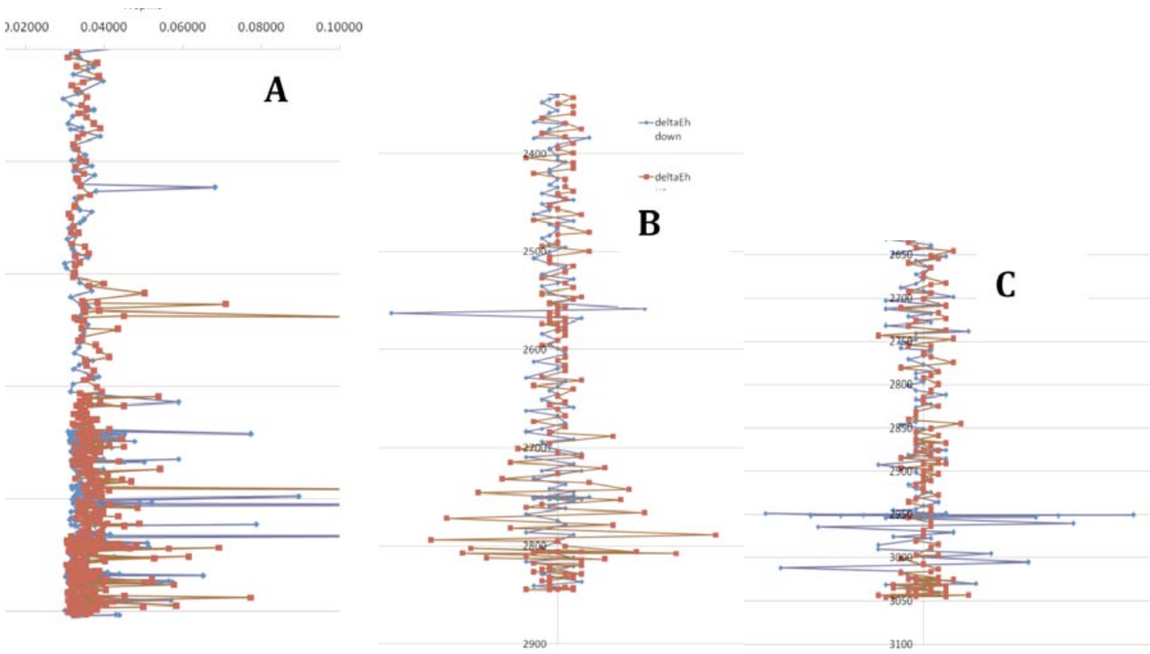

Figure 8.5: A typical neph vs. depth profile from station 73 (A). Unusual Eh vs. depth profiles from station 109 (B) and station 108 (C).These measurements were done by MAPR53, which might be the cause for large scatter.

8.4 Studies at segment 2

Studies at segment 2 (Table 3) were done in two periods. No signs of plumes were detected, although most of the deployments were dredging and small scale chronic plume hydrothermal activity would probably not be seen in the MAPR data. At station 124 rock core was deployed with 5 MAPRs attached to the wire. No anomalies were detected, but MAPR53 gave an erratic Eh profile similar to that observed in Figure 8.5B (station 109). The neph vs. depth profile for MAPR52 was nonsense.
Station 124, deployed with rock core, is situated near a very probable site for hydrothermal activity (fresh basalts recovered from dredge) and done by rock core. The lowest MAPR reached depth of 50 above seafloor, so volcanic or hydrothermal activity would have been seen if it had existed. Other MAPRs were at 10 m intervals above the lowest one.

Table 3. Summary of the MAPR studies at stations 93-97 and 115-124

Stat. No.	Date and Time	Location, instrument	GPS Coordinates	Water Depth
93	16.11.09/11:04-14:11	segment 2, DR	10°22.90'S/152°54.00'E	3293m
95	16.11.09/ 19:25-22:16	segment 2, DR	10°23.20'S/153°08.61'E	3080m
97	17.11.09/ 03:16-06:11	segment 2, DR	10°23.32'S/153°24.42'E	2695m
115	20.11.09/ 01:10-03:52	segment 2, DR	10°21.70'S/153°32.30'E	2706m

116	20.11.09/ 04:44-07:16	segment 2, DR	10°21.40'S/153°37.82'E	2619m
118	20.11.09/ 11:25-13:57	segment 2, DR	10°20.20'S/153°47.20'E	2666m
119	20.11.09/ 15:26-18:22	segment 2, DR	10°19.81'S/153°58.52'E	2803m
124	21.11.09/ 05:28-09:20	segment 2, eastern end near "trans-form fault", VSR	10°19.70'S/154°07.00'E	2852m

At station 93 and 95 the neph and Eh vs. depth profiles were similar to each other and comparable to the profiles with large scatter, but the high values were more common and higher than at any other station. Profiles from station 93 are seen in Figure 8.6 A and B. Again MAPR54, which produces large scatter, was used at this station and may be the cause of the observed signals.

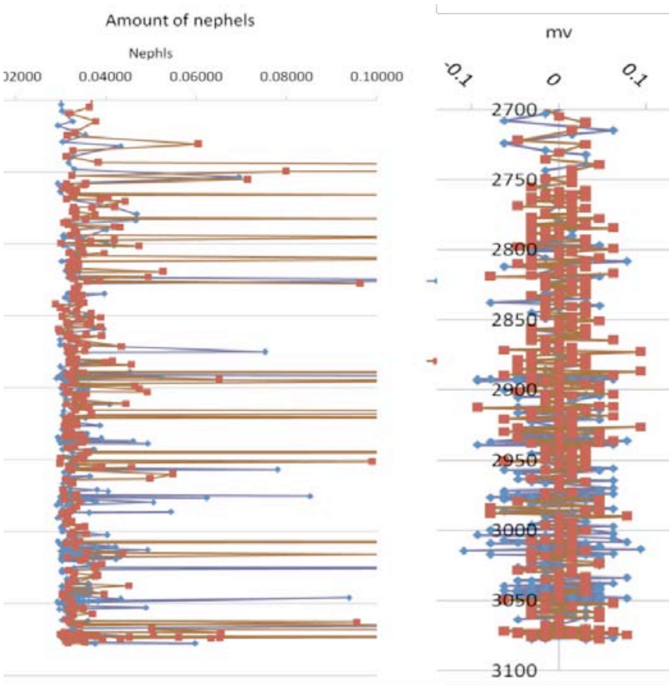

Figure 8.6: Neph (A) and Eh (B) profile at station 93. Showing may single large values for nephels concentration and large scatter in Eh. Similar profiles for station 95.

8.5 Studies at segment 3

MAPR deployments at segment 3 are listed in table 4. At segment 3A no anomalies were detected. Near the eastern end of segment 3 (segment 3B, station 137) a strong plume anomaly was detected by MAPR on the dredge wire. As a result two tow-yo studies were planned to map the plume. According to the available data a single TV grab deployment was chosen in attempt to find the source of the plume. No vent, but vent proximal indicators were found.

Table 4 Summary of MAPR stations 127-150 on segment 3

Stat. No.	Date and Time	Location, instrument	GPS Coordinates	Water Depth
127	22.11.09/ 05:33-08:47	segment 3A, DR	09°52.41'S/154°25.41'E	3411m
128	22.11.09/ 09:29-13:45	segment 3A, DR	09°51.00'S/154°29.40'E	3590m
129	22.11.09/ 14:25-__:__	segment 3A, DR	09°50.30'S/154°32.20'E	3570m
130	22.11.09/ 19:08-22:52	segment 3A, DR	09°47.41'S/154°41.00'E	3769m
131	22.11.09/ 23:27-04:37	segment 3A, DR	09°46.60'S/154°42.49'E	3883m
137	23.11.09/18:33-21:33	segment 3B, DR	09°47.51'S/155°03.60'E	3329m
141	24.11.09/07:28-13:18	E end of segment 3B, T-Y	09°48.12'S/155°01.97'E	3454m
149	26.11.09/01:18-17:18	plume site on segment 3B, T-Y	09°45.86'S/155°02.46'E	3175m
150	26.11.09/08:18-14:19	plume site on segment 3B, TVG	09°47.90'S/155°03.17'E	3374m

8.5.1 Station 137

At station 137 the MAPR was placed 400 m above the dredge. A plume was detected at water depths of ~2850-2950 m. At the start point of dredging (red circle in Figure 8.8) water depth was ~3340 m and at the end point (yellow square in Figure 8.8) 3430 m. The maximum depth of the MAPR was 3140 m. Sheet flow with very thick (>1cm) glass crust and minor Mn-coating was recovered from the dredge.

Because of the height of the plume, a possible source for the anomaly was considered to be an event-type plume. Chronic-type plumes have usually rise heights of less than observed ~500 m. However, the thickness of the plume layer in the water column was surprisingly small. A clear Eh anomaly (Figure 8.7A) showed, that the dredge could not have been very far from the source vent. Eh anomaly was detected a couple of tens of meters lower on the way up than on the way down; this could be caused by the increasing water depth along the dredge profile. The same change is

seen in figure 11. A clear temperature anomaly is seen in the basic absolute temperature vs. depth profile at station 137 (Figure 8.7B).
The depth vs. neph diagram (Figure 8.7C) shows a pattern similar to the Eh anomaly:

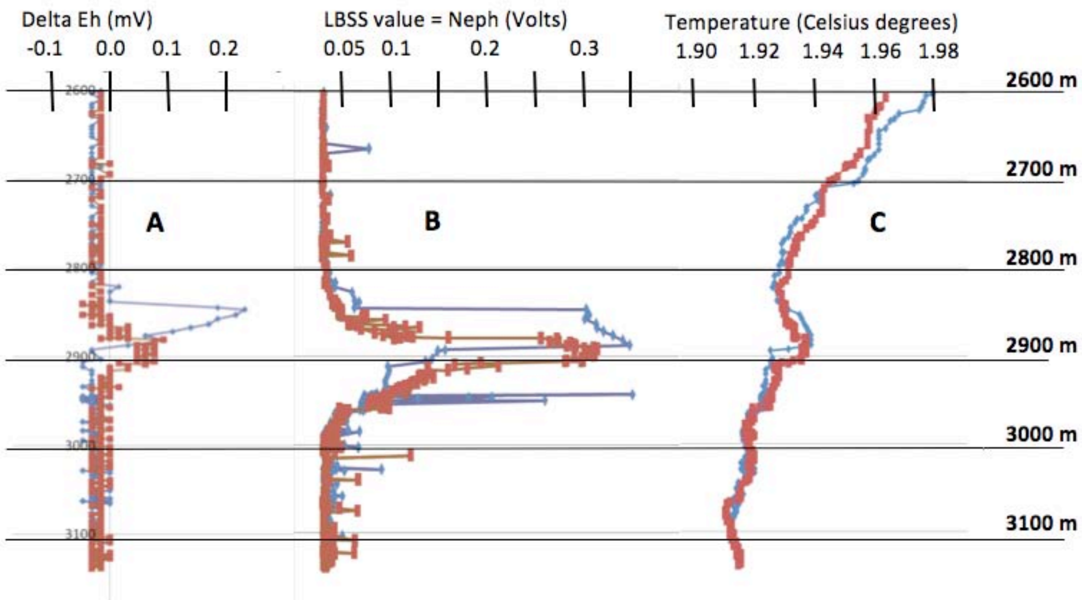

Figure 8.7: MAPR profile from dredge station 137. Depth vs. Delta Eh (A), depth vs. raw nephels measurements (B) and absolute temperature (C). MAPR51 was used. Notice that the horizontal scale is 4x bigger for nephels than in previous figures.

strongest at shallower depth on the way down than on the way up. The way down profile could be interpreted to consist of two different layers of nephels.

8.5.2 Station 141

At station 141 a tow-yo deployment of ~2.5 miles was done. It is marked with black line and white numbers in Figure 8.8. The upper turning points of the tow-yo are marked and numbered to correlate with Eh and neph profiles in Figures 11 A and B.

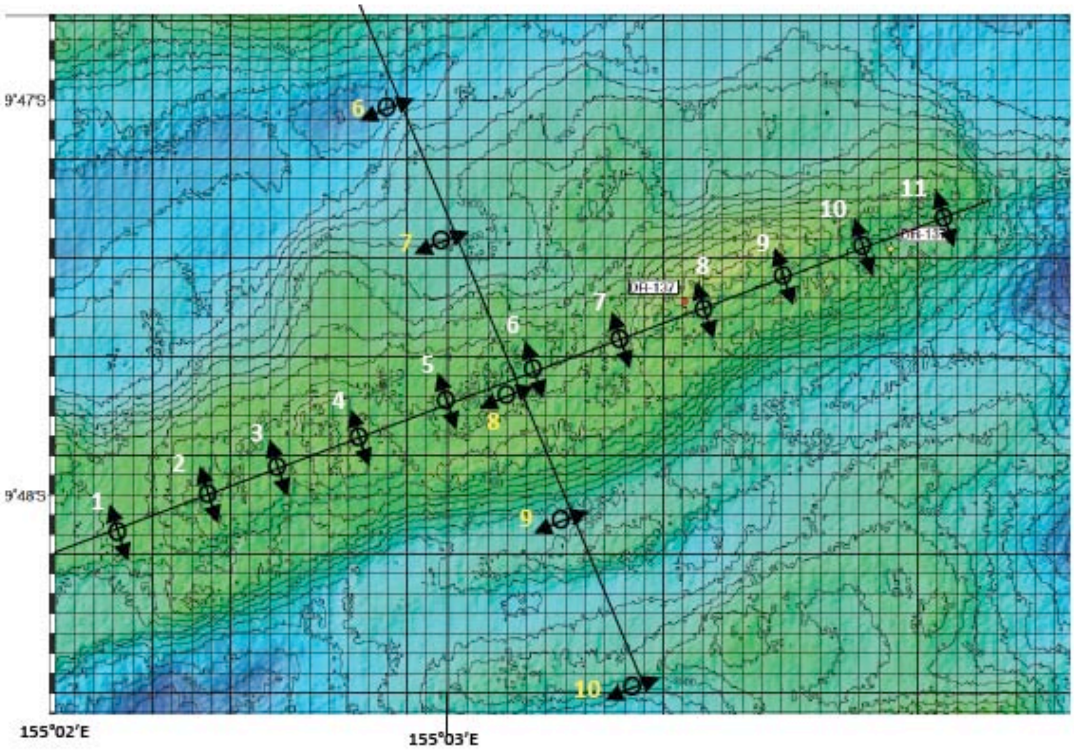

Figure 8.8: A map over the area of plume studies on segment 3B. Only the area where anomalies were detected (time-depth-Eh/Neph diagrams, Figure 8.10) is shown. The roughly North-South profile continues off the map. Circles with arrows mark the upper turning points of tow-yo. The dredge route at station 137 is marked with red circle (start point) and yellow square (end point).

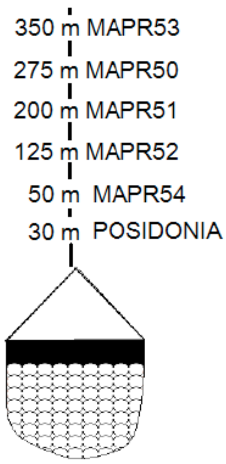

Figure 8.9: The organization of tow-yo at stations 141 and149. The location information was gained from the Posidonia signal.

The WSW-ENE tow-yo at station 141 was planned with 5 MAPRs on the wire. The dredge was used as a weight at the end of the wire. Organization is shown in Figure 8.9. The deployment was planned to map the plume at the depth of 2900 m. Intended vertical depth variation for the tow-you was 500 m. The wire was pulled in and out at the speed of 1 m/s and ship was moving at the speed of 1 knot. In Figure 8.10 is presented the depth vs. Eh results from the tow-yo and in Figure 8.10 A the depth vs. neph profile. The topography of the seabed is see at the bottom of the figures. water depth was between 3420 and3330 m during the whole to-yo(except very first and last (11^{th}) folds).

8.5.3 Station 149

At station 149 a NNW-SSW tow-yo profile was done. The configuration of the MAPRs was the same as at station 141 (Figure 8.9). It was planned to cross the WSW-ENE profile at the place of strongest Eh and neph anomaly. The part of the NNW-SSW profile with anomalous values is shown with yellow numbers on the map in Figure 8.8. The numbers correspond to the upper turning points of the tow-yo route seen in the Figure 12. The start point for the deployment was at 09°45.86'S/155°02.46'E and the end point (dredge on the deck) at 09°49.79'S/155°03.86'E. Profile was planned to test possible sources north and south of the plume. The vertical coverage of the tow-yo profile was again intended to be ~500 m, although the topography of the seafloor was more variable during this deployment compared to the WSW-ENE profile. The water depth varied from 3180 to 3580 meters. The speed of the ship was slightly faster during the second tow-yo, than the first one.

According to the NNW-SSW profile the possibility of remote source from the ridge north from the plume discovery, seemed unlikely. The current direction seemed to be approximately from northeast, but no anomalies were observed NE of the original plume anomaly. The Eh anomaly suggested that source should be near the place where the tow-yo profiles intersect. Nevertheless we didn't find anomalous values from the water column deeper than ~3000 m, which refers to that we didn't pierce the source vent during the to-yoing.

One hypothesis was, that the half volcano like depression at the north flank (at ~09°47.3'S/155°03.0'E) of the "plume ridge" would be the source. The data does not rule out this possibility if the prevailing current is from NE, but it seems unlikely. Usually strongest plume indicator anomalies are found at the topographic highs, where the inflation of the ridge is greater.

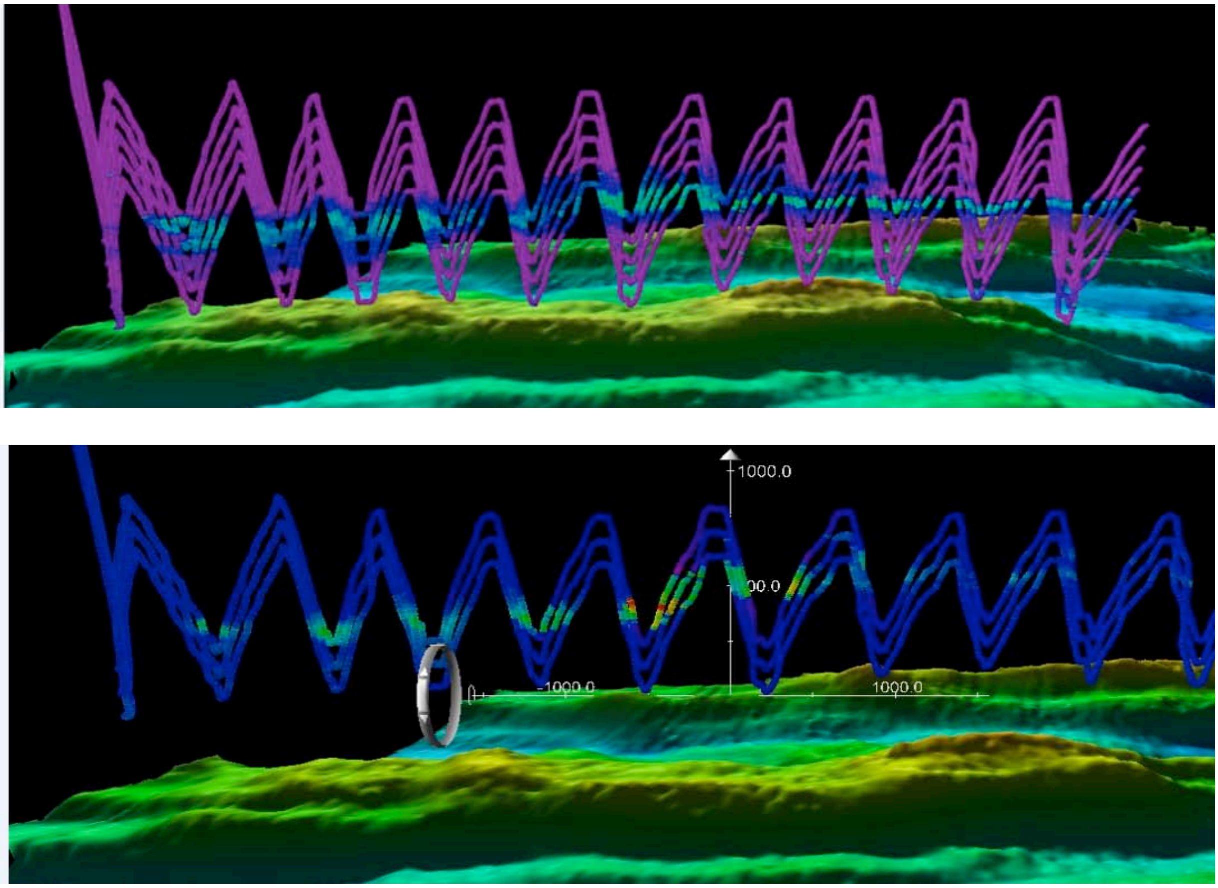

Figure 8.10Measurements from station 141. Depth is at Y-axis, time at x-axis (translated to locations according to data from the Posidonia positioning system). Upper figure (A) is presented with colours the data from the LBSS-sensor (=nephlometer) in Volts. (purple= no anomaly, green= strong anomaly. In lower figure (B) is presented ΔEh (in mV) with colour intensity. Red = highest values

8.5.4 Station 150

A TV grab study was done at the stations 150. The configuration of deployment is shown in Figure 8.11. According to data from the two tow-yos a TV grab deployment was planned. It was considered, that the most probable place to find the source was at the intersection of the two tow-yo profiles.

MAPRs were situated too deep to record the main plume effect, but would detect a near-bottom plume. The original plume remained at the depth of ~2900 m and only the shallowest MAPR was even near this elevation. The plume could be seen in the depth vs. time plots on the way down and up. Some anomalous values are also seen during the TV grabbing at the bottom, but these do not appear to have been the source for the higher plume.

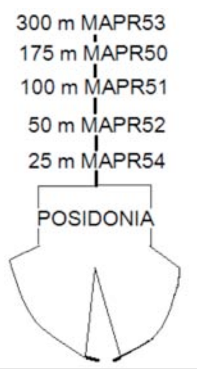

Figure 8.11: The organization of TV grab at stations 150. The location information was gained from Posidonia signal, which is inbuilt in the TV grab.

8.6 Studies at segment 4

The studies at segment 4 are summarised in table 5. No significant anomalies were found, but erratic values at the very bottom of depth vs. Eh profiles at stations 142 and 143 were seen (Figure 8.12A and B)). These were dredging stations, so MAPRs didn't not reach the bottom. At station 142 a slight shift (towards lover values)in the baseline of the neph profile is seen, but this cannot be interpreted as indication of hydrothermal activity.

Table 5. Summary of MAPR stations 142-147 on segment 4.

Stat. No.	Date and Time	Location, instrument	GPS Coordinates	Water Depth
142	24.11.09/16:29-20:00	large flat topped volcano on segment 4A, DR	09°34.41'S/155°16.10'E	3887m
143	24.11.09/21:05-00:10	eastern part of segment 4A, DR	09°31.55'S/155°23.39'E	3920m
144	25.11.09/00:46-04:23	eastern part of segment 4A, DR	09°30.65'S/155°24.85'E	4000m
146	25.11.09/10:28-14:00	segment 4C, DR	09°33.89'S/155°41.59'E	3623m
147	25.11.09/14:45-18:02	segment 4C, DR	09°33.30'S/155°43.61'E	3554m

B

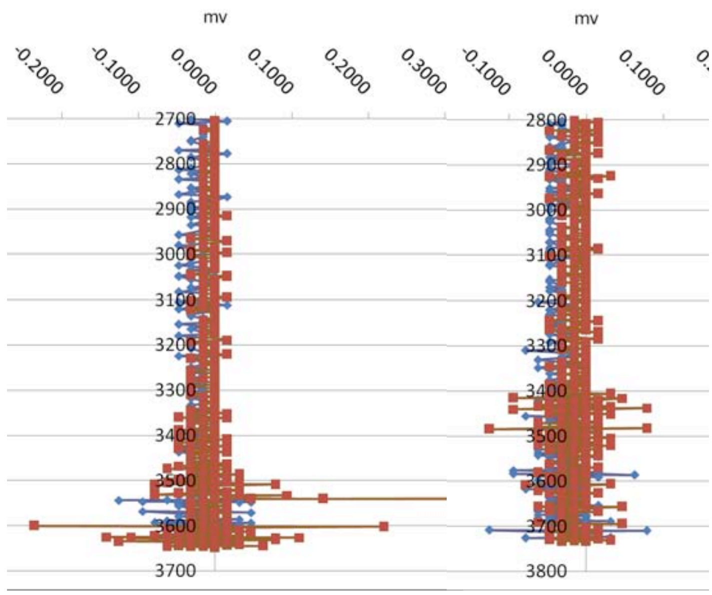

Figure 8.12: Depth vs Delta Eh profiles from stations 142 (Fig. B) and 143 (Fig. A). More erratic values are seen at the bottom in both diagrams. No indication of a plume was seen at depth vs. neph profiles.

8.7 General observations about the observed plumes

Heat is considered as a conservative indicator of plume activity, whereas the nephel signal is nonconservative. Eh anomalies are expected to occur only very near the source of hydrothermal activity. During SO-203 measurements of Eh and nephels were plotted against depth to for every station. Temperature vs. depth diagrams were plotted only where plumes where detected, because of the lack of information about background temperature profiles. The ratio between temperature and neph anomalies can be used as an indicator of age for event plumes. Studying the changes of this ratio with time may help to discriminate between chronic and event plumes. However no further chemical studies of the plume composition were done.

Patchy appearance of the neph anomaly in the plume core may be created by in situ precipitation of hydrothermal material, (e.g. dense minerals like sulphides precipitate fast and near the vent site). This indicates, that the vent site must be near. Homogenous neph anomaly indicates, that deposition rather than precipitation dictates the particle concentration. As a general guideline ΔNTU of approximately 0.01 could be considered anomalous (Baker et al. 2005). At this study background values were around 0.04 V, so values over ~0.05 are considered anomalous The scatter in measurements is significant, so only one or a couple of higher neph values cannot be interpreted as an indication of anomalies. More prominent, systematic shifts in the values instead are a good sign of prominent change in water properties. The amount of dilution also effects the strength of the anomalies, sometimes fluid is more rapidly mixed to the water column, sometimes slower.

A lot more energy is rapidly distributed to water during event plumes. This cause plume to rise much higher, than during chronic vent flux. The anomaly detected on segment 4 could be an event plume, because of its height. The rise height of the plume is comparable to the amount of heat flux and can be up to 1 km above the seabed. Differences in the properties of the plume may also be related to change in fluid chemistry (e.g. amount of brine and vapour). Often eventplumes or megaplumes overlap steady-state vent fields. The heat flux during a megaplume event is ~100-1000 times the normal steady state vent discharge. The heat content of a meagaplume (~10^{17} J) could be comparable to ~5 years of chronic heat flux (rate of ~650MW). According to Baker (1994), however heat production and fluid mass flux in the oceans are dominated by low-temperature diffuse sources.

Large events are more likely to be generated by linear, axisymmetric sources, rather than point sources. However, the small thickness of the plume on segment 4 contrasts with the large plume height of megaplumes. The ratio diameter against thickness of the plume cloud is usually ~0.03 ±0.01 for event plumes and smaller for static plumes. Therefore it remains unclear whether the observed plume is related to hydrothermal venting or an eruption.

The Woodlark Basin is a relatively slow spreading area and hydrothermal activity is assumed to be much less common (roughly half) than at fast spreading ridges. No more than~20-30% of the ridge is expected to be hydrothermally active (Baker et al 2005). Many factors affect how the venting is situated at the ridge axis. The major factor is magmatic budget, which may vary within a single segment of a spreading ridge as well as between segments with similar spreading rates. Ridge morphology and sub-surface structure also affect hydrothermal venting, and it is common to find hydrothermal activity near topographic highs. Sometimes hydrothermal fluids may be transported some distances along fractures and fissures. Lack of an Eh anomaly might imply displacement of a plume away from an underlying vent field source. The large Eh anomaly on segment 4 suggests a proximal source for the detected plume.

9 Analyzing the transport of trace gases from the troposphere into the stratosphere by solar absorption FTIR spectrometry and *in-situ* observations (T. Ridder, C. Weinzierl)

9.1 General Background of Research

The composition and the chemistry of the stratosphere are mainly determined by the entrance of tropospheric trace gases. This entrance is dominant in the tropics due to strong vertical convection processes.
The Western Pacific tropical region is the main region where tropospheric trace gases enter the stratosphere. Beside the convection processes, trace gases can enter the stratosphere along isotropic levels.
For several long- and short-lived species this entry is not well known.

9.2 Method

9.2.1 FITR spectrometry

We perform solar absorption spectroscopic measurements of atmospheric trace gases in the infrared spectral region. The observations yield the total column concentrations of about 20 different trace gases. For about 10 species the concentration profiles can be retrieved up to 30 km altitude (table 1).

Long-lived	N2, CO2, O2
Mainly troposphere	**CH4, N2O, CO, OCS, HCN, C2H6**, C2H2, CH2O, SF6, CFC-12, CFC-22, **H2O**
Mainly stratosphere	**HCl**, ClONO2, NO2, HNO3, **HF**, COF2, **O3**

Table 1: Trace gases, which can be observed by FTIR spectrometry. Column concentration from all listed gases and profile concentration from gases in bold are retrievable

For solar absorption FTIR spectrometry the absorption spectra of the sun are measured. A solar tracker follows the position of the sun, directing the sunlight continuously into the spectrometer. Inside the spectrometer the sunlight is split into two optical paths and after reflection at two retro reflectors the light is recombined. The interfering signal – the interferogram - is measured by a detector. A Fourier Transformation of the interferogram calculates the absorption spectrum of the sun (Figure 9.1)

Figure 9.1: Absorption spectrum of the sun

9.2.2 In-situ FTIR analyzer

We perform *in-situ* measurements with a FTIR analyzer, detecting the concentrations of CO2, CO, CH4, del13C in CO2 and N2O continuously.
The main parts of the FTIR analyzer are a FTIR spectrometer and a gas cell. Outside air is continuously pumped into the gas cell, while the spectrometer measures the absorption of a light beam passing through the cell. From the absorption spectra the gas concentration is automatically calculated and displayed.

9.2.3 In-situ flask sampling

We collect air samples with a flask sampling system. The air samples will be analyzed after the campaign with gas chromatography, revealing the concentrations of CO_2 (d13C, d18O), N_2O, CH4 ($13CH_4$), H_2, CO, SF_6.

9.3 Work Program

During SO203 campaign we measure solar absorption spectra during direct sunlight conditions. On board the solar absorption spectra will be proven for their quality and we frequently perform cell measurements to prove the internal alignment of the spectrometer. The solar absorption spectra will be analyzed after the campaign at the University of Bremen.

In situ measurements are taken with the FTIR analyzer continuously. Maintenance of the device is necessary every 24 hours. The analysis and the calibration of the data will be done after the campaign at the University of Bremen.

Air samples are collected during the cruise. The air samples will be analyzed after the campaign at the Max Planck Institute Jena.

9.4 Preliminary Results

We have performed cell measurements during the campaign to check the alignment of the spectrometer. A symmetric ILS and a deviation of <5% of the Modulation efficiency characterizes good alignment of the spectrometer.

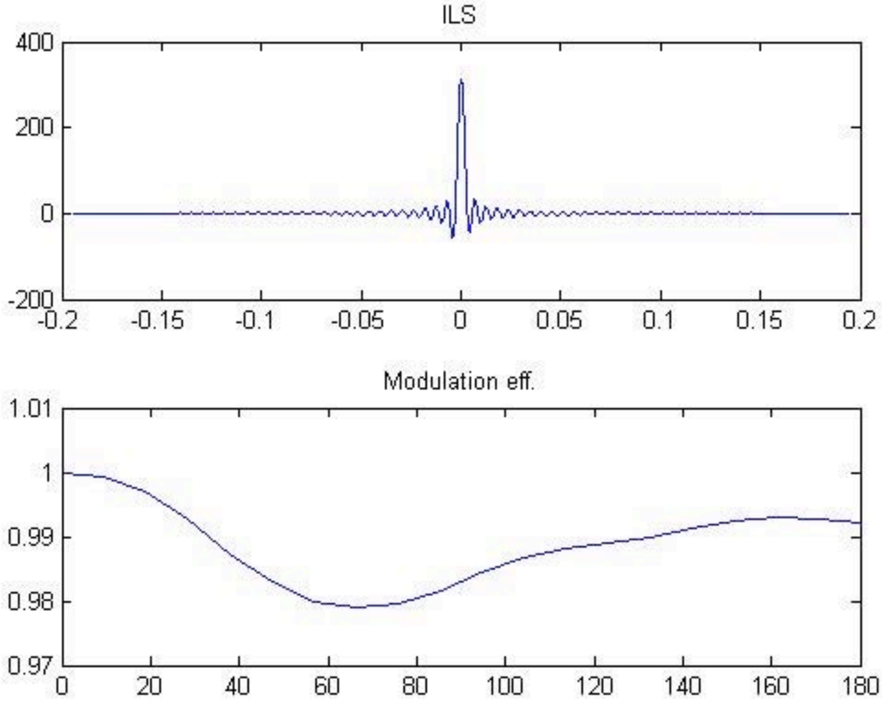

Figure 9.2: Analysis of the cell measurements from 23. Oct. 2009.

9.5 Work program after the campaign

9.5.1 Analysis of the solar absorption spectra

The analysis of the solar absorption spectra will be performed with the help of line-by-line calculations. In a first step the solar absorption spectrum will be simulated with an appropriate model. In a second step the simulated spectrum will be adapted to the measured spectrum by changing the concentration profiles of the appropriate gases. By minimizing the difference between simulated and measured spectrum the real gas concentrations can be found.

9.5.2 Analysis of *in-situ* data

The air samples from the flask samplings system will be analyzed at the Max-Planck-Institute Jena. In addition calibration gas samples from the FTIR analyzer will also be measured. The results from the calibration gas are use to calibrate the data from the FTIR analyzer. This work will be done after the campaign at the University of Bremen.

9.6 Interpretation

The Interpretation of the dataset will be performed with model simulations. Combining the model and the data a deep investigation of transport and chemical processes is possible. The results from the Pacific campaign will be compared to earlier datasets from the Atlantic.

10 Station List (S. Petersen)

Abbreviations: AUV = AUV dive; AUV-T = AUV transponder, CTD = CTD + MAPR; DR = Dredge, GTV = TV-Grab; KAL = Calibration of Posidonia system; MB = Multibeam survey; TowYo = towed MAPR's; VSR = waxcorer with MAPR.

The numbering of the ridge segments follows Martinez et al., (1999). Position for waxcorer stations is the ships position. During TV-grab and TowYo stations the instruments position was recorded using Posidonia©.

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
01_AUV	29.10.09/ 06:00- 06:49	-	11°00.3'S 152°06.5'E	1375m	Test station with AUV dummy
02_CTD	29.10.09/ 12:30- 15:27	segment 1B	09°56.31'S 151°58.24'E	2699m	CTD to acquire sound velocity profile and to test two MAPR's on station of water anomaly from a survey in 2007
03_MB	29.10.09/ 15:58- 21:32	segment 1B	various lines	-	33 nautical miles
03B_AUV	29.10.09/ 23:37- 03:10	segment 1B	Transp. 4D: 09°55.772'S/ 151°59.024'E - Transp. 4B: 09°55.201'S/ 151°59.258'E	2622m 2632m	launching and calibrating the transponders for the AUV survey
04A_AUV	30.10.09/ 05:54- 09:18	segment 1B	-	-	mission cancelled due to error in the mission file
04B_AUV *(Abyss0012)*	30.10.09/ 09:20- 10:17	segment 1B	-	-	re-deployment after reprogramming
05_VSR	30.10.09/ 18:45- 20:20	segment 1B	09°56.579'S 151°59.180'E	2584m	recovery: small basaltic glass chips from 5 cups
06_AUV	30.10.09/ 20:34- 21:56	segment 1B	-	-	recovery of the AUV
07_MB	30.10.09/ 23:02- 12:00	segment 1B to Moresby Seamount	various lines	-	67 nautical miles
08_VSR	31.10.09/ 15:34- 17:00	Cheshire Seamount	09°46.723'S 151°48.675'E	1686m	recovery: small basaltic glass chips with Fe-oxyhydroxide coating from 7 cups

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
09_MB	31.10.09/ 17:15-20:00	segment 1B	various lines	-	13 nautical miles
10_AUV	31.10.09/ 20:01-22:35	segment 1B	-	-	recovery of transponders 4B and 4D
11_AUV	01.11.09/ 00:16-04:15	Franklin Seamount	Transp. 4B: 09°53.684'S/ 151°47.839'E - Transp. 4D: 09°55.274'S/ 151°48.842'E	2413m 2403m	launching and calibrating the transponders.
12_AUV *(Abyss0013)*	01.11.09/ 05:01-05:06	Franklin Seamount	-	-	deployment of the AUV for 400 kHz survey of Franklin Seamount
13_VSR	01.11.09/ 05:59-07:41	mound NW of Franklin Seamount	09°53.904'S 151°48.898'E	2348m	recovery: sediment ooze and glass chips from the top; one piece of pumice
14_AUV	01.11.09/ 10:45-11:15	Franklin Seamount	-	-	recovery of the AUV
15_AUV *(Abyss0014)*	01.11.09/ 11:16-14:50	Franklin Seamount	-	-	deployment of the AUV for 200 kHz survey of Franklin Seamount
16_VSR	01.11.09/ 15:10-16:49	SE rim of crater of Franklin Smt.	09°54.685'S 151°49.815'E	2155m	recovery: small, vesicular basaltic glass chips (plg+ol phenocrysts) from four cups
17_VSR	01.11.09/ 17:16-18:53	ridge SE of Franklin Smt.	09°55.001'S 151°50.333'E	2314m	recovery: small, vesicular basaltic glass chips (plg+ol phenocrysts) from cup #4
18_VSR	01.11.09/ 19:06-20:49	ridge SE of Franklin Smt.	09°55.00'S 151°50.34'E	2366m	recovery: moderately altered basaltic glass chips from cup #3
19_AUV	01.11.09/ 23:06-00:18	Franklin Seamount	-	-	recovery of the AUV
20_AUV	02.11.09/ 00:42-01:25	Franklin Seamount	-	-	recovery of transponder D
21_AUV	02.11.09/ 01:30-02:09	Franklin Seamount	-	-	recovery of transponder B

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
22_MB	02.11.09/ 02:40-19:01	Moresby Seamount	various courses	various courses	infilling segment 1A and near Moresby Seamount: 82 nautical miles
23_KAL	03.11.09/ 00:12-01:24	Franklin Seamount	various courses	various courses	calibrating Posidonia
24_GTV	03.11.09/ 01:57-06:44	Franklin Seamount	09°54.515'S 151°49.687'E	2215m	map geology of the interior of crater; sampled low-T Fe-Mn-oxyhydroxides
25_DR	03.11.09/ 08:22-10:47	large smt. SE of Cheshire	09°49.30'S 151°51.81'E to 09°49.62'S 151°52.13'E	2162m to 2008m	recovery: pillow fragments with gals rinds and minor Mn-coating
26_DR	03.11.09/ 11:38-13:53	small smt. SE of Cheshire	09°48.19'S 151°50.80'E to 09°48.41'S 151°50.95'E	2296m to 2098m	recovery: sheet flow with glass rinds
27_DR	03.11.09/ 15:06-17:30	NW end of Cheshire Smt.	09°45.91'S 151°48.21'E to 09°46.28'S 151°48.19'E	2197m to 1960m	recovery: highly vesicular pillow fragments with thick glass rinds and trace Mn-coating
28_DR	03.11.09/ 18:27-21:10	small seamount near Cheshire	09°46.59'S 151°45.41'E to 09°46.95'S 151°45.68'E	2941m to 2917m	recovery: plag-bearing basalt and aphyric basalt
29_DR	03.11.09/ 22:18-01:16	western tip of segment 1A	09°47.20'S 151°40.49'E to 09°47.61'S 151°40.60'E	3248m to 3238m	recovery: few basalt pillow fragments with minor Mn-coating
30_AUV	04.11.09/ 02:42-02:57	Moresby Seamount	-	-	launching transponder for AUV survey
31_AUV	04.11.09/ 03:11-03:18	Moresby Seamount	-	-	launching transponder for AUV survey
32_AUV	04.11.09/ 03:21-03:49	Moresby Seamount	Transp. 4B: 09°46.376'S/ 151°33.394'E	1144m	calibrating the transponder position.
33_AUV	04.11.09/ 04:56-06:17	Moresby Seamount	Transp. 4D: 09°45.708'S/ 151°34.029'E	1743m	calibrating the transponder position.

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
34_AUV *(Abyss0015)*	04.11.09/ 06:45-09:46	Moresby Seamount	-	-	deployment of the AUV for 200 kHz survey of Franklin Seamount
35_MB	04.11.09/ 11:08-22:30	Moresby Smt.	various courses	-	mapping segment 1A and Moresby Smt.; 69 nautical miles
36_AUV	05.11.09/ 01:15-01:48	Moresby Seamount	-	-	recovery of the AUV
37_AUV	05.11.09/ 01:49-02:27	Moresby Seamount	-	-	recovery of transponder
38_AUV	05.11.09/ 02:28-03:05	Moresby Seamount	-	-	recovery of transponder
39_DR	05.11.09/ 03:34-05:39	Moresby Seamount	09°46.01'S 151°34.31'E to 09°46.31'S 151°45.62'E	1500m to 1243m	recovery: mylonites, quartz±carbonate-veined mafics; few disseminated pyrite-bearing samples
40_DR	05.11.09/ 06:18-07:54	Moresby Seamount	09°46.50'S 151°34.48'E to 09°46.80'S 151°35.31'E	981m to 924m	recovery: sandstones, mylonites, and mafic greenstones
41_DR	05.11.09/ 08:59-11:44	Moresby Smt; northern foot of detachment	09°44.90'S 151°33.55'E to 09°45.35'S 151°33.55'E	2500m to 2063m	recovery: mylonites, diabase, altered fault gauge
42_DR	05.11.09/ 12:52-15:01	Moresby Smt; northern slope of detachment	09°46.08'S 151°32.99'E to 09°46.40'S 151°32.99'E	1607m to 1230m	recovery: sandstone talus, massive and foliated diabase
43_DR	05.11.09/ 15:35-17:15	Moresby Smt; northern slope of detachment	09°46.84'S 151°32.99'E to 09°46.27'S 151°33.01'E	853m to 599m	recovery: sandstones and mudstones; greenstones; abundant microgabbro, few samples with disseminated pyrite (<5%)
44_DR	05.11.09/ 18:43-20:41	Moresby Smt; SE flank above talus fan	09°50.99'S 151°35.99'E to 09°50.81'S 151°36.36'E	1504m to 1270m	recovery: sandstones to few conglomerates

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
45_AUV	05.11.09/ 22:12- 22:27	western end of segment 1A	-	-	launching transponder 4B for AUV survey
46_AUV	05.11.09/ 22:50- 23:07	western end of segment 1A	-	-	launching transponder 4D for AUV survey
47_AUV	05.11.09/ 23:22- 00:33	western end of segment 1A	Transp. 4B: 09°48.301'S/ 151°40.339'E	3217m	calibrating the transponder position.
48_AUV	06.11.09/ 00:45- 02:00	western end of segment 1A	Transp. 4D: 09°48.251'S/ 151°41.978'E	3219m	calibrating the transponder position.
49_AUV *(Abyss0016)*	06.11.09/ 02:30- 04:45	western end of segment 1A	09°48.99'S/ 151°40.39'E	-	deployment of the AUV for 400 kHz survey
50_VSR	06.11.09/ 05:23- 07:37	western end of segment 1A	09°46.00'S/ 151°41.39'E	3195m	recovery: fresh glass bits
51_VSR	06.11.09/ 08:02- 10:15	western end of segment 1A	09°46.91'S/ 151°41.39'E	3209m	recovery: sediment and glass
52_VSR	06.11.09/ 10:40- 12:46	western end of segment 1A	09°47.80'S/ 151°41.40'E	3201m	recovery: sediment
53_VSR	06.11.09/ 13:12- 15:39	western end of segment 1A	09°48.68'S/ 151°41.38'E	3232m	recovery: empty
54_VSR	06.11.09/ 16:02- 18:25	western end of segment 1A	09°49.31'S/ 151°41.39'E	3235m	recovery: few chips in 4 cups
55_AUV	06.11.09/ 21:05- 23:03	western end of segment 1A	-	-	recovery of the AUV
56_DR	06.11.09/ 23:52- 02:14	rise between segments 1B and 1A	09°50.75'S/ 151°44.09'E to 09°50.90'S/ 151°44.16'E	2896m to 2691m	recovery: empty
57DS	07.11.09/ 02:30- 05:35	rise between segments 1B and 1A	09°50.74'S/ 151°44.09'E to 09°51.25'S/ 151°44.27'E	2896m to 2608m	repeat station 56_DR; recovery: vesicular basalt showing pahoehoe texture; pumice
58_MB	07.11.09/ 07:14- 08:28	segment 1A + 1B	various courses	-	infilling map; 11 nautical miles

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
59_DR	07.11.09/ 08:30-10:46	southern slope of “continent” 2	09°52.80’S/ 151°53.61’E to 09°52.64’S/ 151°54.08’E	2000m to 1865m	recovery: few basalt pieces; abundant mineralized and altered breccias
60_DR	07.11.09/ 12:18-15:46	basin between Cheshire and Franklin Smt.	09°52.00’S/ 151°49.50’E to 09°52.48’S/ 151°49.98’E	2895m to 2795m	recovery: empty
61_DR	07.11.09/ 17:00-20:18	basin south of “continent” 1	09°54.48’S/ 151°43.98’E to 09°54.88’S/ 151°44.38’E	3131m to 3124m	recovery: one small piece of pillow basalt
62_MB	07.11.09/ 20:45-22:55	segment 1A + 1B	various courses	-	infilling map; 11 nautical miles
63_DR	08.11.09/ 00:15-02:32	NW flank of Moresby Smt.	09°47.14’S/ 151°32.23’E to 09°47.50’S/ 151°32.61’E	1325m to 610m	recovery: full load of sandstone and mudstone (turbidites)
64_MB	08.11.09/ 03:34-07:28	segment 1A + 1B	various courses	-	infilling map; 19 nautical miles
65_DR	08.11.09/ 08:01-11:14	basin NW of Moresby	09°42.00’S/ 151°24.08’E to 09°42.74’S/ 151°24.84’E	2626m to 2683m	recovery: empty
66_MB	08.11.09/ 12:02-21:12	segment 1A + 1B	various courses	-	infilling map; 50 nautical miles
67_AUV	08.11.09/ 21:20-22:15	western end of segment 1A	-	-	recovery of transponder
68_AUV	08.11.09/ 22:16-23:10	western end of segment 1A	-	-	recovery of transponder
69_DR	08.11.09/ 23:54-02:43	lower part of NE flank of Moresby Smt.	09°46.40’S/ 151°36.39’E to 09°46.84’S/ 151°36.39’E	2224m to 1605m	recovery: quartz-bearing shists and gneises
70_DR	09.11.09/ 06:01-08:36	W slope of “continent” 2	09°52.75’S/ 151°52.99’E to 09°52.38’S/ 151°53.37’E	2175m to 1758m	recovery: SiO_2-rich volcanic lava flows and glass, pumice, hyaloclastites

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
71_MB	09.11.09/ 10:27- 02:00	segment 1B	various courses	-	mapping segment 1 B; 112 nautical miles
72_DR	10.11.09/ 02:39- 05:30	segment 1B	09°57.68'S/ 152°05.98'E to 09°58.02'S/ 152°06.32'E	2846m to 2419m	recovery: slightly sedimented pillow basalt
73_DR	10.11.09/ 06:09- 09:10	segment 1B	09°56.61'S/ 152°04.99'E to 09°56.61'S/ 152°05.62'E	2675m to 2675m	recovery: fresh basalt glass, pumice
74_MB	10.11.09/ 09:11- 04:31	segment 1B	various courses	-	infilling map; 153 nautical miles
75_DR	11.11.09/ 06:15- 08:47	elongated ridge between segments 1B and 1C	09°59.55'S/ 152°19.33'E to 09°59.54'S/ 152°19.85'E	2201m to 1858m	recovery: sedimented pillow basalt
76_DR	11.11.09/ 09:26- 11:57	northern side of elongated ridge between segments 1B and 1C	09°59.50'S/ 152°21.85'E to 10°00.01'S/ 152°21.85'E	2257m to 2041m	recovery: sedimented pillow basalt with large plag. phenocrysts
77_DR	11.11.09/ 12:55- 15:39	small smt. S of elongated ridge between segments 1B and 1C	10°01.50'S/ 152°22.00'E to 10°01.49'S/ 152°22.45'E	2750m to 2600m	recovery: empty
78_DR	11.11.09/ 16:04- 18:56	small smt. S of elongated ridge between segments 1B and 1C	10°01.49'S/ 152°21.99'E to 10°01.49'S/ 152°22.52'E	2750m to 2607m	recovery: pillow basalt with glass
79_ AUV *(Abyss0017)*	11.11.09/ 19:33- 00:04	segment 1C	10°04.00'S/ 152°21.39'E	2873m	system test and plume hunting
80_DR	12.11.09/ 01:15- 04:40	segment 1C; flat part of the axis	10°01.69'S/ 152°11.99'E to 10°01.70'S/ 152°12.78'E	2765m to 2768m	recovery: empty

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
81_DR	12.11.09/ 05:37-08:31	eastern end of segment 1B	09°57.21'S/ 152°16.49'E to 09°57.41'S/ 152°17.06'E	2667m to 2683m	recovery: pillow basalt
82_DR	12.11.09/ 10:04-13:19	segment 1C	10°03.80'S/ 152°22.40'E to 10°04.06'S/ 152°22.65'E	2849m to 2767m	recovery: pillow basalt
83_DR	12.11.09/ 14:29-17:14	segment 1C	10°03.80'S/ 152°27.69'E to 10°03.77'S/ 152°28.04'E	2910m to 2926m	MAPR 300m above dregde recovery: large, glassy pillow basalt
84_DR	12.11.09/ 18:10-20:55	segment 1C	10°03.99'S/ 152°31.99'E to 10°04.01'S/ 152°32.51'E	2908m to 2857m	recovery: empty
85_DR	12.11.09/ 21:19-00:16	segment 1C	10°03.91'S/ 152°32.00'E to 10°03.89'S/ 152°32.47'E	2935m to 2903m	recovery: pillow basalt
86_DR	13.11.09/ 01:46-04:44	segment 1C	10°04.19'S/ 152°38.06'E to 10°04.00'S/ 152°38.64'E	3100m to 2980m	recovery: pillow basalt
87_DR	13.11.09/ 05:24-08:33	south of axis of segment 1C	10°05.49'S/ 152°37.76'E to 10°05.78'S/ 152°38.23'E	3371m to 3381m	MAPR #50 at 400m; recovery: pillow basalt
88_DR	13.11.09/ 09:20-12:01	crater north of axis of segment 1C	10°03.19'S/ 152°36.85'E to 10°03.35'S/ 152°37.29'E	2950m to 2904m	MAPR #50 at 400m; recovery: sheet flow basalt
89_DR	13.11.09/ 13:49-16:18	south of axis of segment 1C	10°09.92'S/ 152°44.51'E to 10°10.30'S/ 152°44.49'E	2616m to 2379m	recovery: pillow basalt
90_MB	13.11.09/ 18:22-00:04	segment 2 to segment 4	various courses	-	along axis mapping; 238 nautical miles

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
91_DR	15.11.09/ 00:15- 03:59	segment 4A	09°32.60'S/ 155°20.60'E to 09°33.04'S/ 155°21.00'E	3973m to 3905m	recovery: pillow basalt
92_MB	15.11.09/ 05:35- 01:03	segment 4 to segment 2	various courses	-	along axis mapping; 186 nautical miles
93_DR	16.11.09/ 11:04- 14:11	segment 2	10°22.90'S/ 152°54.00'E to 10°22.90'S/ 152°54.49'E	3293m to 3240m	MAPR #54 at 400m; recovery: few pieces of slightly sedimented pillow basalt
94_DR	16.11.09/ 15:12- 18:14	segment 2	10°22.49'S/ 153°00.70'E to 10°22.96'S/ 153°00.97'E	3204m to 3085m	recovery: sedimented pillow basalt
95_DR	16.11.09/ 19:25- 22:16	segment 2	10°23.20'S/ 153°08.61'E to 10°23.23'S/ 153°09.11'E	3080m to 3047m	MAPR #54 at 400m; fresh pillow and sheet flow lava (large plag. phenocrysts) plus few pieces of scoria
96_DR	16.11.09/ 23:30- 02:04	segment 2	10°22.70'S/ 153°15.60'E to 10°23.00'S/ 153°15.89'E	2781m to 2665m	recovery: glassy pillow and sheet flow fragments; plag-bearing, thin Mn-coating
97_DR	17.11.09/ 03:16- 06:11	western part of segment 2	10°23.32'S/ 153°24.42'E to 10°23.27'S/ 153°24.93'E	2695m to 2689m	MAPR #50 at 400m; recovery: glassy pillow fragments; plag-bearing, thin Mn-coating
98_AUV	17.11.09/ 17:16- 17:32	western end of segment 1A	-	-	launching transponder 4_ for AUV survey
99_AUV	17.11.09/ 18:13- 18:20	western end of segment 1A	-	-	launching transponder 4_ for AUV survey
100_AUV	17.11.09/ 18:43- 19:51	western end of segment 1A	Transp. 4B: 09°48.301'S/ 151°40.339'E	3217m	calibrating the transponder position.
101_AUV	17.11.09/ 20:06- 21:12	western end of segment 1A	Transp. 4D: 09°48.251'S/ 151°41.978'E	3219m	calibrating the transponder position.

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
102_AUV *(Abyss0018, Abyss0019)*	17.11.09/ 22:00-02:30	western end of segment 1A	09°49.00'S/ 151°40.41'E	-	deployment of the AUV for sub-bottom profiling and 120 kHz sidescan survey; sub-bottom profile aborted; flying only sidescan
103_DR	18.11.09/ 03:30-05:12	Moresby Seamount	09°46.53'S/ 151°34.06'E to 09°46.85'S/ 151°34.06'E	1152m to 890m	recovery: grey-green cohesive cataclasite, epidote-altered and quartz-veined; and few gabbro
104_AUV	18.11.09/ 07:20-08:52	western end of segment 1A	-	-	recovery of the AUV
105_DR	18.11.09/ 10:00-12:58	Moresby Seamount	09°46.09'S/ 151°33.96'E to 09°46.54'S/ 151°33.97'E	1598m to 1134m	recovery: massive cataclasite and foliated rocks with crack and seal fabrics
106_AUV *(Abyss0020)*	18.11.09/ 14:17-17:00	western end of segment 1A	09°49.00'S/ 151°40.39'E	-	410 kHz sidescan survey; aborted
107_VSR	18.11.09/ 17:30-19:40	SE of Moresby Smt.	09°49.77'S/ 151°41.20'E	3232m	glass chips in cup 5; some sediment
108_VSR	18.11.09/ 20:31-22:38	NE of Moresby Smt.	09°45.39'S/ 151°38.70'E	3094m	glass chips in cups 6 and 4; abundant sediment
109_VSR	18.11.09/ 23:49-01:57	ENE of Moresby Smt.	09°45.65'S/ 151°44.75'E	2871m	glass chips in cup 7
110_AUV	18.11.09/ 02:20-03:12	western end of segment 1A	-	-	recovery of transponder 4D
111_AUV	19.11.09/ 03:14-04:03	western end of segment 1A	-	-	recovery of transponder 4B
112_MB	19.11.09/ 05:16-07:44	segments 1B and 1C	various courses	-	extending the southern border of bathymetric map; 19 nautical miles
113_DR	19.11.09/ 11:45-14:35	segment 1C	10°05.90'S/ 152°43.70'E to 10°06.05'S/ 152°44.12'E	3150m to 3102m	recovery: empty with indication of sediment cover

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
114_DR	19.11.09/ 15:32-18:09	E/W trending ridge south of segment 1C	10°09.20'S/ 152°40.29'E to 10°09.63'S/ 152°40.45'E	2604m to 2296m	recovery: vesicular basalt, partly olivine-bearing; medium to fine-grained altered (epidote+py+cpy) intrusive rocks; abundant sediment cover
115_DR	20.11.09/ 01:10-03:52	segment 2	10°21.70'S/ 153°32.30'E to 10°21.71'S/ 153°32.86'E	2706m to 2683m	recovery: fresh lava with glass; plag. phenocrysts
116_DR	20.11.09/ 04:44-07:16	segment 2	10°21.40'S/ 153°37.82'E to 10°21.32'S/ 153°38.26'E	2619m to 2577m	recovery: fresh lava with glass; plag. phenocrysts
117_DR	20.11.09/ 08:00-10:27	segment 2	10°21.67'S/ 153°42.01'E to 10°22.06'S/ 153°42.34'E	2625m to 2651m	recovery: fresh lava with glass
118_DR	20.11.09/ 11:25-13:57	segment 2	10°20.20'S/ 153°47.20'E to 10°20.35'S/ 153°47.62'E	2666m to 2555m	recovery: fresh lava with glass; large plag. phenocrysts
119_DR	20.11.09/ 15:26-18:22	segment 2	10°19.81'S/ 153°58.52'E to 10°19.80'S/ 153°59.15'E	2803m to 2832m	recovery: glassy pillow and sheet flow lava
120_DR	20.11.09/ 19:45-22:25	segment 2, eastern end near "trans-form fault"	10°19.60'S/ 154°07.20'E to 10°19.60'S/ 154°07.66'E	2759m to 2805m	recovery: glassy pillow and sheet flow lava
121_TVG	21.11.09/ 00:27-03:46	central large volcano in basin between segments 2&3	10°08.410'S/ 154°12.448'E	4325m	deep-water test of the new IFM-GEOMAR TV-grab; sedimented cone with fresh glassy basalt
122_DR	21.11.09/ 05:28-09:20	basin between segment 2 and 3	10°10.26'S/ 154°13.00'E to 10°10.19'S/ 154°13.49'E	4246m to 4078m	recovery: empty

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
123_DR	21.11.09/ 05:28-09:20	eastern termination of segment 2	10°16.00'S/ 154°11.40'E to 10°16.50'S/ 154°11.40'E	3534m to 3583m	recovery: empty
124_VSR	21.11.09/ 05:28-09:20	segment 2, eastern end near "trans-form fault"	10°19.70'S/ 154°07.00'E	2852m	all MAPR'S on the cable; recovery: few glass chips in five cups
125_DR	21.11.09/ 19:30-23:48	NE inside corner high of "transform fault" basin	09°56.20'S/ 154°14.81'E to 09°56.43'S/ 154°15.21'E	4319m to 3819m	recovery: medium-grained gabbro; epidote-altered and quartz-veined
126_DR	22.11.09/ 01:06-04:48	western end of segment 3A	09°52.60'S/ 154°21.39'E to 09°52.59'S/ 154°21.96'E	3840m to 3769m	recovery: pillow basalt with Mn-oxide coatings
127_DR	22.11.09/ 05:33-08:47	segment 3A	09°52.41'S/ 154°25.41'E to 09°52.21'S/ 154°25.91'E	3411m to 3455m	MAPR #51 at 400m; recovery: very fresh glassy pillow basalt
128_DR	22.11.09/ 09:29-13:45	segment 3A	09°51.00'S/ 154°29.40'E to 09°51.05'S/ 154°29.38'E	3590m to 3598m	MAPR #51 at 400m; recovery: pillow basalt
129_DR	22.11.09/ 14:25-18:02	segment 3A	09°50.30'S/ 154°32.20'E to 09°50.05'S/ 154°32.84'E	3570m to 3575m	MAPR #51 at 400m; recovery: few pieces pillow basalt with large plag. phenocrysts
130_DR	22.11.09/ 19:08-22:52	segment 3A	09°47.41'S/ 154°41.00'E to 09°47.25'S/ 154°40.60'E	3769m to 3754m	MAPR #51 at 400m; recovery: single piece of pillow basalt
131_DR	22.11.09/ 23:27-04:37	segment 3A	09°46.60'S/ 154°42.49'E to 09°46.64'S/ 154°43.34'E	3883m to 3871m	MAPR #51 at 400m; recovery: pillow basalt with thick glass crust and Mn-coating
132_MB	23.11.09/ 04:57-07:41	segment 3A	various courses	-	mapping NE extension of segment 3A;

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
133_DR	23.11.09/ 07:45- 11:14	segment 3A	09°50.20'S/ 154°55.01'E to 09°50.51'S/ 154°55.50'E	3585m to 3743m	recovery: pillow basalt with Mn-coating and minor glass crust
134_DR	23.11.09/ 11:41- 12:59	segment 3A	various courses	-	extending map
135_DR	23.11.09/ 13:02- 16:34	eastern end of segment 3A	09°44.90'S/ 154°48.84'E to 09°44.73'S/ 154°49.46'E	3865m to 3735m	recovery: pillow basalt with Mn-coating and minor glass crust
136_DR	23.11.09/ 16:48- 18:19	segment 3A	various courses	-	extending map
137_DR	23.11.09/ 18:33- 21:33	segment 3B	09°47.51'S/ 155°03.60'E to 09°47.38'S/ 155°04.13'E	3329m to 3440m	MAPR #51 at 400m; recovery: sheet flow with very thick (>1cm) glass crust; minor Mn-coating; ***strong plume***
138_DR	23.11.09/ 21:52- 22:30	segment 3B	various courses	-	extending map
139_DR	23.11.09/ 22:48- 02:11	eastern end of segment 3B	09°45.41'S/ 155°08.60'E to 09°45.39'S/ 155°09.13'E	3810m to 3778m	recovery: fresh pillow and sheet flow lava
140_DR	24.11.09/ 02:39- 06:00	eastern end of segment 3B	09°46.19'S/ 155°09.50'E to 09°46.20'S/ 155°10.03'E	3743m to 3516m	recovery: glassy pillow lava; some pieces with Mn-staining
141TowYo	24.11.09/ 07:28- 13:18	eastern end of segment 3B	09°48.12'S/ 155°01.97'E to 09°46.19'S/ 155°05.19'E	3454m to 3641m	plume hunting using 5 MAPR's on dredge cable; strong plume indication (nephels, Eh, temp) over entire length of the profile
142_DR	24.11.09/ 16:29- 20:00	large flat topped volcano on segment 4A	09°34.41'S/ 155°16.10'E to 09°34.39'S/ 155°16.64'E	3887m to 3884m	MAPR #50 at 400m; recovery: few small pieces of basaltic glass crust
143_DR	24.11.09/ 21:05- 00:10	eastern part of segment 4A	09°31.55'S/ 155°23.39'E to 09°31.94'S/ 155°23.57'E	3920m to 3879m	MAPR #50 at 400m; recovery: empty

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
144_DR	25.11.09/ 00:46- 04:23	eastern part of segment 4A	09°30.65'S/ 155°24.85'E to 09°31.12'S/ 155°25.01'E	4000m to 3911m	MAPR #50 at 400m; recovery: sheet flows and pillows
145_DR	25.11.09/ 05:30- 09:00	segment 4B	09°33.90'S/ 155°31.49'E to 09°34.38'S/ 155°31.67'E	3923m to 3911m	MAPR #51 at 400m; recovery: pillows showing abundant Mn-coating and little glass
146_DR	25.11.09/ 10:28- 14:00	segment 4C	09°33.89'S/ 155°41.59'E to 09°33.89'S/ 155°42.22'E	3623m to 3655m	MAPR #51 at 400m; recovery: fresh sheet flows with thick glass crust
147_DR	25.11.09/ 14:45- 18:02	segment 4C	09°33.30'S/ 155°43.61'E to 09°32.94'S/ 155°44.22'E	3554m to 3474m	MAPR #51 at 400m; recovery: fresh sheet flows and pillows
148_MB	25.11.09/ 18:13- 22:15	segment 4 and 3	various courses	-	infilling map and determining dredge station south of 4A; 39 nautical miles
149TowYo	26.11.09/ 01:18- 17:18	plume site on segment 3B	09°45.86'S/ 155°02.46'E to 09°49.79'S/ 155°03.86'E	3175m to 3540m	N/S across axis profile with 5 MPAR's; strong plume indications on central ridge
150_TVG	26.11.09/ 08:18- 14:19	plume site on segment 3B	09°47.90'S/ 155°03.17'E to 09°47.84'S/ 155°02.79'E	3374m to 3360m	search for hydrothermal source along central ridge; no success; sedimented basalt; few *Munidopsis* near large fissures; plume signals on MAPR's
151_DR	26.11.09/ 16:57- 19:19	south of segment 4A; age profile	09°39.70'S/ 155°19.23'E to 09°40.04'S/ 155°19.37'E	2603m to 2554m	recovery: few pieces of basalt
152_MB	26.11.09/ 19:28- 20:39	south of segment 4A; age profile	various courses	-	determining dredge station; 11 nautical miles
153_DR	26.11.09/ 21:02- 23:34	south of segment 4A; age profile	09°49.50'S/ 155°17.99'E to 09°49.93'S/ 155°18.00'E	2968m to 3007m	recovery: old pillow basalt with thick Mn-crusts

Station	Date/Time [UTC]	Area	Position Lat./ Long.	Depth [m]	Brief description
154_MB	26.11.09/ 23:50- 00:59	south of segment 4A; age profile	various courses	-	determining dredge station; 8 nautical miles
155_DR	27.11.09/ 01:01- 04:27	south of segment 4A; age profile	09°54.81'S/ 155°16.99'E to 09°55.40'S/ 155°17.00'E	3564m to 3110m	recovery: old pillow basalt with thick Mn-crusts
156_MB	27.11.09/ 05:00- 06:02	south of segment 4A; age profile	various courses	-	determining dredge station; 9 nautical miles
157_DR	27.11.09/ 06:18- 09:11	south of segment 4A; age profile	10°03.61'S/ 155°16.71'E to 10°04.09'S/ 155°16.71'E	3368m to 3352m	recovery: empty
158_MB	27.11.09/ 09:21- 10:40	south of segment 4A; age profile	various courses	-	determining dredge station; 13 nautical miles
159_DR	27.11.09/ 10:57- 13:30	south of segment 4A; age profile	10°12.00'S/ 155°25.49'E to 10°12.33'S/ 155°25.62'E	2807m to 2372m	recovery: empty
160_DR	27.11.09/ 13:52- 16:47	south of segment 4A; age profile	10°11.81'S/ 155°25.79'E to 10°12.24'S/ 155°25.96'E	2894m to 2283m	recovery: few moderately altered basalt fragments with thick Mn-oxide coating
161_MB	27.11.09/ 17:01- 18:00	south of segment 4A; age profile	various courses	-	determining dredge station; 10 nautical miles
162_DR	27.11.09/ 18:14- 22:18	south of segment 4A; age profile	10°17.39'S/ 155°19.91'E to 10°18.16'S/ 155°19.90'E	3862m to 3484m	recovery: empty
163_MB	27.11.09/ 22:28- 23:03	south of segment 4A; age profile	various courses	-	determining dredge station; 2 nautical miles
164_DR	27.11.09/ 23:17- 03:50	south of segment 4A; age profile	10°17.20'S/ 155°18.90'E to 10°17.79'S/ 155°19.00'E	4267m to 3571m	recovery: microgabbros and strongly altered basalt; sandstone and breccia pieces
165_MB	28.11.09/ 03:52- 05:52	south of segment 4A; age profile	various courses	-	determining dredge station; 22 nautical miles
166_GTV	29.11.09/ 22:40- 03:02	-	16°38.00'S/ 159°59.99'E	4554m	test new TV-grab without sampling

11 List of samples taken and descriptions (J. Mahlke)

SO203 - VSR5
E of Franklin Seamount; SE of Cheshire Seamount
VSR on bottom UTC 30/10/09 1929hrs, lat 09º56,579'S, long 151º59,18'E, depth 2584m
total volume: 5/7 cups
Comments: max. rope length 2584m, max. rope tension 20kN; rope speed 1,0m/s; probably pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR5-1	fresh glass, black			X		
VSR5-2	fresh glass, black, brownish=oxidized (Palagonite)			X		
VSR5-3	fresh glass			X		
VSR5-4	fresh glass			X		
VSR5-7	fresh glass, very few small chips			X		

SO203 - VSR8
Peak of Cheshire Seamount
VSR on bottom UTC 31/10/09 1611hrs, lat 09º46,723'S, long 151º48,675'E, depth 1686m
total volume: 7/7 cups
Comments: max. rope length 1706m, max. rope tension 20kN, rope speed 1m/s; probably pillows; MAPR #51 at 50m rope length

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR8-1	very fresh to moderately/strongly altered glass chips; partly vesicular; no phenocrysts visible; partly vesicular, vesicles partly elongated and partly filled			X		
VSR8-2	very few black and fresh glass chips, majority with Palagonite (orange), strongly altered, some with vesicles with Palagonite vesicle filling, vesicles partly elongated, vesicles also with white mineral (?) or sediment (?)			X		
VSR8-3	strongly to moderately altered rock chips, probably basalt, few glass chips with oxidized crusts, Palagonite, glass partly vesicular, vesicles elongated and filled with white mineral, possibly even sediment, very few very fresh nonvesicular glass chips			X		
VSR8-4	very few chips, strongly altered, Palagonite, 2-4 usable chips for EMA, partly to highly vesicular, elongated and filled vesicles			X		
VSR8-5	very few glass chips and basalt (?) chips, some chips strongly altered, approximately 1-2 chips for EMA			X		
VSR8-6	glass chips, orange-brownish oxidized crust/Palagonite?, partly vesicular (>10%), vesicles partly elongated, vesicles partly filled, no phenocrysts visible, fairly fresh, few rock chips, probably basalt, altered			X		
VSR8-7	2 glass chips			X		

SO203 - VSR13
Seamount NW of Franklin Seamount
VSR on bottom UTC 01/11/09 0649hrs, lat 09º53,904'S, long 151º48,898'E, depth 2348m
total volume: 0/7 cups
Comments: max. rope length 2348m, max. rope tension 9.5kN, rope speed 0.3m/s; MAPR #53 at 50m rope length; all cups empty, only sediment at wax corer head

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR13-1	foraminifera and glass chips (~5-10%) in mud on top of wax corer and one larger piece of pumice; glass: nonvesicular, black, very fresh			X		mud in cup; pumice in bag

SO203 - VSR16
Franklin Seamount; SE rim of crater
VSR on bottom UTC 01/11/09 1556hrs, lat 09°54,685'S, long 151°49,815'E, depth 2149m
total volume: 4/7 cups
Comments: max. rope length 2155m; max. rope tension 18,4kN, rope speed 1m/s; MAPR #50 at 50m rope length; scratches on wax corer (hard ground)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR16-1	very few glass chips; black					sample still in cup; wrapped in bag
VSR16-2	very few glass chips; very tiny; black					sample still in cup; wrapped in bag
VSR16-6	very few glass chips; black					sample still in cup; wrapped in bag
VSR16-7	glass; larger than the chips of samples VSR16-1, -2, -6; vesicles: some; partly elongated; vesicle filling: none to slight coating with white min. (Cc?); black glass; Plag, up to 2mm, very fresh; Ol, up to 1mm, very fresh; secondary minerals: white vesicle filling Cc?; alteration: very fresh			X		

SO203 - VSR17
SE of Franklin Seamount
VSR on bottom UTC 01/11/09 1800hrs, lat 09°55,001'S, long 151°50,333'E, depth 2310m
total volume: 1/7 cups
Comments: max. rope length 2310m, max rope tension 18kN, rope speed 1m/s; MAPR #50 at 50m rope length

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR17-4	fresh glass, black (brownish), slightly altered parts, Palagonite, oxidized rims: orange-brownish, vesicles, some with coating, Plag phenocrysts, <<1mm, Ol phenocrysts, <<1mm, one separate one with inclusion			X		

SO203 - VSR18
Small seamount SE of Franklin Seamount
VSR on bottom UTC 01/11/09 1953hrs, lat 09°55,0'S, long 151°50,34'E, depth 2370m
total volume: 1/7 cups
Comments: max. rope length 2366m; max rope tension 18.4kN, rope speed 1m/s; MAPR #51 at 50m rope length

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR18-3	moderately fresh glass chips, slightly oxidized, Palagonite, no phenocrysts visible, few vesicles, some filled, some with coating			X		

SO203 - TVG24
Crater of Franklin Seamount
TVG on bottom UTC 02/11/09 0251hrs, lat 09°54.54'S, long 151°49.70'E
TVG off bottom UTC 02/11/09 0536hrs, lat 09°54.40'S, long 151°49.71'E, depth 2241m
total volume: few rocks
Comments: used equipment: Posidonia; grab position: lat 09°54,515'S, long 151°49,687'E, depth 2215m; rocks: low-T Fe-oxihydroxides; grouped according to Fe-, Mn- and clay content or texture (5 groups)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR24-1	no description available					

SO203 - DR25
NW "nose" of larger seamount SE of Cheshire Seamount
Dredge on bottom UTC 03/11/09 0900hrs, lat 09°49.3'S, long 151°51.809'E, depth 2162m
Dredge off bottom UTC 03/11/09 0959hrs, lat 09°49.618'S, long 151°52.130'E, depth 2008m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2230m on bottom - 2500m max. - 1978m off bottom; pillow fragments with glass and some Mn-crusts

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR25-1	1. Rock Type: pillow fragment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: thin Mn-coating <1mm; glass rim 3-4mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Ol phenocrysts, ~1% 9. Secondary Minerals: some sediment; Mn 10. Degree of Alteration: alteration staining; older-looking	X	X	X		
DR25-2	1. Rock Type: pillow tube 2. Size: 20x20x15cm 3. Shape/Angularity: - 4. Encrustation: glass rim 2-3mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Ol phenocrysts, 1mm, <<1% 9. Secondary Minerals: Palagonite 10. Degree of Alteration: slightly altered	X		X		
DR25-3	1. Rock Type: pillow fragment 2. Size: - 3. Shape/Angularity: 4. Encrustation: glass rim up to 7mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Ol phenocrysts, ~2% 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR25-1*	X		X		
DR25-4	1. Rock Type: pillow fragment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: Mn-dusting on outer surface; glass crust 2-3mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Ol glomerocrysts, <1mm 9. Secondary Minerals: Mn-dusting; Palagonite 10. Degree of Alteration: altered			X		
DR25-5	1. Rock Type: pillow fragment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, 4mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR25-1*	X		X		

DR25-6	1. Rock Type: Pillow sector - talus? 2. Size: - 3. Shape/Angularity: rounded 4. Encrustation: thin glass rim 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: Plag and Ol, <1%, ~1mm 9. Secondary Minerals: - 10. Degree of Alteration: grey weathered	X		X		

SO203 - DR26
Small seamount S of Cheshire Seamount, from foot to top
Dredge on bottom UTC 03/11/09 1215hrs, lat 09º48.195'S, long 151º50.797'E, depth 2296m
Dredge off bottom UTC 03/11/09 0959hrs, lat 09º48.408'S, long 151º50.947'E, depth 2098m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2300m on bottom - 2500 max.; sheet flow lava with thin glassy surface, flow structures

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR26-1	1. Rock Type: large block of sheet lava 2. Size: 30x20x10cm 3. Shape/Angularity: - 4. Encrustation: glass rim, 2-3mm 5. Vesicularity: tube vesicles, ~2% 6. Vesicle Filling: sediment 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: some Fe-staining 10. Degree of Alteration: -	X		X		
DR26-2	1. Rock Type: sheet flow fragment 2. Size: 15x10x8cm 3. Shape/Angularity: - 4. Encrustation: glass rim, 2-3mm 5. Vesicularity: few vesicles, <1% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR26-3	1. Rock Type: pillow piece 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass rim, 2mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: some Fe-staining on fractures 10. Degree of Alteration: -	X		X		
DR26-4	1. Rock Type: pillow piece 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, 1-2mm 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR26-3*	X		X		
DR26-5	1. Rock Type: pillow fragment 2. Size: 10x7x5cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR26-6	1. Rock Type: Pillow piece 2. Size: - 3. Shape/Angularity: - 4. Encrustation: Mn-crust on inner surface; glass rim, 2-3mm 5. Vesicularity: few, <2% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: older-looking	X		X		

SO203 - DR27
Peak at NW end of Cheshire Seamount
Dredge on bottom UTC 03/11/09 1545hrs, lat 09º45.913'S, long 151º48.207'E, depth 2197m
Dredge off bottom UTC 03/11/09 1644hrs, lat 09º48.285'S, long 151º48.188'E, depth 1960m
total volume: 1/3-1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2221m on bottom - 2450m max. - 1920m off bottom; few strong bites; pillow fragments, probably lava flows with glass and minor Mn-crusts, high vesicularity (

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR27-1	1. Rock Type: sheet flow fragment 2. Size: 30x25x8mm 3. Shape/Angularity: - 4. Encrustation: glass rim, 7mm with surface intact 5. Vesicularity: ~5%, large, elongated 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR27-2	1. Rock Type: pillow segment 2. Size: 20x20x5cm 3. Shape/Angularity: - 4. Encrustation: vesicular glass rim 5. Vesicularity: highly vesicular, ~20% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: - *very different to DR27-1*	X		X		

DR27-3	1. Rock Type: pillow piece 2. Size: 10x10x10cm 3. Shape/Angularity: - 4. Encrustation: less glass than DR27-2 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR27-2*	X		X		
DR27-4	1. Rock Type: sheet-like piece 2. Size: 10x10x4cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 2mm 5. Vesicularity: 5% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR27-5	1. Rock Type: sheet-like piece 2. Size: - 3. Shape/Angularity: - 4. Encrustation: thin Mn-coating on underside 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR27-4*	X		X		
DR27-6	1. Rock Type: pillow segment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: yes 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR27-2*	X		X		

SO203 - DR28
Small seamount 2.5nm W of Cheshire Seamount
Dredge on bottom UTC 03/11/09 1827hrs, lat 09º46.593'S, long 151º45.413'E, depth 2941m
Dredge off bottom UTC 03/11/09 2013hrs, lat 09º46.948'S, long 151º45.683'E, depth 2917m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2957m on bottom - 3200m max. - 2755m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR28-1	1. Rock Type: pillow fragment 2. Size: 25x15x15cm 3. Shape/Angularity: - 4. Encrustation: glass rim, 3-5mm; Mn+Fe-coating on fractures 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag phenocrysts, 5mm, glomerocrysts 9. Secondary Minerals: - 10. Degree of Alteration: older than DR28-3 and DR28-4	X		X		
DR28-2	1. Rock Type: pillow segment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR28-1*	X		X		
DR28-3	1. Rock Type: Pillow bud 2. Size: 15x12x12cm 3. Shape/Angularity: - 4. Encrustation: glass rim, 3-5mm 5. Vesicularity: some larger vesicles, 5% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR28-4	1. Rock Type: Pillow bud 2. Size: smaller than DR28-3 3. Shape/Angularity: - 4. Encrustation: glass skin, fresh 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR28-3, but somewhat smaller*	X		X		

SO203 - DR29
Small ridge E of Moresby Seamount, Segment 1A, W-tip; small E-W ridge
Dredge on bottom UTC 03/11/09 2312hrs, lat 09º47.196'S, long 151º40.489'E, depth 3248m
Dredge off bottom UTC 04/11/09 0006hrs, lat 09º47.613'S, long 151º40.598'E, depth 3238m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3269m on bottom - 3550m max. - 3160m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES

DR29-1	1. Rock Type: pillow lava with glass crust 2. Size: 35x17x16mm 3. Shape/Angularity: glass crust rounded, basaltic lava angular 4. Encrustation: class crust, up to 5mm 5. Vesicularity: irregular shape, up to 1mm 6. Vesicle Filling: none, except for one larger vesicle with FeS_2 or FeS filling 7. Matrix Color: dark grey to black 8. Primary Minerals: Plag as phenocrysts and microlites, ~5-10%, up to 3mm, very fresh 9. Secondary Minerals: vesicle filling FeS_2 or FeS 10. Degree of Alteration: very fresh, only outside with oxidation rims (orange)	X		X		
DR29-2	1. Rock Type: pillow lava with glassy crust 2. Size: 19x15x12cm 3. Shape/Angularity: glass crust rounded, basaltic lava angular 4. Encrustation: glassy crust, up to 5mm 5. Vesicularity: irregular shape, up to 4mm 6. Vesicle Filling: almost none, very few with FeS_2 or FeS coating 7. Matrix Color: dark grey to black 8. Primary Minerals: Plag phenocrysts and microlites, up to 7mm, more Plag closer to glassy rim than inside pillow, 5-20% depending on location in rock fragment, very fresh 9. Secondary Minerals: FeS_2/FeS on outer crust of rock and in some vesicles 10. Degree of Alteration: very fresh	X		X		
DR29-3	1. Rock Type: pillow lava fragment with glassy crust 2. Size: 10x10x8cm 3. Shape/Angularity: glass crust rounded, basaltic lava angular 4. Encrustation: glassy crust, up to 5mm 5. Vesicularity: irregular shape, up to 4mm 6. Vesicle Filling: almost none, very few with FeS_2 or FeS coating 7. Matrix Color: dark grey to black 8. Primary Minerals: Plag phenocrysts and microlites, up to 7mm, more Plag closer to glassy rim than inside pillow, 5-20% depending on location in rock fragment, very fresh 9. Secondary Minerals: FeS_2/FeS on outer crust of rock and in some vesicles 10. Degree of Alteration: very fresh *similar to SO203 DR29-2*	X				

SO203 - DR39
Moresby Seamount, 1km E of detachment at ~1500m water depth
Dredge on bottom UTC 05/11/09 0401hrs, lat 09º46.009'S, long 151º34.307'E, depth 1500m
Dredge off bottom UTC 05/11/09 0501hrs, lat 09º46.314'S, long 151º34.615'E, depth 1243m
total volume: full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 1540m on bottom - 1750m max. - 1243m off bottom; according to their deformation fabrics, greenschists have been divided into three groups; a group of quar veins and a group of sulphide bearing cataclasites has been documented as well; group numbers start with number 4, because three special samples have also been numbered

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR39-4	Light green, fine-grained to microcrystalline mylonites and ultramylonites with tight foliation and well-developed stretching lineation. Mylonites show feldspar-rich layers, nevertheless quartz is dominating the deformation fabric. Most mylonites show a strong foliation, sometimes this foliation is folded. Fold geometries vary from open to closed. Fold axis and stretching lineations form an angle of 60°. Samples show quartz-filled and calcite-filled veins, sometimes oriented parallel to the foliation, other veins / healed fractures crosscut the foliation at an angle of 30° to 85°.					Individual sample: DR39-4A, DR39-4B, DR39-4C, DR39-4D, DR39-4E, DR39-4F
DR39-6	Weakly porphyric, coarse-grained (grainsize 1-4 mm) unfoliated greenstones. Minerals: epidote, altered chlorite, feldspar (plagioclase), amphibole, white mica and secondary quartz. Samples from this group do not show deformation fabrics and are therefore interpreted as mafic protoliths of deformed rocks.					Individual sample: DR39-6A, DR39-6B, DR39-6C
DR39-7	Medium-grained chlorite rich (typical grainsizes 0,5-2 mm) greenstones with brittle, cataclastic overprint containing chlorite, epidote, actinolith, and small amounts of quartz					Individual sample: DR39-7A, DR39-7B, DR39-7C
DR39-5	Coarse-grained quartz veins and quartz layers with max. grainsizes of 4-5 mm showing no stretching lineation but in some cases a weak foliation.					Individual sample: DR39-5A, DR39-5B, DR39-5C, DR39-5D, DR39-5E, DR39-5F, DR39-5G, DR39-5H
DR39-8	Dark grey to black quartz-chlorite-muscovite cataclasites with slickensides and abundant quartz veins parallel to a weak foliation. The angular components have a typical size of 3-5 mm and consist of chlorite, plagioclase, white micas, quartz and approximately 5% pyrite. Pyrite is disseminated or segregated in veins.					Individual sample: DR39-8A, DR39-8B

SO203 - DR40
Moresby Seamount, 1km E of detachment at ~1000m water depth
Dredge on bottom UTC 05/11/09 0618hrs, lat 09º46.495'S, long 151º34.978'E, depth 981m
Dredge off bottom UTC 05/11/09 0731hrs, lat 09º46.804'S, long 151º35.307'E, depth 924m
total volume: 3/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 990m on bottom - 1300m max. - 924m off bottom; no strong rope tension recorded; 15-25% sedimentary rocks; dredge contains sedimentary rocks, mylonites greenschists and chlorite schists

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR40-1	Light brown, dark grey and green, fine-grained sandstones. The sandstones comprise basaltic rock fragments, biotite, muscovite, feldspar, and amphibole (?). In some cases, foraminifera could be recognized with a magnifying glass. The only coarser-grained sample DR40-1C shows rock fragments up to 2mm in size.					Individual sample: DR40-1A, DR40-1B, DR40-1C, DR40-1D, DR40-1E, DR40-1F
DR40-2	Very fine-grained, recrystallized, greenish mylonites with well-developed stretching lineation and partly intrafolial folds. Some samples are overprinted by kink bands.					Individual sample: DR40-2A, DR40-2B, DR40-2C, DR40-2D, DR40-2E, DR40-2F, DR40-2G
DR40-3	Metavulcanic chlorite schists and greenschists with intercalated milimeter-wide layers of quartz-white-mica phyllites. Samples show frequent crenulation and partly open folds. In some samples, there are coarse-crystalline, up to 0.5cm-wide, foliation-parallel quartz layers. All samples show extensional crenulation cleavage. Greenstones contain chlorite, epidote, feldspar, quartz, rare actinolith. Secondary calcite-coating on joints and fractures is common. Sample DR40-3J shows calcite-slickencrysts.					Individual sample: DR40-3A, DR40-3B, DR40-3C, DR40-3D, DR40-3E, DR40-3F, DR40-3G, DR40-3H, DR40-3I, DR40-3J

SO203 - DR41
Moresby Seamount, N foot of detachment at ~2500m water depth
Dredge on bottom UTC 05/11/09 0944hrs, lat 09º44.897'S, long 151º33.553'E, depth 2499m
Dredge off bottom UTC 05/11/09 1051hrs, lat 09º45.349'S, long 151º33.547'E, depth 2063m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2519m on bottom - 2700m max. - 2050m off bottom; topography along the dredge haul: plane, smooth, slope on the lower part of the detachment; dredge cro an AUV detected turbidity anomaly; however, recovered rocks did not confirm hydrothermal activity; contains mylonites, cataclasites, eruptive rocks and clay (fault gouge?)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR41-1	Green and grey mylonites and darkgrey ultramylonites, both types are very fine-grained and show a well developed stretching lineation. Foliation varies in intensity. Some, chlorite-rich mylonites do not show a stretching lineation, since chlorite minerals and foliation are parallel. Despite a quartz-rich mineralogy two fine-grained ultramylonites are dark coloured.					Individual sample: DR41-1A, DR41-1B, DR41-1C, DR41-1D, DR41-1E, DR41-1F
DR41-2	Dark grey or black fine-grained to microcrystalline massive rocks with a fine-grained matrix and rare black phenocrysts (amphibole?). Few samples are somewhat coarser-grained, and following minerals could be identified with the magnifying glass: plagioclase (albite?), chlorite, amphibole, biotite and sulfides. Rare veins crosscut the cataclastically-overprinted rock, which might be classified as dark diabase or fine-grained amphibolite.					Individual sample: DR41-2A, DR41-2B, DR41-2C, DR41-2D, DR41-2E, DR41-2F
DR41-3	Greenish-coloured, massive diabase, partly with ophitic structure. Most samples do not show a deformation fabric, in some cases, a weak foliation is developed. Samples contain plagioclase, chlorite, augite, olivine, rare serpentinite.					Individual sample: DR41-3A
DR41-4	Light green, fine-grained diabase with abundant chlorite and epidote. Samples with highest amount of chlorite display a weak foliation. Most samples are cataclastically overprinted.					Individual sample: DR41-4A, DR41-4B, DR41-4C

SO203 - DR42						
Moresby Seamount, N slope of detachment at ~1500m water depth						
Dredge on bottom UTC 05/11/09 1324hrs, lat 09º46.075'S, long 151º32.994'E, depth 1607m						
Dredge off bottom UTC 05/11/09 1426hrs, lat 09º46.401'S, long 151º32.990'E, depth 1230m						
total volume: 1/4 full						
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 1643m on bottom - 1800m max. - 1200m off bottom; topography along the dredge haul: plane, smooth, slope in the middle part of the detachment; contains tv samples of sedimentary rocks, but lots of diabase and greenschist						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR42-1	Two pieces of olive-coloured, fine-grained sandstone containing quartz, feldspar, biotite and white mica, both samples show fossils (foraminifera). Individual grains are rounded to well-rounded, probably due to submarine transport. The degree of consolidation is rather weak and the distance of transport is difficult to estimate. Samples probably originate from the submarine fan above the dredge-axis.					Individual sample: DR42-1A, DR42-1B
DR42-2	Massive, hard diabase with no or only weak foliation. Grey and green colours are typically for these fine-grained rocks, which show light green veins filled with epidote, quartz and feldspar. Some samples show patches of dark-green chlorite.					Individual sample: DR42-2A, DR42-2B, DR42-2C, DR42-2D, DR42-2E, DR42-2F, DR42-2G
DR42-3	Tightly-foliated, in some cases folded greenschists containing chlorite and epidote. Some samples display undulating quartz filled veins. Rhombohedric outbreaks indicate a second foliation. In few samples, the foliation is overprinted by kink bands.					Individual sample: DR42-3A, DR42-3B, DR42-3C, DR42-3D, DR42-3E
DR42-4	Similar mineralogical composition than group 3, however with only very weak foliation, a fine-grained matrix and patches of dark chlorite					Individual sample: DR42-4
DR42-5	The red (hematite) diabse (?) shows multistage veins mostly filled with epidote-quartz and quartz. Crosscutting relations reflect the folded epidote-quartz veins to be oldest, the second generation (quartz filled) gets finally crosscut again (black veins).					Individual sample: DR42-5A, DR42-5B, DR42-5C

SO203 - DR43						
Moresby Seamount, N slope of detachment at ~500m water depth						
Dredge on bottom UTC 05/11/09 1554hrs, lat 09º46.844'S, long 151º32.991'E, depth 853m						
Dredge off bottom UTC 05/11/09 1655hrs, lat 09º46.273'S, long 151º33.011'E, depth 599m						
total volume: full						
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 882m on bottom - 600m max. - 580m off bottom; 50% sediments; topography along the dredge haul: upper end of detachment surface near bulge to summit p Metadiabase, sulfide bearing Metadiabase and sedimentary rocks						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR43-1	Dark-grey mafic rocks showing cataclastic deformation fabrics, host rock of fine-grained samples with grain sizes ≤1mm might represent a microgabbro. Mineralogical composition is pyroxene (70%), feldspar and rare quartz. All samples contain disseminated pyrite and other sulfides. Sulfides do not show characteristics of hydrothermal remobilisation.					Individual sample: DR43-1A/1/2/3
DR43-2	Dark-green to black, fine-grained (0.5-1mm) rocks containing chlorite, pyroxene (approximately 60%), and feldspar. Individual pyroxene minerals are up to 2mm long. All samples are massive and do not show an obvious foliation. They might be Metagabbro or Metabasalt. Some samples show epidote-quartz veins.					Individual sample: DR43-2A, DR43-2B, DR43-2C
DR43-3	Grey to greenish sandstones and siltstones (mainly coarse siltstones), which represent turbidites. Sandstones alternate with siltstones and mudstones, often affected by bioturbation. Fine-grained, bioturbated, silt-clay turbidites show volcanic, terrigenous, and biogenic components. A few samples contain fossils and detritic biotite, some samples show gradation with fining-upward sequences.					Individual sample: DR43-3A, DR43-3B, DR43-3C, DR43-3D

SO203 - DR44						
Moresby Seamount, SE nose of detachment, flank above a talus fan						
Dredge on bottom UTC 05/11/09 1910hrs, lat 09º50.993'S, long 151º35.991'E, depth 1504m						
Dredge off bottom UTC 05/11/09 2011hrs, lat 09º50.807'S, long 151º36.360'E, depth 1270m						
total volume: 1/2 full						
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 1520m on bottom - 1798m max. - 1210m off bottom; topography along the dredge haul: steep flank of a slide; dredge contains exclusively sedimantary rocks						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR44-1	The fine-grained (grainsize ≤0.5mm) sandstones contain volcanic, terrigenous, and biogenic components. In some cases, quartz is not the dominant component, these rocks have been described as greywacke. Some rock samples show bioturbation, i.e. tubes filled with coarser-grained sand.					Individual sample: DR44-1A
DR44-2	Rocks of this group have been divided in fine-grained conglomerates and greywacke/conglomerates. Conglomerates consist of up to 5mm large components, mainly derived from volcanic and terrigenous sources.					Individual sample: DR44-2A, DR44-2B
DR44-3	Coarse-grained sandstones/greywacke with well-rounded components consist of quartz, basaltic rock fragments, plagioclase and patches of siltstone. The source of the siltstone is unclear, maybe this patches are resedimented fragments.					Individual sample: DR44-3A, DR44-3B

SO203 - VSR50						
E of Moresby Seamount						
VSR on bottom UTC 06/11/09 0523hrs, lat 09º46,000'S, long 151º41,391'E, depth 3195m						
total volume: 3/7 cups						
Comments: max. rope length 3195m, max. rope tension 34kN; rope speed 1,0m/s; MAPR #54 at 50m above VSR; probably volcanic glass						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR50-3	very fresh glass, black, very few and small vesicles, plagioklas phenocrysts (also very fresh), only few chips with alteration			X		
VSR50-5	very fresh glass, black, very few and small vesicles, white phenocrysts (calcite?) alteration along thin lines			X		
VSR50-6	fresh black glass, fresh plag phenocrysts, small scale vesicles, microlites, little alteration			X		

SO203 - VSR51						
E of Moresby Seamount						
VSR on bottom UTC 06/11/09 0903hrs, lat 09º46,911'S, long 151º41,386'E, depth 3209m						
total volume: 1/7 cups						
Comments: max. rope length 3211m, max. rope tension 34kN; rope speed 1,0m/s; MAPR #54 at 50m above VSR; instrument partly covered with sediment						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR51-3	moderately altered glass chips, angular, no phenocrysts or vesicles, only some larger pieces + lots of tiny ones			X		

SO203 - VSR52						
East Basin, E of Moresby Seamount; probably on ridge axis						
VSR on bottom UTC 06/11/09 1140hrs, lat 09º47,801'S, long 151º41,399'E, depth 3201m						
total volume: 2/7 cups						
Comments: max. rope length 3201m, max. rope tension 34kN; rope speed 1,0m/s; MAPR #51 at 50m above VSR; mud on the instrument						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR52-1	two pieces of relatively fresh, angular glass chips, no vesicles or phenocrysts			X		
VSR52-3	the same, but only one larger chip			X		

SO203 - VSR53
East Basin, E of Moresby Seamount; probably on ridge axis
VSR on bottom UTC 06/11/09 1411hrs, lat 09º48,680'S, long 151º41,383'E, depth 3232m
total volume: 0/7 cups
Comments: max. rope length 3232m, max. rope tension 35kN; rope speed 1,0m/s; MAPR #51 at 50m above VSR; empty

SO203 - VSR54						
East Basin, E of Moresby Seamount; low-reflectivity area						
VSR on bottom UTC 06/11/09 1703hrs, lat 09º49,309'S, long 151º41,395'E, depth 3235m						
total volume: 4/7 cups						
Comments: max. rope length 3235m, max. rope tension 36kN; rope speed 1,0m/s; MAPR #51 at 50m above VSR; 2 and 5 with only 1-2 small chips						
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR54-2	no description available					

VSR54-3	one larger chip (7x5x5mm), very fresh, Plag phenocrysts, some Ol phenocrysts; smaller pieces: one with glassy crust			X		
VSR54-5	no description available					
VSR54-6	very few fresh glass chips, only some with signs of alteration, rel. large (1mm) Plag phenocrysts, 1 chip with glassy crust			X		

SO203 - DR56
ESE of Moresby Seamount, NW of Franklin Seamount ("Continent 1"); Segment 1B, horst and grabens structure
Dredge on bottom UTC 07/11/09 0049hrs, lat 09°50.751'S, long 151°44.094'E, depth 2896m
Dredge off bottom UTC 07/11/09 0121hrs, lat 09°50.902'S, long 151°44.157'E, depth 2691m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2900m on bottom - 3000m max. - 2669m off bottom; station repeated as DR57

SO203 - DR57
ESE of Moresby Seamount, NW of Franklin Seamount ("Continent 1"); Segment 1B, horst and grabens structure
Dredge on bottom UTC 07/11/09 0320hrs, lat 09°50.744'S, long 151°44.092'E, depth 2896m
Dredge off bottom UTC 07/11/09 0430hrs, lat 09°51.253'S, long 151°44.267'E, depth 2608m
total volume: 3/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2891m on bottom - 3150m max. - 2572m off bottom; repetition of DR56

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR57-1	1. Rock Type: pumice 2. Size: 18x22x12cm 3. Shape/Angularity: irregular shape 4. Encrustation: probably Mn-crust 5. Vesicularity: >50% 6. Vesicle Filling: none 7. Matrix Color: light grey to yellowish 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered, fairly weathered on surface, fresh inside 11. comment: pyroclastic rock of silica-rich magma	X	X	X		
DR57-2A	1. Rock Type: block of high vesicular lava flow 2. Size: 24x17x12cm 3. Shape/Angularity: angular-blocky 4. Encrustation: some glass crust, few Fe-oxides 5. Vesicularity: ~25% 6. Vesicle Filling: some filled with frame work (?) 7. Matrix Color: dark grey 8. Primary Minerals: Ol, 15%, up to 5mm, fresh 9. Secondary Minerals: - 10. Degree of Alteration: altered surface 11. Comment: probably subaerial lava	X	X			
DR57-2B	1. Rock Type: high vesicular basalt column 2. Size: 17x13x13cm 3. Shape/Angularity: angular columns 4. Encrustation: some glass crust, black (Mn?) coating 5. Vesicularity: 50-60% small ones, 10% larger ones 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: Ol, 5-10%, up to 4mm, some altered 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered surface 11. Comment: subaerial	X				
DR57-2C	1. Rock Type: high vesicular basalt column 2. Size: 18x18x12cm 3. Shape/Angularity: angular columns 4. Encrustation: some glass crust, black (Mn?) coating 5. Vesicularity: 50-60% small ones, 10% larger ones 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: Ol, 5-10%, up to 4mm, some altered 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered surface 11. Comment: subaerial *similar to DR57-2B*	X				
DR57-3A	1. Rock Type: Pahoehoe lava 2. Size: 20x17x11cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, Fe-Mn-encrustations, ~1mm 5. Vesicularity: vesicles along flow boundaries, otherwise ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Ol, fresh, 3%, up to 5mm; Plag, few, fresh, 5%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface 11. Comment: subaerial	X	X	X		
DR57-3B	1. Rock Type: Pahoehoe lava 2. Size: 18x9x4cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, Fe-Mn crusts up to 4cm thick 5. Vesicularity: vesicles along flow boundaries, otherwise ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Ol, fresh, 3%, up to 5mm; Plag, few, fresh, 5%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface 11. Comment: subaerial *similar to DR57-3A*	X				
DR57-3C	1. Rock Type: Pahoehoe lava 2. Size: 22x15x8cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, Fe-Mn crusts up to 4cm thick 5. Vesicularity: vesicles along flow boundaries, otherwise ~5%; little higher vesicularity than DR57-3A 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Ol, fresh, 3%, up to 5mm; Plag, few, fresh, 5%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface 11. Comment: subaerial *similar to DR57-3A*	X				

DR57-4	1. Rock Type: basalt (three pieces) 2. Size: 14x8x9cm, 12x12x8cm, 12x8x6.5cm 3. Shape/Angularity: all angular 4. Encrustation: glass crust, Fe-Mn- encrustations ~1mm 5. Vesicularity: high vesicularity, up to 50% (near glassy rim) 6. Vesicle Filling: partly sediment filled, coated dark brownish 7. Matrix Color: black, brownish, grey greenish 8. Primary Minerals: Ol, fresh, 3%, up to 4mm; Plag, fresh, 2%, up to 1mm 9. Secondary Minerals: - 10. Degree of Alteration: slightly to moderately weathered surface	X	X			
DR57-5	1. Rock Type: basalt, flow fragment 2. Size: 30x20x12cm 3. Shape/Angularity: subangular 4. Encrustation: Mn coating, up to 3-4 mm 5. Vesicularity: 5 % larger vesicles, >1mm) 30% smaller ones 6. Vesicle Filling: large ones partly with white coating 7. Matrix Color: grey 8. Primary Minerals: Ol, fresh, 3-4%, up to 6mm; Plag, fresh, 2-3%, up to 1mm 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface 11. Comment: subaerial lava flow	X	X			
DR57-6A	1. Rock Type: Pahoehoe lava 2. Size: 20x14x17cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, Fe-Mn-encrustations, ~1mm 5. Vesicularity: vesicles along flow boundaries, otherwise ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Ol, fresh, 3%, up to 5mm; Plag, few, fresh, 5%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface 11. Comment: subaerial *similar to DR57-3A*	X	X			
DR57-6B	1. Rock Type: Pahoehoe lava 2. Size: 8x8x6cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, Fe-Mn-encrustations, ~1mm 5. Vesicularity: vesicles along flow boundaries, otherwise ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Ol, fresh, 3%, up to 5mm; Plag, few, fresh, 5%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface 11. Comment: subaerial *similar to DR57-3A*	X	X			
DR57-7	1. Rock Type: volcanoclastic rock, clay sediment 2. Size: 21x22x12cm 3. Shape/Angularity: rounded 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: greenish, yellowish, grey 8. Primary Minerals: possibly calcite fragments 9. Secondary Minerals: - 10. Degree of Alteration: ?					

SO203 - DR59
basin N of Franklin Seamount ("Continent 2")
Dredge on bottom UTC 07/11/09 0906hrs, lat 09º52.804'S, long 151º53.607'E, depth 2000m
Dredge off bottom UTC 07/11/09 1005hrs, lat 09º52.635'S, long 151º54.078'E, depth 1865m
total volume: full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2081m on bottom - 2350m max. - 1860m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR59-1A	1. Rock Type: basalt fragment 2. Size: - 3. Shape/Angularity: subangular 4. Encrustation: slight Mn-crust 5. Vesicularity: up to 15%, <3mm, irregular 6. Vesicle Filling: none 7. Matrix Color: dark grey to black 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh	X	X			
DR59-1B	1. Rock Type: strongly altered basalt fragments (3 pieces) 2. Size: - 3. Shape/Angularity: subangular to subrounded 4. Encrustation: Mn coating 5. Vesicularity: ~20%, <1cm, round 6. Vesicle Filling: coated 7. Matrix Color: dark grey to brownish 8. Primary Minerals: none macroscopically visible, mayby microlites 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered	X				3 pieces
DR59-2	basalt hyaloclastic, coarse grained, clasts: 1-3cm, cemented with amorphic silica ± clay material, surface coating of Mn-oxides					
DR59-3	volcanic breccia, composed of variably altered angular clasts: 0.5-2cm in diameter, of probable dacitic composition, dominant clay alteration of clasts and matrix					
DR59-4	massive pale green to grey coherent dacite with quartz filled amygdales and fine fractures with alteration haloes, gas cavities ≤1cm with euhedral quartz and remnants of possible late sulfur crystals					
DR59-5	massive pale green coherent dacite, more intensively altered to clay compared to DR59-4, flattened vesicles					
DR59-6	brecciated massive pale grey to green dacite with minor quartz stockwork and white clay alteration along quartz veinlets					
DR59-7	quartz-rich breccia with intensively clay-altered dacite clasts: 0.5-1cm in diameter, with quartz rims in a quartz matrix, 1-2% disseminated pyrite in quartz					
DR59-8	weathered and moderately oxidizied *similar to DR59-7*					
DR59-9	mixture of quartz rich breccias with highly variably altered dacite clasts: 0.5-1cm in diameter, minor disseminated sulfides					bag of clay
DR59-10	hematitic quartz rich matrix *similar to DR59-7*					
DR59-11	quartz-rich breccia with angular intensively clay-altered dacite clasts: 1-2cm in diameter, dark grey to black quartz matrix with abundant sulfides (pyrite, chalcopyrite, tennantite?)					
DR59-12	weathered, clay altered massive dacite *similar to DR59-4 and DR59-5*					

SO203 - DR60
S of Cheshire Seamount; Basin between Cheshire and Franklin Seamount, between continents
Dredge on bottom UTC 07/11/09 1310hrs, lat 09º52.000'S, long 151º49.499'E, depth 2845m

Dredge off bottom UTC 07/11/09 1439hrs, lat 09°52.483'S, long 151°49.981'E, depth 2795m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2871m on bottom - 3200m max. - 2790m off bottom

SO203 - DR61
W of Franklin Seamount; basin S of "Continent 1"
Dredge on bottom UTC 07/11/09 1754hrs, lat 09°54.480'S, long 151°43.981'E, depth 3131m
Dredge off bottom UTC 07/11/09 1905hrs, lat 09°54.884'S, long 151°44.376'E, depth 3124m
total volume: one rock
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3139m on bottom - 3650m max. - 3112m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR61-1	1. Rock Type: possibly basalt with glass crust 2. Size: 8x6.5x2.5cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, up to 5mm; Mn coating on other side 5. Vesicularity: very dense, few vesicular parts <1%, <1mm 6. Vesicle Filling: coating or alteration 7. Matrix Color: black, dark grey 8. Primary Minerals: Plag 9. Secondary Minerals: Palagonite on glass crust 10. Degree of Alteration: fairly fresh	X		X		

SO203 - DR63
NW flank of Moresby Seamount
Dredge on bottom UTC 08/11/09 0038hrs, lat 09°47.143'S, long 151°32.230'E, depth 1325m
Dredge off bottom UTC 08/11/09 0217hrs, lat 09°47.499'S, long 151°32.607'E, depth 610m
total volume: full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 1350m on bottom - 1650m max. - 570m off bottom; topography along the dredge haul: sampling along a steep flank towards the summit plateau; only sedime
rocks of the Pliocene-Peistocene synrift-sequence; because of the turbiditic deposition regime, samples vary in grainsize and mineralogical composition; the sediment source is interpreted to be located south of Moresby Seamount

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR63-1	The fine-grained sandstones and mudstones of this group are all tectonically overprinted. Brittle deformation is concentrated in finegrained clayey to silty layers. Sample DR63-1A shows slickensides on a sliding surface. Some fault surfaces display slickensides (without calcite fibres). Sample DR63-2A shows laminated domains representing sedimentary layering as well as massive domains. The latter display extensional fractures at an angle of about 30° to the layering. There is, however, no visible offset of layering. Sample DR63-3A is a tectonically overprinted siltstone/claystone with anastomosing shear planes, which might be caused by soft sediment deformation. A few samples show calcite filled tensional fractures perpendicular to the layering.					Individual samples: DR 63-1A, DR 63-1B, DR 63-1C, DR 63-1D
DR63-2	These samples are homogeneous, greenish sandstones, mostly without an internal structure. Some samples show bioturbation, i.e. sand-filled tubes.					Individual sample: DR 63-2A
DR63-3	Very fine-grained, homogeneous sandstones without lamination or other sediment structures consisting of volcanic, terrigenous, and biogenic components, nevertheless quartz is dominating.					Individual sample: DR 63-3A, DR 63-3B
DR63-4	Greywacke to conglomerates with grain sizes from 0.5mm up to 2mm and 2mm up to 5mm, respectively. Most samples are very dark greywackes mainly consisting of basaltic rock fragments and do not show sedimentary structures. Sample DR63-A, a fine-grained conglomerate with clear fining upward sequence, shows well rounded components up to 10mm in size. This sample represents the coarsest recovered sample from the turbiditic succession.					Individual sample: DR 63-4A, DR 63-4B

SO203 - DR65
NW of Moresby Seamount; basin
Dredge on bottom UTC 08/11/09 0847hrs, lat 09°41.949'S, long 151°24.080'E, depth 2626m
Dredge off bottom UTC 08/11/09 1023hrs, lat 09°42.735'S, long 151°24.837'E, depth 2683m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2599m on bottom - 3050m max. - 2600m off bottom; dredge site was not repeated

SO203 - DR69
NW flank of Moresby Seamount, lower part
Dredge on bottom UTC 09/11/09 0038hrs, lat 09°46.395'S, long 151°36.388'E, depth 2224m
Dredge off bottom UTC 09/11/09 0155hrs, lat 09°46.841'S, long 151°36.389'E, depth 1605m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2247m on bottom - 2500m max. - 1610m off bottom; topography along the dredge haul: sampling along a channel in a steep flank towards the summit plateau
quartz-rich metamorphic schists and gneisses; mineralogy indicates at least greenschist-facies conditions

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR69-1	The light-green to dark-green chlorite schists are made of chlorite, serizite, quartz, feldspar, rare biotite, and rare epidote. Samples are tightly-foliated and folded by different fold-types. Kink folds are most common; most samples are additionally overprinted by kink bands. Some samples are only weakly foliated and affected by open folds. Sample DR69-1C is fine-grained, chlorite-rich and contains few coarse-crystalline quartz porphyroclasts up to 2cm in size. The sample also shows weakly-developed shearbands. Some samples display garnet (?) with a grain size of 0.5-1mm. The content of quartz is variable, a few samples contain patches of dark green chlorite					Individual sample: DR 69-1A, DR 69-1B, DR 69-1C, DR 69-1D, DR 69-1E, DR 69-1F, DR 69-1G
DR69-2	The mineralogy and texture of these 6 samples is similar to the previous group. However, this group is affected by hydrothermal, quartz-filled veins.					Individual samples: DR 69-2A/1-6
DR69-3	The dark grey to black, fine-grained to medium-grained quartz-phyllites and schists consist of more than 50% mica. The foliation displays a stretching lineation and is affected by kink folds. The Stretching lineation and fold axes enclose an angle of 30°-35°.					Individual samples: DR 69-3A, DR 69-3B, DR 69-3C
DR69-4	Samples from this group are massive, grey metapelites/metapsammites consisting of feldspar, quartz, and mica. They display a gneissic deformation texture, some samples can be described as proto-mylonites (without porphyroclasts). Samples show abundant, mostly quartz-filled, less calcite-filled, fractures perpendicular to the foliation. Stretching lineation is rare. Sample DR69-4J bears macroscopically visible pyrite.					Individual samples: DR 69-4A, DR 69-4B, DR 69-4C, DR 69-4D, DR 69-4E, DR 69-4F, DR 69-4G, DR 69-4H, DR 69-4I, DR 69-4J
DR69-5	All samples have mineralogical composition similar to samples from group 4, but they are affected by intense crenulation folding overprinting the foliation. Locally, joint- and fracture- surfaces are coated by euhedral calcite crystals.					Individual samples: DR 69-5A, DR 69-5B, DR 69-5C

SO203 - DR70
SE of Cheshire Seamount and NE of Franklin Seamount; SW side of larger seamount, W-facing slope
Dredge on bottom UTC 09/11/09 0639hrs, lat 09°52.749'S, long 151°52.994'E, depth 2175m
Dredge off bottom UTC 09/11/09 0751hrs, lat 09°52.383'S, long 151°53.367'E, depth 1758m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2870m on bottom - 3100m max. - 2421m off bottom; volcanic glass, SiO_2-rich lava flow, pumice, hyaloclastic rocks

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR70-1	Hyaloclastite; size: 25x20x15cm; cm-sized clasts					
DR70-2	Flow-bounded rhyolite, with ~5% elongated vesicles, 1.5cm glass crust, 19x12x9cm	X		X		
DR70-3	Devitrified rhyolite glass, sediment in elongated vesicles, aphyric/no phenocrysts, ~30% vesicles, 10x7x4cm	X	X			
DR70-4	Pumice with Mn-coating, 9x8x6cm	X	X			
DR70-5	Devitrified rhyolite glass, sediment in elongated vesicles, aphyric/no phenocrysts, ~30% vesicles, 13x10x7cm *similar to DR70-3*	X	X			
DR70-6	Rhyolite sheet flow fragment with glassy surface, 1.5cm, elongated vesicles and flow banding, 10x8x7cm	X		X		
DR70-7	Massive almost completely crystallized rhyolite, flow banding almost obliterated (c.f. 8)	X	X			
DR70-8	Partially devitrified rhyolite flow with banding; surface with Mn-coating <1mm; few <1% elongated vesicles; 20x14x11cm	X	X			

SO203 - DR72

Segment 1B; conical volcano
Dredge on bottom UTC 10/11/09 0328hrs, lat 09°57.685'S, long 152°5.982'E, depth 2846m
Dredge off bottom UTC 10/11/09 0438hrs, lat 09°58.021'S, long 152°6.319'E, depth 2419m
total volume: ~3 pieces
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2870m on bottom - 3100m max. - 2421m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR72-1	1. Rock Type: Pillow 2. Size: - 3. Shape/Angularity: - 4. Encrustation: thin glass rim, 1-2mm; Mn-dusting and sediment on fractures 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag, 2%; Ol, 1% 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR72-2	1. Rock Type: Pillow 2. Size: - 3. Shape/Angularity: - 4. Encrustation: thin glass rim, 1-2mm; Mn-dusting and sediment on fractures 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag, 2%; Ol, 1% 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR72-1*	X		X		
DR72-3	1. Rock Type: Pumice (3 pieces) 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: -	X				3 pieces

SO203 - DR73
Segment 1B; flat seafloor
Dredge on bottom UTC 10/11/09 0701hrs, lat 09°56.605'S, long 152°4.988'E, depth 2675m
Dredge off bottom UTC 10/11/09 0758hrs, lat 09°56.606'S, long 152°5.620'E, depth 2675m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2651m on bottom - 2920m max. - 2675m off bottom; MAPR #53 300m above dredge

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR73-1	1. Rock Type: Pillow rim with glass crust 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, 4mm; internal glass veins; some sediment on crack; Mn-dusting on unbroken surfaces 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR73-2	1. Rock Type: Pillow bud 2. Size: small 3. Shape/Angularity: - 4. Encrustation: glass crust, 2-3mm; some sediments in fractures 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: fresh	X		X		
DR73-3	1. Rock Type: Pillow edge 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, 4mm; brown dusting 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: some Fe-oxides on fractures 10. Degree of Alteration: -	X		X		
DR73-4	1. Rock Type: Pillow 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust; Mn-dusting and sediment on internal joints 5. Vesicularity: 1% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR73-5	1. Rock Type: Pumice 2. Size: 5x5x5cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: fresh	X				

SO203 - DR75
W side of continental fragment; Segment 1C
Dredge on bottom UTC 11/11/09 0653hrs, lat 09°59.551'S, long 152°19,332'E, depth 2201m
Dredge off bottom UTC 11/11/09 0809hrs, lat 09°59.540'S, long 152°19,854'E, depth 1858m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2283m on bottom - 2600m max. - 1832m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES

DR75-1	1. Rock Type: Basalt pillow fragment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: Glass crust, up to 2mm 5. Vesicularity: <1% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag phenocrysts <<1%, 1-2mm 9. Secondary Minerals: - 10. Degree of Alteration: -	X		X		
DR75-2	1. Rock Type: Pillow sector 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 2mm 5. Vesicularity: <<1% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR75-1, but more and larger phenocrysts*	X		X		
DR75-3	Piece of bomb or whale bone					
DR75-4	1. Rock Type: Pillow sector 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 2mm 5. Vesicularity: <<1% 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: - *very similar to DR75-2*	X		X		
DR75-5	1. Rock Type: Pillow tongue 2. Size: 30x27x18cm 3. Shape/Angularity: - 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: old-looking	X		X		
DR75-6	1. Rock Type: Basaltic rock fragment 2. Size: - 3. Shape/Angularity: angular 4. Encrustation: thin Mn-coating 5. Vesicularity: 1%, ~0.5mm 6. Vesicle Filling: some with dark coating, does not look like Mn 7. Matrix Color: dark grey 8. Primary Minerals: Plag phenocrysts & microlites, up to 4mm; Ol. up to 0.5mm; % Plag >> % Ol 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered	X	X			
DR75-7	Sediment; greenish-yellowish, clay-silty; white mineral = SiO_2 (biogene)?					

SO203 - DR76
N side of supposed continental block, Segment 1B, almost between Segments 1B and 1C; N slope to the top
Dredge on bottom UTC 11/11/09 1006hrs, lat 09º59,498'S, long 152º21,846'E, depth 2257m
Dredge off bottom UTC 11/11/09 0758hrs, lat 10º00.014'S, long 152º21,847'E, depth 2041m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2255m on bottom - 2600m max. - 2010m off bottom; large pieces of pillow basalts with large Plag phenocrysts

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR76-1	1. Rock Type: Basaltic lava with glass crust 2. Size: 13x12x11cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 6mm; Mn-coating 5. Vesicularity: 5%, round, up to 1mm 6. Vesicle Filling: brownish-yellowish coating, some with black coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 20%, up to 7mm, fresh; Ol, 3-5%, up to 1mm, fresh 9. Secondary Minerals: - 10. Degree of Alteration: slight to no alteration	X		X		
DR76-2	1. Rock Type: Basaltic lava with glass crust 2. Size: 27x15x8cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤5mm; Mn-coating, thin 5. Vesicularity: 5-8%, 1cm wide, 1cm before glass crust, concentrated in a circular structure, elongated towards glass crust, some rounded and filled 6. Vesicle Filling: rounded: filled with darker fabric, but looking the same as matrix; yellowish-orange material 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤7mm, microlites, fresh; Ol, <<1%, <<1mm, fresh 9. Secondary Minerals: orange vesicle filling 10. Degree of Alteration: fairly fresh	X		X		
DR76-3A	1. Rock Type: Pillow 2. Size: 12x10x9cm 3. Shape/Angularity: - 4. Encrustation: thin Fe-Mn-coating, ~2mm 5. Vesicularity: almost no vesicles 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, few phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: -	X	X			
DR76-3B	1. Rock Type: Pillow 2. Size: 9x6x4cm 3. Shape/Angularity: - 4. Encrustation: thin Fe-Mn-coating, ~2mm 5. Vesicularity: almost no vesicles 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, few phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: - *similar to DR76-3A*					

DR76-4A	1. Rock Type: Pillow 2. Size: 17x12x10cm 3. Shape/Angularity: - 4. Encrustation: Fe-Mn-crust; slight glass crust 5. Vesicularity: few vesicles 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag, lots of phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: altered surface	X	X	X		
DR76-4B	1. Rock Type: Pillow 2. Size: 21x13x12cm 3. Shape/Angularity: - 4. Encrustation: Fe-Mn-crust; slight glass crust 5. Vesicularity: few vesicles 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: Plag, lots of phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: altered surface *similar to DR76-4A*					

SO203 - DR77
Seamount between Segments 1B and 1C; E flank to the top
Dredge on bottom UTC 11/11/09 1343hrs, lat 10°01,497'S, long 152°22.00'E, depth 2750m
Dredge off bottom UTC 11/11/09 1441hrs, lat 10°1,493'S, long 152°22,453'E, depth 2600m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2743m on bottom - 3050m max. - 2569m off bottom; station repeated as DR78

SO203 - DR78
Segment 1B; flat seafloor
Dredge on bottom UTC 10/11/09 0701hrs, lat 09°56.605'S, long 152°4.988'E, depth 2675m
Dredge off bottom UTC 10/11/09 0758hrs, lat 09°56.606'S, long 152°5.620'E, depth 2675m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2751m on bottom - 3100m max. - 2580m off bottom; MAPR #53 300m above dredge; repetition of DR77

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR78-1	1. Rock Type: Pillow lava fragment with glass crust 2. Size: 27x26x14cm 3. Shape/Angularity: glass rounded, rock angular 4. Encrustation: glass crust, ≤10mm; Mn-coating 5. Vesicularity: only in inner parts of rock and away from glass crust; 20-30%, all <<1mm 6. Vesicle Filling: not visible 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, ≤2mm, fresh; Ol, <<1%, <<1mm 9. Secondary Minerals: Palagonite on outer glass crust 10. Degree of Alteration: fresh	X		X		
DR78-2	1. Rock Type: Pillow lava fragment with glass crust 2. Size: 17x16x12cm 3. Shape/Angularity: glass rounded, rock angular 4. Encrustation: glass crust, ≤10mm; Mn-coating 5. Vesicularity: only in inner parts of rock and away from glass crust; 20-30%, all <<1mm 6. Vesicle Filling: not visible 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, ≤2mm, fresh; Ol, <<1%, <<1mm 9. Secondary Minerals: Palagonite on outer glass crust 10. Degree of Alteration: fresh *similar to DR78-1*	X		X		
DR78-3	1. Rock Type: Pillow rim 2. Size: 18.5x13x4cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, up to 1.5mm 5. Vesicularity: 5%, some rounded, few not 6. Vesicle Filling: black coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, also on outer glass, up to 5mm, moderately altered; Ol, <1%, <2mm, fresh, with inclusions 9. Secondary Minerals: Palagonite 10. Degree of Alteration: slightly altered, but overall fresh	X		X		
DR78-4	3. Shape/Angularity: glass rounded, rock angular 4. Encrustation: glass crust, ≤10mm; Mn-coating 5. Vesicularity: only in inner parts of rock and away from glass crust; 20-30%, all <<1mm 6. Vesicle Filling: not visible 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, ≤2mm, fresh; Ol, <<1%, <<1mm 9. Secondary Minerals: Palagonite on outer glass crust 10. Degree of Alteration: fresh *similar to DR78-1 and DR78-2*	X		X		
DR78-5	1. Rock Type: Pillow rim 2. Size: 21x17x7.5cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, up to 1.5mm 5. Vesicularity: 5%, some rounded, few not 6. Vesicle Filling: black coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, also on outer glass, up to 5mm, moderately altered; Ol, <1%, <2mm, fresh, with inclusions 9. Secondary Minerals: Palagonite 10. Degree of Alteration: slightly altered 11. Comments: more altered and more Mn-crust then DR78-3, lower rim with Mn-coating; dripping structure underneath, degassing structure --> vesicles rising to surface (glass rim) *similar to DR78-3*	X		X		
DR78-6	1. Rock Type: Pillow lava fragment with glass crust 2. Size: 25x20x17cm 3. Shape/Angularity: glass rounded, rock angular 4. Encrustation: glass crust, up to 3-5mm; Mn-coating thicker than of DR78-2 and DR78-3 5. Vesicularity: only in inner parts of rock and away from glass crust; 20-30%, all <<1mm 6. Vesicle Filling: not visible 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, ≤2mm, fresh; Ol, <<1%, <<1mm 9. Secondary Minerals: Palagonite on outer glass crust 10. Degree of Alteration: fresh *similar to DR78-1 and DR78-2*	X		X		

SO203 - DR80
Axis Segment 1C, new axis? oriented 070°; flat part pf this "new" axis
Dredge on bottom UTC 12/11/09 0209hrs, lat 10°1.691'S, long 152°11.989'E, depth 2765m
Dredge off bottom UTC 12/11/09 0329hrs, lat 10°1.700'S, long 152°12.781'E, depth 2768m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2762m on bottom - 3050m max. - 2710m off bottom; MAPR #51 300m above dredge

SO203 - DR81
E end of Segment 1B
Dredge on bottom UTC 12/11/09 0626hrs, lat 09º75.206'S, long 152º16.491'E, depth 2667m
Dredge off bottom UTC 12/11/09 0740hrs, lat 09º57.414'S, long 152º17.062'E, depth 2683m
total volume: 2 pieces
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2709m on bottom - 3050m max. - 2556m off bottom; pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR81-1	1. Rock Type: Pillow rim with some palagonite sediment coating 2. Size: 10x11x4cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to ≤5mm; Mn-dusting on broken surface 5. Vesicularity: ~5% 6. Vesicle Filling: some with black coating 7. Matrix Color: dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: Palagonite 10. Degree of Alteration: more altered than DR81-2	X		X		
DR81-2	1. Rock Type: Pillow bud 2. Size: 10x8x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 4mm 5. Vesicularity: 1%, irregular 6. Vesicle Filling: black coating 7. Matrix Color: dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: none 10. Degree of Alteration: fresher looking than DR81-1	X		X		
DR81-3	1. Rock Type: Pillow bud 2. Size: several pieces 3. Shape/Angularity: - 4. Encrustation: glass crust, 4mm 5. Vesicularity: 1%, irregular 6. Vesicle Filling: black coating 7. Matrix Color: dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: none 10. Degree of Alteration: fresher looking than DR81-1 11. Comments: several small fragments	X		X		several pieces

SO203 - DR82
Segment 1C, ridge axis; central rise of the ridge axis
Dredge on bottom UTC 12/11/09 1136hrs, lat 10º3.801'S, long 152º22.399'E, depth 2849m
Dredge off bottom UTC 12/11/09 1222hrs, lat 10º4.056'S, long 152º22.653'E, depth 2767m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2851m on bottom - 3067m max. - 2720m off bottom; pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR82-1	1. Rock Type: Pieces of a pillow with cooling columns 2. Size: 23x20x18cm 3. Shape/Angularity: - 4. Encrustation: glass crust 5. Vesicularity: ~5% 6. Vesicle Filling: black coating 7. Matrix Color: grey 8. Primary Minerals: Ol, <2mm, ~3% 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered (slight Fe-Mn-encrustation)	X		X		
DR82-2	1. Rock Type: Pieces of a pillow with cooling columns 2. Size: 21x18x15cm 3. Shape/Angularity: - 4. Encrustation: glass crust 5. Vesicularity: ~5% 6. Vesicle Filling: black coating 7. Matrix Color: grey 8. Primary Minerals: Ol, <2mm, ~3% 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered (slight Fe-Mn-encrustation) *similar to DR82-1*	X		X		
DR82-3	1. Rock Type: Pieces of a pillow with cooling columns 2. Size: 12x9x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust 5. Vesicularity: ~5% 6. Vesicle Filling: black coating 7. Matrix Color: grey 8. Primary Minerals: Ol, <2mm, ~3% 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered (slight Fe-Mn-encrustation) similar to DR82-1	X		X		
DR82-4	1. Rock Type: Pieces of a pillow with cooling columns 2. Size: 16x10x9cm 3. Shape/Angularity: - 4. Encrustation: glass crust 5. Vesicularity: ~5% 6. Vesicle Filling: black coating 7. Matrix Color: grey 8. Primary Minerals: Ol, <2mm, ~3% 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered (slight Fe-Mn-encrustation) similar to DR82-1	X		X		

SO203 - DR83
Segment 1C, ridge axis; central rise
Dredge on bottom UTC 12/11/09 1524hrs, lat 10º3.795'S, long 152º27.692'E, depth 2910m
Dredge off bottom UTC 12/11/09 1607hrs, lat 10º3.766'S, long 152º28.036'E, depth 2926m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2912m on bottom - 3150m max. - 2905m off bottom; MAPR #50 300m above dredge

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR83-1	1. Rock Type: pillow fragment 2. Size: 20x15x10cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1cm; Mn-coating 5. Vesicularity: large: >1mm, 1-3%; small: <<1mm, 10-20%, irregular 6. Vesicle Filling: some with black coating (Mn? ± FeS/eS$_2$?) 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-3%, up to 4mm, mostly <1mm, fresh; Ol, <<1%, <<1mm, slighty altered 9. Secondary Minerals: Palagonite, FeS/FeS$_2$ 10. Degree of Alteration: slightly to moderately altered	X (1A?)		X		

DR83-2	2. Rock Type: Basalt lava with glassy crust 2. Size: 12x8x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 3mm; Mn-coating 5. Vesicularity: >1mm: 5%; <<1mm: 10-20%; irregular 6. Vesicle Filling: FeS/FeS_2, black coating, yellowish powder 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, <4mm, ancicular, altered; Ol, 1%, ≤1mm, moderately altered 9. Secondary Minerals: FeS/FeS_2, Palagonite 10. Degree of Alteration: slightly to moderately altered	X		X		
DR83-3	1. Rock Type: large piece of pillow 2. Size: 70x45x25cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 3mm; Mn-coating 5. Vesicularity: >1mm: 5%; <<1mm: 10-20%; irregular 6. Vesicle Filling: FeS/FeS2, black coating, yellowish powder 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, <4mm, ancicular, altered; Ol, 1%, ≤1mm, moderately altered 9. Secondary Minerals: FeS/FeS2, Palagonite 10. Degree of Alteration: slightly to moderately altered *probably the same sample as DR83-1; check EMA data!*	X		X		glass needs to be washed!

SO203 - DR84
Axis Segment 1C; central volcanic rise of ridge axis
Dredge on bottom UTC 12/11/09 1858hrs, lat 10°3.995'S, long 152°31.995'E, depth 2908 m
Dredge off bottom UTC 12/11/09 1958hrs, lat 10°4.006'S, long 152°32.505'E, depth 2857m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2917m on bottom - 3300m max. - 2837m off bottom; station repeated as DR85

SO203 - DR85
Axis Segment 1C; central volcanic rise of ridge axis
Dredge on bottom UTC 12/11/09 2209hrs, lat 10°3.906'S, long 152°31.995'E, depth 2935m
Dredge off bottom UTC 12/11/09 2304hrs, lat 10°3.893'S, long 152°32.474'E, depth 2903m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2950m on bottom - 3300m max. - 2875m off bottom; repetition of DR84

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR85-1	1. Rock Type: few fragments of glassy crust 2. Size: - 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1.5cm thick 5. Vesicularity: <1%, irregular 6. Vesicle Filling: few with dark coating 7. Matrix Color: dark grey, glass black 8. Primary Minerals: Plag, up to 7mm, ancicular, 3-5%, fairly fresh; glomerocrysts with Ol ~3%, <1mm, fresh 9. Secondary Minerals: Palagonite 10. Degree of Alteration: moderately fresh	X		X		
DR85-2	1. Rock Type: Pumice 2. Size: - 3. Shape/Angularity: angular 4. Encrustation: - 5. Vesicularity: 90% or more 6. Vesicle Filling: (sediment) 7. Matrix Color: greyish 8. Primary Minerals: ? 9. Secondary Minerals: ? 10. Degree of Alteration: ?	X	X			

SO203 - DR86
Axis Segment 1C?; linear E-W ridge
Dredge on bottom UTC 13/11/09 0238hrs, lat 10°4.193'S, long 152°38.060'E, depth 3100m
Dredge off bottom UTC 13/11/09 0340hrs, lat 10°4.004'S, long 152°38.639'E, depth 2980m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3077m on bottom - 3400m max. - 2948m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR86-1	1. Rock Type: pillow fragment 2. Size: 15x13x10cm 3. Shape/Angularity: - 4. Encrustation: glass crust, few mm 5. Vesicularity: 5-7% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: some Ol crystals, <1%, <1mm 10. Degree of Alteration: fairly fresh *similar to DR86-3, but fresher*	X		X		
DR86-2	1. Rock Type: basaltic lava with glassy crust 2. Size: 15x14x10cm 3. Shape/Angularity: - 4. Encrustation: glassy crust up to 1cm 5. Vesicularity: ~10% 6. Vesicle Filling: some vesicles filled by darker, highly vesicular lava 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~5%, <3mm; Ol, <1%, 1-2mm 9. Secondary Minerals: Palagonite 10. Degree of Alteration: moderately to strongly altered *similar to DR86-5*	X		X		
DR86-3	1. Rock Type: pillow fragment 2. Size: 35x25x25cm 3. Shape/Angularity: - 4. Encrustation: glass encrustations; Mn-Fe coating 5. Vesicularity: ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: similar to DR86-1, but more altered, slightly to moderately altered	X		X	separate sample taken for sulfur	
DR86-4	1. Rock Type: probably crust of a sheet flow 2. Size: 11x6.5x2.5cm 3. Shape/Angularity: - 4. Encrustation: glass crust, <3mm; Mn-crust on lower side 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Ol, 1-2%, 1-2mm 9. Secondary Minerals: Palagonite 10. Degree of Alteration: slightly altered on top, strongly beneath (Mn-crust)	X		X		

DR86-5	1. Rock Type: basaltic lava with glassy crust 2. Size: 27x23x17cm 3. Shape/Angularity: - 4. Encrustation: glassy crust up to 1cm 5. Vesicularity: ~10% 6. Vesicle Filling: some vesicles filled by darker, highly vesicular lava 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~5%, <3mm; Ol, <1%, 1-2mm 9. Secondary Minerals: Palagonite 10. Degree of Alteration: moderately to strongly altered *similar to DR86-2*	X		X	separate sample taken for sulfur	

SO203 - DR87
South of axis Segment 1C
Dredge on bottom UTC 13/11/09 0625hrs, lat 10º5.492'S, long 152º37.755'E, depth 3371m
Dredge off bottom UTC 13/11/09 0739hrs, lat 10º5.779'S, long 152º38.228'E, depth 3381m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3358m on bottom - 3690m max. - 3312m off bottom; MAPR #50 400m above dredge

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR87-1	1. Rock Type: pillow lava ? 2. Size: 13x12x8cm 3. Shape/Angularity: angular 4. Encrustation: glass crust; slight Mn-Fe-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: altered on surfaces, fairly altered	X		X	separate sample taken for sulfur	
DR87-2	1. Rock Type: pillow lava, similar to 1 2. Size: 20x14x9 3. Shape/Angularity: angular 4. Encrustation: glass crust; slight Mn-Fe-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: altered on surfaces, fairly altered *similar to DR87-1*	X		X		
DR87-3	1. Rock Type: pillow ? 2. Size: 16x7x7cm 3. Shape/Angularity: subangular 4. Encrustation: glass encrustation; slight Mn-coating 5. Vesicularity: ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: fresher looking than DR87-1 *similar to DR87-1*	X		X		
DR87-4	1. Rock Type: piece of pillow lava or lava pillar 2. Size: 13x13x12cm 3. Shape/Angularity: angular 4. Encrustation: glass crust; slight Mn-Fe-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: altered on surfaces, fairly altered *similar to DR87-1*	X		X		

SO203 - DR88
N of axis Segment 1C; cone with 2 craters (~40m deep)
Dredge on bottom UTC 13/11/09 1014hrs, lat 10º3.195'S, long 152º36.849'E, depth 2950m
Dredge off bottom UTC 13/11/09 1105hrs, lat 10º3.351'S, long 152º37.294'E, depth 2904m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2951m on bottom - 3250m max. - 2890m off bottom; MAPR #50 400m above dredge; pieces of fresh looking sheet flows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR88-1	1. Rock Type: piece of sheet flow 2. Size: 30x26x10cm 3. Shape/Angularity: - 4. Encrustation: thick glass encrustations, 3-4mm 5. Vesicularity: large vesicles, 1%, >1mm; small: 5-20%, <1mm; depending on location in rock 6. Vesicle Filling: yellow and black coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2%, few ancicular; Ol, 2% 9. Secondary Minerals: Palagonite? 10. Degree of Alteration: fresh looking, sediments but no coating, slightly altered glass crust	X		X		
DR88-2	1. Rock Type: piece of sheet flow 2. Size: 9x8x3cm 3. Shape/Angularity: - 4. Encrustation: thick glass crust, up to 1.2cm 5. Vesicularity: few large ones 6. Vesicle Filling: black coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%; Ol, 2% 9. Secondary Minerals: Palagonite 10. Degree of Alteration: slightly altered glass crust, overall fresh	X		X		
DR88-3	1. Rock Type: piece of sheet flow 2. Size: 18x9x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 4mm 5. Vesicularity: large: 5%, 0.5mm and up to >1mm; small: 20%, <<1mm 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2%, ancicular; Ol, 2% 9. Secondary Minerals: Palagonite, looking dirty 10. Degree of Alteration: slightly altered glass crust	X		X		
DR88-4	1. Rock Type: piece of sheet flow 2. Size: 9x7x6cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 3mm 5. Vesicularity: few: >1mm, mostly (10%): <<1mm 6. Vesicle Filling: none 7. Matrix Color: grey, lighter colour than DR88-1, DR88-2, DR88-3, DR88-5 8. Primary Minerals: Plag, 1%, ancicular; Ol, 1% 9. Secondary Minerals: - 10. Degree of Alteration: fresh, no alteration	X		X	separate sample taken for sulfur	

DR88-5	1. Rock Type: piece of sheet flow 2. Size: 13x11x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 6-7mm 5. Vesicularity: large vesicles, 1%, >1mm; small: 5-20%, <1mm; depending on location in rock; similar to DR88-1 6. Vesicle Filling: starting of brownish-yellowish coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 5%, few ancicular; Ol, 2% 9. Secondary Minerals: Palagonite, glass bluish 10. Degree of Alteration: slightly altered on glass crust	X		X		

SO203 - DR89
South of Segment 1C; E End
Dredge on bottom UTC 13/11/09 1437hrs, lat 10º9.918'S, long 152º44.510'E, depth 2616m
Dredge off bottom UTC 13/11/09 1524hrs, lat 10º10.300'S, long 152º44.492'E, depth 2379m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2637m on bottom - 2800m max. - 2310m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR89-1	Coarse grained Granodiorite? few fragments (could be Qtz added hydrothermally); size: 9x8x6cm; shape: angular; thin Mn-coating, <1mm on few sides; epidote, green, depending on fragment between 5-20%; Qtz, up to 50%; strongly altered					
DR89-2	Diorite; finer grained than DR89-1; medium grained *similar to DR89-1*					
DR89-3	Diorite; same as DR89-1 and DR89-2, but finer grained than DR89-2 *similar to DR89-1 and DR89-2*					
DR89-4	Diorite or Diabase; very fine grained *similar to DR89-1, DR89-2 and DR89-3*					
DR89-5A	probably Andesite; presence of vesicles filled by epidote and qtz; strongly altered					
DR89-5B	probably Andesite; cut by fine fractures; lined by epidote *same as DR89-5A*					
DR89-5C	probably Andesite; porphorytic; epidote=replacement of calcic Fsp (secondary)					
DR89-5D	porphyric mafic with black phenocrysts: Hbl?					
DR89-6	probably Andesite; fine grained; mafic volcanic; probably same as DR89-5; intensely silicified; cut by Qtz veins with Chloritic margins *similar to DR89-5*					
DR89-7	Fault breccia (porphyric); with brecciated Qtz-vein material					
DR89-8	Breccia (porphyric), clast-supported; polymictic; clast: medium grained altered granodiorite, finer grained mafic volcanic and preexisting breccia; dissemination sulfides and pyrite in clasts; clasts up to 1cm					

SO203 - DR91
1st larger volcano in mountain range of Segment 4A; Central sampling location of Segment 4A
Dredge on bottom UTC 15/11/09 0126hrs, lat 9º32.596'S, long 155º20.595'E, depth 3973m
Dredge off bottom UTC 15/11/09 0239hrs, lat 9º33.039'S, long 155º21.004'E, depth 3905m
total volume: 3/4 full;
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 4007m on bottom - 4300m max. - 3747m off bottom; dredged towards 135°

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR91-1	1. Rock Type: Pillow 2. Size: 23x22x15cm 3. Shape/Angularity: - 4. Encrustation: glass crust; thin Fe-Mn-coating 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: Plag, 1-3%, <1mm 10. Degree of Alteration: hydrothermally alterated surface, fresh interior	X		X		
DR91-2	1. Rock Type: Pillow 2. Size: 21x13x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust; thin Fe-Mn-coating 5. Vesicularity: 5-7% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: probably some small Plag phenocrysts 9. Secondary Minerals: - 10. Degree of Alteration: hydrothermally altered surface, fresh beneath surface *similar to DR91-1*	X		X		
DR91-3	1. Rock Type: Pillow 2. Size: 26x25x20cm 3. Shape/Angularity: - 4. Encrustation: glass crust; thin Fe-Mn-coating 5. Vesicularity: 3-5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: Ol and Plag, <1mm 10. Degree of Alteration: hydrothermally altered surface, fresh beneath surface *similar to DR91-1*	X		X		
DR91-4	1. Rock Type: Pillow 2. Size: 21x17x16cm 3. Shape/Angularity: - 4. Encrustation: glass crust; thin Fe-Mn-coating 5. Vesicularity: very small vesicles, ~3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: hydrothermally altered surface, fresh beneath surface *similar to DR91-1*	X		X		
DR91-5	1. Rock Type: Pillow 2. Size: 7x7x5cm 3. Shape/Angularity: - 4. Encrustation: glass crust 5. Vesicularity: 3-5% 6. Vesicle Filling: - 7. Matrix Color: dark grey, almost black 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: very fresh looking	X		X		

DR91-6	1. Rock Type: Pillow 2. Size: 11x9x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, slight Fe-Mn-coating 5. Vesicularity: ~3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: almost fresh looking	X		X		
DR91-7	1. Rock Type: Pillow 2. Size: 17x12x12cm 3. Shape/Angularity: - 4. Encrustation: glass crust, slight Fe-Mn-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: hard to see, probably Plag, <1%, <1mm; one single Ol, up to 4mm 9. Secondary Minerals: - 10. Degree of Alteration: almost fresh looking *similar to DR91-6*	X		X		

SO203 - DR93
W end of ridge axis Segment 2
Dredge on bottom UTC 16/11/09 1204hrs, lat 10°22.899'S, long 152°54.001'E, depth 3293m
Dredge off bottom UTC 16/11/09 1258hrs, lat 10°22.901'S, long 152°54.493'E, depth 3240m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3297m on bottom - 3550m max. - 3190m off bottom; MAPR #54 at 400m above DR

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR93-1	1. Rock Type: Pillow fragment 2. Size: 27x22x20cm 3. Shape/Angularity: - 4. Encrustation: yellowish coating, glass on top ≤3mm 5. Vesicularity: 3-5%, ≤1mm, various shapes, mostly round 6. Vesicle Filling: slight yellowish coating 7. Matrix Color: dark grey 8. Primary Minerals: Plag microlites, few ancicular 9. Secondary Minerals: Palagonite on glass crust 10. Degree of Alteration: not fresh looking on the outside, beneath surface: fresh	X		X		
DR93-2	1. Rock Type: Pillow fragment 2. Size: 23x22x20cm 3. Shape/Angularity: - 4. Encrustation: yellowish coating, glass on top ≤3mm 5. Vesicularity: 3-5%, ≤3mm, various shapes, some angular 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag microlites, few ancicular 9. Secondary Minerals: - 10. Degree of Alteration: not fresh looking on the outside, beneath surface: fresh *similar to DR93-1*	X		X		
DR93-3	1. Rock Type: Pillow fragment 2. Size: 14x12x8cm 3. Shape/Angularity: - 4. Encrustation: yellowish coating, glass on top < 3mm 5. Vesicularity: ~5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-5%, <1mm; Ol, just one, ~3mm 9. Secondary Minerals: - 10. Degree of Alteration: not fresh looking on the outside, beneath surface: fresh *similar to DR93-1*	X		X		

SO203 - DR94
Ridge axis of segment 2 (volcanic cone on axis)
Dredge on bottom UTC 16/11/09 1609hrs, lat 10°22.492'S, long 153°00.700'E, depth 3204m
Dredge off bottom UTC 16/11/09 1709hrs, lat 10°22.961'S, long 153°00.968'E, depth 3085m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3222m on bottom - 3450m max. - 3037m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR94-1	1. Rock Type: Pillow fragment?; basaltic lava with glassy crust 2. Size: 26x16x18cm 3. Shape/Angularity: - 4. Encrustation: glass, up to 5mm, dull; slight Mn-coating 5. Vesicularity: 1-2%, ≤1mm 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: Plag, <1%, microlites, few up to 1mm 9. Secondary Minerals: Palagonite on glass crust 10. Degree of Alteration: yellowish, greyish on the outside - altered; beneath surface: fresh; glass fairly fresh 11. Cooling crack on surface	X		X		
DR94-2	1. Rock Type: Pillow fragment 2. Size: 17x13x7cm 3. Shape/Angularity: - 4. Encrustation: glass, up to 1.2cm, shiny; slight Mn-coating, less than at DR94-1 5. Vesicularity: 1-2%, ≤1mm 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: Plag, <1%, microlites, few up to 1mm 9. Secondary Minerals: some Palagonite on glass crust 10. Degree of Alteration: slightly more altered than DR94-1 (beneath surface), but glass looks fresher in DR94-1 *similar to DR94-1*	X		X		
DR94-3	1. Rock Type: Small basaltic lava fragment with Pahoehoelava-surface (glass) 2. Size: 9x5x4cm 3. Shape/Angularity: - 4. Encrustation: glass, Pahoehoe, dull, up to 2cm 5. Vesicularity: 1-2%, ≤1mm 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: towards glassy rim large Plag phenocrysts, up to 5mm 9. Secondary Minerals: Palagonite on glass crust 10. Degree of Alteration: surface: slightly altered, beneath surface: fairly fresh 11. Comments: thick glass crust! *similar to DR94-1 and DR94-2*	X		X		

DR94-4	1. Rock Type: Lava with glassy crust; similar to DR94-1, but fresher looking 2. Size: 16x11x12cm 3. Shape/Angularity: - 4. Encrustation: glass, up to 7mm; Mn-coating on some sides 5. Vesicularity: 3%, ≤1mm 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: few Plag phenocrysts, ≤2mm, mostly microlites; Ol? 9. Secondary Minerals: Palagonite 10. Degree of Alteration: surface: slightly altered, beneath surface: fairly fresh *similar to DR94-1, DR94-2 and DR94-3*	X		X		
DR94-5	1. Rock Type: Basaltic lava fragment with thick glassy crust; similar to DR94-3 2. Size: 12x12x12cm 3. Shape/Angularity: - 4. Encrustation: glass, up to 7mm, Mn-coating on some sides 5. Vesicularity: 3%, ≤1mm 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: few Plag phenocrysts, ≤2mm, mostly microlites; Ol? 9. Secondary Minerals: Palagonite 10. Degree of Alteration: outside: strongly altered beneath surface: fresh looking 11. Comments: Large bubble inside *similar to DR94-3*	X		X		

SO203 - DR95
Ridge axis of segment 2
Dredge on bottom UTC 16/11/09 2022hrs, lat 10º23.202'S, long 153º08.606'E, depth 3080m
Dredge off bottom UTC 16/11/09 2113hrs, lat 10º23.231'S, long 153º09.112'E, depth 3047m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3097m on bottom - 3350m max. - 3030m off bottom; MAPR #54 400m above dredge; dredged towards 90°; pillow fragments, basalts with thick glass crust

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR95-1	1. Rock Type: Volcanic rock with large "bubbles"; almost completely consisting of glass 2. Size: 23x11x11cm 3. Shape/Angularity: angular 4. Encrustation: consisting of glass crust, Palagonite-coating; no Mn-coating 5. Vesicularity: 70-80%, ~4cm in diameter 6. Vesicle Filling: - 7. Matrix Color: dark grey to black 8. Primary Minerals: large Plag phenocrysts, ≤1cm, fresh, melt inclusions? 9. Secondary Minerals: Palagonite? 10. Degree of Alteration: moderately altered on outer crust 11. Comments: large degassing bubbles à flow on sediment (water involved? continental?)	X		X		(mystery sample) Sedimentprobe abgefüllt
DR95-2	1. Rock Type: Pillow bud with glassy crust 2. Size: 14x10x8cm 3. Shape/Angularity: round like nodule 4. Encrustation: glass, up to 7mm 5. Vesicularity: <1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: large Plag phenocrysts, some altered, up to ≤1cm, few with melt inclusions 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered	X		X		
DR95-3	1. Rock Type: Sheet lava with thick glassy crust 2. Size: 28x18x9cm 3. Shape/Angularity: - 4. Encrustation: top: glass, ≤1cm; bottom: glass, ≤5mm 5. Vesicularity: 2-3%, round, mostly in the middle, less closer to glass crust 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag phenocrysts, 1-2%, ≤7mm; slightly altered, Ol, <<1%, ≤2mm, melt inclusions, fresh 9. Secondary Minerals: Palagonite 10. Degree of Alteration: slightly altered	X		X		
DR95-4	1. Rock Type: Sheet lava fragment with glassy crust 2. Size: 9x8x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 4-5mm, top and bottom 5. Vesicularity: ≤1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag phenocrysts, 3-5%, ≤5mm; slightly altered, more in glass crust than inside rock 9. Secondary Minerals: oxidation on outer surface 10. Degree of Alteration: slightly altered	X		X		

SO203 - DR96
Segment 2 of ridge axis, W part; one larger cone at 153°16'
Dredge on bottom UTC 17/11/09 0010hrs, lat 10º22.699'S, long 153º15.595'E, depth 2781m
Dredge off bottom UTC 17/11/09 0107hrs, lat 10º22.996'S, long 153º15.886'E, depth 2665m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2820m on bottom - 3100m max. - 2575m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR96-1	1. Rock Type: flow fragment 2. Size: 18x15x6cm 3. Shape/Angularity: - 4. Encrustation: ~8mm glass crust on upper side; thick Mn-coating on lower side 5. Vesicularity: 1%, round, ≤1mm 6. Vesicle Filling: few with Mn-coating (?) or yellowish coating 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 5%, up to 4mm, few ancicular; Ol, ~1%, up to 4mm 9. Secondary Minerals: thick Palagonite on outer glass crust 10. Degree of Alteration: moderate to strongly altered on outer crust, fairly fresh beneath surface	X		X		
DR96-2	1. Rock Type: flow fragment 2. Size: 17x14x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1cm; Mn-coating on glass and lower side 5. Vesicularity: 1%, round, ≤1mm 6. Vesicle Filling: few with Mn-coating (?) or yellowish coating 7. Matrix Color: medium grey 8. Primary Minerals: Ol smaller than in DR96-1; Plag, overall smaller and less than in DR96-1 9. Secondary Minerals: thick Palagonite on outer glass crust 10. Degree of Alteration: moderate to strongly altered outside *similar to DR96-1*	X				

DR96-3	1. Rock Type: pillow lava fragment with glassy crust 2. Size: 15x13x9cm 3. Shape/Angularity: - 4. Encrustation: Top: glass crust, up to 3mm; white and yellowish coating, slight Mn-coating 5. Vesicularity: ≤1%, ≤1mm, round 6. Vesicle Filling: brown and yellowish coating 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ≤1%, up to 4mm, when ancicular, lots of microlites; Ol, <<1%, <<1mm, microlites; Px? 9. Secondary Minerals: Palagonite on outer glass crust 10. Degree of Alteration: slightly to moderately altered	X				

SO203 - DR97
Segment 2 of ridge axis, W part
Dredge on bottom UTC 17/11/09 0405hrs, lat 10°23.319'S, long 153°24.415'E, depth 2695m
Dredge off bottom UTC 17/11/09 0507hrs, lat 10°23.274'S, long 153°24.931'E, depth 2689m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2704m on bottom - 3050m max. - 2678m off bottom; MAPR #50 400m above dredge

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR97-1	1. Rock Type: pillow block fragment 2. Size: Ø 11x9cm 3. Shape/Angularity: rounded 4. Encrustation: glass crust up to 5 mm 5. Vesicularity: < 1-2%, < 1mm 6. Vesicle Filling: 7. Matrix Color: dark grey 8. Primary Minerals: plag phenocrysts < 1 % up to 6 mm, few microlites, fresh; ol present at plag, << 1%, <<1mm 9. Secondary Minerals: 10. Degree of Alteration: very fresh	X		X		
DR97-2	1. Rock Type: pillow lava with glassy crust 2. Size: 20x20x15cm (?) 3. Shape/Angularity: 4. Encrustation: Glass up to 4mm, Mn coating 5. Vesicularity: 3%, mostly round (<0,5mm) 6. Vesicle Filling: 7. Matrix Color: dark grey 8. Primary Minerals: few plag phenocrysts, up to 3mm, few microlites 9. Secondary Minerals: very little palagonite 10. Degree of Alteration: slightly to moderately altered	X		X		
DR97-3	1. Rock Type: pillow fragment 2. Size: 15x15x8cm 3. Shape/Angularity: 4. Encrustation: Top: glass up to 1mm; Mn coating 5. Vesicularity: 2-3%, < 1mm 6. Vesicle Filling: 7. Matrix Color: medium grey 8. Primary Minerals: Plag phenocrysts <3mm; fresh, with microlites 9. Secondary Minerals: little palagonite 10. Degree of Alteration: slightly altered	X		X		
DR97-4	1. Rock Type: pillow fragment 2. Size: 3. Shape/Angularity: 4. Encrustation: Glassy crust up to 4mm 5. Vesicularity: 5%, < 2cm 6. Vesicle Filling: 7. Matrix Color: medium grey 8. Primary Minerals: 1-2% Plag phenocrysts <1.5mm, fresh; << 1% Ol, < 0.5mm 9. Secondary Minerals: palagonite on outer crust 10. Degree of Alteration: moderately altered	X		X		

SO203 - DR103
N slope of Moresby Seamount; upper detachment surface on Moresby
Dredge on bottom UTC 18/11/09 0357hrs, lat 9°46.528'S, long 151°34.056'E, depth 1152m
Dredge off bottom UTC 18/11/09 0445hrs, lat 9°46.851'S, long 151°34.052'E, depth 890m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 1172m on bottom - 1350m max. - 890m off bottom; dredges towards 180°; green cataclasites, white and yellow unconsolidated sediment; topography along t
dredge haul: sampling along fault scarp towards upper smooth detachment surface

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR103-1	The cohesive cataclasites (chlorite breccia) consist of angular components of greenschist-facies, heavily-fractured, and mineralized metadiabase with abundant quartz- and epidote veins. Some cataclasites are foliated and display brittle and ductile deformation. They show extensional crenulation cleavage and ductile shearfolds, but also brittely-deformed layers of feldspar and extensional fractures. Samples show syntectonic veins, which are often parallel to the foliation and affected by progressive shearing. Repeated rupture-and-healing events within the veins are common. Samples contain variable amounts of chlorite, feldspar, quartz, and amphibole (?) indicating a mafic protolith as recovered at greater depths (e.g. sample DR103-2A).					Individual samples: DR103-1A, DR103-1B, DR103-1C, DR103-1D, DR103-1E, DR103-1F, DR103-1G, DR103-1H, DR103-1I, DR103-1J, DR103-1K
DR103-2	The dark, black gabbro or diorite of feldspar, pyroxene, and rare olivine represents a protholitic host rock.					Individual samples: DR103-2A
DR103-3	The samples of less deformed, greenish and altered diabase consist of chlorite, epidote, feldspar, some amphibole and show a pervasive network of multistage veins filled with quartz and epidote. Older veins are folded whereas younger veins are disrupted and sheared.					Individual samples: DR103-3A, DR103-3B, DR103-3C, DR103-3D

SO203 - DR105
N slope of Moresby Seamount
Dredge on bottom UTC 18/11/09 1035hrs, lat 9°46.093'S, long 151°33.955'E, depth 1598m
Dredge off bottom UTC 18/11/09 1151hrs, lat 9°46.535'S, long 151°33.965'E, depth 1134m
total volume: full
Comments: small dredge (without sediment catcher); rope length: 1613m on bottom - 1850m max. - 1110m off bottom; topography along the dredge haul: sampling along rock slide and slide escarpment; cataclasites and foliated sa
with crack and seal fabric

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR105-1	The tightly-foliated samples show foliation-parallel quartz- and calcite veins with crack and seal fabrics, which are healed by several generations of antitaxial calcite.					Individual samples: DR105-1A, DR105-1B
DR105-2	All samples of this group are gabbroic rocks. Sample DR105-2A is a hard, medium grained (minerals ≤4mm) greenish gabbro with black patches of pyroxene aggregates. Bright minerals are plagioclase. Sample DR105-2B/2C shows a classic gabbroic texture, but is dissected by plagioclase-filled veins and joints.					Individual samples: DR105-2A, DR105-2B, DR105-2C
DR105-3	Two samples of hydrothermal mineralized 2cm broad plates/layers. DR105-3A consists of relatively coarse-grained calcite fibres. DR105-3B is fine-grained and mineralized by feldspar, epidote and quartz.					Individual samples: DR105-3A, DR105-3B
DR105-4	The green, massive cataclasites without foliation and/or semiductile deformation fabrics consist of chlorite, feldspar and some quartz. All samples are fine-grained and hydrothermally altered. Pyrite coating on fracture surfaces is abundant, sometimes slickensides are coated with pyrite. Dispersely-distributed pyrite is frequent in all samples.					Individual samples: DR105-4A, DR105-4B, DR105-4C, DR105-4D, DR105-4E
DR105-5	Similar samples as group 4, however, without hydrothermal mineralization. On saw-cut surfaces, fine-grained pyrite in the cataclasites is also visible. Therefore, the division between group 4 and 5 is slightly arbitrary. Samples show two types of veins: (1) light green to white, smooth veins filled with epidote, feldspar and quartz and (2) openly-folded dark-grey to violet hydrothermal remobilized veins with fine quartz minerals and segregated pyrites.					Individual samples: DR105-5A, DR105-5B, DR105-5C, DR105-5D

DR105-6	This cohesive cataclasites (chlorite breccia) are similar to group DR103-1, however they show smaller, greyish rock fragments with dark grey patches of altered chlorite up to 1.5cm in size. Sample DR105-6B is crosscut by wrinkled quartz-veins.					Individual samples: DR105-6A, DR105-6B
DR105-7	This group represents weakly-foliated cataclasites with less cohesion as compared to cataclastic groups described above. Some samples can easily be broken by hand. Another typical feature is a blue colour. In some cases, weakly-developed shear fabrics are visible. Some samples (e.g. DR105-7B) are crosscut by fine-grained, 1cm broad quartz layers.					Individual samples: DR105-7A, DR105-7B, DR105-7C, DR105-7D, DR105-7E, DR105-7F
DR105-8	The foliated cataclasites show features of both, brittle and ductile deformation: extensional crenulation cleavage, shearbands, ducitle shear folds, σ-clasts with weakly-developed recrystallised wings, but also brittely-sheared feldspar layers and extensional fractures. Foliation is typically straight, in some cases anastomosing and often affected by shear bands. In all samples, crosscutting extensional fractures perpendicular to the foliation are frequent. No obvious stretching lineation was developed during greenschist-facies deformation, however, orientations of strain axes may be determined through foliation planes and shear bands.					Individual samples: DR105-8A, DR105-8B, DR105-8C, DR105-8D, DR105-8E, DR105-8F

SO203 - VSR107
small lava lake in the southern East Basin (E of Moresby Smt)
VSR on bottom UTC 18/11/09 1831hrs, lat 09º56.768'S, long 151º41.199'E, depth 3232m
total volume: 1/7 cups
Comments: max. rope length 3236m, max. rope tension 43kN; rope speed 1,0m/s

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR107-5	very tiny fresh looking glass chips or other rock fragments, brownish black (check if it is really glass!)			X		check, if it is really glass

SO203 - VSR108
small cone in western part of Middle Basin (NE of Moresby Smt)
VSR on bottom UTC 18/11/09 2130hrs, lat 09º45.386'S, long 151º38.701'E, depth 3094m
total volume: 2/7 cups
Comments: max. rope length 3120m, max. rope tension 20kN; rope speed 1,0m/s

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR108-4	glassy chips, 3 small pieces, looking very fresh			X		
VSR108-6	rock? could be piece of steel, since wax corer touched the deck			X		check again, if it is really glass

SO203 - VSR109
in AUV area, NE of Moresby Smt
VSR on bottom UTC 19/11/09 0044hrs, lat 09º45.651'S, long 151º44.748'E, depth 2871m
total volume: 1/7 cups
Comments: max. rope length 2895m, max. rope tension 20kN; rope speed 1,0m/s

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR109-7	glass with basalt, outside: very strongly altered and Palagonite and Fe-oxides, glass inside black and very fresh looking			X		

SO203 - DR113
axial rise of segment 1C
Dredge on bottom UTC 19/11/09 1239hrs, lat 10º05.898'S, long 152º43.700'E, depth 3150m
Dredge off bottom UTC 19/11/09 1328hrs, lat 10º06.048'S, long 152º44.115'E, depth 3102m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3140m on bottom - 3400m max. - 3078m off bottom

SO203 - DR114
S of segment 1C, E end; uphill a bathymetric high, see also DR89
Dredge on bottom UTC 19/11/09 1618hrs, lat 10º09.202'S, long 152º40.294'E, depth 2604m
Dredge off bottom UTC 19/11/09 1720hrs, lat 10º09.632'S, long 152º40.452'E, depth 2296m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2621m on bottom - 2850m max. - 2272m off bottom; lava/basalt fragmends and medium- to fine-grained intrusive rocks, lots of muddy sediment on all rocks

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR114-1	Fine to medium grained equigranular intrusive rock; mafic to intermediate composition (diabase) with minor dissemination pyrite ± cpy; unaltered					
DR114-2	Very fine grained mafic to intermediate volcanic rock with epidote-replaced fsp phenocrysts; epidote filled fractures; 2-3mm Mn-crust					
DR114-3	Strongly altered and weined fine-grained mafic to intermediate volcanic rock with clay-filled fractures; one piece with epidote filled fractures and vesicles (?); 3-5mm Mn-crust					
DR114-4	Intensely silicified, medium to fine grained, mafic to intermediate intrusive rock with quartz and epidote filled fractures and veins (2-5mm wide)					
DR114-5	Pale green, very fine grained, intensely altered mafic to intermediate volcanic rock; possible quartz phenocrysts; very fine disseminated py ± cpy					
DR114-6	Weakly to moderately altered medium-grained, intermediate intrusive rock (diorite); epidote-replaced feldspars and epidote filled fractures					
DR114-7	Fine grained, porphyritic mafic rock with dark, possibly chloritic matrix; black mafic phenocrysts (2-3mm), possibly pyroxene, with altered rims; trace sulfide					
DR114-8A	1. Rock Type: basalt fragment with large Ol 2. Size: 8.5x7x7cm 3. Shape/Angularity: subangular 4. Encrustation: (stongly) altered glass crust, up to 5mm; Mn-coating on some sides 5. Vesicularity: <<1mm and up to ~4mm; irregular shape; ~15% 6. Vesicle Filling: towards rim: brownish/yellowish coating 7. Matrix Color: dark to very light grey (towards glassy rim) 8. Primary Minerals: Ol, ~5-10%, up to 5mm, some with inclusions, looking fresh; Plag, few, ≤1%, smaller than Ol 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered	X	X			
DR114-8B	1. Rock Type: basalt fragment with large Ol 2. Size: 7.5x7x6cm 3. Shape/Angularity: subangular 4. Encrustation: (stongly) altered glass crust, up to 5mm; Mn-coating on some sides 5. Vesicularity: mostly rounded, ~20%, <1mm and up to 1cm 6. Vesicle Filling: towards rim: brownish/yellowish coating 7. Matrix Color: dark to very light grey (towards glassy rim) 8. Primary Minerals: Ol, ~5-10%, up to 5mm, some with inclusions, looking fresh; Plag, few, ≤1%, smaller than Ol 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered	X	X			
DR114-9	1. Rock Type: small piece of vesicular basalt 2. Size: 5.5x4.5x4cm 3. Shape/Angularity: sunangular 4. Encrustation: slight Mn-coating? 5. Vesicularity: ~10%, up to 3mm, rounded to elongated 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh, freshest-looking sample of dredge	X	X			

DR114-10A	1. Rock Type: highly vesicular small basalt fragment 2. Size: 9x6x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating on some sides 5. Vesicularity: 5-10%; few 0.5-2mm, mostly <<1mm, rounded 6. Vesicle Filling: brownish coating in some vesicles 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 2-3%, ≤1mm, fresh-looking; Ol, ≤1%, fresh-looking 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered	X	X			
DR114-10B	1. Rock Type: highly vesicular small basalt fragment 2. Size: 8.5x5x4cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating on some sides 5. Vesicularity: 5-10%; few 0.5-2mm, mostly <<1mm, rounded 6. Vesicle Filling: brownish coating in some vesicles 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ≤1%, <1mm 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered 11. Comments: shortly accidently mixed up with DR114-14B	X	X			
DR114-10C	1. Rock Type: highly vesicular small basalt fragment 2. Size: 10x5.5x6cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating on some sides 5. Vesicularity: 5-10%; few 0.5-2mm, mostly <<1mm, rounded 6. Vesicle Filling: black coating 7. Matrix Color: medium grey 8. Primary Minerals: Plag, <1%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: slightly altered	X	X			
DR114-11	1. Rock Type: small piece of basalt 2. Size: 6x4.5x4.5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: 10%, elongated, up to 1.5cm long 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: fresh, except for Mn-coating	X	X			
DR114-12	1. Rock Type: large piece of basalt 2. Size: 23x16x12cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: 5%, round or irregular, ≤1mm 6. Vesicle Filling: orange to brownish coating 7. Matrix Color: medium grey 8. Primary Minerals: aphyric 9. Secondary Minerals: brownish mineral 10. Degree of Alteration: slightly to moderately altered	X	X			
DR114-13A	1. Rock Type: basalt with cooling cracks or flowing structure 2. Size: 9.5x8x5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: 1-2%, ≤1.5mm, 2 kinds: some irregular in lines, some round 6. Vesicle Filling: grey and brownish coating 7. Matrix Color: light to medium grey 8. Primary Minerals: aphyric 9. Secondary Minerals: ? 10. Degree of Alteration: moderately altered	X	X			
DR114-13B	1. Rock Type: basalt with cooling cracks or flowing structure 2. Size: 15x8x6.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: 1-2%, ≤1.5mm, 2 kinds: some irregular in lines, some round 6. Vesicle Filling: grey and black coating 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, <<1% 9. Secondary Minerals: ? 10. Degree of Alteration: fairly fresh	X	X			
DR114-14A	1. Rock Type: vesicular basalt with glassy (altered) crust 2. Size: 15x13x8cm 3. Shape/Angularity: angular 4. Encrustation: possibly 5mm thick glass crust (altered) or just Mn intruded into fragment; Mn-coating on some sides 5. Vesicularity: highly vesicular, 10-20% 6. Vesicle Filling: yellowish, brownish, orange coating 7. Matrix Color: dark brownish grey to light grey --> Mn? --> black 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered	X	X			
DR114-14B	1. Rock Type: vesicular basalt with glassy (altered) crust 2. Size: 8.5x7x6cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating on some sides 5. Vesicularity: highly vesicular, ~10%, irregular shape 6. Vesicle Filling: yellowish, brownish, orange coating 7. Matrix Color: dark brownish grey to light grey --> Mn? --> black 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered 11. Comments: shortly accidently mixed up with DR114-10B	X	X			
DR114-15	1. Rock Type: small piece of vesicular altered basalt 2. Size: 6x6x3.5cm 3. Shape/Angularity: angular to subangular 4. Encrustation: Mn-coating 5. Vesicularity: 1-3%, elongated, up to 2x8mm, mostly ≤1mm 6. Vesicle Filling: few with brown (reddish) and yellowish coating; Cc? or Zeolites? 7. Matrix Color: light brownish grey 8. Primary Minerals: some altered Plag microlites 9. Secondary Minerals: Zeolites?, Cc? 10. Degree of Alteration: strongly altered	X	X			

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR114-16	1. Rock Type: altered basalt 2. Size: 10x9.5x6.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating; strongly sediment-covered 5. Vesicularity: ≤1%, few ~1-2mm, mostly <<1mm (~10%), round 6. Vesicle Filling: - 7. Matrix Color: light to medium grey 8. Primary Minerals: aphyric 9. Secondary Minerals: ? 10. Degree of Alteration: fairly fresh	X	X			
DR114-17	1. Rock Type: strongly altered dense rock 2. Size: 8x5.5x5cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating 5. Vesicularity: none 6. Vesicle Filling: none 7. Matrix Color: brownish, yellowish, grey 8. Primary Minerals: ? 9. Secondary Minerals: ? 10. Degree of Alteration: strongly altered, transported (rounded)	X	X			
DR114-18	1. Rock Type: several pumice fragments, 2 kinds (one dark grey, others lighter grey) 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Degree of Alteration: -	X				

SO203 - DR115
Segment 2, W flank of axial high; linear volcanic ridge
Dredge on bottom UTC 20/11/09 0159hrs, lat 10º21.704'S, long 153º32.299'E, depth 2706m
Dredge off bottom UTC 20/11/09 0253hrs, lat 10º21.705'S, long 153º32.859'E, depth 2683m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #50 400m above dredge; rope length: 2704m on bottom - 2950m max. - 2605m off bottom; pieces of pillows, very fresh looking

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR115-1	1. Rock Type: Pillow tube 2. Size: 32x13x11cm 3. Shape/Angularity: - 4. Encrustation: fresh glass; some Fe-Mn-coating 5. Vesicularity: ~2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey to almost black 8. Primary Minerals: Plag, 3-5%, ancicular, up to 7mm; probably some small Ol phenocrysts or microlites 9. Secondary Minerals: - 10. Degree of Alteration: fresh-looking, only some Fe-Mn-oxides on surface	X		X	separate sample taken for sulfur	
DR115-1A	1. Rock Type: Pillow tube 2. Size: 32x13x11cm 3. Shape/Angularity: - 4. Encrustation: fresh glass; some Fe-Mn-coating 5. Vesicularity: ~2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey to almost black 8. Primary Minerals: Plag, 3-5%, ancicular, up to 7mm; probably some small Ol phenocrysts or microlites 9. Secondary Minerals: - 10. Degree of Alteration: fresh-looking, only some Fe-Mn-oxides on surface *similar to DR115-1*					Archive
DR115-1B	1. Rock Type: several pieces of pillow tubes 2. Size: various 3. Shape/Angularity: - 4. Encrustation: fresh glass; some Fe-Mn-coating 5. Vesicularity: ~2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey to almost black 8. Primary Minerals: Plag, 3-5%, ancicular, up to 7mm; probably some small Ol phenocrysts or microlites 9. Secondary Minerals: - 10. Degree of Alteration: fresh-looking, only some Fe-Mn-oxides on surface *similar to DR115-1*					Archive

SO203 - DR116
Segment 2, W flank of axial high; linear volcanic ridge
Dredge on bottom UTC 20/11/09 0534hrs, lat 10º21.401'S, long 153º37.819'E, depth 2619m
Dredge off bottom UTC 20/11/09 0632hrs, lat 10º21.322'S, long 153º38.262'E, depth 2577m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #50 350m above dredge; rope length: 2600m on bottom - 2560m max. - 2550m off bottom; pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR116-1	1. Rock Type: pillow lava 2. Size: 23x19x17cm 3. Shape/Angularity: - 4. Encrustation: glass crust + Palagonite; Fe-Mn-coating 5. Vesicularity: 3-5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, in glass: 10-15%, up to 10mm, in matrix: only few, <1%, <1-2mm 9. Secondary Minerals: Palagonite crust 10. Degree of Alteration: hydrothermally altered surface (?)	X		X		
DR116-2	1. Rock Type: Pillow lava 2. Size: 19x14x11cm 3. Shape/Angularity: - 4. Encrustation: glass crust with Palagonite; Fe-Mn-coating 5. Vesicularity: 4-5% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, in glass: 10-15%, ≤7mm, in matrix: ~5-10%, ≤5mm; some Ol phenocrysts, 1-3%, ≤3mm 9. Secondary Minerals: some Palagonite 10. Degree of Alteration: weathered surface	X		X		

DR116-3	1. Rock Type: Pillow bud 2. Size: 11x9x9cm 3. Shape/Angularity: - 4. Encrustation: glass crust with beginning devitrification 5. Vesicularity: 1-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, up to 1cm, in glass: up to 5% 9. Secondary Minerals: - 10. Degree of Alteration: very fresh looking	X		X		
DR116-4	1. Rock Type: Pillow lava 2. Size: 24x19x15cm 3. Shape/Angularity: - 4. Encrustation: glass crust with Palagonite; Fe-Mn-coating 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: Plag, 3-5%, ancicular, ≤2.5mm; very few Ol phenocrysts, ≤1mm 9. Secondary Minerals: Palagonite on glass crust 10. Degree of Alteration: strongly altered	X		X		
DR116-5	1. Rock Type: Pillow lava 2. Size: 10x10x8cm 3. Shape/Angularity: - 4. Encrustation: thin glass crust 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: Plag, 2-3%, ancicular, ≤2mm; very few Ol phenocrysts, ≤1.5mm, in contact with Plag 9. Secondary Minerals: - 10. Degree of Alteration: weathered surface	X		X		

SO203 - DR117
Segment 2; linear volcanic ridge
Dredge on bottom UTC 20/11/09 0845hrs, lat 10°21.666'S, long 153°42.009'E, depth 2625m
Dredge off bottom UTC 20/11/09 0632hrs, lat 10°22.063'S, long 153°42.331'E, depth 2651m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2639m on bottom - 2950m max. - 2564m off bottom; pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR117-1	1. Rock Type: Piece of large pillow 2. Size: 18x18x16cm 3. Shape/Angularity: - 4. Encrustation: glass crust, partly palagonitized; Fe-Mn-coating 5. Vesicularity: <1% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤3mm, ancicular; few Ol phenocrysts, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: fairly hydrothermally altered surface, hydrothermally altered rim ~2mm thick	X		X		
DR117-2	1. Rock Type: Piece of large pillow 2. Size: 23x22x15cm 3. Shape/Angularity: - 4. Encrustation: glass crust, partly palagonitized; Fe-Mn-coating 5. Vesicularity: <1% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤3mm, ancicular; few Ol phenocrysts, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: stronger hydrothermal alteration than DR117-1 (natrolite/celadonite zeolites: red-brown-yellow-green) *similar to DR117-1*	X		X		
DR117-3	1. Rock Type: basaltic lava 2. Size: 25x13x10cm 3. Shape/Angularity: - 4. Encrustation: some Mn-coating 5. Vesicularity: ≤1% 6. Vesicle Filling: - 7. Matrix Color: altered rim: light grey, core: dark grey 8. Primary Minerals: a lot Plag, 25-30%, ≤2.5mm; probably some Ol phenocrysts, <1mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered surface, hydrothermally altered rim ~8mm thick	X	X			

SO203 - DR118
Axial ridge of Segment 2; flat Seamount in N part of axial rift valley
Dredge on bottom UTC 20/11/09 1217hrs, lat 10°20.197'S, long 153°47.200'E, depth 2666m
Dredge off bottom UTC 20/11/09 1306hrs, lat 10°20.346'S, long 153°47.621'E, depth 2555m
total volume: 3 pieces of pillow lava
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #50 400m above dredge; rope length: 2650m on bottom - 2900m max. - 2540m off bottom; pillow lava

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR118-1A	1. Rock Type: Pillow roof 2. Size: 13x9x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust with Plag phenocrysts, ≤10%, up to 7mm large 5. Vesicularity: <<1%, <<1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 5-10%, ≤5mm, yellowish, slightly to moderately altered; Ol, <1%, <1mm, fresh 9. Secondary Minerals: - 10. Degree of Alteration: slightly to moderately altered, only minor oxidation; glass blueish 11. Comments: dripping structure on bottom	X		X		

DR118-1B	1. Rock Type: Pillow? 2. Size: 10x7x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust with Plag phenocrysts, ≤10%, up to 8mm large 5. Vesicularity: <<1%, <<1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 5-10%, ≤5mm, yellowish, slightly to moderately altered; Ol, <1%, <1mm, fresh 9. Secondary Minerals: - 10. Degree of Alteration: slightly to moderately altered, only minor oxidation; glass blueish *similar to DR118-1A*					Archive
DR118-2	1. Rock Type: Pillow bud 2. Size: 7x5x5cm 3. Shape/Angularity: - 4. Encrustation: glass crust with Plag phenocrysts, 10-15%, up to 7mm 5. Vesicularity: <<1% 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 10-15%, ≤6mm, some slightly altered, yellowish 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, almost no oxides	X		X		

SO203 - DR119
Ridge axis, E part of Segment 2
Dredge on bottom UTC 20/11/09 1611hrs, lat 10°19.805'S, long 153°58.515'E, depth 2803m
Dredge off bottom UTC 20/11/09 1722hrs, lat 10°19.200'S, long 153°59.146'E, depth 2832m
total volume: 3/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #50 400m above dredge; rope length: 2822m on bottom - 3200m max. - 2810m off bottom; pillow and sheet lava and flow fragments

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR119-1A	1. Rock Type: Pillow tube fragment 2. Size: 12x10x9cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1.5mm, with Plag phenocrysts 5. Vesicularity: <<1%, ≤0.5mm 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-5%, ≤5mm + microlites; Px? 9. Secondary Minerals: some oxidatation on glass = Palagonite? 10. Degree of Alteration: fresh	X		X		
DR119-1B	1. Rock Type: Pillow tube fragment 2. Size: 11.5x11x9cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1.5mm, with Plag phenocrysts; Mn-coating on top of pillow tube, not on glass crust 5. Vesicularity: <<1%, ≤0.5mm 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-5%, ≤5mm + microlites; Px? 9. Secondary Minerals: some oxidatation on glass = Palagonite? 10. Degree of Alteration: fresh *similar to DR119-1A*					Archive
DR119-2	1. Rock Type: Sheet flow or flat Pillow tube fragment 2. Size: 17x16x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust, ≤3mm, with Plag phenocrysts; Mn-coating on one side (like DR119-1B) 5. Vesicularity: <1%, ≤1mm, + cracks ~parallel to outer shape 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1%, up to 3mm and microlites, some ancicular 9. Secondary Minerals: - 10. Degree of Alteration: fresh	X		X		
DR119-3	1. Rock Type: Pillow fragment 2. Size: 29x23x17cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1.5cm 5. Vesicularity: <<1%, <<0.5mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, up to 4mm + microlites, 1-2%, fresh 9. Secondary Minerals: yellowish, orange oxidation (Fe-oxides) 10. Degree of Alteration: fairly fresh inside, moderately altered outside	X		X		
DR119-4	1. Rock Type: Flow fragment 2. Size: 10x6x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 2.5mm, with Plag phenocrysts 5. Vesicularity: cracks and irregular vesicles, ≤1mm, ~2% 6. Vesicle Filling: some closer to rim with yellowish coating 7. Matrix Color: medium to dark grey 8. Primary Minerals: Plag, <1%, up to 2mm, fresh; Ol? 9. Secondary Minerals: yellowish to brownish coating 10. Degree of Alteration: fairly fresh to slightly altered	X		X		Archive
DR119-5	1. Rock Type: Pillow fragment 2. Size: 11x8x8.5cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 3mm; Mn-coating 5. Vesicularity: <<1%, irregular shape, <<0.5mm 6. Vesicle Filling: some with yellowish or brownish coating 7. Matrix Color: mnedium grey 8. Primary Minerals: Plag, ≤2mm + microlites, ≤1%; Ol? 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh to slightly altered	X		X		

SO203 - DR120
E part of Segment 2 of ridge axis, just W of transform fault; largest outsticking seamount within ridge axis at that place
Dredge on bottom UTC 20/11/09 2028hrs, lat 10°19.601'S, long 154°7.195'E, depth 2759m
Dredge off bottom UTC 20/11/09 2125hrs, lat 10°19.600'S, long 154°7.664'E, depth 2805m

total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2831m on bottom - 3150m max. - 2754m off bottom; pillow and flow fragments, freshest samples of all dredges so far

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR120-1	1. Rock Type: Flow fragment 2. Size: 28x26x20cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to >1cm, with Plag phenocrysts, brownish fresh coating 5. Vesicularity: <1%, <<0.5mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ≤1%, up to 2mm, fresh, some slightly yellowish 9. Secondary Minerals: Fe-oxides outside (very slightly) 10. Degree of Alteration: fresh!	X		X		
DR120-2	1. Rock Type: Pillow tube fragment 2. Size: 14x11x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust, at least 5mm thick, with Plag phenocrysts 5. Vesicularity: <1%, ≤0.5mm 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, up to 1.2cm + microlites, some yellowish, mistly white and fresh, ancicular 9. Secondary Minerals: 10. Degree of Alteration: very fresh	X		X		Archive
DR120-3	1. Rock Type: Flow fragment 2. Size: 20x16x6cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 3-4mm 5. Vesicularity: <1%, <<0.5mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ≤1%, up to 2mm, fresh, some slightly yellowish 9. Secondary Minerals: Fe-oxides outside (very slightly) 10. Degree of Alteration: fresh! *similar to DR120-1*	X		X		
DR120-4	1. Rock Type: Flow fragment with Pahoehoe glass crust 2. Size: 21x16x13cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to at least 1cm, Pahoehoe 5. Vesicularity: <1%, <<0.5mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ≤1%, up to 2mm, fresh, some slightly yellowish 9. Secondary Minerals: Fe-oxides outside (very slightly) 10. Degree of Alteration: fairly fresh (slightly more altered than DR120-1) very *similar to DR120-1, except for Pahoehoe lava structure (partly glassy) and some more Fe-oxides*	X		X		

SO203 - DR122
Segment 2, N-S profile, S end of basin; cone structure
Dredge on bottom UTC 21/11/09 0642hrs, lat 10°10.256'S, long 154°14.999'E, depth 4246m
Dredge off bottom UTC 21/11/09 0746hrs, lat 10°10.191'S, long 154°13.489'E, depth 4078m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 4272m on bottom - 4600m max. - 4037m off bottom

SO203 - DR123
Most E location of Segment 2, S end of transform fault
Dredge on bottom UTC 21/11/09 1120hrs, lat 10°15.999'S, long 154°11.400'E, depth 3534m
Dredge off bottom UTC 21/11/09 1218hrs, lat 10°16.499'S, long 154°11.399'E, depth 3583m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3546m on bottom - 3900m max. - 3545m off bottom

SO203 - VSR124
E part of Segment 2 of ridge axis, just W of transform fault; largest outsticking seamount within ridge axis at that place; same position as DR120
VSR on bottom UTC 21/11/09 1524hrs, lat 10°19.701'S, long 154°7.000'E, depth 2852m
total volume: 5/7 cups
Comments: max. rope length 2863m, max. rope tension 3.8t, rope speed 1m/s; MAPR #50 at 20m, MAPR #51 at 40m, MAPR #52 at 60m, MAPR #53 at 80m, MAPR #54 at 100m rope length; few glass chips

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
VSR124-2	no description available			X		
VSR124-4	no description available			X		
VSR124-5	no description available			X		
VSR124-6	no description available			X		
VSR124-7	no description available			X		

SO203 - DR125
W end of Segment 3A
Dredge on bottom UTC 21/11/09 2055hrs, lat 9°56.200'S, long 154°14.813'E, depth 4319m
Dredge off bottom UTC 21/11/09 2219hrs, lat 9°56.428'S, long 154°15.212'E, depth 3819m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 4319m on bottom - 4620m max. - 3797m off bottom; dredged towards 120°; topography along the dredge haul: 600m long sampling along plane slope of inne corner high of the transform fault; only gabbroic rocks of lower oceanic crust were recovered

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR125-1	Unaltered, white to grey gabbro with subhedrale grain shapes, equigranulare grain boundaries and grainsizes up to 2-3 mm. Rocks consist in equal amounts of pyroxene and feldspar. All samples contain a high content (up to 5%) of pyrite, pyrrhotite and other sulfides.					Individual samples: DR125-1A
DR125-2	Altered gabbros with similar texture and grainsize than group 1, however, this group is crosscut by a first generation of epidote-quartz-filled veins often with altered rims. The syntaxial veins are again crosscut by extensional fractures. All samples are sulfide-bearing. Sample DR 125-2B shows two different textures (1) some areas still with the primary, intrusive texture and (2) areas consisting only of recrystallized pyroxene and less feldspar.					Individual samples: DR125-2A, DR125-2B, DR125-2C
DR125-3	This massive quartz veins in gabbroic rocks crystallised during the extensional stage of the transform fault in a quite shallow crustal level. The crosscutting relationship of this quartz veins and epidote-quartz veins defines the latter to be older. Despite sufficient silicate-rich fluid, intern cavities are visible. This extensional fractures represent the youngest tectonic activity.					Individual samples: DR125-3A, DR125-3B, DR125-3C, DR125-3D
DR125-4	Green altered gabbro with 60% pyroxene and 40% feldspar, with grain sizes up to 4-6mm and thus, coarser-grained than other gabbro groups. Sample DR125-4C shows green to black veins with fine-grained minerals (quartz with bands of chlorite and graphite?) and accumulations of sulfides along the median line of the vein, indicating antitaxial growth.					Individual samples: DR125-4A, DR125-4B, DR125-4C
DR125-5	These rocks show features of brittle and ductile deformation beyond fractures, veins, and joints, such as extensional crenulation cleavage, cataclastic areas and folded veins. In sample DR125-5B/5C relicts of the gabbroic host rock are visible. Sample DR125-5A is fine-grained (≤1mm) to microcrystalline and contains chlorite, feldspar and epidote. Due to the strong alteration and the small grainsizes it is difficult to determine the protolith (maybe gabbro?). All samples of this group are sulfide-bearing					Individual samples: DR125-5A, DR125-5B, DR125-5C, DR125-5D

SO203 - DR126
W end of Segment 3A, NE of transform fault
Dredge on bottom UTC 22/11/09 0217hrs, lat 9º52.595'S, long 154º21.387'E, depth 3840m
Dredge off bottom UTC 22/11/09 0327hrs, lat 9º52.589'S, long 154º21.964'E, depth 3769m
total volume: 4 pieces
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3900m on bottom - 4250m max. - 3765m off bottom; pillow, fresh

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR126-1	1. Rock Type: Pillow lava 2. Size: 10x10x9cm 3. Shape/Angularity: round 4. Encrustation: glass crust; some Fe-Mn-coating 5. Vesicularity: <<1% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2%, ≤10mm; few Ol, ≤1mm 9. Secondary Minerals: Fe-oxides outside (very slightly) 10. Degree of Alteration: only some hydrothermal alteration on surface	X		X		
DR126-2	1. Rock Type: Pillow lava 2. Size: 9x8x6cm 3. Shape/Angularity: - 4. Encrustation: glass crust with large Plag phenocrysts (5-7%, ≤7mm) 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~2%, ≤10mm; few Ol, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh	X		X		Archive
DR126-3	1. Rock Type: Pillow bud 2. Size: 8x6x5cm 3. Shape/Angularity: - 4. Encrustation: glass crust, partly devitrified 5. Vesicularity: <1% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, up to 10mm; very few Ol, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: only slight hydrothermal alteration	X		X	separate sample taken for sulfur	
DR126-4	1. Rock Type: Pillow lava 2. Size: 10x10x8cm 3. Shape/Angularity: - 4. Encrustation: thin glass crust, some Mn-coating 5. Vesicularity: ~1% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, up to 3mm; Ol, <1%, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: moderate hydrothermal alteration	X		X		

SO203 - DR127
W end of Segment 3A; volcano
Dredge on bottom UTC 22/11/09 0634hrs, lat 9º52.406'S, long 154º25.407'E, depth 3411m
Dredge off bottom UTC 22/11/09 0731hrs, lat 9º52.211'S, long 154º25.937'E, depth 3455m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3430m on bottom - 3750m max. - 3369m off bottom; fresh pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR127-1	1. Rock Type: Pillow lava, massive glass 2. Size: 8x7x6cm 3. Shape/Angularity: - 4. Encrustation: massive glass crust 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: dark grey to black 8. Primary Minerals: glassy, aphyric 9. Secondary Minerals: - 10. Degree of Alteration: very fresh, partly devitrified	X		X	separate sample taken for sulfur	2 similar pieces (also DR127-1) for Archive
DR127-2	1. Rock Type: Pillow lava 2. Size: 17x15x11cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 5mm; some Fe-Mn-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, <1-2%, ≤7mm; few Ol, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: some hydrothermal alteration	X		X	separate sample taken for sulfur	
DR127-3	1. Rock Type: Pillow lava 2. Size: 11x9x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 7 mm 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~1%, up to 10mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, glass partly devitrified	X		X	separate sample taken for sulfur	
DR127-4	1. Rock Type: Pillow lava 2. Size: 9x9x7cm 3. Shape/Angularity: - 4. Encrustation: thin glass crust, ≤3mm 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~1%, up to 5mm 9. Secondary Minerals: - 10. Degree of Alteration: some hydrothermal alteration	X		X		1 similar piece (also DR127-4) for Archive

SO203 - DR128
Rift valley of Segment 3A
Dredge on bottom UTC 22/11/09 1033hrs, lat 9º50.997'S, long 154º29.402'E, depth 3590m

Dredge off bottom UTC 22/11/09 1237hrs, lat 9°51.053'S, long 154°29.379'E, depth 3598m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3609m on bottom - 3950m max. - 3550m off bottom; dredge was stuck for one hour; all samples very similar

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR128-1	1. Rock Type: Pillow lava 2. Size: 12x10x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 5mm 5. Vesicularity: <1%, ≤0.25mm 6. Vesicle Filling: too small to be visible 7. Matrix Color: medium grey 8. Primary Minerals: Plag, <<1%, few microlites; mostly aphyric 9. Secondary Minerals: Fe-oxides on outer surface 10. Degree of Alteration: some hydrothermal alteration	X		X	separate sample taken for sulfur	
DR128-2	1. Rock Type: Pillow lava 2. Size: 16x13x11cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 5mm 5. Vesicularity: <1% 6. Vesicle Filling: - 7. Matrix Color: medium to dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: some hydrothermal alteration *similar to DR128-1*	X		X		
DR128-3	1. Rock Type: Pillow lava 2. Size: 16x10x10cm 3. Shape/Angularity: - 4. Encrustation: glass crust, ~5mm, with thick Mn-coating 5. Vesicularity: <1%, ~90% of vesicles: ≤0.25mm, ~10% of vesicles: ≤1mm 6. Vesicle Filling: none 7. Matrix Color: medium grey 8. Primary Minerals: Plag, <<1%, microlites; overall aphyric 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: strongly weathered surface	X		X		
DR128-4	1. Rock Type: Pillow lava 2. Size: 11x8x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust, ~5mm, with thick Mn-coating (thicker than DR128-3) 5. Vesicularity: <1% 6. Vesicle Filling: - 7. Matrix Color: medium to dark grey 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Degree of Alteration: some hydrothermal alteration (similar to DR128-1) *similar to DR128-1 and DR128-3*	X		X		
DR128-5	1. Rock Type: Basaltic lava 2. Size: 13x10x7cm 3. Shape/Angularity: - 4. Encrustation: Fe-Mn-coating 5. Vesicularity: <1%, <0.25mm, round 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: overall aphyric; very few <<1% microlites, greenish = Ol?, white = Plag? 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: strongly weathered surface	X	X			

SO203 - DR129
Segment 3A of ridge axis; axial rift valley
Dredge on bottom UTC 22/11/09 1531hrs, lat 9°50.298'S, long 154°32.203'E, depth 3570m
Dredge off bottom UTC 22/11/09 1631hrs, lat 9°50.046'S, long 154°32.842'E, depth 3575m
total volume: 3/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3584m on bottom - 3950m max. - 3560m off bottom; pillow and flow fragments with glass crust and large Plag phenocrysts

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR129-1	1. Rock Type: Large pillow tube fragment 2. Size: 21x20x17cm 3. Shape/Angularity: - 4. Encrustation: glass crust, with brown cooling coating, up to 7mm thick, with Plag crystals 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤1.2cm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, hydrothermally altered on surface/fractures	X		X	separate sample taken for sulfur	
DR129-2	1. Rock Type: Pillow fragment 2. Size: 18x17x14cm 3. Shape/Angularity: - 4. Encrustation: glass crust, with fresh brown cooling coating, up to 1cm thick, with Plag crystals, slightly fresher than DR129-1 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤1.2cm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, hydrothermally altered on surface/fractures *similar to DR129-1*	X		X		
DR129-3	1. Rock Type: Pillow tube fragment 2. Size: 9x9x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 3mm, large Plag phenocrysts up to 1cm 5. Vesicularity: 1-2%, round, irregular towards glassy rim 6. Vesicle Filling: none 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, large, up to 1.2cm; Ol, <1%, ~1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: overall fresh	X		X		

DR129-4	1. Rock Type: Pillow or flow roof 2. Size: 20x13x4.5cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 2-3mm, with large Plag phenocrysts up to 1cm 5. Vesicularity: ~3-5%, slightly more than DR129-1 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤1.2cm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, hydrothermally alterated on surface/fractures *similar to DR129-1*	X		X		

SO203 - DR130
Segment 3A of ridge axis; axial rift valley
Dredge on bottom UTC 22/11/09 2021hrs, lat 9°47.405'S, long 154°40.095'E, depth 3769m
Dredge off bottom UTC 22/11/09 2113hrs, lat 9°47.248'S, long 154°40.578'E, depth 3754m
total volume: one piece
Comments: small dredge (without sediment catcher) + MAPR #51 400m above dredge; rope length: 3769m on bottom - 4050m max. - 3713m off bottom; dredges towards 70°; one altered pillow fragment

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR130-1	1. Rock Type: Pillow fragment 2. Size: 13x13x10cm 3. Shape/Angularity: quite angular 4. Encrustation: glass crust, up to 5mm, with thick Mn-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤5mm; Ol, <1%, ≤2mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly hydrothermally altered surface	X		X	separate sample taken for sulfur	

SO203 - DR131
Segment 3A of ridge axis, most E dredge station of Segment 3A; axial rift valley
Dredge on bottom UTC 23/11/09 0040hrs, lat 9°46.595'S, long 154°42.493'E, depth 3883m
Dredge off bottom UTC 23/11/09 0312hrs, lat 9°46.639'S, long 154°43.342'E, depth 3871m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3919m on bottom - 4150m max. - 3770m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR131-1	1. Rock Type: Pillow fragment 2. Size: ? 3. Shape/Angularity: - 4. Encrustation: Mn-coating on surface 5. Vesicularity: 5%; 0.25-1mm, round 6. Vesicle Filling: black and yellowish/orange coating 7. Matrix Color: medium and dark grey 8. Primary Minerals: Plag, ~1-2%, ≤3mm, some ancicular or together with Ol, microlites; Ol, <1%, ≤1mm, together with Plag 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: slightly altered	X		X	separate sample taken for sulfur	
DR131-2	1. Rock Type: Pillow fragment 2. Size: ? 3. Shape/Angularity: - 4. Encrustation: glassy crust, up to 5mm, Mn-coating on some sides of rock and on glass 5. Vesicularity: 1-2%; ≤0.5mm, overall round 6. Vesicle Filling: black coating 7. Matrix Color: relatively light grey 8. Primary Minerals: Plag, <<1%, ≤1mm; Ol, <<<1%, <0.25mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: slightly altered	X		X		
DR131-3	1. Rock Type: Pillow or lava flow fragment 2. Size: ? 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1cm, with brown cooling crust and Palagonite 5. Vesicularity: <1%; <<0.25mm 6. Vesicle Filling: too small to be visible 7. Matrix Color: light and medium grey 8. Primary Minerals: Plag, <1%, microlites 9. Secondary Minerals: Fe-oxides on surface, Palagonite on glass 10. Degree of Alteration: slightly to moderately altered	X		X		
DR131-4	1. Rock Type: Pillow or lava flow fragment 2. Size: ? 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1.5cm (no cooling crust, no Palagonite); Mn-coating on some sides 5. Vesicularity: ≤1%; ≤0.5mm, mostly round 6. Vesicle Filling: black coating 7. Matrix Color: light to medium grey 8. Primary Minerals: few Plag and/or Ol microlites left, mostly altered --> now orange or dark fabric 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderately to strongly altered *similar to DR131-3*	X		X	separate sample taken for sulfur	
DR131-5	1. Rock Type: Pillow or lava flow fragment 2. Size: ? 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 7mm 5. Vesicularity: ≤1%, ≤0.25mm, overall round 6. Vesicle Filling: black coating 7. Matrix Color: relatively light grey 8. Primary Minerals: Plag, ≤1%, microlites, ancicular; minerals towards one side of rock altered 9. Secondary Minerals: Fe-oxides on some sides of rock; Palagonite 10. Degree of Alteration: moderately altered	X		X		

SO203 - DR133
Segment 3, W edge of 3B; axial rift valley
Dredge on bottom UTC 23/11/09 0851hrs, lat 9°50.195'S, long 154°55.007'E, depth 3585m
Dredge off bottom UTC 23/11/09 0956hrs, lat 9°50.506'S, long 154°55.521'E, depth 3743m
total volume: 3/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3625m on bottom - 4000m max. - 3519m off bottom; Mn-coated pillow basalts with Plag phenocrysts and glass

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES

DR133-1	1. Rock Type: Pillow fragment 2. Size: 11x10x10cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 3mm thick, Plag phenocrysts 5. Vesicularity: 1%; mostly round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤3mm, fairly fresh; Ol, 2-3%, ≤4mm, fairly fresh 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: slightly altered surface, fresh beneath	X		X		
DR133-2	1. Rock Type: Pillow fragment 2. Size: 18x17x17cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 2mm, Fe-Mn-crust, Mn: 2mm on glass crust; Fe-oxides: 1mm on surface 5. Vesicularity: ≤1%, <1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 2%, up to 3mm, fresh; Ol, <1%, <1mm, fresh 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderately altered surface, beneath: fresh	X		X		
DR133-3	1. Rock Type: Sheet flow? 2. Size: 15x12x9cm 3. Shape/Angularity: - 4. Encrustation: glass crust, 1-2mm; Fe-oxides 5. Vesicularity: 1-2%; ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, up to 3mm, fresh; Ol, 2%, up to 2mm, fresh 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: slightly altered surface, beneath: fresh	X		X		
DR133-4	1. Rock Type: Pillow fragment 2. Size: 13x10x11cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 2mm; Fe-oxides 5. Vesicularity: 1-2%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, 5-6%, up to 3mm, mostly smaller than 3mm; Ol, 1-2%, up to 2mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderately to strongly altered surfaced, beneath: fresh	X		X		

SO203 - DR135
Segment 3A, E part; ridge axis
Dredge on bottom UTC 23/11/09 1410hrs, lat 9º44.898'S, long 154º48.838'E, depth 3865m
Dredge off bottom UTC 23/11/09 1514hrs, lat 9º44.731'S, long 154º49.450'E, depth 3735m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3883m on bottom - 4200m max. - 3725m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR135-1	1. Rock Type: Pillow fragment 2. Size: 11x11x8cm 3. Shape/Angularity: - 4. Encrustation: glass crust, ≤4mm, some Fe-Mn-coating 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~2%, ≤5mm; Ol, few, <<1%, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: some hydrothermal alteration on surface	X		X		3 similar pieces (also DR135-1) for Archive
DR135-2	1. Rock Type: Pillow lava 2. Size: 8x7x6cm 3. Shape/Angularity: - 4. Encrustation: glass crust, ≤2-3mm; some Fe-Mn-coating 5. Vesicularity: 1-2% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~2%, ≤5mm; Ol, few, <<1%, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: some hydrothermal alteration on surface *similar to DR135-1*	X		X		
DR135-3	1. Rock Type: Pillow lava 2. Size: 7x7x4cm 3. Shape/Angularity: - 4. Encrustation: glass crust, ≤5mm; some Fe-Mn-coating 5. Vesicularity: 2-3% 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~2%, ≤5mm; Ol, few, <<1%, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: some hydrothermal alteration on surface, like DR135-1, but slightly fresher *similar to DR135-1*	X		X		

SO203 - DR137
Segment 3B of ridge axis, E part; axial rift valley
Dredge on bottom UTC 23/11/09 1932hrs, lat 9º47.511'S, long 155º3.604'E, depth 3329m
Dredge off bottom UTC 23/11/09 2027hrs, lat 9º47.377'S, long 155º4.131'E, depth 3440m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3350m on bottom - 3600m max. - 3289m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES

DR137-1	1. Rock Type: Sheet flow/flow fragment 2. Size: 46x35x15cm 3. Shape/Angularity: - 4. Encrustation: glass crust, on both sides, top: ≤5mm, with Mn-coating and flowing structure, bottom: ≤4mm, contact to water = glass, no pillow roof, Mn-coating on crust 5. Vesicularity: <<1%; ≤1mm, round 6. Vesicle Filling: black coating 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, <1%, ≤0.5mm, looking fresh 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: slightly altered surface according to Mn, fresh beneath 11. Comments: flow structure on glass crust and Pahoehoe	X (2)		X	separate sample taken for sulfur	
DR137-2	1. Rock Type: Flow fragment 2. Size: 23x15x15cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 2cm, with fresh brownish coating, glass on some sides slightly blueish, glass on almost all sides of rock 5. Vesicularity: ≤1%; ≤2mm, irregular shape 6. Vesicle Filling: black coating = Mn 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, <1%, ≤0.5mm, looking fresh 9. Secondary Minerals: very few Fe-oxides on surface 10. Degree of Alteration: fresh 11. Comments: flow structure visible on glass surface	X (2)		X		
DR137-3	1. Rock Type: Pillow tube fragment 2. Size: 12x8.5x7cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 5mm, very fresh with slight brown coating, flowing structure, with small Plag phenocrysts 5. Vesicularity: <1%; ≤1.5mm, irregular shape 6. Vesicle Filling: black and partly yellowish/brownish coating 7. Matrix Color: medium grey 8. Primary Minerals: Plag, <<1%, <0.25mm 9. Secondary Minerals: - 10. Degree of Alteration: very fresh	X		X		
DR137-4	1. Rock Type: Pillow roof or flow roof fragment 2. Size: 14x10x3.5cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1cm, with brown coating and Palagonite 5. Vesicularity: <1%; ≤1cm (elongated ones), irregular shape 6. Vesicle Filling: yellowish/brownish coating in some 7. Matrix Color: medium grey 8. Primary Minerals: Plag, <<1%, <0.25mm, microlites; Ol, <<1%, ≤0.5mm 9. Secondary Minerals: some Fe-oxides on surface; Palagonite on glass crust 10. Degree of Alteration: slightly altered surface, beneath: fresh	X		X	separate sample taken for sulfur	

SO203 - DR139
E end of Segment 3B of ridge axis, S end of transform fault (transition to transform fault), large flat seamount at S end of transform fault
Dredge on bottom UTC 23/11/09 2355hrs, lat 9º45.405'S, long 155º8.597'E, depth 3810m
Dredge off bottom UTC 24/11/09 0048hrs, lat 9º45.395'S, long 155º9.126'E, depth 3778m
total volume: 1/5 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3832m on bottom - 4100m max. - 3750m off bottom; fresh pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR139-1	1. Rock Type: Sheet flow 2. Size: 14x13x5cm 3. Shape/Angularity: flat, subrounded 4. Encrustation: glass crust, ≤5mm, cooling crust 5. Vesicularity: 1-2%, round, few elongated 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤3mm; Ol, 1-2%, <1mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, only minor hydrothermal alteration	X		X		
DR139-2	1. Rock Type: Sheet flow 2. Size: 23x17x14cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤5mm, cooling crust with Fe-Mn-coating 5. Vesicularity: ≤1%; ≤2mm, irregular shape 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤3mm; Ol, 1-2%, <1mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, only minor hydrothermal alteration *similar to DR139-1*	X		X	separate sample taken for sulfur	
DR139-3	1. Rock Type: Pillow lava, tube fragment 2. Size: 21x15x10cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, up to 4mm 5. Vesicularity: 1-2%, round, few elongated 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤3mm; Ol, 1-2%, <1mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, only minor hydrothermal alteration *similar to DR139-1*	X		X		
DR139-4	1. Rock Type: Pillow lava 2. Size: 20x14x12cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤4mm, probably some Palagonite; some Fe-Mn-coating 5. Vesicularity: 1-2%, round, few elongated 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤3mm; Ol, 1-2%, <1mm 9. Secondary Minerals: Palagonite? 10. Degree of Alteration: quite fresh, only minor hydrothermal alteration *similar to DR139-1*	X		X		

DR139-5	1. Rock Type: Sheet flow fragment 2. Size: 11x10x8cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤8mm; some Mn-coating 5. Vesicularity: ≤5-7%, some large vesicles --> flow structure 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤3mm; Ol, 1-2%, <1mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, only minor hydrothermal alteration *similar to DR139-1*	X		X		

SO203 - DR140
E end of Segment 3B of ridge axis, S end of transform fault
Dredge on bottom UTC 24/11/09 0340hrs, lat 9º46.189'S, long 155º9.502'E, depth 3743m
Dredge off bottom UTC 24/11/09 0446hrs, lat 9º46.204'S, long 155º10.025'E, depth 3516m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3752m on bottom - 4050m max. - 3500m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR140-1	1. Rock Type: Pillow lava 2. Size: 20x18x12cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, up to 1.5cm, some Mn-crust 5. Vesicularity: ≤1%; ≤2mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤5mm; Ol, few, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderate hydrothermal alteration	X		X	separate sample taken for sulfur	
DR140-2	1. Rock Type: Pillow lava 2. Size: 20x16x13cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤3mm, Palagonite --> old-looking; some Mn-coating 5. Vesicularity: ≤1%; ≤2mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤5mm; Ol, few, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderate hydrothermal alteration *similar to DR140-1*	X		X		
DR140-3	1. Rock Type: Pillow lava 2. Size: 18x15x13cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤1cm, thick Mn-crust 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤5mm; Ol, few, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderate hydrothermal alteration *similar to DR140-1*	X		X		
DR140-4	1. Rock Type: Pillow lava 2. Size: 20x17x10cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤3mm, Fe-Mn-coating in veins 5. Vesicularity: ≤1%; ≤2mm, round 6. Vesicle Filling: - 7. Matrix Color: grey 8. Primary Minerals: Plag, 4-6%, ≤5mm; Ol, ≤1%, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderate hydrothermal alteration *similar to DR140-1*	X		X		
DR140-5	1. Rock Type: Pillow lava 2. Size: 13x11x9cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤3mm 5. Vesicularity: ≤1%; ≤2mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-4%, ≤5mm; Ol, few, ≤1mm 9. Secondary Minerals: Fe-oxides on surface 10. Degree of Alteration: moderate hydrothermal alteration *similar to DR140-1*	X		X		
DR140-6	1. Rock Type: Pillow lava 2. Size: 7x7x6cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, ≤3mm 5. Vesicularity: 1-2%; ≤2.5mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey to black 8. Primary Minerals: Plag, 1-3%, ≤5mm; Ol, <1%, ≤1mm 9. Secondary Minerals: 10. Degree of Alteration: quite fresh looking *similar to DR140-1*	X		X		
DR140-7	1. Rock Type: Pillow lava 2. Size: 22x17x14cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, with thick Mn-crust, altered rim, up to 1.5cm 5. Vesicularity: 1-2%, up to 8mm, round 6. Vesicle Filling: - 7. Matrix Color: medium to dark grey 8. Primary Minerals: Plag, 5-7%, up to 4mm; Ol, 1-2%, up to 2mm 9. Secondary Minerals: - 10. Degree of Alteration: strong hydrothermal alteration	X		X		

SO203 - DR142
Segment 4A of ridge axis, W end, N/NE of transform fault, most W sampling location of 4A; on axis volcano
Dredge on bottom UTC 24/11/09 1739hrs, lat 9º34.410'S, long 155º16.097'E, depth 3887m

Dredge off bottom UTC 24/11/09 1828hrs, lat 9°34.387'S, long 155°16.641'E, depth 3884m
total volume: very few tiny pieces
Comments: small dredge (without sediment catcher) + MAPR #50 400m above dredge; rope length: 3889m on bottom - 4200m max. - 3860m off bottom; glass crusts, very fresh!

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR142-1	1. Rock Type: several pieces of glass crusts 2. Size: very small pieces, largest one: 6.5x4x3cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, up to 3cm thick, very fresh, slight fresh brown coating 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Color: black 8. Primary Minerals: few Plag phenocrysts, ≤0.5mm 9. Secondary Minerals: none 10. Degree of Alteration: very fresh	X		X		

SO203 - DR143
Segment 4A of ridge axis, E end of 4A, most E sampling location of 4A; same seamount chain as DR91, but further ENE of DR91
Dredge on bottom UTC 24/11/09 2217hrs, lat 9°31.547'S, long 155°23.392'E, depth 3920m
Dredge off bottom UTC 24/11/09 2302hrs, lat 9°31.944'S, long 155°23.566'E, depth 3879m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #50 400m above dredge; rope length: 3940m on bottom - 4100m max. - 3765m off bottom; dredged towards 155°, repeated as DR144, further ENE

SO203 - DR144
Segment 4A of ridge axis, E end of 4A; seamount chain further ENE from DR143
Dredge on bottom UTC 25/11/09 0204hrs, lat 9°30.653'S, long 155°24.847'E, depth 4000m
Dredge off bottom UTC 25/11/09 0258hrs, lat 9°31.118'S, long 155°25.008'E, depth 3911m
total volume: 1/5 full
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #50 400m above dredge; rope length: 4005m on bottom - 4200m max. - 3768m off bottom; dredged towards 160°, sheet, blocky lava, quite fresh, some hydroth. al

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR144-1	1. Rock Type: Piece of blocky lava 2. Size: 10x8x10cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, up to 1.2cm, some Palagonite; slight Mn-coating 5. Vesicularity: ~1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, ~1%, ≤7mm 9. Secondary Minerals: Palagonite 10. Degree of Alteration: some Mn-coating, slight hydrothermal alteration	X		X		
DR144-2	1. Rock Type: Piece of blocky lava 2. Size: 12x10x8cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, up to 7mm, some Palagonite 5. Vesicularity: <1%, <1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤6mm 9. Secondary Minerals: - 10. Degree of Alteration: moderate hydrothermal alteration	X		X		
DR144-3	1. Rock Type: Pillow bud 2. Size: 10x9x5cm 3. Shape/Angularity: subrounded 4. Encrustation: glass crust, ≤3mm 5. Vesicularity: 1-2%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤5mm 9. Secondary Minerals: - 10. Degree of Alteration: quite fresh, almost no hydrothermal alteration	X		X		
DR144-4	1. Rock Type: Piece of sheet flow 2. Size: 16x14x4cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, up to 1.5cm, some Palagonite 5. Vesicularity: 1-2%, <1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 1-2%, ≤6mm 9. Secondary Minerals: - 10. Degree of Alteration: slight to moderate hydrothermal alteration	X		X	separate sample taken for sulfur	
DR144-5	1. Rock Type: Piece of blocky lava 2. Size: 14x14x10cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, up to 1.2cm, with some Mn-coating 5. Vesicularity: ≤1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, <1%, ≤5mm 9. Secondary Minerals: - 10. Degree of Alteration: strong hydrothermal alteration on surface	X		X		

SO203 - DR145
Segment 4B of ridge axis, W end of ridge axis
Dredge on bottom UTC 25/11/09 0637hrs, lat 9°33.900'S, long 155°31.491'E, depth 3923m
Dredge off bottom UTC 25/11/09 3911hrs, lat 9°34.382'S, long 155°31.667'E, depth 3911m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3923m on bottom - 4200m max. - 3773m off bottom; old pillows

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR145-1	1. Rock Type: Pillow lava 2. Size: 27x23x17cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤1cm; thick Mn-crust 5. Vesicularity: <1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤2mm, ancicular; Ol, <1%, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered, lots of sediment and hydrothermal alteration	X		X	separate sample taken for sulfur	

DR145-2	1. Rock Type: Piece of basaltic lava 2. Size: 14x8x7cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤5mm; Mn-coating 5. Vesicularity: <1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤2mm, ancicular; Ol, <1%, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered, lots of sediment and hydrothermal alteration *similar to DR145-1*	X		X		
DR145-3	1. Rock Type: Pillow lava 2. Size: 22x15x15cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤3mm; Mn-coating 5. Vesicularity: <1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤2mm, ancicular; Ol, <1%, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered, lots of sediment and hydrothermal alteration *similar to DR145-1*	X		X		
DR145-4	1. Rock Type: Pillow lava 2. Size: 16x10x12cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤1cm; Mn-coating 5. Vesicularity: <1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤2mm, ancicular; Ol, <1%, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered, lots of sediment and hydrothermal alteration *similar to DR145-3*			X		
DR145-5	1. Rock Type: Pillow lava 2. Size: 17x16x14cm 3. Shape/Angularity: subangular 4. Encrustation: glass crust, ≤3mm; Mn-coating 5. Vesicularity: <1%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 2-3%, ≤2mm, ancicular; Ol, <1%, ≤1mm 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered, lots of sediment and hydrothermal alteration *similar to DR145-3*			X		

SO203 - DR146
Segment 4C of ridge axis; on-axis volcanic cone
Dredge on bottom UTC 25/11/09 1135hrs, lat 9°33.889'S, long 155°41.594'E, depth 3623m
Dredge off bottom UTC 25/11/09 1236hrs, lat 9°33.889'S, long 155°42.216'E, depth 3655m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3648m on bottom - 4000m max. - 3627m off bottom; quite fresh pieces of sheet flow

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR146-1A	1. Rock Type: Sheet flow 2. Size: 22x16x7cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤1.5cm, some Palagonite 5. Vesicularity: 1-2%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-5%, ≤5mm; Ol, ≤1%, ≤2mm 9. Secondary Minerals: Palagonite 10. Degree of Alteration: very fresh, almost no hydrothermal alteration	X		X		
DR146-1B	1. Rock Type: Sheet flow 2. Size: 20x20x7cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤1.5cm, some Palagonite 5. Vesicularity: 1-2%, ≤1mm, round 6. Vesicle Filling: - 7. Matrix Color: dark grey 8. Primary Minerals: Plag, 3-5%, ≤5mm; Ol, ≤1%, ≤2mm 9. Secondary Minerals: Palagonite 10. Degree of Alteration: very fresh, almost no hydrothermal alteration *similar to DR146-1A*	X		X	separate sample taken for sulfur	

SO203 - DR147
Segment 4C of ridge axis
Dredge on bottom UTC 25/11/09 1549hrs, lat 9°33.304'S, long 155°43.610'E, depth 3554m
Dredge off bottom UTC 25/11/09 1645hrs, lat 9°32.939'S, long 155°44.223'E, depth 3474m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; MAPR #51 400m above dredge; rope length: 3519m on bottom - 3850m max. - 3490m off bottom; fresh looking pieces of sheet lava and pillow lava

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR147-1A	1. Rock Type: Pillow fragment or flow roof 2. Size: 15x14x6cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1cm, with Plag phenocrysts 5. Vesicularity: <<1%, very few up to 1cm, usually <0.25mm 6. Vesicle Filling: - 7. Matrix Color: black and dark grey 8. Primary Minerals: Plag, 2-3%, ≤3mm, mostly in glass, fresh; Ol: 2-3%, ≤2mm, mostly in rock not glass, fresh; 9. Secondary Minerals: little Palagonite 10. Degree of Alteration: fresh	X		X	separate sample taken for sulfur	

DR147-1B	1. Rock Type: Pillow fragment or flow roof 2. Size: 9x13x6cm, 10x8x7cm, 14x7x5cm 3. Shape/Angularity: - 4. Encrustation: glass crust, up to 1cm, with Plag phenocrysts 5. Vesicularity: <<1%, very few up to 1cm, usually <0.25mm 6. Vesicle Filling: - 7. Matrix Color: black and dark grey 8. Primary Minerals: Plag, 2-3%, ≤3mm, mostly in glass, fresh; Ol: 2-3%, ≤2mm, mostly in rock not glass, fresh; 9. Secondary Minerals: little Palagonite 10. Degree of Alteration: fresh *similar to DR147-1A*					
DR147-2	1. Rock Type: Flow or pillow fragment 2. Size: 14x8x12cm 3. Shape/Angularity: - 4. Encrustation: glass crust up to 2cm, with Plag phenocrysts 5. Vesicularity: <<< 1% 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag: ≤1-2%, up to 3mm, slightly altered, also in glass 9. Secondary Minerals: ? 10. Degree of Alteration: slightly altered (see Plag in glass)	X		X		

SO203 - DR151
W end of Segment 4, S of Segment 4A
Dredge on bottom UTC 26/11/09 1742hrs, lat 9º39.702'S, long 155º19.225'E, depth 2603m
Dredge off bottom UTC 26/11/09 1830hrs, lat 9º40.040'S, long 155º19.329'E, depth 2554m
total volume: 5 pieces
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2640m on bottom - 2850m max. - 2433m off bottom; dredged towards 170°

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR151-1	1. Rock Type: Basalt fragment 2. Size: 6x5.5x4.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, up to 3mm 5. Vesicularity: 1%, usually <<0.25mm 6. Vesicle Filling: none 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 1-2%, ≤0.25mm, fresh looking 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh inside, strongly altered outside	X	X			
DR151-2	1. Rock Type: Basalt fragment 2. Size: 5.5x4x4.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, up to 3mm 5. Vesicularity: 1%, usually <<0.25mm 6. Vesicle Filling: none 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 1-2%, ≤0.25mm, fresh looking 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh inside, strongly altered outside *similar to DR151-1*	X	X			
DR151-3	1. Rock Type: Basalt fragment 2. Size: 6x5.5x4.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust up to ≤8mm 5. Vesicularity: 1%, usually <<0.25mm 6. Vesicle Filling: none 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ~3%, ≤0.25mm, fresh looking 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh inside, strongly altered outside (more & thicker Mn-crust) *similar to DR151-1*	X	X			
DR151-4	1. Rock Type: Basalt fragment 2. Size: 14x11x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, ≤1cm 5. Vesicularity: <<1%, very few ~1mm, others <<0.25mm 6. Vesicle Filling: yellowish filling 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, ~1%, up to 3mm, few ancicular 9. Secondary Minerals: - 10. Degree of Alteration: fairly fresh inside, strongly altered outside	X	X			
DR151-5	1. Rock Type: Basalt fragment 2. Size: 12.5x9.5x4.5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, <1mm 5. Vesicularity: ≤1%, very few ~1mm 6. Vesicle Filling: some with no filling, some with white-bluish-grey filling 7. Matrix Color: light to medium grey, consisting of Plag and dark minerals 8. Primary Minerals: Plag: ≤2mm, fairly fresh; dark minerals: ? 9. Secondary Minerals: - 10. Degree of Alteration: moderate to strongly altered, most altered of all 5 samples from DR151 *different from DR151-1 to DR151-4*	X	X			

SO203 - DR153
Segment 4A, N flank of seamount chain structure
Dredge on bottom UTC 26/11/09 2158hrs, lat 9º49.499'S, long 155º17.986'E, depth 2968m
Dredge off bottom UTC 26/11/09 2242hrs, lat 9º49.932'S, long 155º18.003'E, depth 3007m
total volume: 1/4 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3000m on bottom - 3200m max. - 2872m off bottom; dredged towards 180°

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR153-1	1. Rock Type: Basalt fragment 2. Size: 12x9x10.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, ≤5mm; thin glass crust, strongly altered 5. Vesicularity: ≤1%, close to glass crust (former glass crust) --> near surface, irregular; usually <0.5mm 6. Vesicle Filling: some with orange filling or black coating 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, ≤0.25mm, mostly smaller, some ancicular, fairly fresh looking; Ol ? 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered	X		X		

DR153-2	1. Rock Type: Basalt fragment 2. Size: 16x13x10cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, ≤3mm; glass crust, up to 5mm, quite fresh, more glass available! 5. Vesicularity: ≤1%, close to glass crust (former glass crust) --> near surface, irregular; usually <0.5mm 6. Vesicle Filling: some with orange filling or black coating 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, ≤0.25mm, mostly smaller, some ancicular, fairly fresh looking; Ol ? 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered *similar to DR153-1*	X		X		
DR153-3	1. Rock Type: Basalt fragment 2. Size: 14x12x10cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, up to 7mm; thin glass crust, strongly altered 5. Vesicularity: ≤1%, close to glass crust (former glass crust) --> near surface, irregular; usually <0.5mm 6. Vesicle Filling: some with orange filling or black coating 7. Matrix Color: light to medium grey 8. Primary Minerals: Plag, ≤0.25mm, mostly smaller, some ancicular, fairly fresh looking; Ol ? 9. Secondary Minerals: - 10. Degree of Alteration: moderately altered *similar to DR153-1*	X		X		

SO203 - DR155
Across-axis profile, 3rd dredge S of segment 4A; 3rd larger mountain chain (W-E-trending), largest peak on this mountain chain
Dredge on bottom UTC 27/11/09 0201hrs, lat 9°54.805'S, long 155°16.991'E, depth 3564m
Dredge off bottom UTC 27/11/09 0319hrs, lat 9°55.404'S, long 155°16.995'E, depth 3110m
total volume: 1/2 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3571m on bottom - 3800m max. - 3060m off bottom; dredged towards 180°

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR155-1	1. Rock Type: Lava fragment 2. Size: 15x13x11.5cm 3. Shape/Angularity: angular 4. Encrustation: thick Mn-coating; glass crust, ≤1.5cm 5. Vesicularity: 1-2%, round, ≤1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, 1-2%, ≤3mm, ancicular 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered	X		X		
DR155-2	1. Rock Type: Lava fragment 2. Size: 15x12x11.5cm 3. Shape/Angularity: angular 4. Encrustation: thick Mn-coating; glass crust, ≤4mm 5. Vesicularity: <<1%, round, ≤1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ~1-2%, ≤2mm, ancicular 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered, alteration rim ≤2cm	X		X		
DR155-3	1. Rock Type: Lava fragment 2. Size: 15x12x10cm 3. Shape/Angularity: angular 4. Encrustation: thick Mn-coating on top; glass crust, ≤3mm 5. Vesicularity: 2-3%, round, ≤1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag; ~1-2%, ≤4mm, ancicular 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered surface	X		X		
DR155-4	1. Rock Type: Lava fragment 2. Size: 23x21.5x11cm 3. Shape/Angularity: angular 4. Encrustation: glass crust, ≤16mm, some Palagonite; much Mn 5. Vesicularity: 1-2%, round, ≤1mm 6. Vesicle Filling: - 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ~1-2%, ≤3mm, ancicular 9. Secondary Minerals: - 10. Degree of Alteration: strongly altered surface	X		X		

SO203 - DR157
Across-axis profile, S of Segment 4A
Dredge on bottom UTC 27/11/09 0714hrs, lat 10°3.605'S, long 155°16.708'E, depth 3368m
Dredge off bottom UTC 27/11/09 0808hrs, lat 10°4.087'S, long 155°16.707'E, depth 3352m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3361m on bottom - 3550m max. - 3173m off bottom

SO203 - DR159
Across-axis profile, S of Segment 4A
Dredge on bottom UTC 27/11/09 1146hrs, lat 10°12.001'S, long 155°25.489'E, depth 2807m
Dredge off bottom UTC 27/11/09 1248hrs, lat 10°12.329'S, long 155°25.617'E, depth 2372m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2835m on bottom - 3050m max. - 2330m off bottom

SO203 - DR160
Across-axis profile, S of Segment 4A; flank of a seamount
Dredge on bottom UTC 27/11/09 1440hrs, lat 10°11.810'S, long 155°25.794'E, depth 2894m
Dredge off bottom UTC 27/11/09 1558hrs, lat 10°12.244'S, long 155°25.958'E, depth 2283m
total volume: few rocks
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 2927m on bottom - 3200m max. - 2270m off bottom; repetition of DR159, further E than DR159

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR160-1	1. Rock Type: Basalt fragment 2. Size: 13x8x6cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, glass crust, ≤4mm, and Mn-coating 5. Vesicularity: <<1%, ≤1/3mm, round 6. Vesicle Filling: some with white or yellow filling, some with no filling 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ~2-3%, ≤1mm, some fresh, some yellowish and strongly altered 9. Secondary Minerals: dark mineral 10. Degree of Alteration: moderately to strongly altered	X	X			

DR160-2	1. Rock Type: Basalt fragment 2. Size: 28x28x25cm 3. Shape/Angularity: angular to subangular 4. Encrustation: Mn-crust, 2-3mm 5. Vesicularity: <<1%, <0.25mm 6. Vesicle Filling: white filling 7. Matrix Color: medium grey 8. Primary Minerals: Plag, ≤2mm, some ancicular, microlites, overall fresh; Ol, <<1%, microlites (or altered Plag?) 9. Secondary Minerals: - 10. Degree of Alteration: beneath surface: slightly altered 11. Comments: alteration rim towards outer surface of rock piece	X	X			

SO203 - DR162
Across-axis profile, S of Segment 4A
Dredge on bottom UTC 27/11/09 1921hrs, lat 10°17.386'S, long 155°19.906'E, depth 3862m
Dredge off bottom UTC 27/11/09 2102hrs, lat 10°18.160'S, long 155°19.900'E, depth 3484m
total volume: empty
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 3870m on bottom - 4050m max. - 3440m off bottom; station repeated as DR164

SO203 - DR164
Across-axis profile, S of Segment 4A
Dredge on bottom UTC 28/11/09 0037hrs, lat 10°17.197'S, long 155°18.900'E, depth 4267m
Dredge off bottom UTC 28/11/09 0217hrs, lat 10°17.789'S, long 155°18.995'E, depth 3571m
total volume: 1/3 full
Comments: small KUM type I K/MT9000 chain bag dredge; rope length: 4290m on bottom - 4500m max. - 3551m off bottom

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	GLASS	OTHER GROUPS	NOTES
DR164-1	Microgabbro; size: 26x13x12cm; overall light grey appearance; primary minerals: light and dark fine crystals; secondary minerals: very fine disseminated pyrite; degree of alteration: up to 1.5cm alteration rim (greenish grey); partly coated with Fe-oxides	X	X			
DR164-2	strongly altered volcanic rock (basalt?); size: 22x13x8cm; large plag phenocrysts, up to 0.5mm; some dark phenocrysts ≤3mm; secondary minerals: hematite <0.25mm; strongly altered	X				
DR164-3	Microgabbro; 22x11x9cm; greenish grey; primary minerals: one large altered phenocryst 1x0.5cm (Plag?); dark grey crystals/clay areas (?); secondary minerals: pyrite, larger than in DR164-1; strongly altered, yellow-reddish alteration along cracks	X				
DR164-4	fine grained sandstone; 7x7x2cm	X				
DR164-5	Breccia; 7x7x3cm; different components show varying alteration degrees	X				
DR164-6	Microgabbro; 10x8x6cm; some light yellowish greenish veins (0.5mm); small veinlets of hematite, goethite (?)	X				
DR164-7	Microgabbro, talus; 20x20x10cm; Fe-oxides, hematite up to 5mm	X				

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2	RV Sonne Fahrtbericht / Cruise Report SO 181 TIPTEQ (from The Incoming Plate to mega Thrust EarthQuakes) 06.12.2004.-26.02.2005. Ed. by Ernst R. Flueh & Ingo Grevemeyer, 2005, 533 pp. In English
3	RV Poseidon Fahrtbericht / Cruise Report POS 316 Carbonate Mounds and Aphotic Corals in the NE-Atlantic 03.08.–17.08.2004. Ed. by Olaf Pfannkuche & Christine Utecht, 2005, 64 pp. In English
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