



IFM-GEOMAR

Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

FS Sonne
Fahrtbericht / Cruise Report SO193
MANIHIKI

Temporal, Spatial, and Tectonic Evolution
of Oceanic Plateaus

Suva/Fiji – Apia/Samoa
19.05. - 30.06.2007



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

Nr. 13
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SUMMARY

The research project SO193 MANIHIKI comprises investigations of volcanic and tectonic structures, magmatic rocks and marine organisms at the submarine Manihiki Plateau in the SW-Pacific. The Manihiki Plateau largely consists of volcanic rocks and represents a Mid-Cretaceous flood basalt or Large Igneous Province (LIP). The geological studies carried out on R/V SONNE cruise SO193 focused on bathymetric mapping of key areas in the Manihiki Plateau region, and representative hard rock sampling of all major geomorphological units of the plateau as well as seamounts on the adjacent oceanic crust, and the major fault systems crosscutting the plateau. SO193 MANIHIKI aims to reconstruct the origin and spatial and temporal evolution of the Manihiki Plateau and to characterize the relationship between the Manihiki Plateau and other LIPs in the western and southwestern Pacific.

The R/V SONNE cruise SO193 started in Suva/Fiji on May 19, 2007 and ended in Apia, Samoa on June 30, 2007. Complementing 4,671 nm of Simrad EM120 multi beam mapping of the ocean floor and Parasound sub-bottom profiling, a total of 82 dredges, eight TV grabs, eight multi corers, and two OFOS profiles were carried out during SO193 on the Manihiki Plateau and in the adjacent Central Pacific, Penrhyn and Samoan Basins. Of these deployments, 77 recovered magmatic or sedimentary rock. Olivine bearing sheet and pillow lavas dominate among these rocks, but various types of volcanoclastic rocks are also common, some of them indicate subaerial or shallow water volcanic activity and/or deposition. Minor lithologies include, among others, picritic lavas, serpentinites, evolved lavas (e.g., trachytes?), and subvolcanic intrusiva. Unexpectedly, in some areas of the Manihiki Plateau, namely the Suvorov Trough, the North Plateau, the NE corner of the High Plateau, and at the southern margin, at least the upper directly accessible portions of the dredged features appear to be mainly made up of solidified, indurated or lithified sediments. The origin and age of these sediments is unclear at this stage, but their partially strong solidification may suggest secondary heating and/or intense tectonic movements. By contrast to the Hikurangi Plateau, being surveyed on SO168, guyots exist only in some restricted areas of the Manihiki Plateau. The recent depth of their erosional platforms vary unsystematically between 1,600 m and 2,500 m b.s.l., implying different ages of these volcanoes or non-uniform subsidence rates. On the other hand, uneroded seamounts are common on and close to the Manihiki Plateau and rise up to 600 m below sea level. Pillow lavas dredged from the crest of a ridge rising ~600 m from the High Plateau, considered to be formed in subaerial conditions by previous studies, also suggest several phases of volcanic activity in the Manihiki Plateau area. Taken together, the preliminary results of mapping and sampling of SO193 suggest a complex geodynamic history for the Manihiki Plateau, including intense tectonic movements and several phases of volcanic activity. Multi-beam mapping, dredging, and OFOS profiles carried out during SO193 also revealed that the fault systems and scarps of Manihiki Plateau are predestinated for more detailed studies of oceanic LIP basement, in particular stratigraphically controlled sampling of the magmatic succession of the plateau basement using, for example, a remote operate vehicle (ROV).

Biological material was obtained successfully as macrofauna and as sediment samples containing meiofaunal organisms with the help of a geological chain bag dredge, sediment traps, a multicorer and a TV-grab. Macrofaunal organisms were recovered from 51 out of 98 stations, 67 stations revealed sediment samples. During the cruise, a total of 3,113 meiofaunal organisms were isolated from 61 kg of sediment. In comparison to previous results from expeditions to the Pacific (SO144-3, SO158, SO168), the Manihiki Plateau fauna turned out to be rather impoverished. Food depletion in the water column and the high number of collecting stations below the CCD ("carbonate compensation depth") may account for the small amount of specimens recovered. OFOS and TV-grab videos revealed the same scarcity of animals in the deep. These results do not support the hypothesis of the Manihiki Plateau as a biodiversity 'hot spot' and a potential centre of origin for benthic invertebrates *sensu* Ladd (1960). In contrast, the ongoing analysis of the impoverished fauna found on the Manihiki Plateau may show a rather high degree of endemism.

ZUSAMMENFASSUNG

Im Forschungsprojekt SO193 MANIHIKI werden vulkanische und tektonische Strukturen, magmatische Gesteine und marine Organismen im Bereich des Manihikiplateaus im Südwestpazifik untersucht. Das Manihikiplateau ist überwiegend aus vulkanischen Gesteinen aufgebaut und wird als kretazische ozeanische Flutbasaltprovinz ("Large Igneous Province", LIP) angesehen. Die geologischen Untersuchungen auf der F.S. SONNE Expedition SO193 konzentrierten sich auf die bathymetrische Kartierung von Schlüsselgebieten am Manihikiplateau und auf eine repräsentative Hartgesteinsbeprobung aller bedeutenden geomorphologischen Einheiten des Plateaus sowie benachbarter Strukturen und der großen Störungssysteme, die das Plateau durchschneiden. Mit SO193 MANIHIKI soll der Ursprung sowie die räumliche und zeitliche Entwicklung des Plateaus rekonstruiert und mit der anderer LIP's im westlichen und südwestlichen Pazifik verglichen werden.

Die FS SONNE-Ausfahrt SO193 begann am 19. Mai 2007 in Suva (Fidschi) und endete am 30. Juni 2007 in Apia (Samoa). Neben 4.671 nm Profilmfahrten (SIMRAD/Parasound) wurden während SO193 insgesamt 82 Dredgezüge, 8 TV-Greifereinsätze, 8 Multicorereinsätze und 2 OFOS-Profile durchgeführt. 77 dieser Geräteeinsätze erbrachten magmatische oder sedimentäre Gesteine. Darunter dominieren Olivin-führende Schicht- und Pillowlaven. Ebenfalls häufig sind verschiedene Vulkaniklastika, deren Struktur und Textur teilweise auf vulkanische Aktivität an Land oder in flachem Wasser hindeutet. Untergeordnete Lithologien sind u.a. pikritische Laven, Serpentine, entwickelte Laven (z.B. Trachyte?) oder subvulkanische Intrusiva. Unerwarteterweise scheinen in einigen Bereichen des Manihikiplateaus (u.a. Suvorov Trog, "North Plateau", NE-Ecke des "High Plateau") die oberen, direkt zugänglichen Ablagerungen der beprobten Strukturen überwiegend aus verfestigten oder lithifizierten Sedimenten zu bestehen. Der Ursprung und das Alter dieser Sedimente ist noch unklar, aber ihre teilweise sehr starke Verfestigung scheint auf eine sekundäre Aufheizung oder intensive tektonische Bewegungen hinzudeuten. Im Gegensatz zum Hikurangiplateau, das bei SO168 untersucht wurde, existieren Guyots nur in einigen begrenzten Gebieten des Manihikiplateaus. Die heutige Lage ihrer Erosionsplateaus in 1.600 bis 2.500 m Wassertiefe zeigt, dass sie entweder unterschiedliche Alter haben oder dass die Absenkungsraten im Bereich des Manihikiplateaus variieren. Unerodierte Seamounts sind dagegen auf oder nahe dem Plateau relativ häufig und ragen bis zu ca. 600 m unter die Wasseroberfläche auf. Auch Pillowlaven, die am Top eines Rückens gedredged wurden, der ca. 600 m von dem wahrscheinlich in subaerischen oder Flachwasserbedingungen entstandenen "High Plateau" aufragt, weisen auf mehrere Phasen vulkanischer Aktivität am Manihikiplateau hin. Zusammengefasst deuten die ersten Ergebnisse von SO193 auf eine komplexe geodynamische Entwicklung des Manihikiplateaus hin, die von intensiver Tektonik und langanhaltendem oder wiederholtem Vulkanismus gekennzeichnet ist. Ferner zeigte SO193, dass sich das Manihikiplateau mit seinen vielen Störungssystemen und "Scarps" hervorragend für detailliertere Untersuchungen des ozeanischen Basements von LIPs eignet, insbesondere für eine stratigraphisch kontrollierte Beprobung der magmatischen Abfolge des LIP Basements mit z.B. einem Tauchboot oder Tauchroboter (ROV).

Biologisches Material (Makrofauna und Meiofauna aus Sedimentproben) konnte mit Hilfe von geologischen Dredgen, Sedimentfallen, einem Multicorer und einem TV-Greifer gesammelt werden. Makrofauna-Organismen fanden sich an 51 von insgesamt 98 Stationen, an 67 Stationen konnten Sedimentproben gewonnen werden. Bereits an Bord wurden 3.113 Meiofauna-Organismen aus insgesamt 61 kg Sediment isoliert. Im Vergleich zu früheren Expeditionen in den Pazifik (SO144-3, SO158, SO168), erwies sich das Manihiki Plateau als sehr artenarm. Möglicherweise ist Nährstoffmangel im Wasser dafür verantwortlich. Auch die Lage vieler Stationen unterhalb der CCD (Karbonat-Kompensations-Tiefe) könnte zur geringen Menge an Makrofauna-Organismen in den Proben und (entsprechend) auf den Videoaufzeichnungen mit OFOS und TV-Greifer beigetragen haben. Damit erweist sich das Manihiki-Plateau nicht als sogenannter Biodiversitäts-'hot spot' und auch eine Funktion als mögliches Artbildungszentrum *sensu* Ladd (1960) kann ausgeschlossen werden. Vielmehr ist aufgrund dieser ersten Ergebnisse zu vermuten, dass die artenarme und verinselt auftretende Benthosgemeinschaft des Manihiki-Plateaus einen relativ hohen Endemismusgrad aufweist.

1. ACKNOWLEDGEMENTS

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2. PARTICIPANTS

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Dieks, Haye	2 st Officer	Rieper, Uwe	Electrician
Angermann, Rudolf	Chief Electronican	Noack, Robert	Motorman
Leppin, Jörg	Systems Manager	Blohm, Volker	Fitter
Ehmer, Andreas	Systems Manager	Slotta, Werner	Chief Steward
Schlenker, Wilhelm	Surgeon	Pohl, Andreas	2 nd Steward
Tiemann, Frank	Chief Cook	Finck, Christian	Apprentice
Oryszewski, Kryzstof	2 nd Cook	Heinrich, Finn Janning	Apprentice
Kraft, Jürgen	Boatswain	Stegmann, Tim	Apprentice
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3. BACKGROUND AND MAJOR OBJECTIVES OF SO193 MANIHIKI

SO193 MANIHIKI (<http://www.ifm-geomar.de/index.php?id=manihiki>) comprises investigations of volcanic and tectonic structures, magmatic rocks and marine organisms at the submarine Manihiki Plateau in the SW-Pacific. The Manihiki Plateau largely consists of volcanic rocks and represents a Mid-Cretaceous flood basalt or Large Igneous Province (LIP). The geological studies carried out on R/V SONNE cruise SO193 focused on bathymetric mapping and hard rock sampling of all major geomorphological units of the plateau and adjacent seamounts of the plateau, and the major fault systems cutting the plateau. Subsequent morphological, volcanological, petrological, geochemical, and geochronological analyses aim to reconstruct the origin and spatial and temporal evolution of the Manihiki Plateau and to characterize the relationship between the Manihiki Plateau and the other LIPs in the western and southwestern Pacific (Ontong Java Plateau off the Solomon Islands and Hikurangi Plateau off New Zealand, Fig. 3.1.). SO193 MANIHIKI is partially based on the results of previous studies (e.g., BMBF project SO168 ZEALANDIA, <http://www.ifm-geomar.de/div/projects/zealandia/>). The major objectives of the research project are (1) to contribute to a better understanding of LIPs and associated mantle processes, (2) to provide new information on the origin, extent and effects of the huge Cretaceous magmatic events which caused the formation of LIPs, and (3) to enable a more detailed reconstruction of the geodynamic evolution of the SW-Pacific. Furthermore SO193 MANIHIKI intends to test the hypothesis that the formation of the Manihiki Plateau has been part of the so-called „Greater Ontong Java Plateau Event“. This submarine event occurred ~120 Mill. years ago and is the largest-known magmatic event on our planet which may have covered nearly 1% of the Earth's surface with volcanism. Additionally, representative samples of the deep-sea meiofauna and macrofauna are collected in order to investigate the diversity and the distributional patterns of the benthic invertebrate communities throughout the Manihiki Plateau. Especially in comparison to results of the previous expedition SO168 to the Hikurangi Plateau and surrounding areas, the species composition of the Manihiki benthos may or may not be interpretable as closely related to the fauna of New Zealand waters, thereby delivering additional (biological) arguments for or against the „Greater Ontong Java Plateau Event" hypothesis.

3.1. LARGE IGNEOUS PROVINCES (LIP'S)

Continental and oceanic LIP's belong to the most extreme volcanic events on earth and have major implications for the short-term mass transfer between mantle and lithosphere and consequently for the heat budget and heat flux in the Earth's interior. During LIP formation up to 100 cubic kilometers of volcanic rocks may be produced within a short time period (Hooper 2000). Such extensive volcanism not only contributes significantly to the growth of the earth's crust but also influences the entire Earth system inclusively the evolution of life. Besides the release of huge amounts of climate influencing gases (e.g., CO₂), large LIPs may cause changes of oceanic current systems and of the chemical composition of the sea water. Therefore LIPs could be responsible for changes of the global environment and mass extinctions (e.g., Tarduno et al. 1998, Courtillot 1999, Larson und Erba 1999).

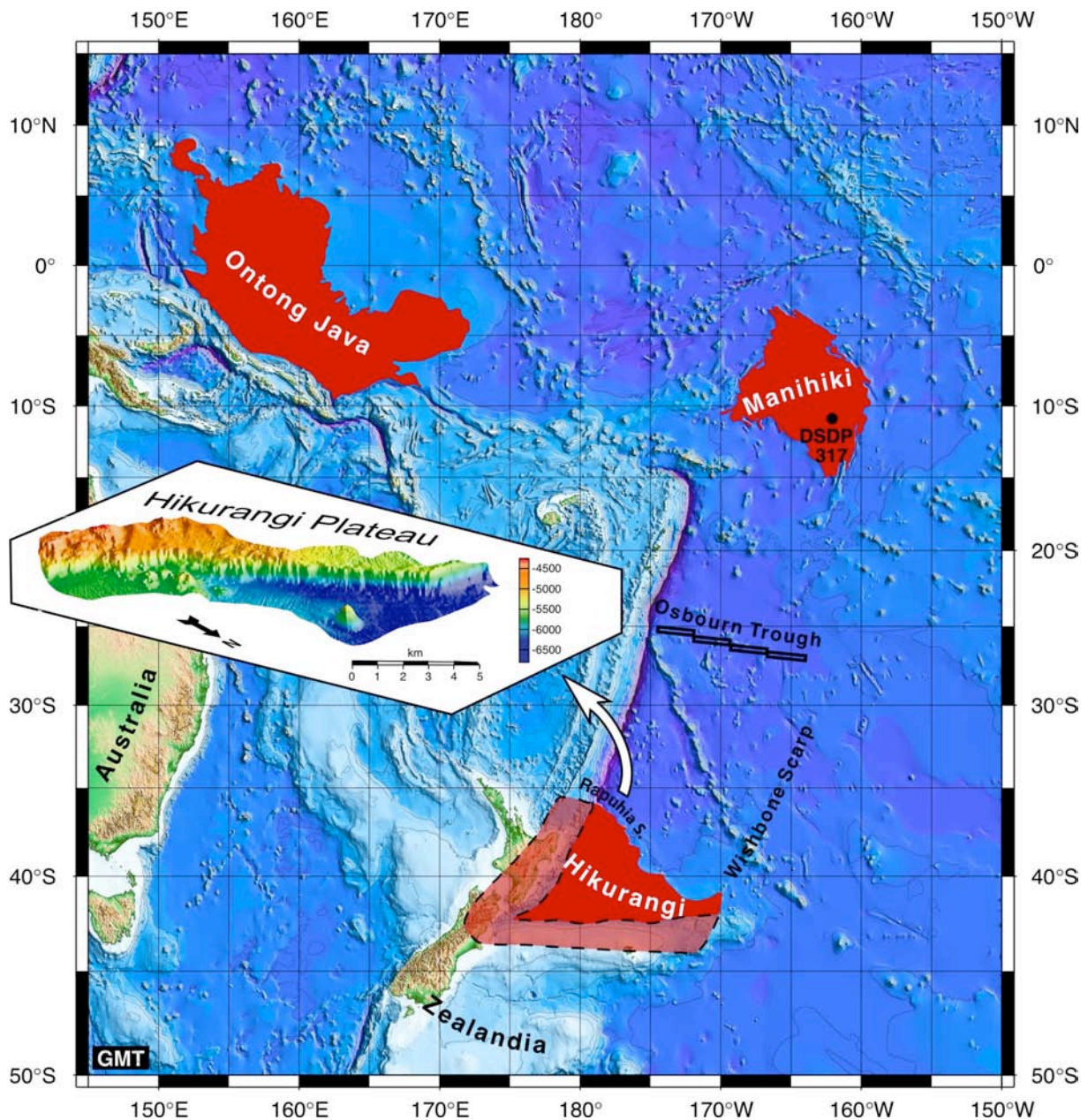


Fig. 3.1.: Overview bathymetric map of SW Pacific including Ontong Java, Manihiki and Hikurangi Plateaus. Inset: Morphology of Rapuhia Scarp (northern part of NE Hikurangi plateau margin) obtained during SO168 ZEALANDIA expedition.

The „classic“ model to explain the formation of LIPs is based on the mantle plume or hotspot hypothesis (e.g., White and McKenzie 1995). Mantle plumes are considered to be cylindrical or pipe-like regions of rising mantle rock several hundred kilometers in diameter. These regions of upwelling mantle, which rise at rates of tens of centimeters per year, extend from a thermal boundary layer within the Earth, such as the core/mantle boundary, to the base of a lithospheric plate. As a result of dynamic uplift of the rising plume material and thinning and heating of the lithospheric plate, a swell or upward bulge is formed in the lithosphere above the plume and melts from the plume ascend to the surface forming volcanoes. It has been postulated that the ascending mantle material forms mushroom-like plume head which may broaden laterally up to 2,500 km when it hits the base of the lithosphere (Griffits and Campbell 1991, Richards et al. 1989). In this initial stage melt production rates above a mantle plume are especially high and many million cubic kilometers of volcanic rocks may form over large areas within a few million years. This process

may lead to the formation of LIPs as, for example, the Dekkan Trapp in India, the Columbia River Basalts, the Caribbean Plate or the Ontong Java, Hikurangi, and Manihiki Plateaus. $^{40}\text{Ar}/^{39}\text{Ar}$ age dating confirms the geologically extreme short duration of LIP formation for some continental LIPs (e.g., Duncan and Pyle 1988, Peate 1997). However, by contrast to the well exposed continental LIPs not much is known about the significantly larger oceanic LIPs. Open questions concern, among others, their internal structure, geochemical heterogeneities, their relationship to local tectonism and, above all, the duration of their formation. Recent studies suggest that some oceanic plateaus being considered as LIPs have not formed within a few million years but over much longer time scales (e.g., over some 10 mill. years). In response to increasing problems in explaining LIP formation solely with the plume head model a global debate has developed on the origin of these dramatic volcanic events (e.g., O'Connor et al. 2000, Fitton et al. 2003, Anderson 2003, Coffin 2003, Hoernle et al. 2004a).

Alternative models for the formation of oceanic LIP's propose, for example, plateau formation by plume-ridge interaction as it is currently the case at the Iceland and Galápagos hotspots (e.g., Mahoney and Spencer 1991), melt formation caused by the impact of meteorites (e.g., Rogers 1982, Ingle und Coffin 2004), accumulation of several smaller terranes, formed at different times by intraplate volcanism, to a large plateau by, for example, subduction processes (e.g., Hoernle et al. 2004a). Such terranes may have been formed either above different hotspots or by individual, temporal delimited pulses of a single hotspot. Such a pulsing activity has recently been postulated for the Icelandic mantle plume (O'Connor et al. 2000). In summary, there are many open questions concerning LIP formation which will also be addressed by the research project SO193 MANIHIKI, in particular since the investigation of LIP's through a combination of age dating, tectonic, volcanological, petrological, and geochemical methods has major implications for the evaluation of plume models and the understanding of mantle dynamics.

3.2. THE MANIHIKI PLATEAU AND THE LARGE PLATEAUS IN THE SW-PACIFIC

The Manihiki Plateau is located between $\sim 3^\circ\text{S}$ and $\sim 16^\circ\text{S}$ and $\sim 159^\circ\text{W}$ and $\sim 169^\circ\text{W}$ (Figs. 3.1. and 3.2.) and covers $\sim 800,000$ square kilometers (more than twice the area of Germany). The plateau elevates $\sim 2,000$ - $\sim 4,000$ m above the Cretaceous Pacific sea floor at a depth of 4,000 - 5,500 m. Numerous seamounts and a couple of small islands and atolls, belonging to the Cook Islands, are situated on the plateau. The values for the crustal thickness of the Manihiki Plateau range from 15 km (e.g., Hussong et al. 1979, Mahoney and Spencer 1991) up to 25 km (Viso et al. 2005), its volume is estimated of 8.8 - 13.6 Million cubic kilometers.

During the past 40 years several cruises (incl. Deep Sea Drilling Program [DSDP] Site 317) have been carried out to the Manihiki Plateau. In the sixties and early seventies of the past century, geophysical surveys allowed first insights into the morphology and structure of the plateau. Based on these data Winterer et al. (1974) subdivided the Manihiki Plateau into three major geomorphological units: (1) „High Plateau“ in the east, (2) „North Plateau“, and (3) „Western Plateaus“ (Fig. 3.2.). These units are separated by deep fault systems which are considered to be rift structures (Mahoney and Spencer 1991). The most prominent fault system are the Danger Islands Troughs which are a large fault-bounded series of en echelon, up to $\sim 6,200$ m deep bathymetric depressions, named after the atolls at its southern end. The en echelon basins strike north-south, bifurcate the Manihiki Plateau into the High Plateau to the east and the Western Plateaus to the west, and diverge into the Suvorov Trough and the southern Danger Islands Troughs south of 10°S (Fig. 3.2.). Among others because of the geomorphological features Winterer et al. (1974)

postulate that the Manihiki Plateau has been formed during active rifting in Barremium when it was at or near the middle Cretaceous triple junction between the Pacific, Antarctic, and Farallon plate. Other authors attribute the formation of the Manihiki Plateau to arrival of a plume head (e.g., Mahoney and Spencer 1991) or to a combination of plume activity and rifting (e.g., Larson 1997).

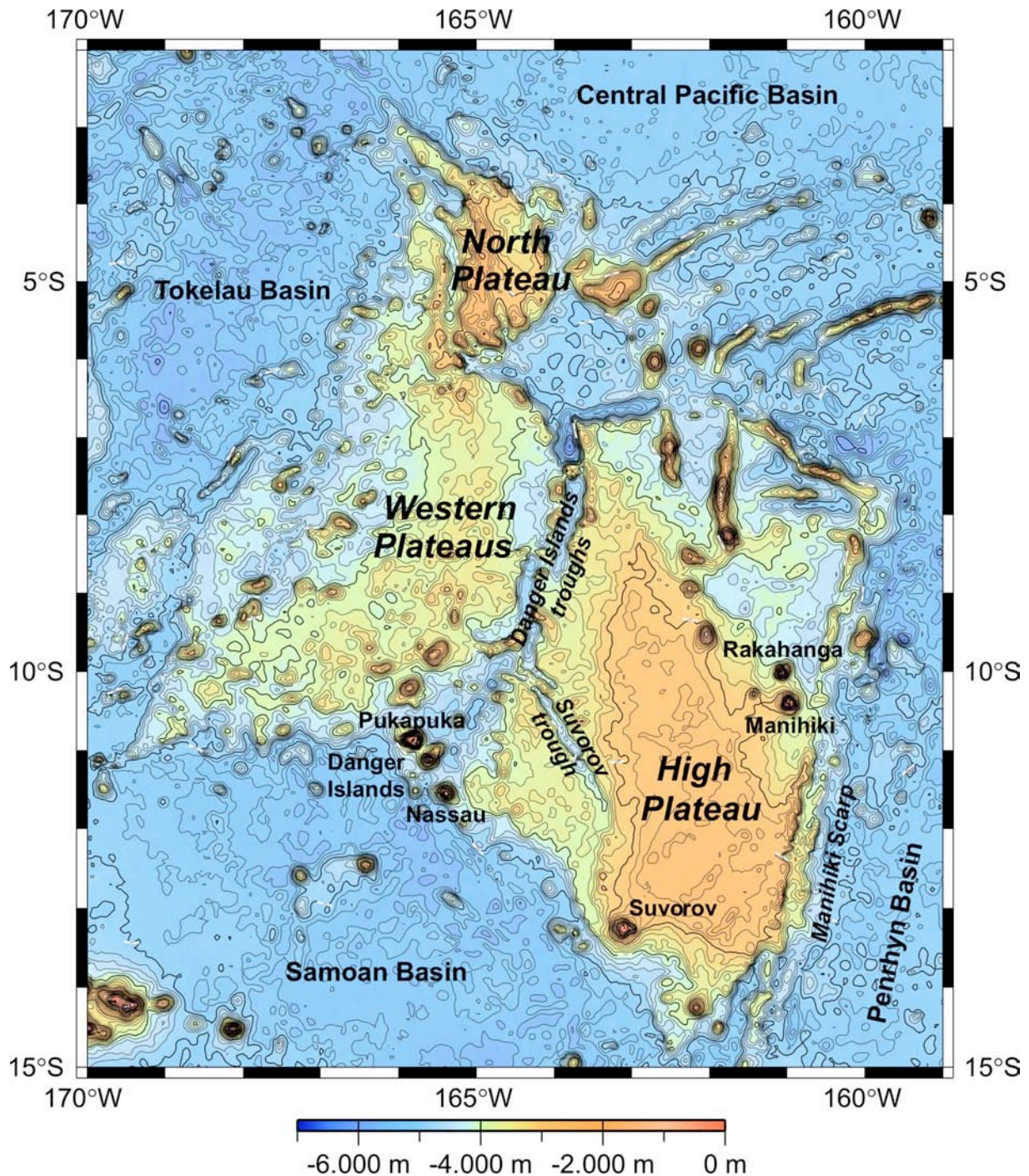


Fig. 3.2.: Overview map showing the major geomorphological units of the Manihiki Plateau (predicted bathymetry after Smith and Sandwell 1997).

The igneous basement of the troughs and plateaus of the Manihiki Plateau is covered by up to 1 km thick sediments (e.g., Winterer et al. 1974). At DSDP Site 317, being located approximately in the center of the High Plateau, 910 m of sediments and 34 m of the underlying basaltic basement have been drilled. Sediment samples yielded from Site 317 and on former R/V SONNE cruise (SO35) as well as seismic

reflexion data indicate that continuous volcanoclastic layers cover large areas of the High Plateau (Schlanger et al. 1976, Beiersdorf and Erzinger 1989). According to Jenkyns (1976) these deposits probably result from volcanic activity during an early stage of subsidence of the plateau. Their upper layers have been deposited in approximately 100 m water depth as indicated by macro vertebrates (probably Valanginium-Albium, Kauffman 1976). Additional evidence for formation of the High Plateau in shallow water (or even subaerial) conditions comes from the basalts drilled at Site 317. Among them are 10 highly vesicular lava flows which have probably been erupted in water depths of less than 400 m (Jackson et al. 1976, Mahoney and Spencer 1991), indicating at least 3.000 m subsidence of the Plateau since its formation.

Prior to the SO193 cruise, only minor amounts of igneous rocks from the Manihiki Plateau and associated features have been sampled. Analyzed and/or dated rock samples only exist from DSDP Site 317 (Jackson et al. 1976), from some dredge locations at the flanks of the Danger Islands Troughs (Clague 1976, Ingle et al. 2007), from a 1.900 m high seamount („Mt. Eddie“) on the High Plateau, and from the base of the Manihiki atoll (Beiersdorf et al. 1995). Consequently the age and composition of the Manihiki Plateau is not well constrained yet. K/Ar-dating of basement rocks drilled at DSDP Site 317 yielded ages of $106 \pm 3,5$ Ma (Lanphere and Dalrymple 1976) which, however, are not consistent with the age of the overlying sediments (~ 116 Ma [middle Aptium], Sliter 1992). Neal et al. (1997) cite unpublished $^{40}\text{Ar}/^{39}\text{Ar}$ -ages from R.A. Duncan (1993) of ~ 122 Ma for the Manihiki Plateau basement. Step heating experiments at samples dredged on cruise SO67-1 at Mt. Eddie volcano (Beiersdorf et al. 1995) did not yield unequivocal plateau ages and therefore have been calculated as total-fusion-ages. Three of these ages (81,6 Ma, 75,1 Ma, und 75,2 Ma) may represent reliable eruption ages of Mt. Eddie and indicate late stage volcanism on the High Plateau. Mt. Eddie, however, is situated directly on the plateau basement and therefore Beiersdorf et al. (1995) favor formation of this volcano 100 Mill. years ago (or earlier) \pm contemporaneous with the basement. On the other hand, Mt. Eddie did not show an erosional platform, indicating that the seamount did not rise above water level (contradicting a formation of the High Plateau in shallow water conditions, see below) or, more likely, post-erosional volcanism on the plateau. Recent $^{40}\text{Ar}/^{39}\text{Ar}$ ages of $117,9 \pm 3,5$ Ma and $99,5 \pm 0,7$ Ma from lavas dredged on R/V HAKUHO MARU CRUISE KH03-01 at the flanks of the Danger Islands Troughs (Ingle et al. 2007) also indicate at least two phases of volcanic activity at the Manihiki Plateau.

The available geochemical data from igneous rocks of the Manihiki Plateau and associated features show a broad variety of compositions and suggest different or heterogeneous mantle sources and a complex history of the sampled features. The trace element compositions of the tholeiitic basalts from Site 317 show flat patterns similar to enriched mid ocean ridge basalt (MORB, Jackson et al. 1986). Their isotope ratios, however, differ from MORB and resemble those of the EM1-type (enriched mantle type 1) ocean islands like Pitcairn or Koolau (Hawaii) as well as those of the Kerguelen and Ontong Java LIPs (Mahoney and Spencer 1991). Volcanic rocks dredged at Mt. Eddie and from the base of the Manihiki Atoll are SiO_2 -undersaturated and show, by contrast to the tholeiitic Site 317 basalts, an enrichment in light rare earth elements (Beiersdorf et al. 1995). Recent Sr-Nd-Pb-isotope analyses of these rocks (Hoernle, Hauff, unpublished data) revealed „HIMU“ (high time-integrated U/Pb-ratios in the source region) signatures suggesting a plume component in their magma source. The major element composition of largely unaltered basalts and gabbros dredged at the flanks of the Danger Islands Troughs (Clague 1976) are consistent with high degrees of melting. Their isotope ratios differ

from those of the Site 317 basalts and plot close to the „FOZO component“ which is believed to represent material from the lower mantle (Hart et al. 1992). Both, high melting degrees and a magma source in the lower mantle would be consistent with a plume origin of these rocks. However, age data do not exist from these rocks and it is not clear if they represent the plateau basement and a later stage of volcanism. Recent age (see above) and geochemical data (Ingle et al. 2007) indicate a tholeiitic plateau stage and an alkalic late stage at the Danger Islands Troughs. Whereas the composition of the alkalic rocks is consistent with an origin by small degrees of melting, the tholeiitic rocks show unusual trace element characteristics which may result from extensive melting of depleted mantle material mixed with small amounts of subducted, possibly ocean island derived volcanoclastic sediment (Ingle et al. 2007).

Two other large oceanic plateaus being considered as LIPs do exist in the SW-Pacific: The Ontong Java Plateau ~2,200 km to the west of the Manihiki Plateau covers 1.5 million square kilometers (approximately twice as large as Turkey) and is the largest LIP on Earth, and the Hikurangi LIP (350,000 square kilometers, similar in size to Germany) approximately 3,000 km south of the Manihiki Plateau. According to some authors (e.g., Coffin and Eldholm 1993, Ingle and Coffin 2004), the Manihiki (and Hikurangi) Plateau may have formed during the same event which caused the formation of the Ontong Java Plateau („Greater Ontong Java Event“). Other studies suggest that the Manihiki Plateau may have once been connected to the Hikurangi Plateau (e.g., Billen and Stock 2000, Hoernle et al. 2004b). The inset in figure 3.1. shows a 3D-map of the NE edge (Rapuhia Scarp) of the Hikurangi Plateau which has been mapped and sampled on R/V SONNE cruise SO168. The Rapuhia Scarp rises up to 1,000 m above the Cretaceous Pacific abyssal plain and may represent a rifted margin. The Hikurangi Plateau may have been separated in the Cretaceous by seafloor spreading at the Osbourn Trough, a paleo-spreading center.

3.3. OBJECTIVES OF THE MANIHIKI PROJECT

The major objectives of the geological investigations in the frame of the research project SO193 MANIHIKI are to improve our understanding of:

- (1) the age range and temporal evolution of the Manihiki Plateau, i.e. was it formed within several million years (consistent with the „classical“ model for the formation of LIPs) or over much longer time scales and did much of the plateau form during the Greater Ontong Java event?
- (2) the origin of the Manihiki Plateau, i.e. has it formed by shallow or deep magma sources or interaction of both (e.g., plume, plume-ridge interaction, impact etc.)?
- (3) the range in geochemistry, i.e. how homogeneous or heterogeneous are oceanic LIPs and how did the Manihiki Plateau develop geochemically compared to the Ontong Java and Hikurangi Plateaus?
- (4) the paleo-environment at the time of formation of the Manihiki Plateau, i.e. did the volcanic activity take place in shallow water conditions as suggested by prior studies for some areas of the plateau and, if so, how did the subsidence history of the Manihiki Plateau develop?
- (5) whether the Manihiki Plateau was once connected to the Hikurangi Plateau and, if so, to constrain the time of the break-up of this paleo-plateau.

The integration of the results with existing data from the Manihiki, Hikurangi and Ontong Java Plateaus should result in a new and improved model for the spatial, temporal, and magmatic evolution of the Manihiki Plateau. This approach should contribute towards a better understanding of the formation of Large Igneous Provinces and the geodynamic evolution of the SW-Pacific. Furthermore SO193 MANIHIKI aims to verify if the Manihiki Plateau possibly represents only a part of the

products of a much larger magmatic event and, therefore, has been formed by a Cretaceous „mega event“ with huge magma production rates (e.g., „Greater Ontong Java Plateau Event“). Such extensive volcanism no doubt had a dramatic impact on the paleo-environment of the southwest Pacific but possibly also had implications for the mass transfer between mantle and lithosphere and consequently for the heat budget and heat flux in the Earth's interior. Whether separate events or a single mega event, the volcanism associated with these three oceanic plateaus must have had a dramatic impact on the chemistry, temperature and life in the southwest Pacific Ocean.

Furthermore the diversity and the distributional patterns of the invertebrate communities are investigated in the framework of SO193 MANIHIKI. The Manihiki Plateau is a submarine archipelago. In general, hard bottom grounds in the deep sea are a rare resource for benthic sessile invertebrate filter feeders to live on. Some of these "submerged mountains" have a high degree of endemism and may also serve as a refuge for very old lineages of animals ("relict species"). It was the aim of the biological part of the project to assess, whether this hypothesis holds for the Manihiki Plateau, which represents a vast and coherent outcrop of lava and, therefore, may provide a suitable habitat for sessile invertebrates. Another aim was (and still is) to compare the collected faunas with those found on the Hikurangi Plateau, which was comprehensively sampled during SO168. It could well be that a positive relation between the faunas on both plateaus will lead to supportive biological arguments for the „Greater Ontong Java Plateau Event“.

The Manihiki Plateau is vertically structured and comprises seamounts, slopes and deep-sea plains. The plateau's species composition should reflect this morphology with higher endemism rates on top of the seamounts. Comprehensive sampling of all possible habitats on the plateau and subsequent analysis of their diversity should give us an idea about the biogeography of benthic invertebrates in the study area. Due to their expected abundances (based on previous expeditions), we focused on invertebrate key groups, such as sponges (Porifera), moss animals (Bryozoa), lamp shells (Brachiopoda), Kinorhyncha and Loricifera, representing both macro- and meiofaunal elements.

4. CRUISE NARRATIVE

The starting point of the SO193 cruise funded by the German Ministry of Education and Research (BMBF) was the port of Suva on Viti Levu island (Fiji, Figs. 4.1., 4.2.). In the afternoon of Friday the 18th of May SO193 scientists had the opportunity to present the SO193 expedition and the related research project „MANIHIKI“ to students and faculty of the University of the South Pacific (USP) in Suva. In the morning of the following day the SO193 scientific party boarded R/V SONNE. Although it was a busy harbor day the R/V SONNE crew enabled tours of the ship for two student groups from USP, which were received with great interest.

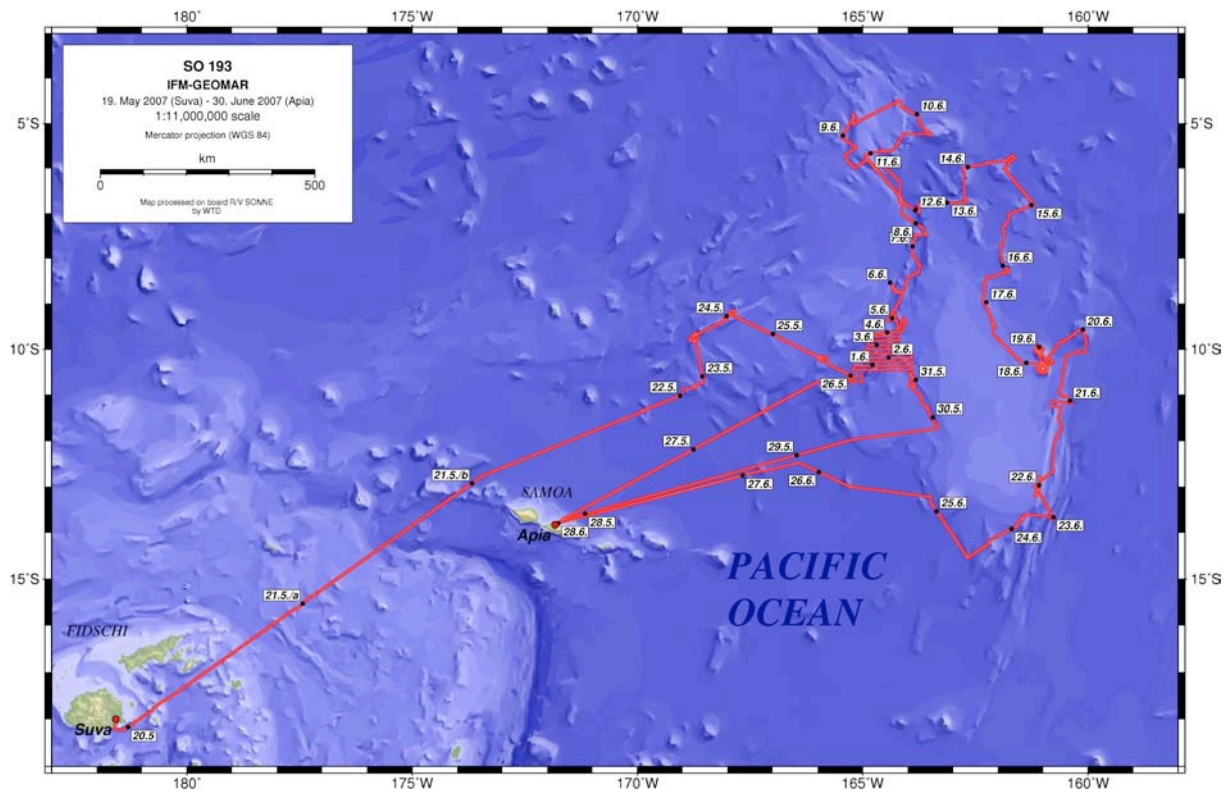


Fig. 4.1.: Cruise track for SO193.



Fig. 4.2.: Left: R/V SONNE in the port of Suva. Right: View of Suva upon departure.

On May 20th, R/V SONNE left Suva at 9:00 a.m. under nice but windy weather conditions and headed towards the Manihiki Plateau. The three days of transit to the Manihiki Plateau were used by the scientists to accommodate on board, to unpack the equipment and to setup the labs. In the afternoon of May 22nd R/V SONNE finally reached the southwestern corner of the Manihiki Plateau, where the scientific work of SO193 started with the deployment of the CTD to receive a sound speed profile for calibration of the SIMRAD echosounding system. Directly on the plateau edge we discovered a chain of ridge like volcanic structures that were aligned parallel to the plateau edge. These volcanoes have been successfully sampled by dredge (Fig. 4.3.). During the following days a total of 5 seamounts and seamount complexes, located in the inner part of the Western Plateaus, were mapped and sampled. Additionally two TV grab and multi corer (Fig. 4.3.) were carried out for biological studies on one of the seamounts and on the plateau surface, respectively.



Fig. 4.3.: Above: Basaltic pillow lava, dredged from a seamount on the western part of the Manihiki Plateau at 2.800 water depth. Right: Samples of the sediment surface from the Western Plateaus, yielded with a multi-corer out of >3,000 m water depth for biological studies.

After finishing geological and biological work on the southwestern Manihiki Plateau on May 25th, the focus of SO193 shifted to hard rock sampling and bathymetric mapping at the southwestern termination of the Danger Islands Troughs. During bathymetric mapping, we also found several seamounts in the vicinity of faults bounding the southern Danger Island Troughs from which we dredged lavas amongst other rocks. The work at the southern end of the Danger Islands Troughs was followed by a longer mapping profile that encompassed seamounts south of the Manihiki Plateau and parts of its southern margin. On May 28th this survey has been interrupted for a short port call in Apia/Samoa.

In the early morning of May 30th, R/V SONNE moved from the southern margin of the Manihiki Plateau northeastward to the NW-SE trending Suvorov Trough. The unusual, for this region, Russian name of the fault-bounded trough derives from a nearby atoll that was discovered in 1814 by the crew of the Russian ship „Suvorov“. While bathymetric maps based on satellite altimetry depict the Suvorov Trough as a chain of basins, our multi beam mapping reveals a more or less continuous trough with mostly steep flanks. Several dredges of the flanks suggest that they consist of solidified or lithified sediment. On May 31st we discovered farther north ridges along

the edges of the Suvorov Trough that either strike parallel or oblique to the basin flanks. Two dredges along these ridges sampled among other rocks unusual picritic lava and serpentinite breccia.

In the late evening of June 1st, SO193 started a 3.5 day mapping and sampling program where the Suvorov Trough and Danger Islands Troughs intersect (called “triple junction” by the cruise participants). Among the samples from this area aphyric or olivine-rich lava dominates, and other rocks such as volcanoclastic material and lithified sediment were also recovered by dredging.

After finishing our work at the “triple junction” during the night of June 3rd to 4th, SO193 concentrated on the northern Danger Islands Troughs til June 8th. The northern Danger Islands Troughs were mapped in 2003 by scientists aboard the Japanese R/V HAKUHO MARU, so we were able to concentrate on sampling these structures. Along the flanks of the troughs and at volcanic structures we carried out a total of 17 dredges and one TV grab, which recovered a wide spectrum of volcanic rocks. Additionally two multi-corer stations were used to sample sediments for biological studies on the floor of the troughs. On June 5th a photo and video sled (OFOS, Ocean Floor Observation System) profile, carried out on the western bounding scarp of the Danger Island Troughs, showed that the slope consists largely of pillow-like lava. The night from June 8th to 9th marked the halfway point of SO193. During a mapping transit to our northernmost work area, the North Plateau that marks the northwestern corner of the Manihiki Plateau, the “hump day” was celebrated in the evening of June 8th.

On the morning of the 9th of June, R/V SONNE reached the northernmost work area of SO193, the North Plateau, which rises up to 4,000 m above the surrounding seafloor. During bathymetric mapping, it was quickly realized that this part of the Manihiki Plateau differs structurally from the southwestern and central portions of the Manihiki Plateau. Dredge hauls from the North Plateau’s flanks recovered mainly indurated sediment and lithified sedimentary rock. Nevertheless, from the base of the North Plateau’s eastern flank we finally managed to recover pillow-like lava. On June 11th, work on the North Plateau was briefly interrupted to sample a seamount complex to the east that rises 3,000 m above the ocean basin floor. During the transit to this structure, many volcanic cones have been found on the seafloor.

After finishing work on the North Plateau and environs, SO193 sampled lava from a single seamount en route south on June 12th. In the evening of the same day, R/V SONNE reached the northern margin of the Western Plateaus, where lava fragments and volcanic breccias were dredged from a ridge. The most important sampling target in the area east of the Danger Islands Troughs, however, was Manihiki Plateau basement. Here the northern flank of the High Plateau steeply drops into a 6,000 m deep basin that stretches east–west over a distance of ca. 120 km. Along the western half of the northern flank, dredge hauls carried out at the base of the flank as well as along shallower ridges all yielded highly lithified sedimentary rock instead of anticipated volcanic rocks. Farther east, SO193 finally managed to obtain magmatic rocks presumed to represent plateau basement at several locations along the lower slope.

Overnight from June 14th to 15th, R/V SONNE headed towards two seamounts rising from ocean basin depths north of the High Plateau. Both seamounts have been mapped and sampled. Furthermore, two volcanic ridges were surveyed to the north of the High Plateau. Rocks obtained from the ridges comprise a large variety of volcanic rocks.

From June 16th to June 20th, the High Plateau was the focus of R/V SONNE expedition SO193. Prior to the starting work on the High Plateau, R/V SONNE mapped and sampled a 200 km long, N-S striking volcanic ridge to the north on June

16th. Several dredge hauls along this structure recovered volcanic rocks along with Mn crust and biological material. A TV grab for biological sampling, carried out on an erosional plateau of a large seamount forming the southern termination of this ridge, revealed mostly barren outcrops of lava. Due to a 1,000 m thick sediment blanket on the High Plateau we concentrated our research efforts on seamounts and atolls. On June 17th, R/V SONNE commenced work on three seamounts on the northern High Plateau, all of which are characterized by steep flanks and erosional plateaus at their crests. Dredging recovered various types of volcanic rocks and carbonates. In between the seamounts a multi corer yielded sediment for biological studies from the surface of the High Plateau. The crest of the southernmost seamount was explored with another TV grab, and exposures of lava dominated, similar to the seamount at the termination of the N-S- trending ridge. In addition to sediment for the biologists, the TV grab recovered unusually large manganese nodules and lava fragments.

On the morning of June 18th, R/V SONNE transited from the seamounts to the Manihiki and Rakahanga atolls, part of the Cook Islands (Fig. 4.4.). En route we have carried a second multi corer on the High Plateau surface and later on out we passed over a seamount that had been mapped and sampled by R/V SONNE expedition SO67-1 in 1990, and named “Mt. Eddie” by cruise participants. Both atolls consist of a narrow strip of land encircling a lagoon that is protected from the open sea by reefs. Despite their small areas of only a few km² and their remote location, each atoll is inhabited by about 300 people. By request of the Cook Islands, or more precisely SOPAC (“South Pacific Applied Geoscience Commission”), R/V SONNE mapped the submarine foundations of both atolls. In addition, sampling by dredge and TV grab were planned at the flanks of the atolls. While the dredges recovered volcanic rocks (Fig. 4.4.), biological sampling via TV grab proved to be unexpectedly difficult in the rugged volcanic terrane. Nevertheless we managed to obtain biological material and volcanic rocks.

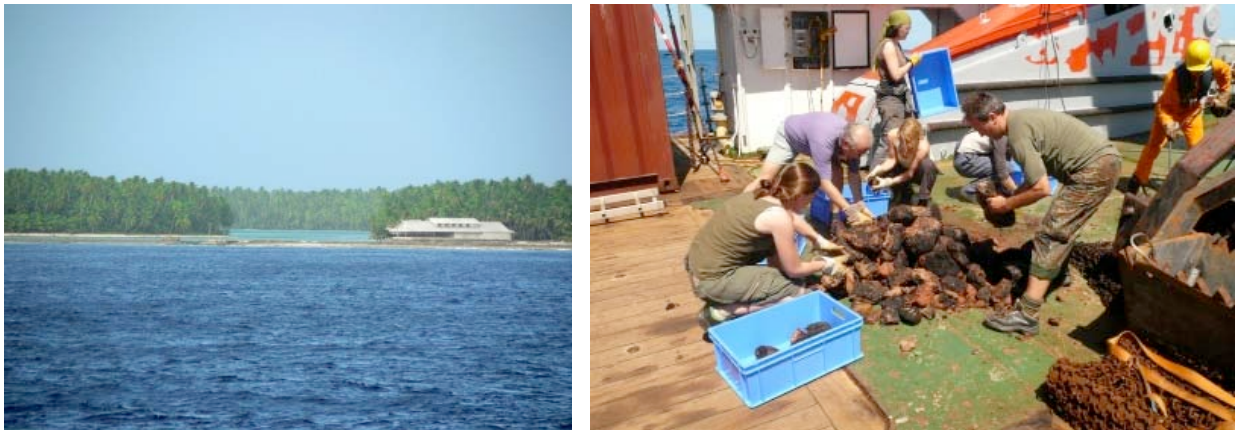


Fig. 4.4.: Left: View through the main passage into Rakahanga Atoll's lagoon, which can only be navigated by small boats. A community meeting and storage facility for atoll inhabitants flanks the entrance. Right: Freshly dredged rocks are inspected by geologists and biologists.

On June 20th, R/V SONNE departed the atolls for the nearby Manihiki Scarp, a prominent fault zone that defines the eastern boundary of the High Plateau. Through work along the Manihiki Scarp, SO193 has conducted more than 400 nm of mapping, 12 dredges along the scarp, an OFOS profile, and one multi corer. The dredges have yielded a wide spectrum of magmatic and sedimentary rocks. We are quite confident that some stations also recovered lava from the basement of the High Plateau, thereby achieving our primary objective along the Manihiki Scarp. The OFOS profile was made at the southern Manihiki Scarp and revealed that lava outcrops, debris

covered areas, and small sediment ponds alternate down slope. Slightly east of the Manihiki Scarp, we carried out the deepest dredge of SO193 at a water depth of nearly 5,500 m along a fault zone within oceanic crust. Here we recovered feldsparphyric lava (Fig. 4.5.), which will allow us to determine the formation age of the adjacent oceanic crust during shore-based analyses.



Fig. 4.5.: Left: Lava sample with common feldspar recovered from a water depth of ~5,500 m.. Below: View of Apia upon arrival of SONNE at the end of expedition SO193.



On June 24th, R/V SONNE departed the Manihiki Scarp and proceeded westward. The last three days of the SO193 scientific program were dedicated to sampling four seamounts located on the southern margin and south of the plateau (Samoa Basin). In addition, we attempted to sample plateau basement at one location along the southern margin. However, this dredge recovered only strongly lithified sediment. Additionally soft sediment for the biologists was sampled from the top of the southern plateau margin using the multi corer. Sampling of the seamounts yielded mostly volcanic rock and carbonate. Our mapping with the SIMRAD EM120 multi beam system revealed that one of these seamounts is about 2,000 m higher than shown by the predicted bathymetry. The scientific work of SO193 ended with the 100th deployment of scientific gear, specifically the multi corer that recovered surficial sediment for biological investigations from a water depth greater than 5,600 m.

In the afternoon of June 27th, R/V SONNE proceeded towards the port of Apia/Samoa. The scientists spent the last day at sea packing and cleaning up the laboratories. On late afternoon of June 28th, R/V SONNE docked in Apia (Fig. 4.5.).

5. BATHYMETRY AND ROCK SAMPLING

5.1. METHODS

5.1.1. Bathymetry

Data Acquisition

Since June 2001 the R/V SONNE is equipped with the SIMRAD EM120 multi-beam echo sounder (Kongsberg) for a continuous mapping of the seafloor. This system substitutes the former echo sounder HYDROSWEEP. The SIMRAD EM120 echo sounder system consists of several units. A transmit and a receive transducer array is fixed in a mills cross below the keel of the vessel. A preamplifier unit contains the preamplifiers for the received signals. The transceiver unit contains the transmit and receive electronics and processors for beam-forming and control of all parameters with respect to gain, ping rate and transmit angles. It has serial interfaces for vessel motion sensors, such as roll, pitch and heave, external clock and vessel position. Furthermore the system contains a SUN-workstation as an operator station. The operator station processes the collected data, applying all corrections, displays the results and logs the data to internal or external disks. The EM120 system has an interface to a sound speed sensor, which is installed near by the transducers.

SIMRAD EM120 uses a frequency of about 12 KHz with a whole angular coverage sector of up to 150° (75° per port-/starboard side). If one ping is sent the transmitting signal is formed into 191 beams by the transducer unit through the hydrophones. The beam spacing can be defined in an equidistant or equiangular distance, or in a mix of both of them. The ping-rate depends on the water depth and the runtime of the signal through the water column. The variation of angular coverage sector and beam pointing angles was set automatically. This optimized the number of usable beams.

During the survey the transmit fan is split into individual sectors with independent active steering according to vessel roll, pitch and yaw. This forces all soundings on a line perpendicular to the survey line and enables a continuous sampling with a complete coverage. Pitch and roll movements within ± 10 degrees are automatically compensated by the software. Thus, the SIMRAD EM120 system can map the seafloor with a swath width about up to six times the water depth. The geometric resolution depends on the water depth and the used angular coverage sector and is less than 10 m at depths of 2,000 - 3,000 m.

The accuracy of the depth data obtained from the system is usually critically dependent upon weather conditions and the use of a correct sound speed profile. During SO193 two sound profiles have been recorded at different stations. Thus, the correct sound velocity was used in the different geographical areas on this cruise.

Data Processing

The collected data were processed onboard with the coverage software EM120. The post-processing was done on two other workstations by the accessory software Neptune. The Neptune software converted the raw data in 9 different files which contains informations about position, status, depth, sound velocity and other parameters and are stored in a SIMRAD own binary format.

The data cleaning procedure was accomplished by the Neptune software. The first step was to assign the correct navigational positions to the data without map projections. The second step was the depth corrections, for which a depth threshold was defined to eliminate erratic data points. In the third part of post-processing statistical corrections were applied. Therefore, a multitude of statistical functions are available in a so called BinStat window where the data are treated by calculating grid

cells with an operator-chosen range in x and y direction. Each kind of treatment is stored as rule and has an undo option. For the calculation the three outermost beams (1-3 and 188-191) were not considered. Also a noise factor, filtering and a standard deviation were applied to the calculated grid. All this work was done by the system operators of R/V SONNE (H. Grassel [Tethys Geoconsulting GmbH/Hochschule Neubrandenburg] helped with data cleaning). After the post-processing the data have been exported in an ASCII x,y,z file format with header informations and it was transferred to another workstation where assembling, girding and contouring with the GMT software (Wessel and Smith 1995) took place.

All maps presented in this report are created by J. Leppin, and A. Ehmer (RF Forschungsschiffahrt GmbH, scientific and technical department [WTD]) onboard R/V SONNE (except of Figs. 3.1., 3.2., 6.1. - 6.5. and Appendix IV and V).

5.1.2. Rock Sampling

Rock sampling on SO 193 was carried out using chain bag dredges and, at some stations using a TV guided grab. Chain bag dredges are similar to large buckets with a chain bag attached to their bottom and steel teeth at their openings, which are dragged along the ocean floor by the ship or the ship's winch. The TV-grab consists essentially of a set of steel jaws with a video camera in the center, which transmits pictures of the ocean floor. Suitable objects for sampling can be identified on a monitor and sampled from the ocean floor by closing the hydraulic jaws by remote control around the objects and then heave them on board.

Selection of Dredge Sites

Sites for detailed SIMRAD EM120 mapping and dredging were chosen on the basis of a number of existing datasets. These include:

1. Free air gravity maps (Sandwell and Smith 1997) and predicted bathymetry, derived from gravity data and ship depth soundings (Smith and Sandwell 1997).
2. swath bathymetry data and maps, provided by Mike Coffin (cruise R/V HAKUHO MARU KH03-01), Joann Stock (cruise R/V ROGER REVELLE KIWI Leg 12), and the Marine Geoscience Data System (<http://www.marine-geo.org>) (R/V N.B. PALMER cruises 9806A, 0207, 0304, 0304A, B, C).
3. Seismic reflection profiles published by Winterer et al. (1974).
4. Published monographs and papers (see, for example, chapter 3.).

Shipboard Procedure

Once onboard, a selection of the rocks were cleaned and cut using a rock saw. They were then examined with a hand lens and microscope, and grouped according to their lithologies and degree of submarine weathering. The immediate aim was to determine whether material suitable for geochemistry and radiometric age dating had been recovered. Suitable samples have an unweathered and unaltered groundmass, empty vesicles, glassy rims (ideally), and any phenocrysts that are fresh. If suitable samples were present, the ship moved to the next station. If they were not, then the importance of obtaining samples from the station was weighted against the available time. A second dredge nearby and on the same station was sometimes possible.

Fresh blocks of representative samples were then cut for thin section and microprobe preparation, geochemistry and further processes to remove manganese and alteration products and/or to extract glass (if applicable). Each of these sub-samples, together with any remaining bulk sample, was described, labeled, and finally sealed in either plastic bags or bubble wrap for transportation to IFM-GEOMAR or cooperating institutions.

Shore based analyses

Magmatic rocks sampled by the R/V SONNE from the ocean floor will be analyzed using a variety of different geochemical methods. The ages of whole rocks and minerals will be determined by $^{40}\text{Ar}/^{39}\text{Ar}$ laser dating. Major element geochemistry by XRF and EMP will constrain magma chamber processes within the crust, and also yield information on the average depth of melting, temperature and source composition to a first approximation. Phenocryst assemblages and compositions will be used to quantify magma evolution, e.g. differentiation, accumulation and wall rock assimilation. Petrologic studies of the volcanic rocks will also help to constrain the conditions under which the melts formed (e.g., melting depths and temperatures). Further analytical effort will concentrate on methods that constrain deep seated mantle processes. For example, trace element data by ICPMS will help to define the degree of mantle melting and help to characterize the chemical composition of the source. Long-lived radiogenic isotopic ratios by TIMS and MC-ICPMS such as $^{87}\text{Sr}/^{86}\text{Sr}$, $^{143}\text{Nd}/^{144}\text{Nd}$, $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$, $^{208}\text{Pb}/^{204}\text{Pb}$, and $^{187}\text{Hf}/^{188}\text{Hf}$ are independent of the melting process and reflect the long term evolution of a source region and thus serve as tracers to identify mantle and recycled crust sources. Additionally, morphological studies and volcanological analyses of the dredged rocks will be used to constrain eruption processes, eruption environment and evolution of the volcanoes. Through integration of the various geochemical parameters, the morphological and volcanological data, and the age data the origin and evolution of the sampled structures can be reconstructed.

Non-magmatic rocks (e.g., solidified or lithified sediments, carbonates) and Mn-Fe oxides yielded by dredging and TV-grab will be transferred to co-operating specialists for further shore based analyses.

5.2. SAMPLING REPORT AND PRELIMINARY RESULTS

This section gives background information and short summaries of the features sampled and/or mapped with the SIMRAD EM120 multi beam echo-sounding system and of the rocks yielded by dredging of TV grab. Refer to Appendix I and II for latitude, longitude and exact depth of dredge sites and a summary of rock descriptions. The depths of dredge hauls given in this chapter are the approximate water depths at the begin of the dredge tracks. Refer to figures 5.1. - 5.34. for bathymetric maps of the dredge sites generated by the SIMRAD EM 120 system onboard R/V SONNE. The location of the map sections are shown in Appendix IV. Appendix V shows an overview map with all SO193 sampling sites. Distances between seamounts are given between the seamount tops and are approximate only; dimensions and heights are preliminary and are included only to give a rough idea of dimensions of morphological features.

5.2.1. Western Plateaus (DR 1 - DR 13)

The Western Plateaus have an aerial extend of $\sim 250,000 \text{ m}^2$ above the 5,000 m contour line and represent the second largest morphological unit of the Manihiki Plateau (Fig. 3.2.). To the west and south they are bound by the Tokelau and Samoan Basins respectively, whereas to the North and East they are separated by a series of faults from the Northern and High Plateau. According to the predicted bathymetry (Smith and Sandwell 1997) the abyssal plains of the Western Plateaus lie at an average water depth of $\sim 3,500$ to 4,000 m. From here several large seamounts rise to 2,000 m below sea level (b.s.l.), but on the average their tops lie between 3,000 and 3,500 m b.s.l. Most seamounts are located along the southwestern, southern and southeastern margins and only a few occur within the interior of the

Western Plateaus. The presence of seamounts on top of the abyssal plateau plain implies that at least two magmatic phases; a plateau phase followed by a seamount phase, contributed to the formation of the Western Plateaus.

The southwest corner of the Western Plateaus rises about 1,000 m above the surrounding 5,000 m deep seafloor. A single dredge (DR 1) was carried out at ~4,100 m b.s.l. at the plateau edge within a fault scarp that resembles a slope failure (Fig. 5.1.). DR 1 recovered a few pieces of manganese encrusted, solidified yellowish-brown sediments. From this it was concluded that the plateau edge in this area consists of sediment or is at least covered with sediments as a result of the relatively shallow slope (~10 - 20°). Approximately 10 nm east of DR 1 and directly on the plateau edge multi beam mapping revealed a chain of ridge-like volcanic structures and cones, aligned parallel to the plateau edge (Fig. 5.1.). From the lower slope (~4,800 - 4,380 m b.s.l.) of this N-S trending ridge a few manganese crusts were dredged (DR 2). A third dredge (DR 3) carried out further upslope in ~3,700 m b.s.l. at the largest volcanic cone in the area finally recovered Mn-encrusted rounded lava fragments and volcanoclastic sediments from a talus deposit. The olivine-feldsparphyric basalts contains 3%, up to 2 mm sized altered olivine and fresh plagioclase phenocrysts.

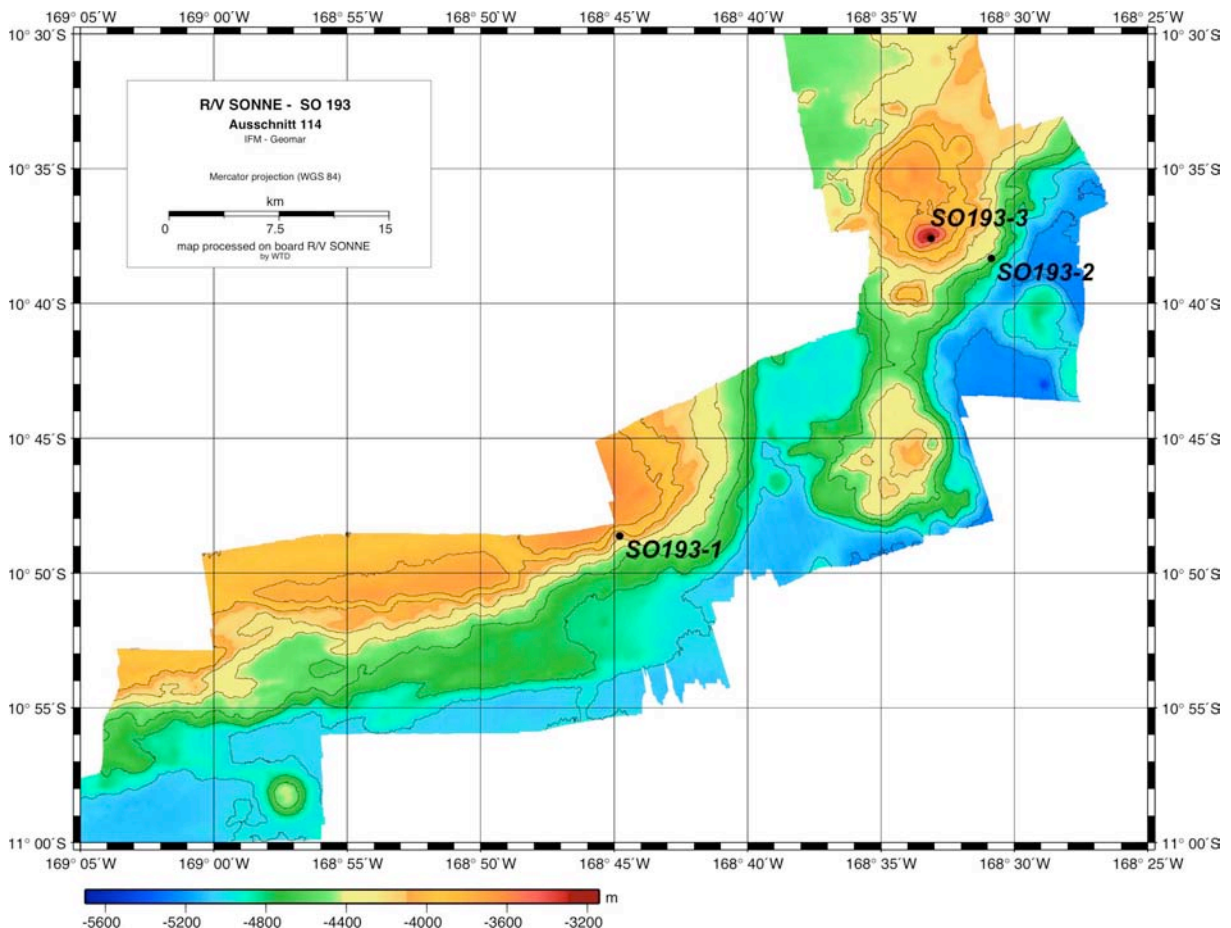


Fig. 5.1.: Dredge sites DR 1 - 3 at the southwest corner of the Western Plateaus.

After crossing the southwest corner of the Western Plateaus one of the western seamounts was reached. Mapping revealed that this seamount has a rather complex, U-shaped structure consisting of several large volcanic cones that are aligned along a circular ridge system that is open to the northeast (Fig. 5.2.). On its northwestern side, the seamount rises from 5,000 to 2,800 m b.s.l. whereas its southeastern flank extends from 4,600 to 2,600 m b.s.l. From the bathymetry no indications of erosional

processes at sea level were observed, suggesting that the seamount was probably submerged at all times. DR 4, carried out along the south facing slope of a volcanic cone at the southeastern volcanic ridge at ~2,900 m b.s.l., recovered subangular to rounded, very strongly altered, aphyric lava clasts with 15 - 20% filled vesicles as well as lapilli tuffs with lithic fragments of basaltic composition. A single piece of carbonate has been identified as a fossil coral. A second dredge (DR 5) was placed along the northwest facing slope of the westernmost cone at ~2,800 m b.s.l. and sampled 2 large pillow fragments together with several blocks of volcanoclastic material. The pillow lava contains about 1% altered olivine, less than 1 mm in diameter and with 5 - 10% vesicles up to 1 cm in diameter, which are sometimes filled with calcite or possible zeolithes. The matrix of the lava appears, however, fairly fresh.

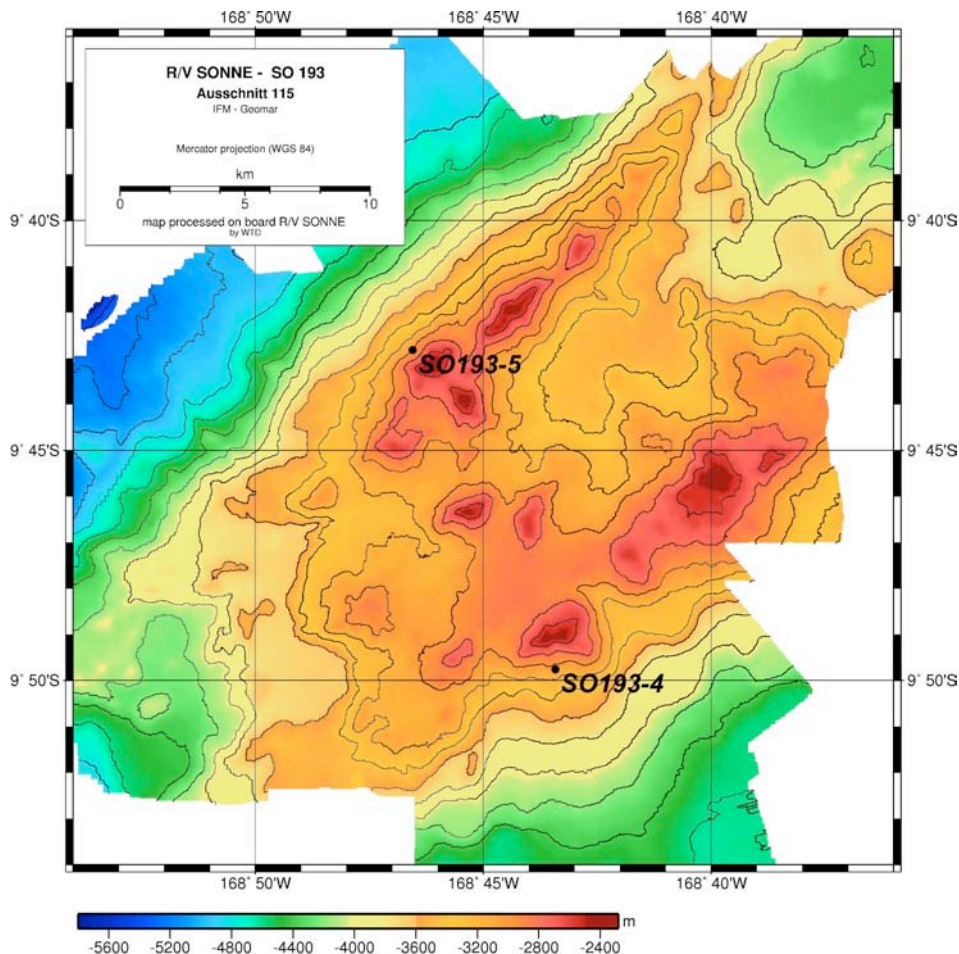


Fig. 5.2.: Dredge sites DR 4 and 5 at an U-shaped seamount on the Western Plateaus.

The next seamount to be mapped and sampled is located 100 nm to the northeast of DR 4 and 5 and has been given the working name “Foram-Seamount” due to abundant foraminifera ooze sampled in the top region by TV-grab (TVG 6, see chapter 7). Foram-Seamount actually consists of two large volcanic structures (Fig. 5.3.). The southwestern half is made up of a NNE - SSW trending volcanic ridge that rises from the 4,000 m b.s.l. to slightly less than 2,600 m b.s.l. The ridge type morphology does not contain any indications of subaerial exposure or erosion at sea level. The northeastern end of the ridge is connected via a broad 4.5 nm wide saddle with the second volcanic structure of Foram Seamount, a large volcanic cone, that has a base diameter of ~10 nm and rises from 4,000 m b.s.l. to less than 2,400 m b.s.l. Notably a very small flat lying plateau forms the top of the cone, which could have formed

through erosion at sea level. DR 8 carried out along a small cone of the NNE-SSW trending ridge only recovered a single subrounded piece of strongly altered, vesicular aphyric lava. On the other hand DR 9 located 2 nm southwest of DR 8 recovered a full dredge of pillow lava, volcanoclastics and Mn-crusts. The Mn-encrusted plagioclase-olivine aphyric pillow lavas are medium to strongly altered with sample SO193 DR 9-1 containing up to 20% fresh plagioclase phenocrysts that are 1 mm long and 0.3 mm thick. The volcanoclastic material is a lapilli tuff that contains highly vesicular lapilli with open vesicles 0.5 to 1 mm in diameter. The significant degassing as documented by the highly vesicular lapilli could be taken as a hint for eruption in a shallow water environment (see also chapter 5.3.) and further implies that significant subsidence in the order of 2,500 m must have occurred since then.

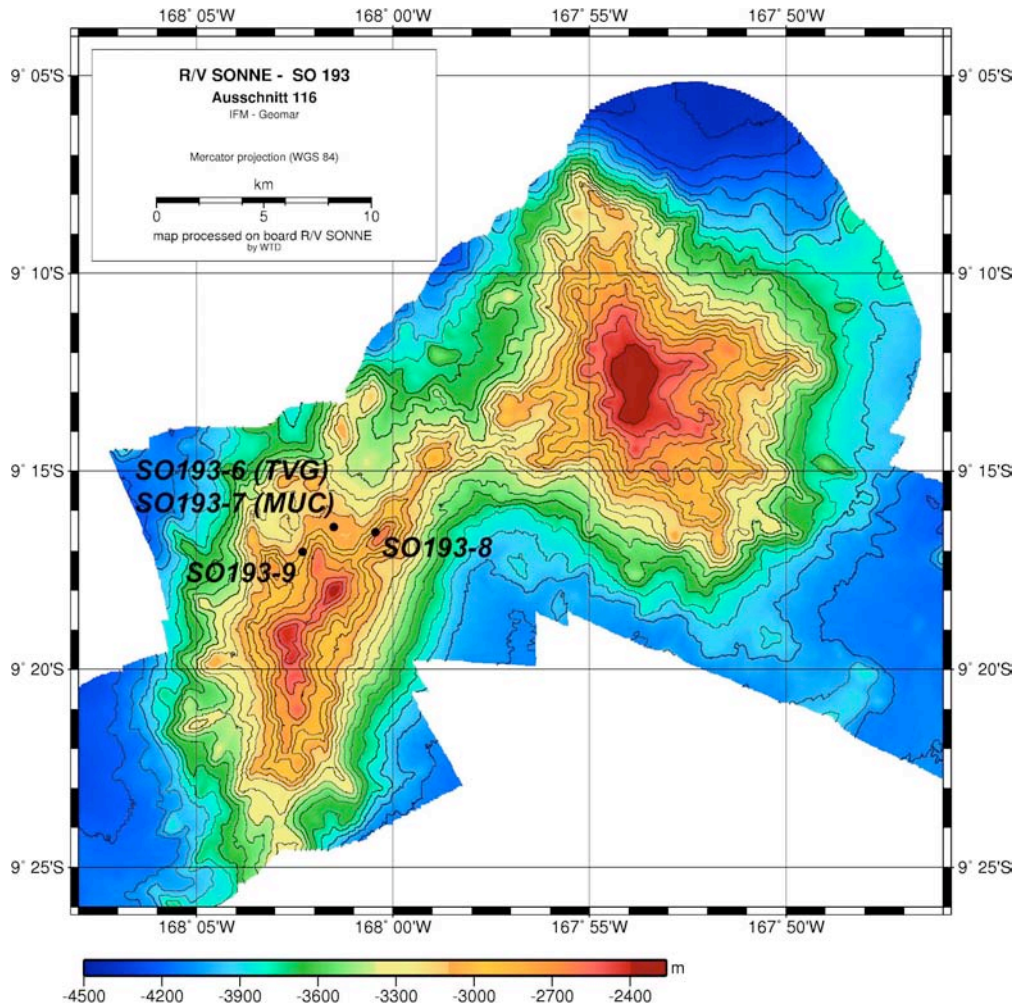


Fig. 5.3.: Stations TVG 6, MUC 7, DR 8, and DR 9 at “Foram Seamount”.

The last group of seamounts on the Western Plateaus was sampled in their southeastern portion near the southern extension of the Danger Islands Troughs. The first seamount is a typical guyot type seamount rising from 3,800 m b.s.l. to less than 1,600 m b.s.l. and the plateau edge lying at the 1,900 m b.s.l. (Fig. 5.4.). The bathymetry of this seamount thus far provides the clearest evidence that it once formed an ocean island. Notably no volcanic cones were found on the erosional plateau as it has been the case for seamounts located on the Hikurangi Plateau; the supposed counterpart of the Manihiki Plateau. Unfortunately dredging of a small cone at the northwestern base at ~3,300 m b.s.l. returned no rocks (DR 12). Temporal constraints did not allow to carry out a second dredge in the upper portions of the seamount.

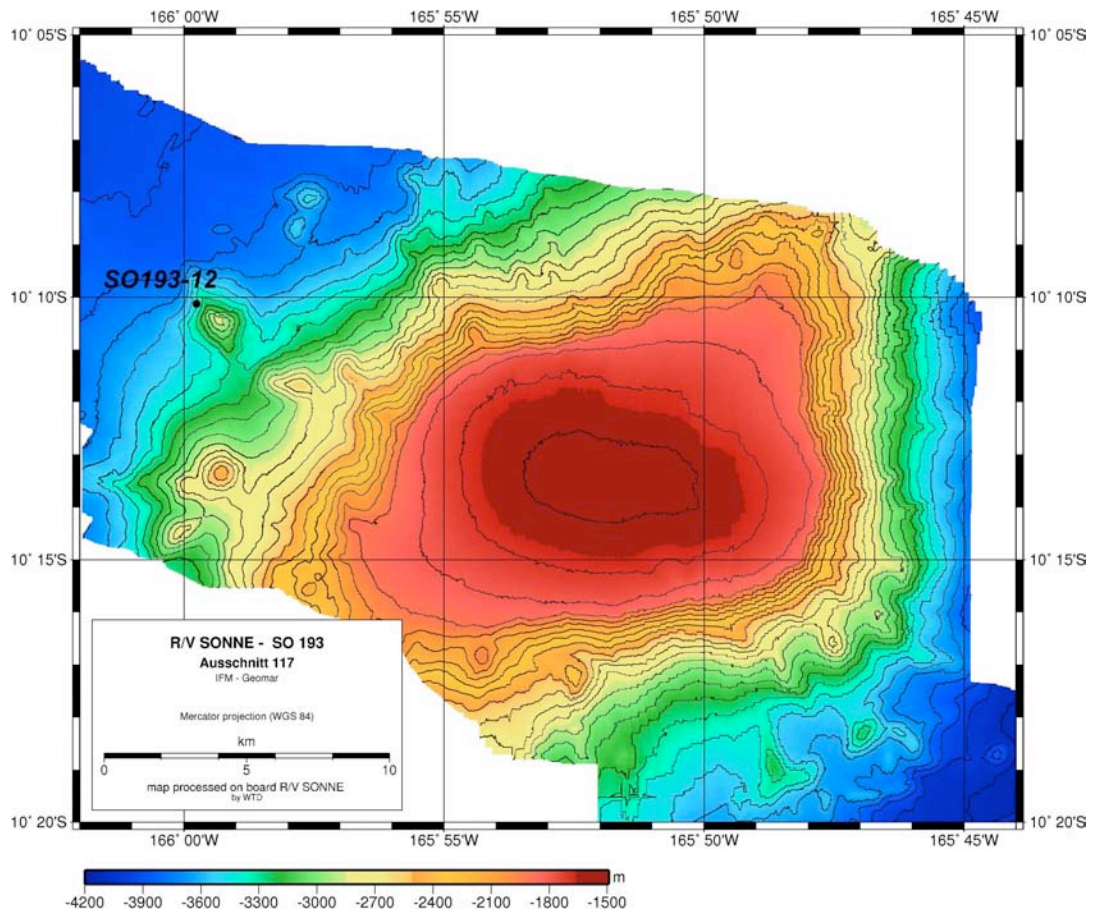


Fig. 5.4.: Dredge site DR 12 at a guyot on the southeastern portion of the Western Plateaus.

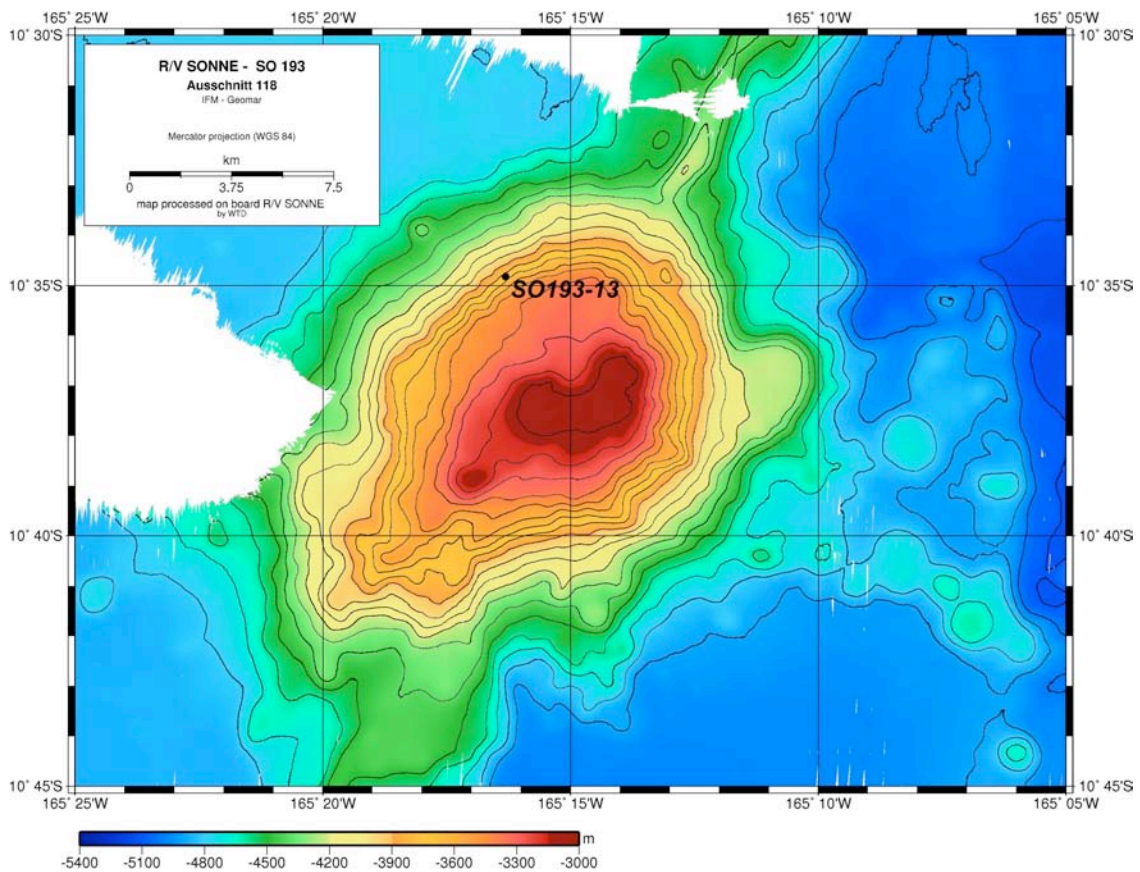


Fig. 5.5.: Dredge site DR 13 at a seamount at the edge of the Western Plateaus into the southern branch of the Danger Islands Troughs.

Right at the edge into the southern branch of the Danger Islands Troughs a conical shaped seamount was mapped and sampled (Fig. 5.5.). Probably owing to its transitional location between the Western Plateaus and the Danger Islands Troughs the base of the seamount lies with 4,800 m b.s.l. significantly deeper than the seamounts surveyed in the interior of the Western Plateaus. The top of the seamount reaches 3,050 m b.s.l. but does not form an erosional plateau. DR 13 carried out along its northwestern flank yielded angular to subangular lava fragments that contain 1 - 2%, < 0.5 mm altered olivine. The dark grey matrix appears for the most part quite fresh and therefore these lavas were classified as being slightly to moderately altered.

In summary, a total of 5 seamounts and seamount complexes, located in the southern part of the Western Plateaus, were mapped and sampled. While three of these structures consist of several volcanic cones and ridges, two seamounts possess a guyot-like morphology with steep flanks and an erosional plateau at the top. Today's water depth above the erosional plateaus indicates that since erosion they drowned by about 1,800 and 2,500 m, respectively. Dredge sampling of the seamounts on the Western Plateaus recovered basaltic sheet and pillow lava, volcanoclastic rocks, manganese crusts and solidified sediment.

5.2.2. The Large Interior Fault Systems: Suvorov Trough and Danger Islands Troughs (DR 14 - DR 38 and DR 47 - DR 54)

The Danger Islands Troughs mainly strike north-south and diverge into two arms south of 10°S, with the southeastern branch representing the Suvorov Trough (Fig. 3.2.). Both trough systems are named after the atolls at their respective southern ends. The Danger Islands Troughs consist of deep, elongated basins; that are aligned in an en echelon fashion in the north and reach water depths as great as 6,000 m. In addition to the initial survey by Winterer et al (1974) this part of the Danger Islands Troughs (6°30' S to 9°30' S) has been surveyed again in 2003 through the Japanese R/V HAKUHO MARU which carried out detailed multi beam mapping and reconnaissance dredges (e.g., Coffin pers. com., Ingle et al. 2007). The southwestern portion of the Danger Islands Troughs, on the other hand, is morphologically not as strongly expressed. While bathymetric maps based on satellite altimetry depict the Suvorov Trough as a chain of basins, our multi beam mapping reveals a more or less continuous 8-12 km-wide trough extending for more than 200 km in NW-SE direction with seafloor lying at ~4,500 m b.s.l., and mostly steep flanks with relief of up to 1,000 m (Fig. 5.6.). The different trends of the two fault systems imply that multiple episodes of deformation affected the Manihiki Plateau (see also chapter 6.).

SO193 mapped and sampled the Suvorov Trough from its southeastern termination to the area where it connects with the Danger Islands Troughs (Fig. 5.6.). DR 14 to DR 17 carried out south of 11°50'S at ~3,900 to 4,400 m b.s.l. suggest that the flanks of the Suvorov Trough consist of indurated sediment and lithified sedimentary rocks. Because the sediments differ from normal pelagic sediment capping oceanic plateaus in color and structure, it may be volcanoclastic. Farther north, ridges along the edges of the Suvorov Trough were discovered that either strike parallel or oblique to the basin flanks. DR 18 along the southwest facing slope of an E-W striking ridge, recovered from ~3,300 m b.s.l. unusual ultramafic lava (?) of probably picritic composition together with strongly altered, vesicular lavas, a serpentinite breccia and a wide spectrum of volcanoclastic deposits. Notably some of the picritic rocks contain unusually fresh (!) olivine. The presence of brecciated serpentinite, although to be confirmed by shore based investigations, suggests a tectonic origin of this ridge, that exposes igneous plateau basement in an area that is

otherwise dominated by solidified, very fine grained volcanoclastic (?) sediments. Approximately 7 nm northwest of DR 18, a ridge striking parallel to the Suvorov Trough has been dredged in 3,600 m b.s.l. and recovered besides lithified reddish and yellow-brown clay rich sediment, medium altered, aphyric and vesicular lavas (DR 19).

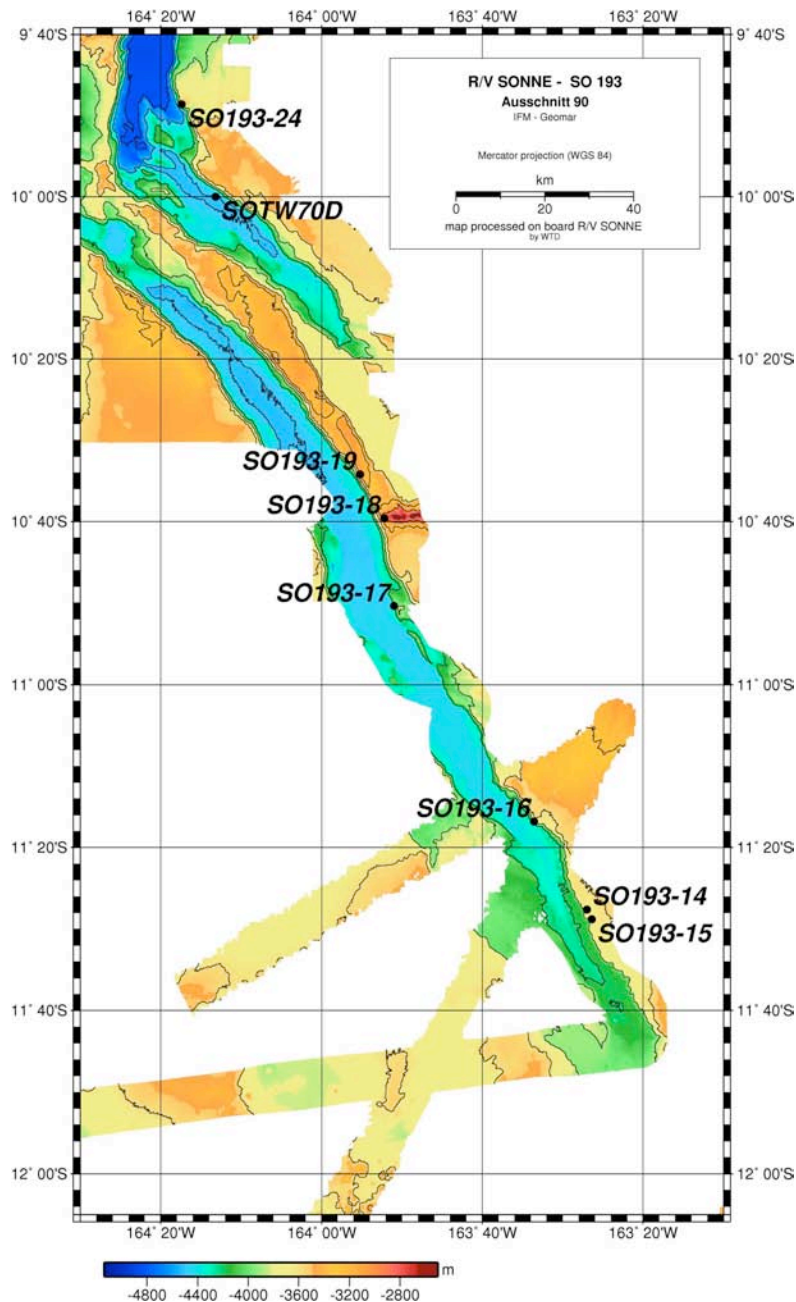


Fig. 5.6.: SO193, KIWI12, and R/V HAKUHO MARU KH03-01 multi beam bathymetry of the Suvorov Trough including locations of SO193 dredge sites DR 14 - 19 and 24, and Scripps dredge SOTW70D.

A 3.5 day mapping and sampling program was exercised at the intersection of the Suvorov Trough with the Danger Islands Troughs; the so called “triple-junction” (Fig. 5.7.). Through this it was aimed to learn more about the geodynamic processes that caused this large fault system to form and to connect aerial mapping with the extensive bathymetry obtained by R/V HAKUHO MARU further north (see also chapter 6.). The center of the triple junction area houses two large seamounts, located on the eastern edge of the SW branch of the Danger Islands Troughs and

sampled during DR 20 and DR 22 (Fig. 5.7.). DR 20 is located on the SE flank of the southern seamount in ~4,400 m b.s.l. and recovered volcanoclastic material that also contained moderately altered, slightly olivine phyric lava fragments. Similarly DR 22 at the seamount ~15 nm further NNW of DR 20 recovered subrounded volcanoclastic material from 3,500 m b.s.l. Opposite of DR 20, the western edge of the Danger Islands Troughs was sampled during DR 21 along a SSW facing slope of a volcano in ~3,800 m b.s.l. (Fig. 5.7.). DR 21 recovered slightly to moderately altered, olivine phyric lava fragments. In this area the western fault scarp of the Danger Islands Troughs has been sampled during DR 23 in 4,750 m b.s.l. and provided brecciated and/or tectonized rocks of probably basaltic composition. Some samples contained up to 2 cm wide cataclastic zones or contain conjugate sets of veins, consistent with brittle deformation of these rocks. Not unexpectedly lithified sediments were also recovered by dredging in the “triple junction” area immediately north of where the Suvorov terminates (Fig. 5.7.). Notably within the lithified sediment of DR 24 (4,200 m b.s.l.) numerous fossil mussel shells were found. Their taxonomy and geochemistry should provide information on age of the sediment and depositional environment (e.g., water depth), and therefore could also provide insights into tectonic processes.

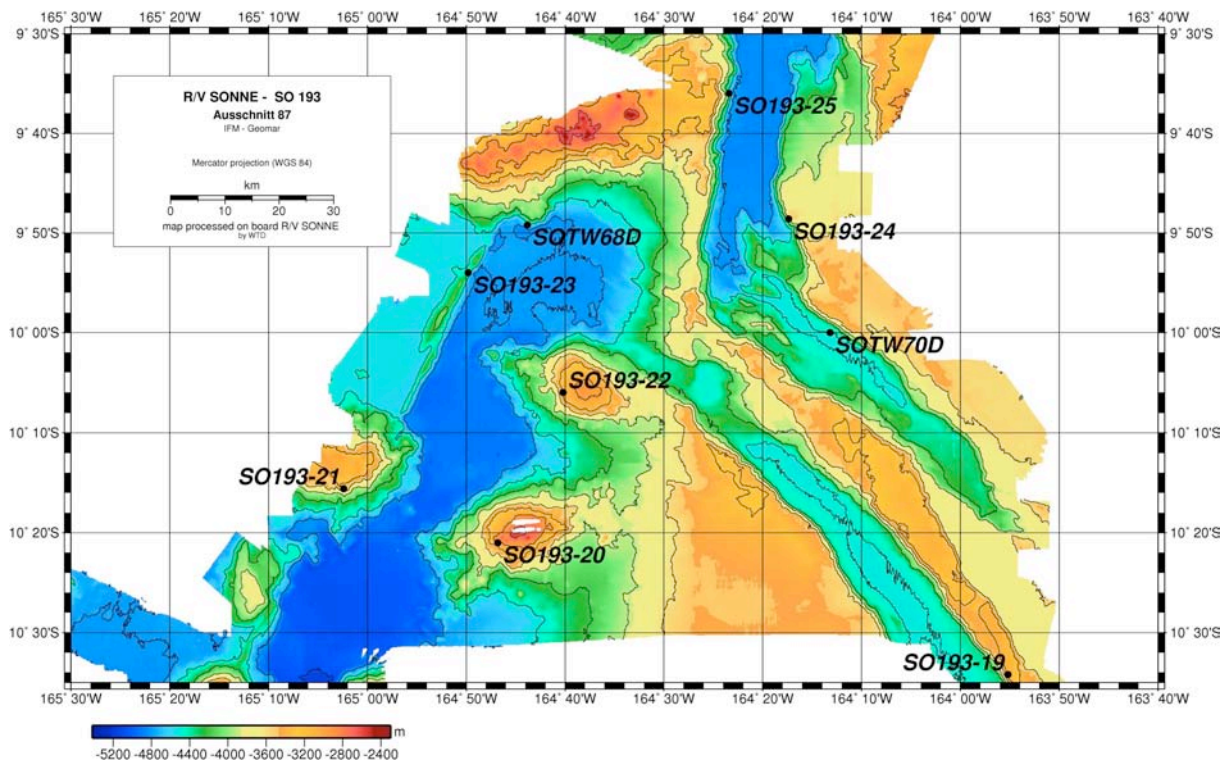


Fig. 5.7.: SO193 and R/V HAKUHO MARU KH03-01 multibeam bathymetry of the triple junction including locations of SO193 dredge sites DR 19 - 25 and Scripps dredges SOTW68D and SOTW70D.

Sampling of the N-S striking Danger Islands Troughs was carried out from DR 25 through DR 38 and from DR 47 through DR 54 (Fig. 5.8.). Four elongated basins extend north from the triple junction for ~340 km, terminating at the northwestern corner of the High Plateau and the northeastern corner of the Western Plateaus. The basins are slightly offset from one another, reach maximum water depths of 5,000 to 6,000 m, and have steep flanks with as much as 1,600 m of relief. DR 25, TVG 31, and DR 35 were carried out on the western side of the Danger Islands Troughs and strictly speaking sampled the Western Plateaus basement (Fig. 5.8.). DR 25 lies close to the southern tip of the southernmost trough and recovered a few slightly to moderately, aphyric rocks of probably volcanic origin. TVG 31 was conducted in the

top region (2,900 m b.s.l.) of a seamount located on the NW margin of the southernmost Danger Islands Trough and sampled subangular to subrounded olivine and olivine-pyroxene phyric lava that for the most part were strongly altered. The western flank of the central Danger Islands Trough has been sampled at DR 35 along the flank of a seamount located at the northern end of the trough. This dredge contained several pieces of sometimes fairly fresh olivine phyric lavas that in places also contained fresh feldspar microlites.

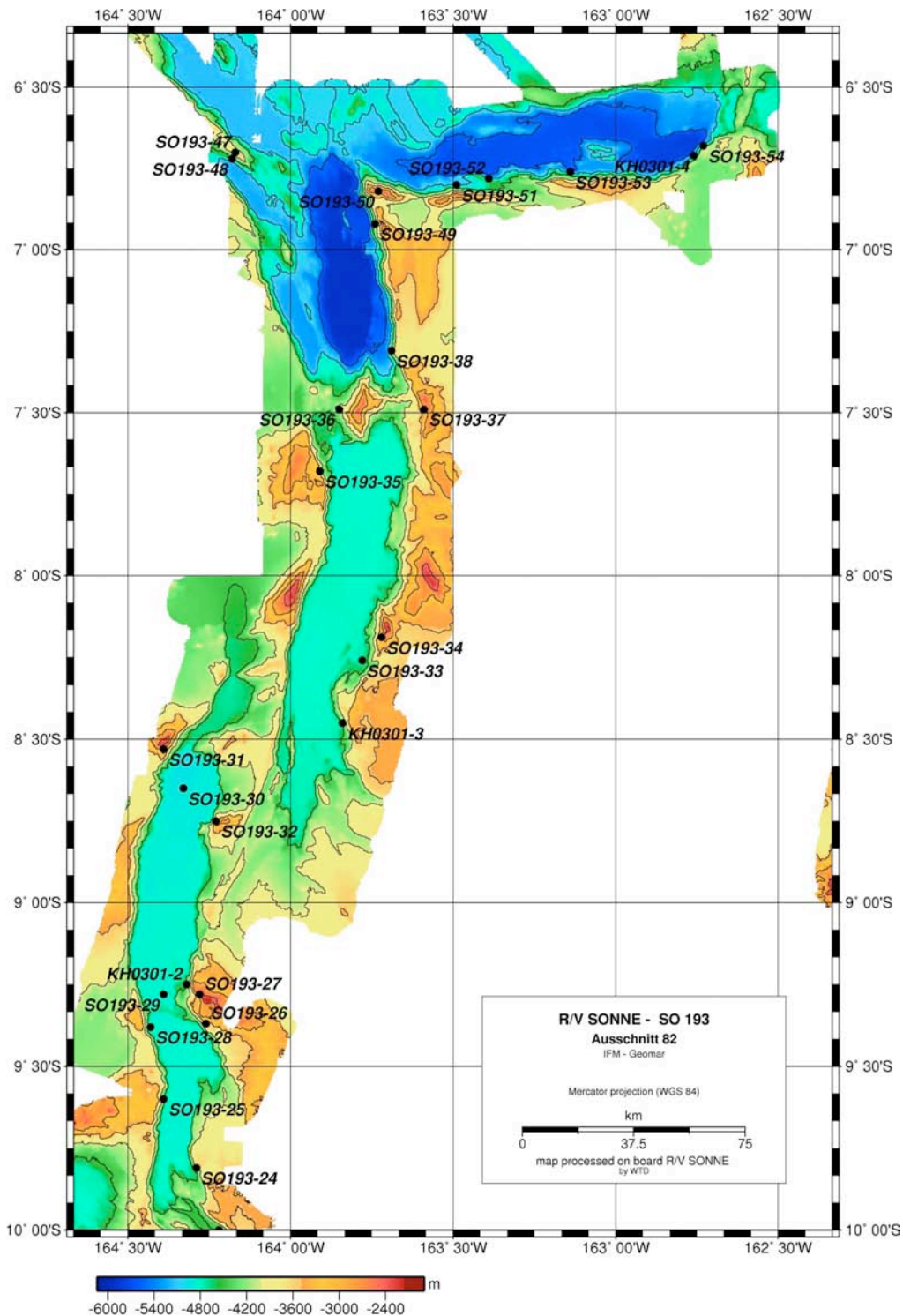


Fig. 5.8.: SO193 and R/V HAKUHO MARU KH03-01 multi beam bathymetry of the Danger Islands Troughs including locations of SO193 and KH03-01 sampling sites.

The majority of dredges within the northern Danger Islands Troughs, however, was carried out along the eastern scarps, due to the prevailing trade winds that restrict dredging to eastward directions most of the time. DR 26 was carried out in ~4,000 m b.s.l. along the SW facing slope immediately beneath a local plateau edge (Fig. 5.8.) and recovered a full dredge of partially glassy pillow lavas, pillow lava fragments and inter-pillow hyaloclastites. The pillow lavas are slightly to moderately altered and contain 10-15% partially altered olivine, up to 5 mm in diameter as well as up to 10% % pyroxenes of medium quality, that are smaller than 3 mm in diameter. Most notably is the presence of larger amounts of fresh glass in this dredge. DR 27 was carried out about 5 nm north of DR 26 at ~3,000 m b.s.l. along a steep slope that appears to be a tectonically truncated flank of a larger seamount. Due to a hung up of the dredge only a few rocks were recovered. They comprised a highly vesicular, aphyric tuff, that consists of 30% unfilled vesicles and has a homogeneous reddish-brown altered matrix. These observations may reflect eruption under subaerial conditions (?), but we note that the seamount does not possess an erosional plateau and rather resembles a tectonically rotated block with a steep flank towards the trough and a much shallower slope towards the High Plateau. At the base of this structure dredge KH0301-2 has been carried out earlier by the R/V HAKUHO MARU and Ingle et al. (2007) report an Ar-Ar age of 117.9 ± 3.9 Ma for a basalt from here. This age lies within error of age dates for basalts from DSDP Site 317 on the High Plateau (see chapter 3.), suggesting that volcanism in the DR 26 - 27 area was at least synchronous to the final stages of plateau forming volcanism on Manihiki. The eastern scarp of the central Danger Islands Trough was dredged during DR 33, 34, and 37 (Fig. 5.8.). Based on the available bathymetric data DR 33 was intended to sample the plateau edge at 3,800 m b.s.l. and recovered amongst abundant lapilli tuffs angular clasts of relatively fresh olivine phyric and olivine-feldspar-clinopyroxene phyric lavas. Approximately 10 nm south of here, R/V HAKUHO MARU sampled 99.5 ± 0.7 Ma alkali basalts at their KH0301-3 location (Ingle et al. 2007), indicating that during a later stage of Manihiki plateau formation a second and compositionally different phase of volcanism has occurred in this area. DR 34 was carried out ca 5 nm NE of DR 33 along the western slope of seamount (3,400 m b.s.l.) located directly on the eastern margin of the central trough (Fig. 5.8.). Samples recovered include fragments of lapilli tuff and relatively aphyric and dense (< 2% vesicles) lavas with clusters of microlithic plagioclase in a relatively fresh, dark-grey matrix. DR 37 located close to the boundary of the central with the northern Danger Islands Troughs, sampled the upper parts of a large seamount structure in ~3,100 m b.s.l. and mainly delivered a huge block of lapilli tuff with lithic fragments of rounded lava clasts. These lavas appear moderately to strongly altered and contain 3 - 4% altered olivine, 1% pyroxene and < 1% feldspar. The field relations demonstrate that the lavas must have formed prior to the deposition of the lapilli tuff as they occur as rounded clasts within the tuff.

Volcanic structures located within the Danger Islands Troughs were sampled at locations DR 32 and DR 36 (Fig. 5.8.). DR 32 lies on the eastern slope of a seamount on the boundary between the southernmost and central Danger Islands Troughs. Here small, medium altered, pyroxene-feldspar phyric pillow fragments were recovered along with yellowish-green lapilli tuffs. DR 36 sampled a small cone at the western base of the prominent seamount that marks the boundary between the central and northern Danger Islands Troughs. In addition to yellow lapilli tuffs numerous, medium altered pillow fragments with 3% altered olivine and 2% plagioclase laths were recovered. Age determinations of the samples from these two interbasin seamounts may provide a minimum age for the opening of the Danger Islands Troughs. Additional age constraints may come from the seamounts located

along the flanks of the Danger Islands Troughs as this volcanism could be contemporaneous to extensional or strike-slip tectonics.

DR 47 and 48 have been carried out at the northern termination of the Danger Island Troughs at NW-SE trending ridge-like structure at the northeastern corner of Western Plateaus (Fig. 5.8.). DR 47 yielded altered, slightly vesicular olivine phyric lavas from the top area of the ridge ~4,000 m water depth. Some of these rock fragments show serpentinite (?) grease on their surfaces. DR 48, carried out at lower southern slope of the ridge in ~4,900 m water depth, recovered olivine-feldspar phyric lava fragments, volcanic breccias and Mn crusts.

The deepest Danger Islands Troughs with almost 6,000 m b.s.l. are represented by the northern trough and the E-W striking trough along the NW margin of the High Plateau. The northern trough has been sampled at the locations DR 38 and DR 49, whereas the NW margin at stations DR 50 through DR 54 (Fig. 5.8.). DR 38 was carried out at ~4,600 m b.s.l. and surprisingly recovered mainly yellowish-brown, sand to silt sized lithified sediment and only 2 small pieces of subangular, moderately altered, olivine-feldspar phyric lavas. About 24 nm further north at DR 49 only a few rocks were recovered from 4,700 m b.s.l. which consisted exclusively of lithified, fine grained and grayish sediment. The northwestern corner of the High Plateau, which is occupied by a prominent, E-W striking, ridge type seamount, has been the target of DR 50. This dredge sampled the southern slope beneath the ridge summit in ca 3,000 m b.s.l. and recovered once again lithified sediments that were mostly fine grained but this time quite variable in coloration ranging from brown, yellow to greenish. The origin and age of these sediments is somewhat unclear at this stage, but their occurrence from near the base of the plateau to near the summit of local ridges implies that the NW corner of the High Plateau experienced intense tectonic movements. Also the presence of abundant lithified sediment is somewhat surprising since the sediment strata of DSDP Site 317 appears less compacted, even in its lower portion. It is yet unclear whether the sediments found along the NW High Plateau margin correlate in age and facies with those of Site 317 or whether they are even older than the Manihiki plateau basement. DR 51 located at the base of an E-W striking ridge similar to DR 50 unfortunately returned empty. Still, 6 nm further east, below a characteristic northward curvature of the 4,000 m depth contour into the basin, DR 52 finally sampled relatively fresh, slightly olivine-feldspar phyric pillow lava fragments from 5,300 m b.s.l. Notably some of the DR 52 samples may still contain fresh glass for spot analyses. More strongly altered pyroxene phyric lava fragments were sampled by DR 53 in ca 5,500 m b.s.l. The easternmost location DR 54 recovered several small, angular lava fragments with minor Mn coating.

In summary, a total of 17 dredges and one TV grab were carried out along the flanks of the four basins and recovered a wide spectrum of volcanic rocks, including abundant olivine phyric pillow lava, volcanic breccia, and lapilli tuffs, as well as the omnipresent manganese crusts. In contrast to the Suvorov Trough, the flanks of which obviously consist mostly of lithified sediment, the flanks of the Danger Islands Troughs appear to be dominated by lava, except for the NW corner of the High Plateau. This interpretation is supported by observations from a OFOS profile on the western bounding scarp of a basin. The OFOS 28 profile began at the top of a slope in water depths of ~2,980 m, and finished after descending to ~4,800 m, traversing a horizontal distance of 1.5 km. Video footage and photographs show that the slope consists mostly of pillow-like lava, which is interrupted in places by small terraces of sediment characterized by numerous small manganese nodules (Fig. 5.9.). Only the lower slope is covered by widespread sediment and talus.

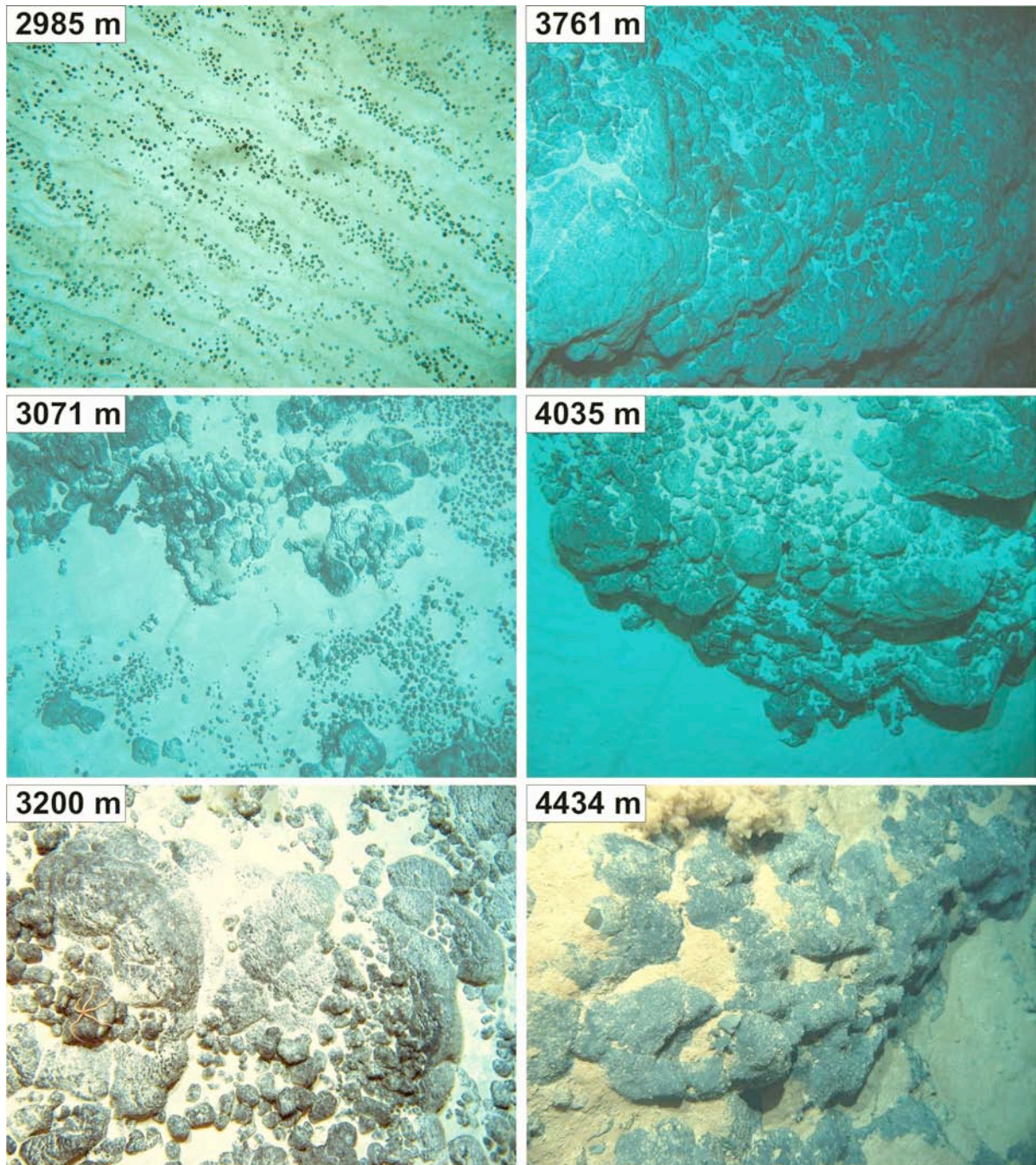


Fig. 5.9.: Pictures of the ocean floor in water depths of ~3,000 and 4,500 m taken during an OFOS profile across the western bounding scarp of one of the Danger Islands Troughs. The slope consists mostly of *in-situ* pillow-like lavas. Between lava slopes lie small sediment terraces with small manganese nodules. Ripples indicate strong currents either active today or in the relatively recent past (upper left picture).

5.2.3. North Plateau and Adjacent Areas (DR 39 - DR 46)

The North Plateau is considered to be the northernmost morphological province of the Manihiki Plateau. The roughly rhomb-shaped plateau has an aerial extend of ~60,000 m² above the 4,500 m contour and rises up to <1.500 m b.s.l. By contrast to the rough basement topography of its central part, the northeastern region of the plateau is smooth with as much as 1 km sediment cover (Winterer et al. 1974). Close to its western margin, the Plateau is cut by a deep trough which strikes NW-SE in its northern part and bends to N-S direction further south (Fig. 3.2.). According to

bathymetric maps based on satellite altimetry, this trough consists of elongated basins that are aligned in an en echelon fashion (similar to the Danger Island Troughs) and reach water depths of up to 4,200 m.

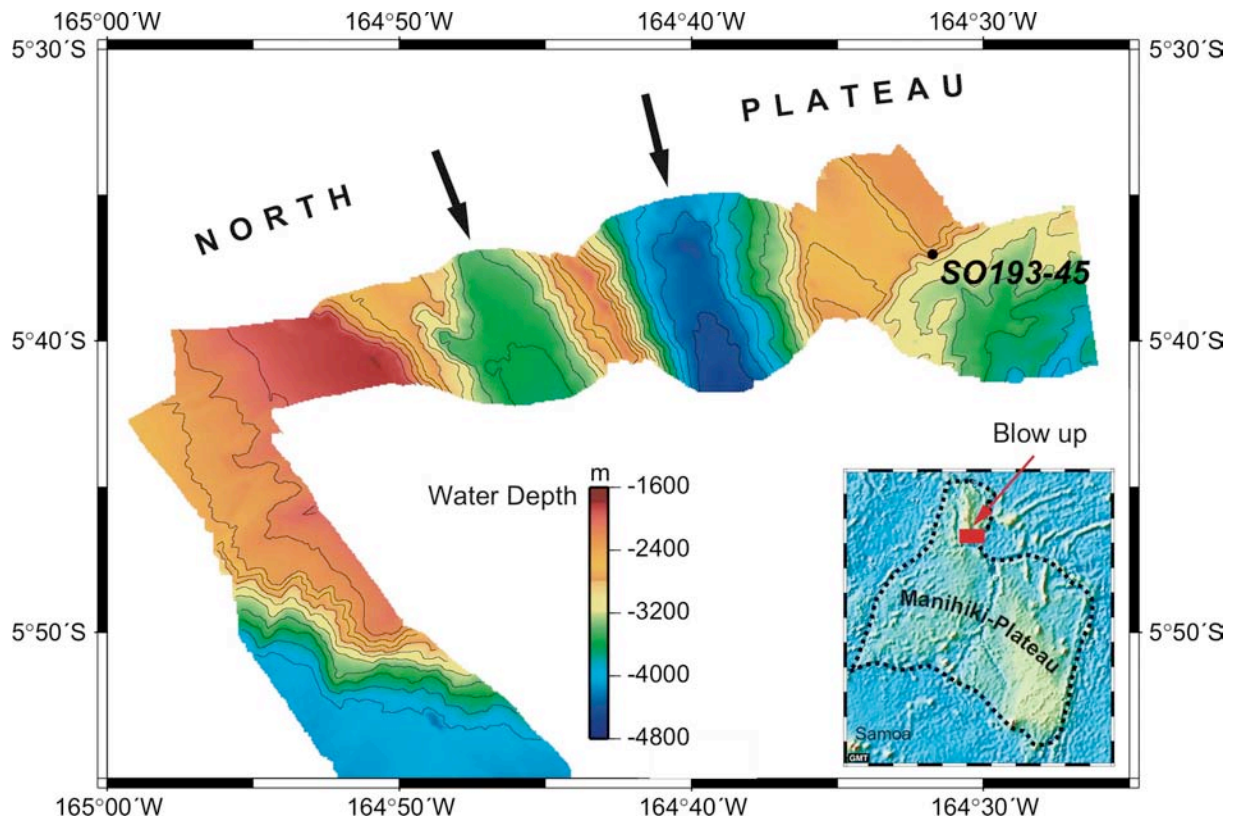


Fig. 5.10.: Mapped strip along the southern margin of the North Plateau using the SIMRAD EM120 multibeam system of SONNE. The deep canyons (black arrows) are striking as well as the flat areas of the upper parts of the plateau.

Due to time constraints, SO193 conducted only reconnaissance mapping of the North Plateau. However, it was quickly realized that this part of the Manihiki Plateau differs structurally from the southwestern and central portions of the Manihiki Plateau. Intriguingly, deep canyons, indicating erosion and mass transport from the plateau into deeper adjacent areas, cut the North Plateau's steep flanks (Fig. 5.10.). Above the flanks lie flat plains or ridges, neither of which possess typical volcanic morphologies. Four dredge hauls have been carried out at the North Plateau. DR 39 is located on the western flank of the trough cutting the plateau but unfortunately failed to return rocks. DR 40 was made on the opposite side of the trough at ~3,500 m water depth (Fig. 5.11.) and contained fine-grained, brownish indurated sediment. DR 45 sampled a wide spectrum of indurated and lithified sediments from the upper part of the southern flank of the North Plateau (Fig. 5.10.). These samples include sandstones, fine-grained sedimentary rocks embedding up to 5 - 7% clasts of different materials (rock fragments, mineral grains?), breccias consisting of subangular sedimentary clasts in a fine-grained, white to yellowish matrix (clay?, calcareous?), and chert-like compacted ooze. Only DR 41, made on the lower eastern flank at ~3,700 m water depth (Fig. 5.12.), finally yielded volcanic rocks from the North Plateau. Samples recovered are moderately to strongly altered, olivine bearing pillow lava fragments with up to 7 mm thick palagonized glassy rims. Apart from the pillow lavas, DR 41 yielded brownish, fine grained sediments which may be volcanoclastic in origin. Taken together, the morphology of the North Plateau and the predominance of indurated and lithified sediments among the recovered rocks there

suggest that at least the upper directly accessible portions of the feature are mainly made up of thick sediment and sedimentary rock layers. The initial results from the North Plateau are surprising, and we expect that analyses of the pillow lava as well as of the sediment and sedimentary rock will deliver further interesting information concerning the origin and evolution of this distinctive structure.

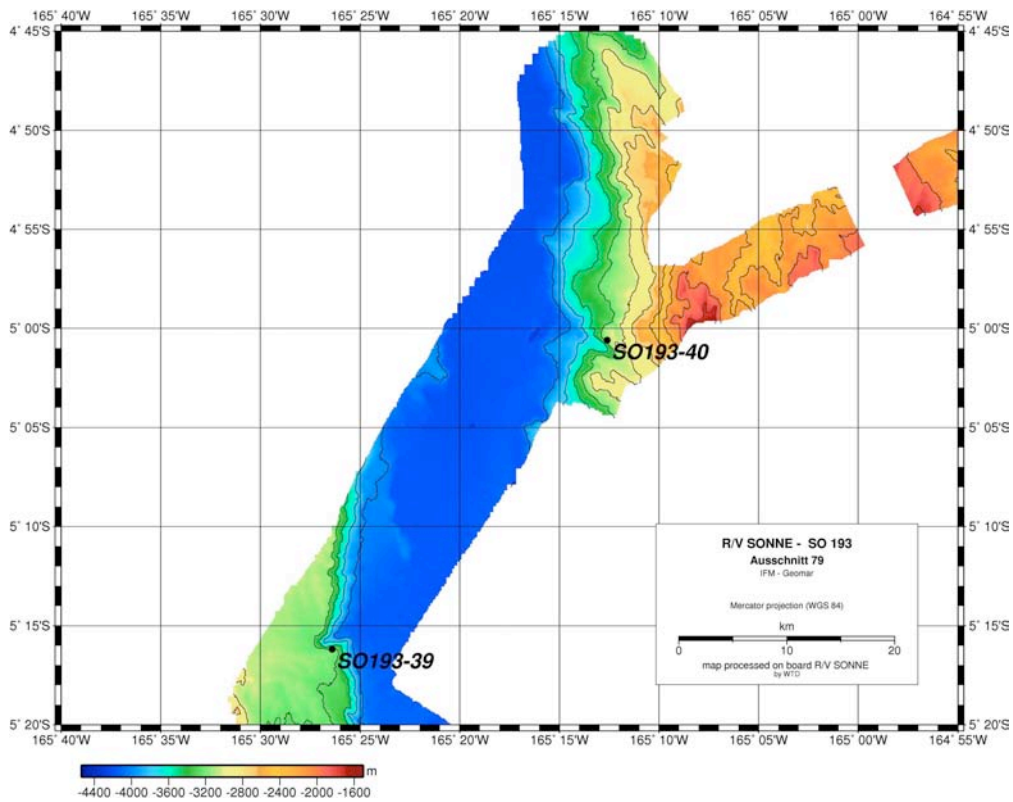


Fig. 5.11.: Dredge sites DR 39 and 40 on the flanks of the trough cutting the North Plateau.

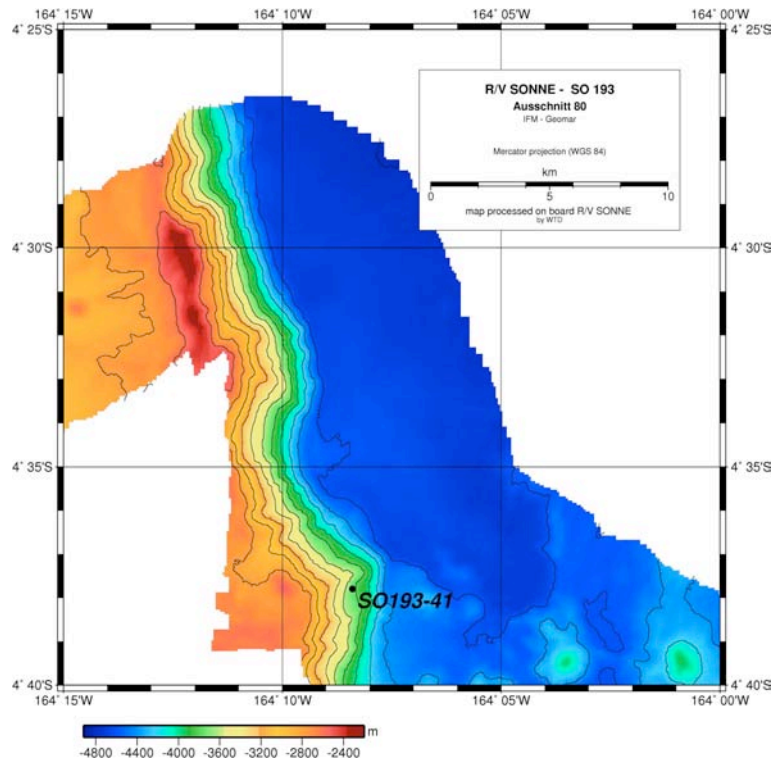


Fig. 5.12.: Dredge site DR 41 on the lower eastern flank of the North Plateau.

Approximately 40 nm east of the North Plateau, a huge seamount complex rises >3,000 m above the ~4,500 to 5,000 m deep ocean basin floor. The seafloor adjacent to this feature appears to be covered by numerous small, up to some 100 m high volcanic cones. The morphology of the seamount complex as well as the recovered rocks clearly show that its origin is volcanic. DR 42 was made at a small cone on its western flank at ~3,300 m water depth (Fig. 5.13.) and yielded one fragment of a strongly altered olivine basaltic breccia. DR 43, however, recovered a large amount of volcanic rocks out of ~2,000 m water depth from the upper southeastern slope of the seamount (Fig. 5.13.). These rocks mainly comprise lapilli tufts which enclose rounded, vesicular aphyric or olivine bearing lava clasts being up to ~8 cm in diameter. DR 44, located ~5 nm SE of DR 43 at the lower southeastern slope, was unsuccessful.

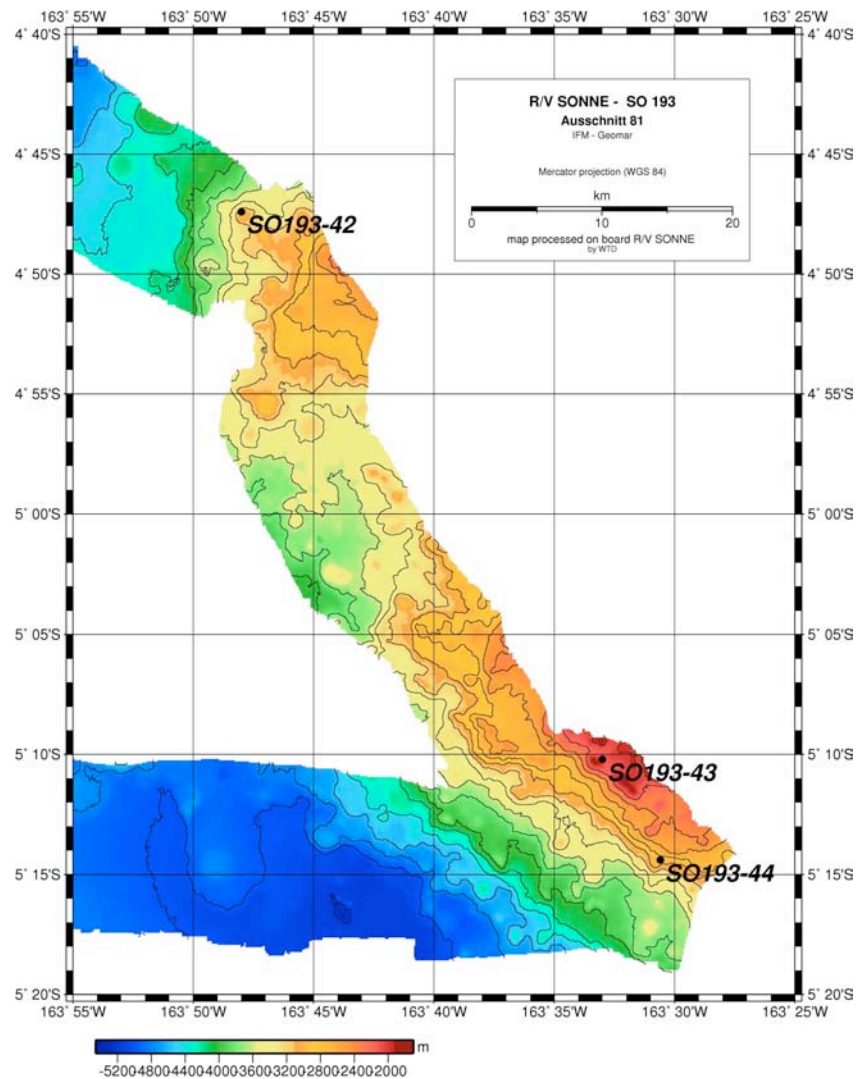


Fig. 5.13.: Dredge sites DR 42 - 44 at a seamount complex east of the North Plateau.

Approximately 9 nm south of the southern termination of the North Plateau, SO193 discovered a ~2,000 m high, ENE-WSW trending ridge-like seamount measuring 11 x 20 km at its base. A dredge haul (DR 46, Fig. 5.14.) at the top of this seamount at ~2,600 m water depth yielded dense, olivine phyric basalt clasts, fine-grained volcanic (?) breccias, Mn-crusts, and carbonates. Some of the volcanic rocks show features such as yellow staining along cracks or highly reflective, silver to yellowish secondary minerals which may suggest hydrothermal overprinting.

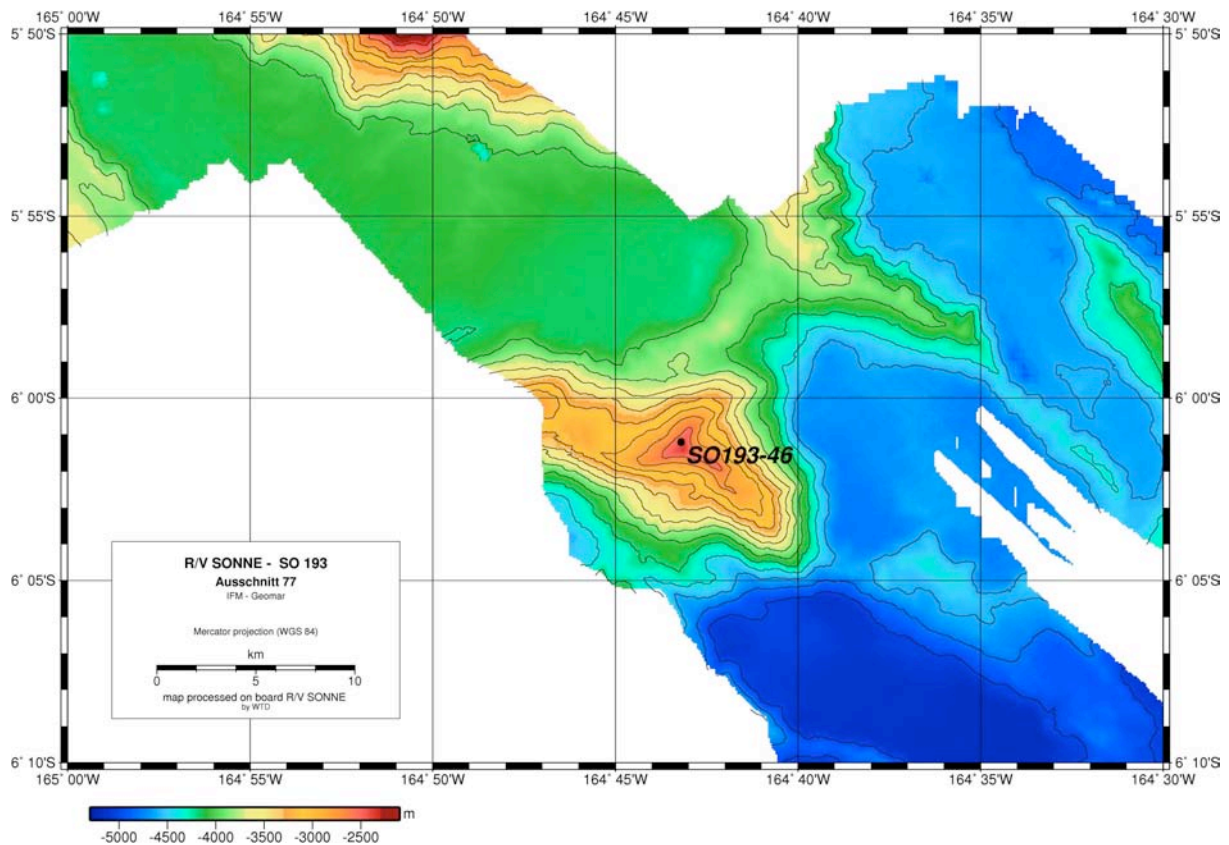


Fig. 5.14.: Dredge site DR 46 at a ridge-like seamount south of the North Plateau.

5.2.4. The Northwestern Margin and Adjacent Features (DR 55 - DR 66)

The area east of the North Plateau and north(west) of the High Plateau, respectively, is characterized by several large seamounts and mainly ENE-WSW or N-S striking linear ridges which rise from abyssal plain depths of 5,000 to 5,500 m (Fig. 3.2., see also chapter 6.3.3.). Since these features have not been investigated yet, SO193 conducted limited multi beam mapping and sampling of some selected seamounts and ridges in this region before heading to the High Plateau.

The first surveyed seamount is located ~40 nm north of the High Plateau's northern margin. From the predicted bathymetry this seamount appears to belong to a linear, approximately NNE-SSW striking, ~500 km long chain of seamounts and ridges which extends from the High Plateau til 5°S to the north into the Central Pacific Basin (Fig. 3.2.). The seamount revealed to be a ~3,400 m high guyot with roughly circular, steep-sided base and a flat top from which smaller volcanic cones rise another 300 m (Fig. 5.15.). Its base lies in ~5,000 m b.s.l. and has a diameter of ~35 km. Small volcanic rifts (?) emanate from its base to the north and to the south, being consistent with the overall direction of the seamount chain mentioned above. The flat top (~18 km in diameter, ~2,000 m b.s.l. at the edges and ~1,600 m b.s.l. in the center) is interpreted to be an erosional plateau being formed by wave activity at sea level. The inward shoaling of the platform is consistent with subsidence occurring contemporaneously with erosion at sea level to form the plateau. The younger volcanic cones on the plateau are well preserved and must have formed after the seamount subsided below wave base, indicating a second or late stage of volcanic activity. Two dredge hauls were made at this seamount. DR 55 yielded dense to slightly vesicular olivine-feldspar-pyroxene bearing lava fragments and volcanic breccias from the northeastern flank beneath the plateau edge. DR 56 sampled a small cone on the plateau in ~1,600 m b.s.l. (Fig. 5.15.) and obtained several blocks of partly highly vesicular, olivine bearing lava fragments, volcanic breccias and

lapillituffs with up to 10 cm (!) thick Mn crusts. Some 35 nm further east, a second guyot has been partly mapped and sampled by SO193 (Fig. 5.16.). It rises from the abyssal plain at ~4,800 m b.s.l. to a erosional plateau at ~2,000 m b.s.l. (edge) - ~1,600 m b.s.l. (center) and is similar in dimension to the guyot described above (37 km in diameter at its base and 17 km at the plateau). However, younger volcanic cones are not visible in the surveyed area of the plateau and there is no evidence for a second stage of volcanic activity. DR 57 was made on the on the upper eastern flank just beneath the plateau edge and yielded dense feldspar-pyroxene bearing lava fragments. The depth of the edges of the erosional platforms of both guyots indicate a total net subsidence of ~2,000 m of this region north of the High Plateau.

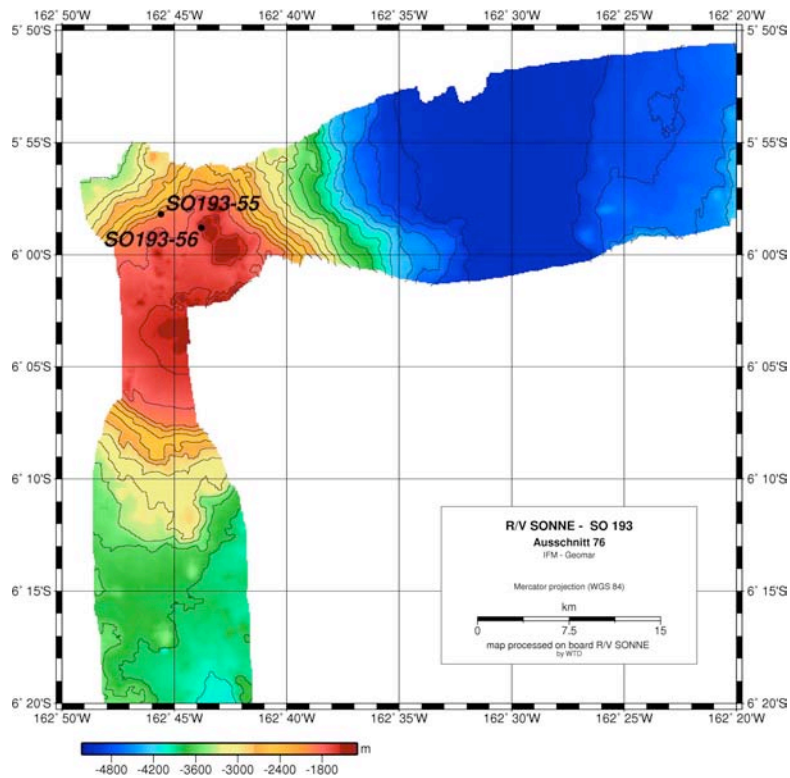


Fig. 5.15.: Dredge sites DR 55 and 56 at the western guyot ~40 nm north of the High Plateau's northern margin. Note the volcanic cones rising from the erosional plateau.

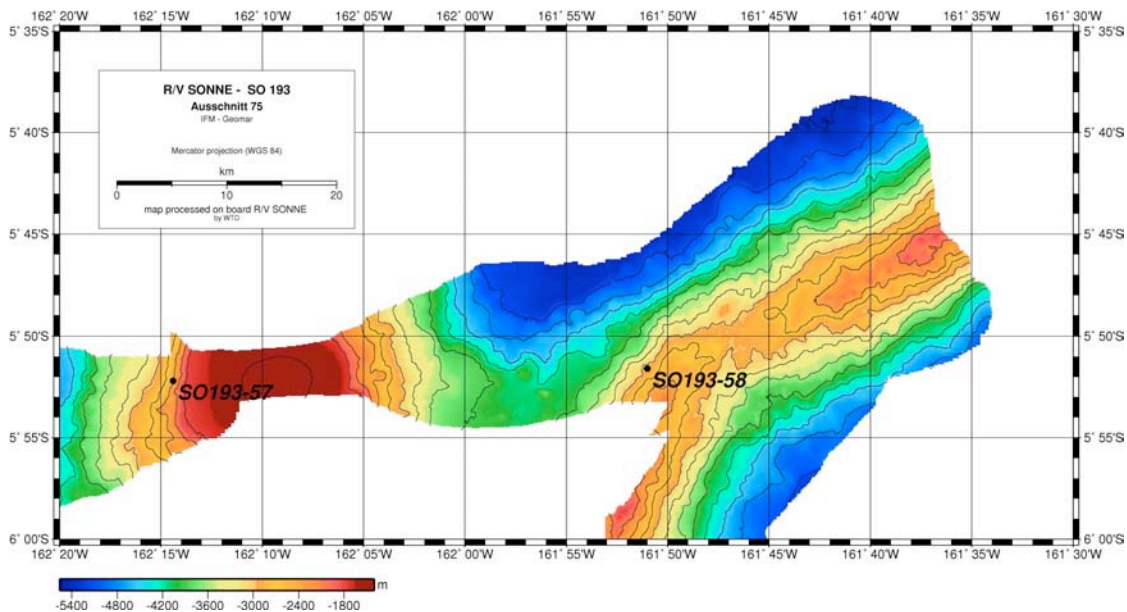


Fig. 5.16.: Dredge site DR 57 at the eastern guyot and DR 58 at an adjacent ridge.

Directly east of the eastern guyot, SO193 sampled and partly mapped a SW-NE trending ridge (Fig. 5.16.) which possibly has a rift-related origin (see chapter 6.3.3.). It is ~75 km long (according to predicted bathymetry), ~22 km wide and elevates from ~5,000 m b.s.l. at its base to almost 2,000 m b.s.l. at its crest. DR 58 has been carried out on the upper northern slope of the ridge where the ridge bends towards SSW (Fig. 5.16.). The dredge haul recovered olivine bearing lavas of different structure, among others almost dense sheet lava fragments and highly vesicular pillow lavas, partly with thin (<1 mm) glassy rims. Apart from the lavas, DR 58 contained lapilli tuffs with highly vesicular, partly pumice-like lapilli and abundant lithic fragments, volcanic breccias with highly vesicular lava clasts, and Mn crusts. The high vesicularity of most volcanics dredged out of ~3,400 m water depth at this ridge possibly indicates much shallower water depths at time of eruption, being consistent with the high subsidence of this area inferred from the seamounts.

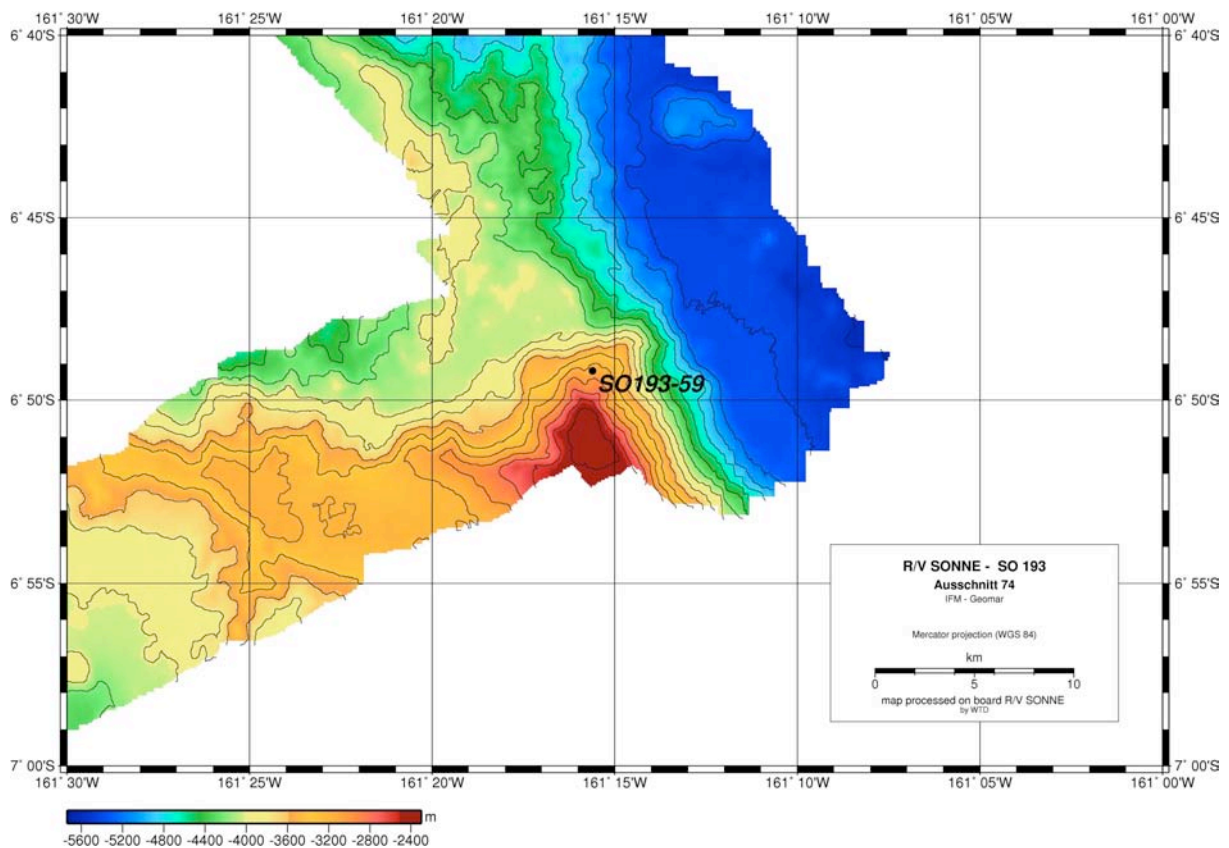


Fig. 5.17.: Dredge site DR 59 at the northern tip of a NW-SE striking ridge north of the High Plateau.

Approximately 70 nm SSW of DR 58, the northern tip of a ~180 km long, unusually NW-SE striking ridge has been sampled by DR 59 (Fig. 5.17.). This dredge recovered a surprisingly wide spectrum of volcanic rocks from the upper northern flank out of ~3,500 m b.s.l.. The major lithologies are dense, highly porphyric lavas with up to 15% feldspar phenocrysts (up to 10 mm in size) and up to 10% olivine (up to 5 mm) and slightly vesicular, olivine bearing pillow fragments with up to 15 mm thick chilled margins. Other lavas and volcanoclastic rocks are minor.

En route to the High Plateau, a 200 km long, N-S striking ridge has been surveyed and sampled along its entire length (Fig. 5.18.). At its northern end, the ridge is only ~12 km wide at its base in ~4,300 m water depth and rises up to ~2,300 m. b.s.l. Southward, the base of the ridge broadens and its crest becomes more or less continuously shallower. The southern termination of the ridge, is located on the

northern margin of the High Plateau, and consists of a large seamount rising from 4,000 m b.s.l. to an erosional plateau at 950 m b.s.l. A total of six dredge hauls and one TV grab have been carried out along the ridge and the southern seamount (Fig. 5.18.). DR 60 at the northern tip of the ridge yielded only Mn crusts and a fish. DR 61 was made 12 nm farther south on the ridge crest in ~1,900 m water depth and recovered highly vesicular, Mn-encrusted lapilli tuffs. Ten nm farther to the south, DR 62 yielded mainly olivine (and partly feldspar) phyric, slightly vesicular lava fragments from the lower eastern slope of the ridge. DR 63 is located more or less in the middle of the ridge on the upper eastern flank at ~2,500 m water depth and gave olivine phyric and aphyric lava fragments and a variety of volcanoclastic rocks, among them highly vesicular lapilli tuffs (see also chapter 5.3.). Finally two dredge hauls and the TV grab have been deployed at the seamount that forms the southern termination of the ridge. DR 65 was conducted directly beneath the plateau margin on its eastern side in ~1,700 m water depth and recovered highly vesicular olivine and feldspar bearing lava fragments. DR 66, located 2 nm south of DR 65, failed to return rocks. TV grab 64 surveyed on the upper plateau region of the seamount in 975 m water depth for biological sampling. Surprisingly the TV grab showed mostly barren outcrops of lava and an almost complete lack of sediment, indicating that strong currents apparently affect the guyot's erosional plateau.

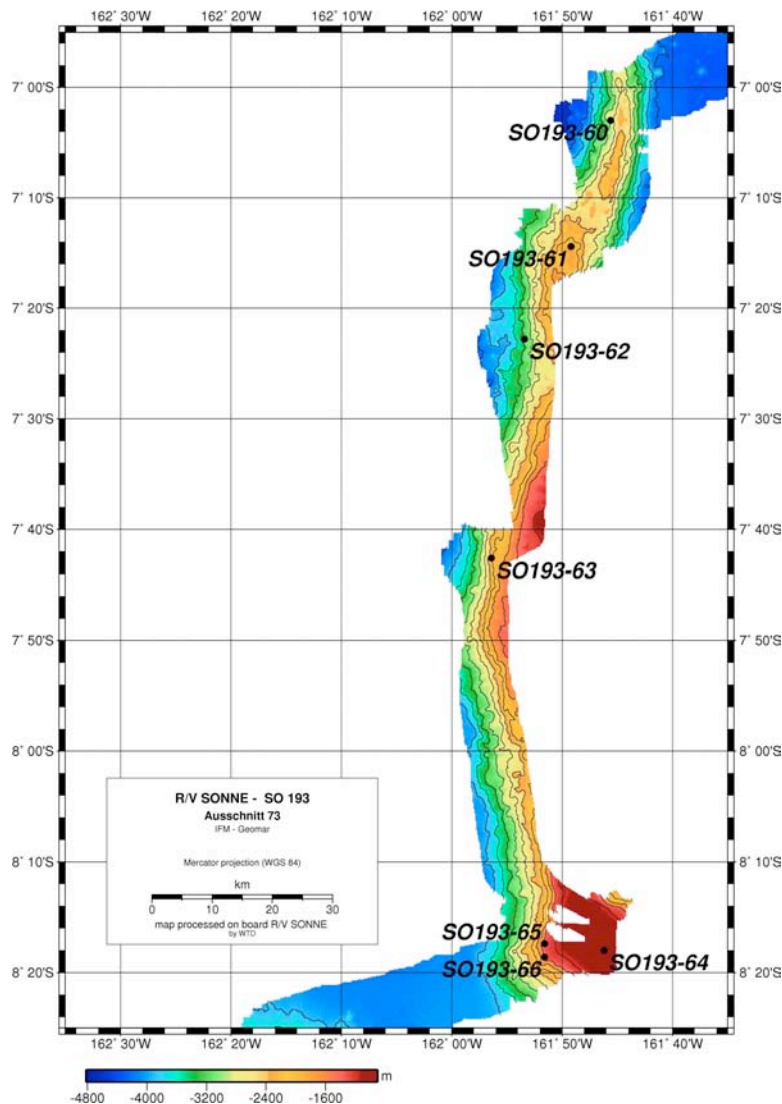


Fig. 5.18.: Dredge sites DR 60 - 66 and TV-grab 64 at a ~200 km long, N-S striking ridge which emanates from the northern margin of the High Plateau.

5.2.5. High Plateau (DR 67 - DR 77)

The roughly rhomb-shaped High Plateau rises more than 2,500 m above the surrounding sea floor and represents the major geomorphological unit of the Manihiki plateau by area and volume (Fig. 3.2.). To the north, east and south it is bounded by the Central Pacific, Penrhyn, and Samoan Basins, respectively, and to the west it is separated by the Danger Island Troughs from the Western Plateaus. Whereas the eastern and western margin of the High Plateau is formed by distinct scarps (i.e. Danger Islands Troughs and Manihiki Scarp, see chapters 5.2.2. and 5.2.6.), its northern and southern margins are somewhat diffuse and not well-defined (e.g., chapter 5.2.9.). The surface of the High Plateau lies at an average water depth of ~2,500 to 3,000 m and gradually deepens to ~4,000 m towards its marginal areas (except to the east). According to Winterer et al. (1974) the acoustic basement of the plateau is smooth and covered by up to 1 km of pelagic and/or volcanogenic sediments. Seamounts and atolls occur only in the marginal areas of the High Plateau, in particular in the northeast (Fig. 3.2.). Here, four large seamounts, among them “Mt. Eddie”, and two atolls (Manihiki and Rakahanga) rise from the plateau plains. Due to the thick sediment blanket on the High Plateau basement, the SO193 research efforts concentrated on these seamount features. An important geological question is whether these structures formed more or less contemporaneously with plateau basement or during subsequent episodes of volcanism. Prior to SO193, igneous rocks of the inner High Plateau have been sampled from Mt. Eddie and the Manihiki atoll (SO 67-1) and at DSDP Site 317 (see chapter 3.2.).

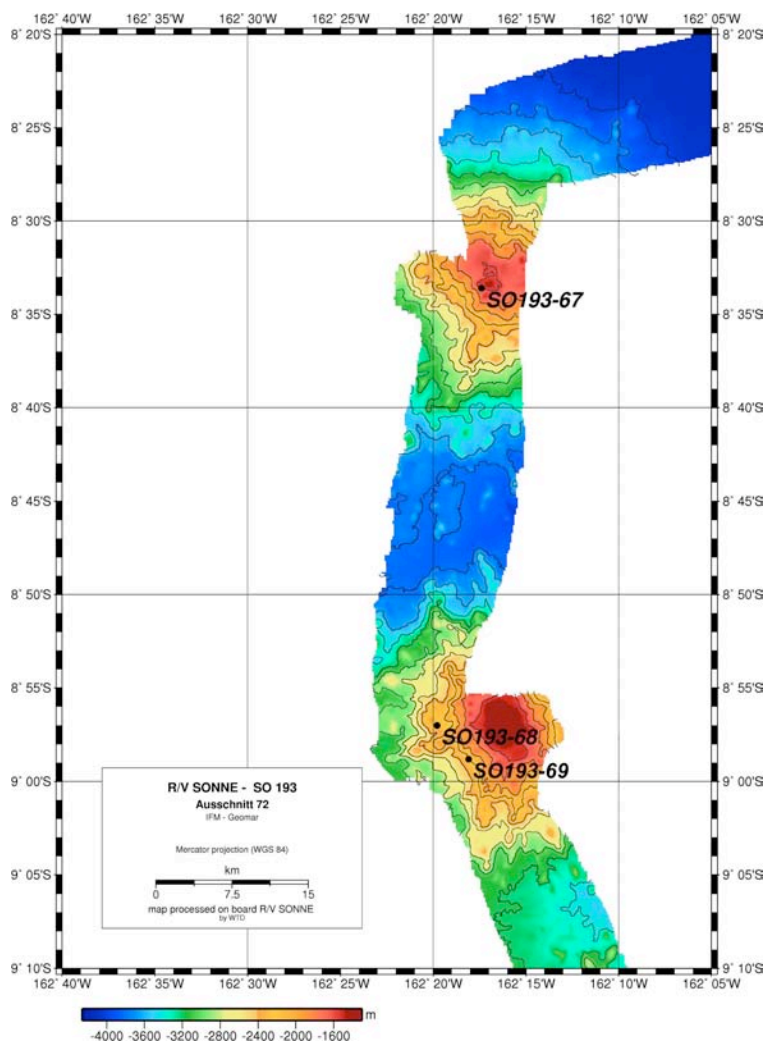


Fig. 5.19.: Dredge sites DR 67 - 69 at guyots on the High Plateau.

Except of “Mt. Eddie”, the large northeastern seamounts are aligned in NNW-SSE direction and form the southern termination of the approximately N-S trending chain of ridges and seamounts which extends from the High Plateau towards northward til 5°S (see chapter 5.2.4.). Multi beam mapping revealed these three seamounts to be guyots with steep flanks and erosional plateaus at their top. The northern and the central seamounts have roughly circular bases which lie at 3,400 - 4,000 m water depth and have a diameter of ~28 km (Fig. 5.19.). Small volcanic rifts (?) appear to emanate from both volcanoes in several directions. However, any preferred directions of these features could not be identified due to time limits for mapping.

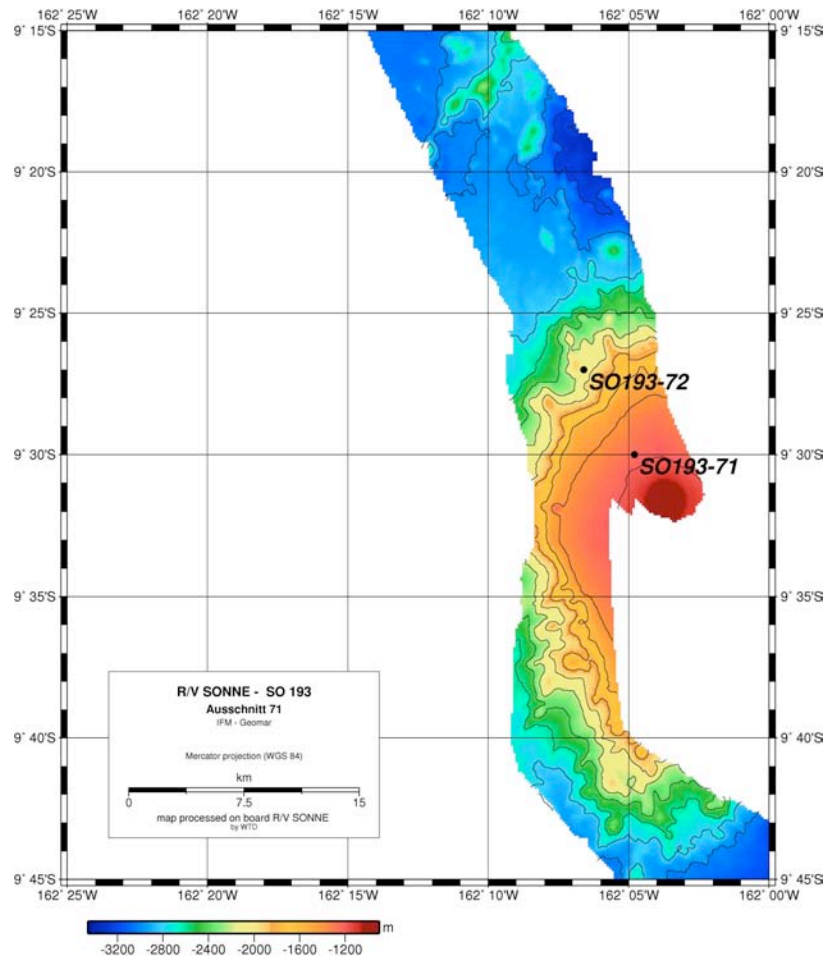


Fig. 5.20.: TV-grab 71 and dredge site DR 72 at southern guyot on the northern High Plateau.

The southern seamount is oval-shaped with a dimension of ~40 x 25 km at its base in 3.000 m b.s.l. and is elongated in NNW-SEE direction (Fig. 5.20.). The erosional plateaus of the three seamounts that formed at sea level all lie at relatively uniform depths of 1,600 to 1,700 m b.s.l. These observation suggests a uniform subsidence rate for the northern High Plateau as well as similar ages for the guyots. DR 65 yielded slightly vesicular olivine and feldspar phyric pillow lava fragments, volcanic breccias, and chert-like rocks out of 1,700 m water depth from the southeastern plateau edge of the northern seamount. The central seamount has been sampled by two dredges. DR 68 targeted on a small cone situated on its western flank at ~2,400 m water depth and recovered vesicular lava fragments, containing small feldspar phenocrysts and sometimes small amounts of olivine and pyroxene, as well as volcanoclastic rocks consisting of a chert-like matrix and small clasts, among them pumice. Approximately 2 nm further southeast, DR 69 was

carried out beneath the western plateau edge of this guyot but recovered only carbonatic rocks with distinct holes in their surfaces (worm borings?). The southern guyot was sampled at its northwestern flank at ~2,300 m water depth by DR 72. Besides large amounts of carbonates and Mn-crusts the dredge contained one vesicular, olivine and feldspar bearing lava fragment. The top plateau of this seamount was explored with TV grab 71 and exposures of lava dominated, similar to the seamount at the termination of the N-S- trending ridge. In addition to sediment for the biologists, the TV grab recovered unusually large manganese nodules (up to 20 cm in diameter) whose cores are partially formed by slightly vesicular, moderately to strongly altered lava fragments with olivine and partly fresh (!) feldspar.

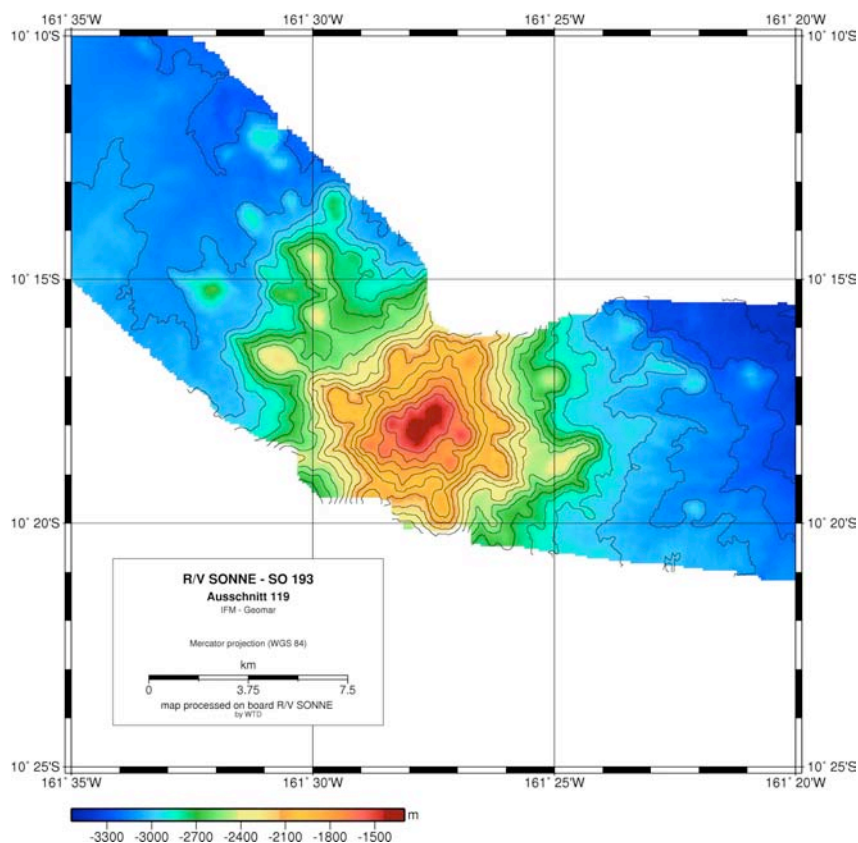


Fig. 5.21.: SO193 multi beam bathymetry of “Mt. Eddie”.

En route to the Manihiki and Rakahanga atolls, SO193 passed “Mt. Eddie”. By contrast to the other seamounts in this region, SIMRAD EM120 mapping revealed “Mt. Eddie” not to be a guyot (Fig. 5.21.), confirming SeaBeam data by Beierdorf et al. (1995) (see chapter 3.2.). The Manihiki atoll has a roughly circular, steep side base and a flat top in shallow water depth on which a narrow strip of land encircling a lagoon rises above sea level (Fig. 5.22.). Such atolls are eroded ocean island volcanoes, which, in contrast to the guyot-type seamounts, have not yet subsided well below sea level. The base of Manihiki lies at ~3,400 m water depth and has a diameter of ~35 km. Several small ridges emanate from the atoll in southern and northern directions. TV grab 74 was deployed on such a small ridge or nose in 1,200 m water depth and displayed a rugged volcanic terrane that mainly consists of volcanic deposits and fossil corals but failed to return rocks or biological material. A striking feature of Manihiki is a 6 km wide depression in the northeastern flank of its base which most likely has been formed by slope failure. Today, the deposits of this slumping form a smooth elevation on the ocean floor NE of the atoll. DR 75 was made at ~2,400 m water depth on the upper northern slope of Manihiki and yielded

vesicular lava fragments (partially in the form of beach cobbles) and volcanic breccias. The lavas as well as the clasts in the breccias contain moderate amounts of altered olivine, partially fresh feldspar, and fresh pyroxene phenocrysts (up to ~5% each). Notably the pyroxenes are quite large with up to 13 mm in length. Rakahanga is located ~12 nm NNW of Manihiki. This atoll is somewhat smaller in dimension than Manihiki, with approximately 26 x 20 km at its base in 3,500 m water depth and an elongation in N-S direction (Fig. 5.23.). At least three large but, compared to Manihiki, less distinct depressions are visible in the flanks of Rakahanga which may have formed by slumps, suggesting that instability of the flanks and slope failure may be a common feature of such atolls. DR 77 is located on a small ridge-like structure on the lower northwestern slope of the volcano in ~3,400 m water depth. The dredge yielded a full chain bag containing rounded lava boulders, beach cobbles, and volcanoclastic breccias. Vesicular, olivine pyroxene phyric lava, similar to those dredged at the Manihiki atoll, dominates. TV grab 76 has been deployed in 1,470 m water depth on a small plateau along the upper southeastern slope of Rakahanga. Despite serious difficulties due to the rugged terrane, the TV grab sampled besides biological material, 4 boulders of indurated lapilli tuffs which contain pumice clasts and lava fragments with pyroxene crystals up to 3 cm (!) long.

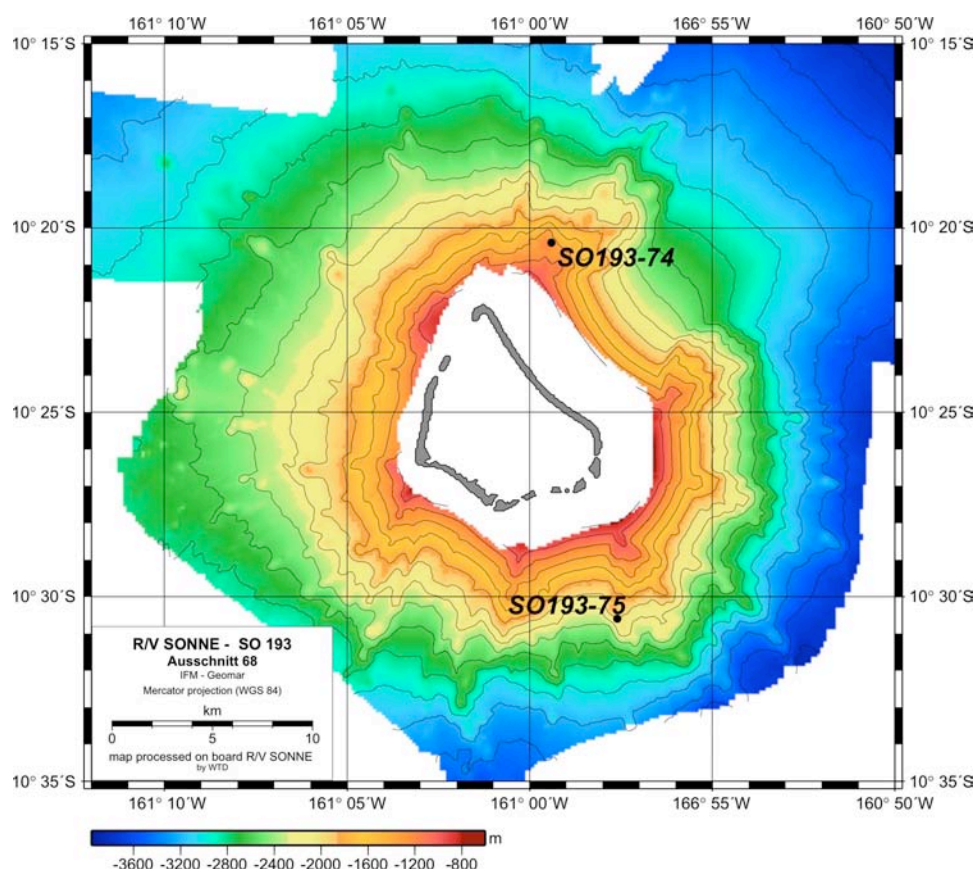


Fig. 5.22.: Bathymetric map of the submarine base of the Manihiki atoll including locations of TV grab 74 and dredge site DR 75.

In summary, three large guyots and two atolls have been surveyed and sampled on the Manihiki northeastern High Plateau. The recent depth of the erosional plateaus of the guyots indicate uniform subsidence of this area by ~1,600 - 1,700 m since erosion of these volcanoes. The morphology of the flanks of Manihiki and Rakahanga suggest that slope failure is a common process at these atolls. Olivine (and partially feldspar and pyroxene) phyric sheet and pillow lava fragments and volcanoclastic rocks dominate among the rocks dredged at the guyots and atolls. The

predominance of moderate to highly vesicular lavas as well as the occurrence of pumice and scoriaceous components within the volcanoclastic rocks is consistent with significant subsidence of the High Plateau as postulated in previous studies (see chapter 3.2.).

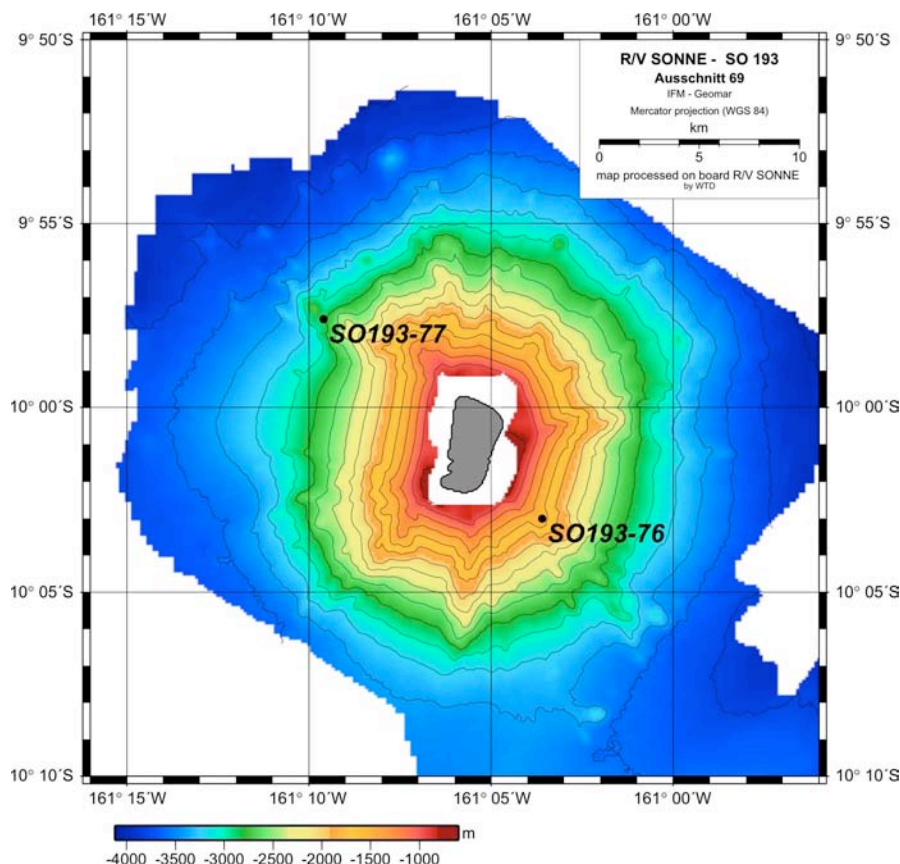


Fig. 5.23.: Bathymetric map of the submarine base of the Rakahanga atoll including locations of TV grab 76 and dredge site DR 77.

5.2.6. Manihiki Scarp (DR 78 - DR 91)

The SSW-NNE trending Manihiki Scarp is a prominent, >650 km long fault zone that defines the eastern boundary of the High Plateau and borders the entire plateau on the eastern side (see also chapter 6.3.5.). At the scarp, the ocean floor descends abruptly from ca. 2,500 - 3,800 to 5,500 m b.s.l. The complex morphology of the Manihiki Scarp includes steep steps, tectonically tilted units, volcanic ridges, troughs, and individual seamounts (Figs. 5.24. - 5.27.). Seismic reflection profiles across the Manihiki Scarp published by Winterer et al. (1974) show a succession ridges being parallel to the main scarp, a steep-facing scarp (the “real” plateau margin), and an elevated rim of the plateau. This feature, here called “elevated plateau rim”, is a linear, relatively flat-topped ridge-like structure that stretches for more than 400 km along the upper part of the scarp. It is 500 - 600 m higher than the adjacent High Plateau and appears to dam the thick sediment sequence of the plateau. Judging from the ridge morphology, this structure could be of tectonic or volcanic origin. According to Winterer et al. (1974) the “elevated plateau rim” is formed by tilted sedimentary rocks in the north and farther south by a “basement” high. To our knowledge hard rocks from the Manihiki Scarp have only been recovered by piston coring on the VEMA-18 cruise (Heezen et al. 1966). Some cores contained a variety of rock types that had been mixed during slumping, among them fragments of volcanic breccias and serpentinite. The work of SO193 along the Manihiki Scarp

intended to gain new insights into the nature of High Plateau basement as well as the volcanic and tectonic processes leading to formation of the scarp and associated volcanic structures.

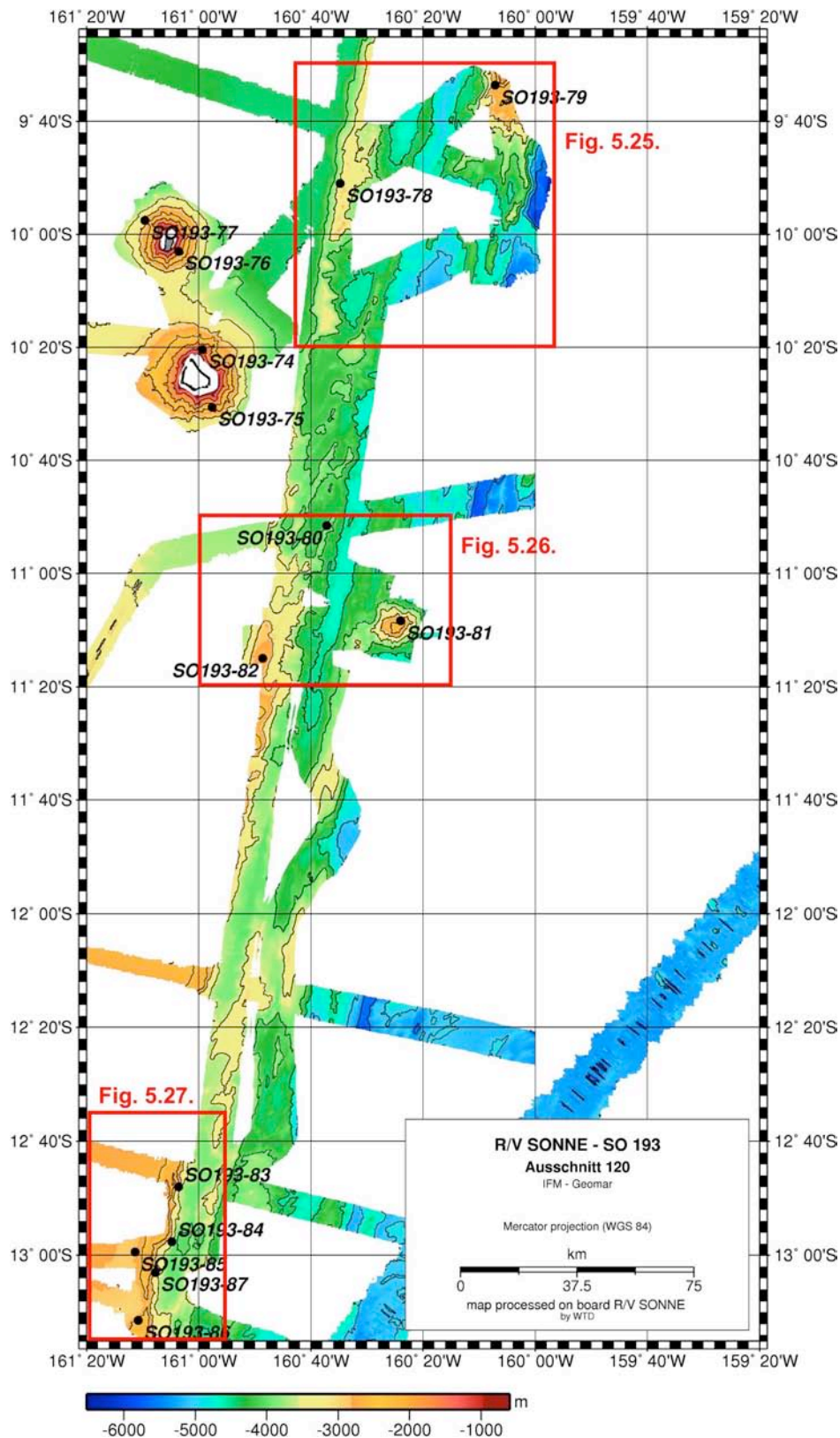


Fig. 5.24.: SO193, R/V PALMER (various cruises), and KIWI12 multi beam bathymetry of the Manihiki Scarp and adjacent areas including locations of SO193 sampling sites. Red boxes indicate locations of figures 5.25. - 5.27.

The northernmost area of the Manihiki Scarp being surveyed and sampled by SO193 lies east of the Rakahanga atoll between $\sim 9^{\circ}30'S$ and $10^{\circ}00'S$ (Figs. 5.24., 5.25.). Here the scarp is marked by multiple ridges and elongated basins which strike slightly oblique to the “elevated plateau rim” (Fig. 5.25.). DR 78 was made at $\sim 3,500$ m water depth on the upper western slope of the “elevated plateau rim”. Besides Mn-crusts the dredge yielded 2 moderate vesicular, olivine-pyroxene phyric lava fragments. Thirty nm nautical miles farther to the northeast, DR 79 recovered a full chain bag containing a wide range of mainly volcanic rocks from 2,900 m water depth at the southwestern flank of a large seamount located at the outer part of the scarp. Slightly vesicular olivine-feldspar phyric lava, vesicular aphyric lava, and tuff containing feldspar phenocrysts dominate among these rocks. Minor lithologies are lapillituffs with pumice clasts, matrix-supported breccias of unclear origin, and indurated clay sediments. The broad variety of rock types may indicate that DR 79 sampled debris from the upper part of the seamount.

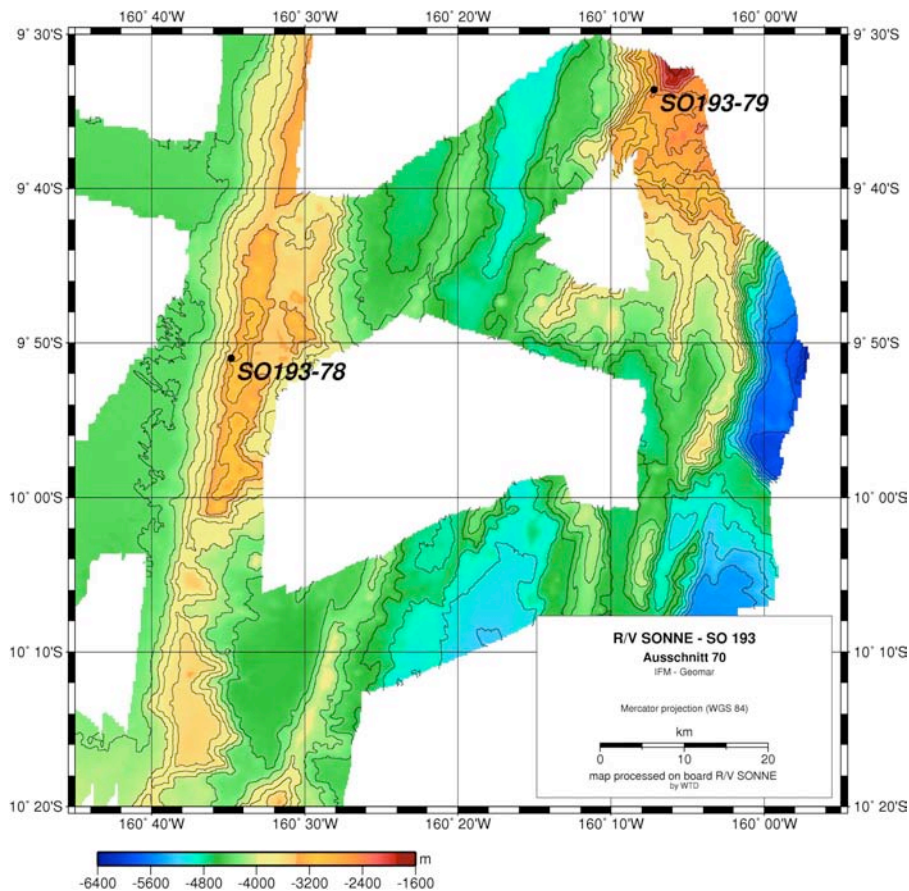


Fig. 5.25.: Dredge sites DR 78 and 79 in the northernmost area of the Manihiki Scarp.

Approximately 60 - 80 nm farther south, three dredge hauls have been carried out at different structures of the scarp (Figs. 5.24., 5.26.). DR 80 gave Mn-encrusted, indurated sediments and sedimentary breccias from the upper western slope of a linear ridge just east of the High Plateau’s margin. DR 81 has been carried out at 2,800 m water depth in the top region of a cone-shaped, $\sim 2,300$ m high seamount at the outer part of the scarp. The roughly circular base of this seamount lies at $\sim 4,600$ m water depth and measures ~ 20 km in diameter. The dredge yielded two pieces of strongly altered, vesicular olivine bearing lava and boulders of lapilli tuff which appears to be less altered than the lava fragments. DR 82 was made at 2,600 m water depth on a small cone-like structure on top of the “elevated plateau rim” and

recovered slightly to moderately vesicular, olivine bearing pillow lavas and fine-grained carbonates.

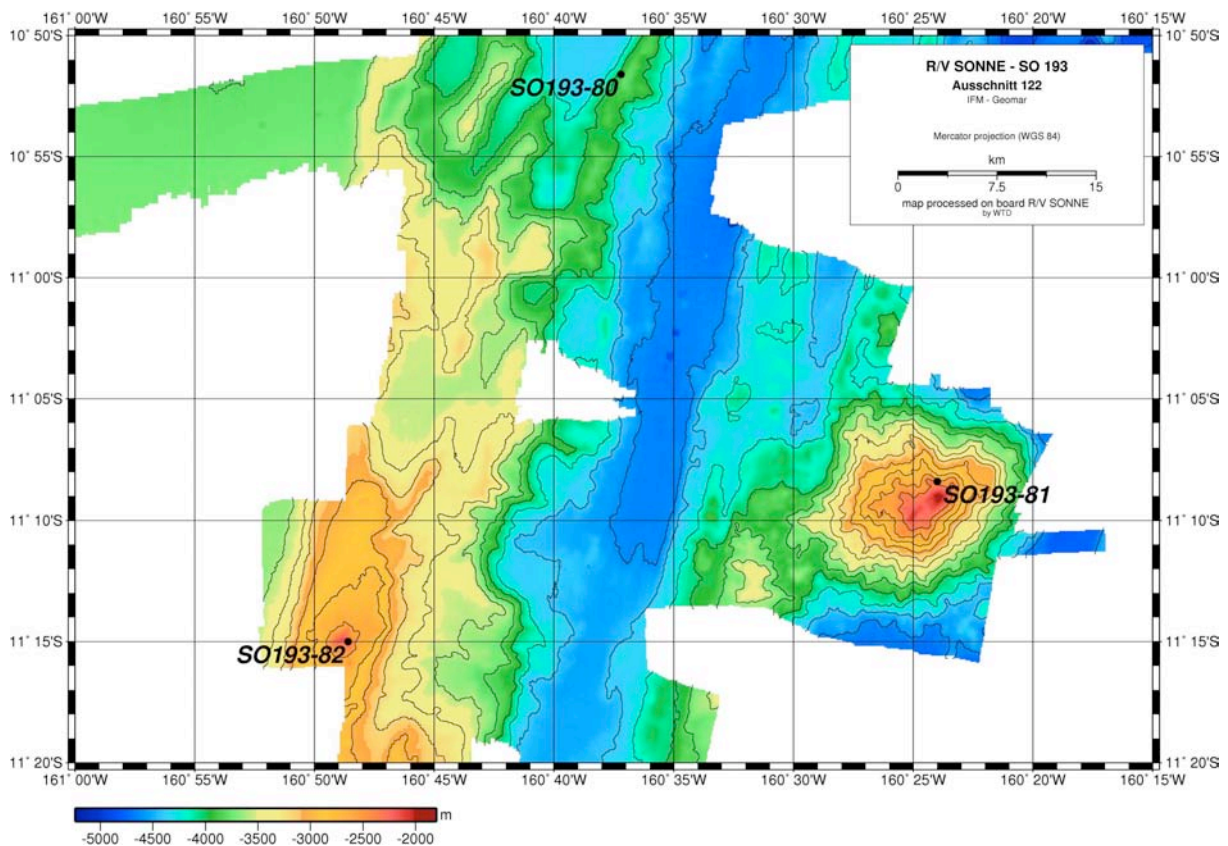


Fig. 5.26.: Dredge sites DR 80 - 82 at the central Manihiki Scarp.

Between ca. $12^{\circ}45'S$ and $13^{\circ}15'S$, SO193 focused on the “elevated plateau rim” and the High Plateau margin (Figs. 5.24., 5.27.). Dredge haul 83 was made oblique to the slope of the plateau margin at a nose-like structure at 3,200 m water depth and recovered only a few pieces of solidified or lithified sediments and a small piece of breccia which contains a strongly altered lava fragment. By contrast, DR 84 recovered a wide range of volcanic and sedimentary rocks out of ~3.600 m water depth from the lower plateau margin. The rock mainly comprise dense to slightly vesicular lava fragments, breccias consisting of volcanic clasts and/or sedimentary rocks, lapillituff and various types of fine-grained sedimentary rocks, among them clay stone. Some of the fine-grained sedimentary rocks may represent compacted volcanic ash. The lava fragments and the volcanic clasts in the breccias are generally olivine bearing and contain sometimes feldspar and/or pyroxene phenocrysts. Some of these phenocrysts (incl. olivine!) appear to be fresh or only slightly altered. On the other hand, DR 84 also contained strongly altered and/or tectonically (?) overprinted rocks. The variety of rock types and degree of alteration suggests that DR 84 has sampled a debris fan at the base of the slope. In this case the slope above the dredge location would consist of a succession of solidified or lithified sediments and volcanic rocks, which may have been partially overprinted by tectonic processes. DR 86 is located at 2,700 m water depth on the upper western slope of the “elevated plateau rim”. Here the “elevated plateau rim” is marked by a gentle western slope and a distinct flat top (Fig. 5.27.). This morphology rather points to a non-volcanic than to a volcanic origin. DR 86, however, yielded exclusively slightly vesicular, olivine and feldspar phytic pillow fragments and large boulders of lapilli tuff which contain fragments of the pillow lavas. This clearly indicates that this part of the

“elevated plateau rim” is at least partially volcanic in origin. Dredge haul 87 was made oblique to the eastern plateau margin across a nose-like structure just beneath the “elevated plateau rim” at 3,200 m water depth. The major lithology recovered by DR 87 are slightly to moderately altered, predominantly dense feldspar-phyric trachytic (?) lava fragments and breccias consisting of clasts from these lavas. Apart from that a variety of strongly altered volcanic and sedimentary rocks were found in this dredge.

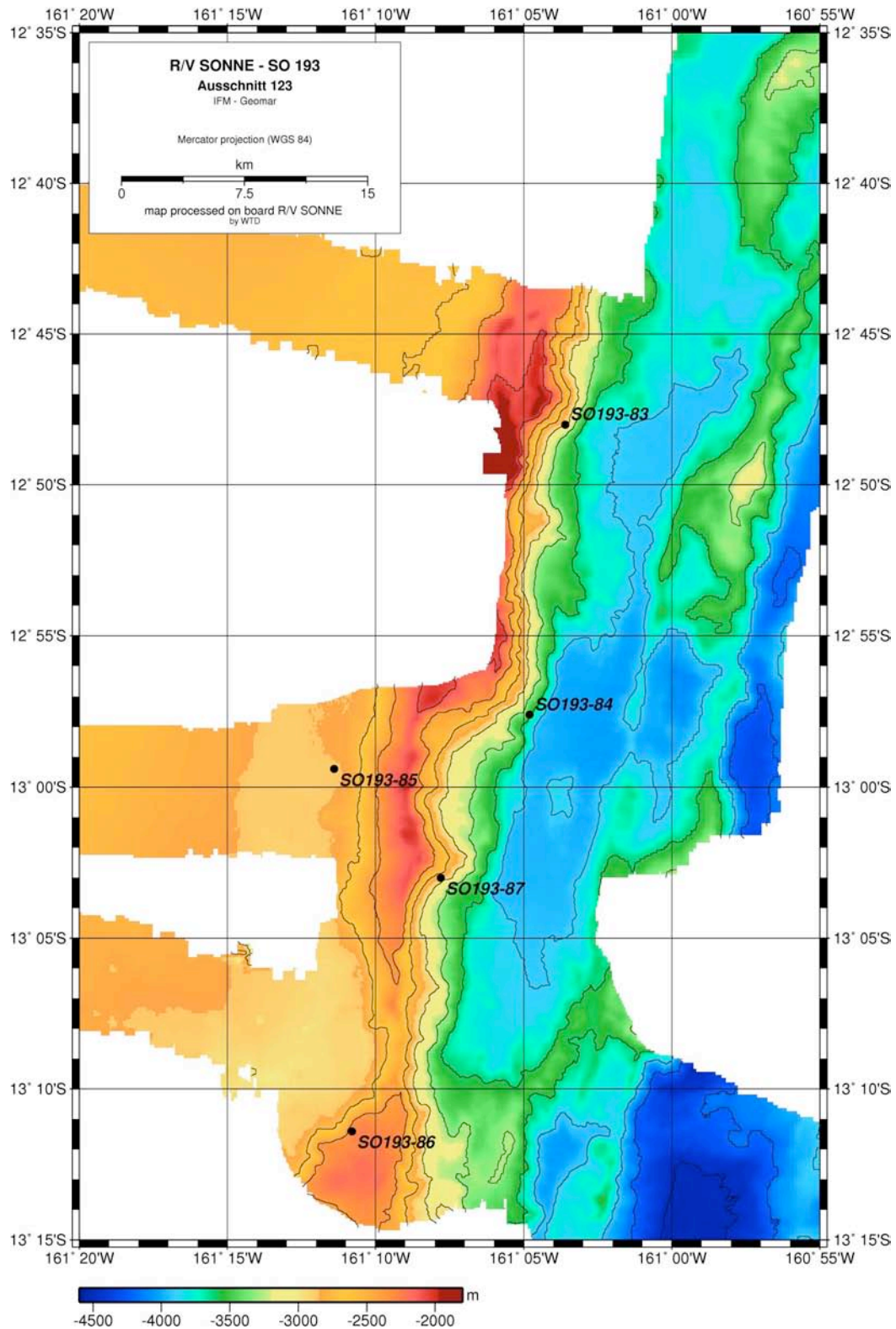


Fig. 5.27.: Dredge sites DR 83 - 87 and MUC 85 at the southern Manihiki Scarp.

Slightly east of the Manihiki Scarp, the deepest dredge (DR 88) of SO193 has been carried out at a water depth of nearly 5,500 m along a NNE-SSW striking fault zone within the neighboring oceanic crust (Fig. 5.28.). DR 88 mainly recovered very dense, feldspar-phyric lava. Some of the lava fragments also contain small amounts olivine and pyroxene. Minor lithologies yielded from this fault zone comprise aphyric lava fragments and a greenish “greasy” rock which may be serpentinite. The feldspars of these lavas will probably allow us to obtain age information over the course of the shore-based analytical program. The formation age of the oceanic crust adjacent to the Manihiki Plateau will provide crucial information on the geodynamic evolution of this area.

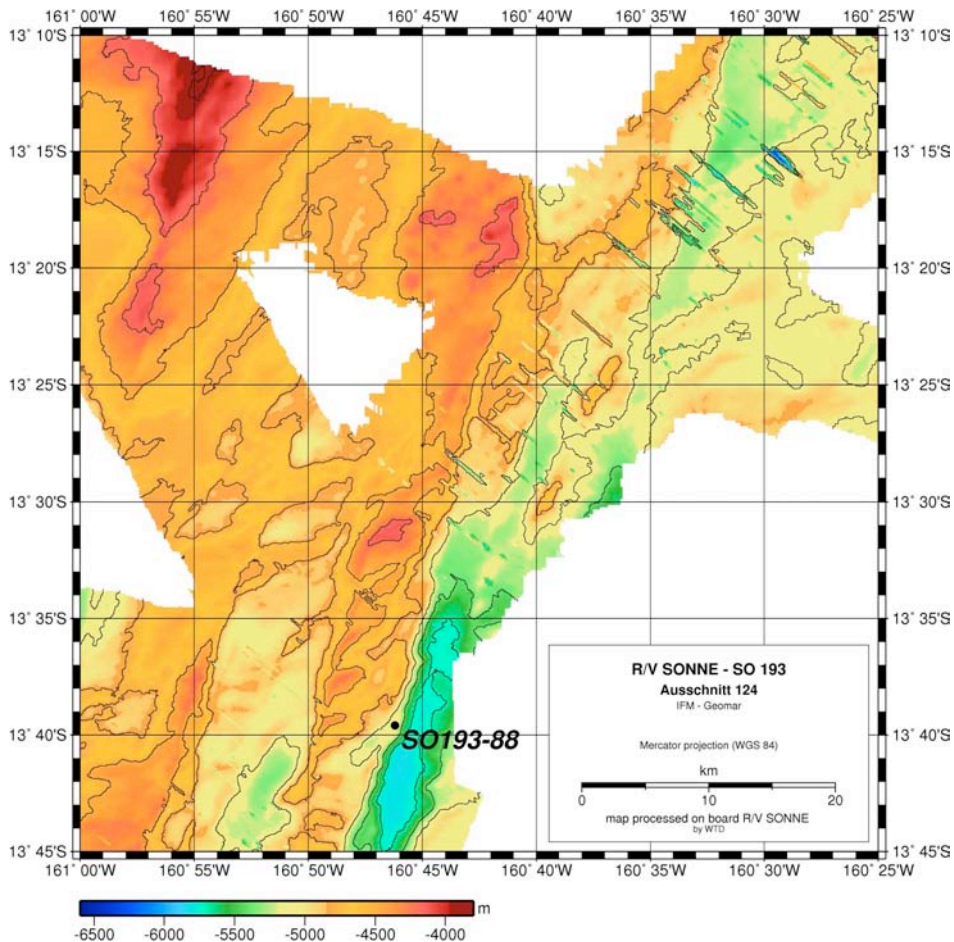


Fig. 5.28.: Dredge site DR 88 along a fault zone within the ocean crust east of the Manihiki Scarp.

The southernmost location surveyed and sampled by SO193 in the area of the Manihiki Scarp is the High Plateau margin between 13°30'S and 14°00'S. Here the plateau margin strikes oblique to the “real” Manihiki Scarp in NE-SW direction and forms a steep step where the ocean floor descends abruptly from 3,500 to 5,300 m b.s.l. (Fig. 5.29.). DR 90 was made at ~4,200 m water depth across the upper part of the slope and gave an almost dense, relatively fresh olivine-feldspar phyric lava fragment and several pieces of an altered volcanoclastic breccia. DR 91 is located 12 nm southeast of DR 90 in ~4,600 m water depth and yielded slightly to moderately vesicular, olivine (and in some cases also feldspar and pyroxene) phyric lava fragments. Similar to the survey of the Danger Islands Troughs (see chapter 5.2.2.), visual observations of the ocean floor were undertaken with the photo and video sled (OFOS, Ocean Floor Observation System) across this part of the High Plateau

margin. OFOS profile 89 commenced close to the location of DR 90 on the upper slope at a water depth of 3,500 m and finished at 4,800 m at its base (Fig. 5.29.). The observations revealed that large lava outcrops, debris covered areas, and small sediment ponds alternate down slope (Fig. 5.30.). On the middle of the slope OFOS imaged a bizarre morphology of up to 40 m high lava cliffs.

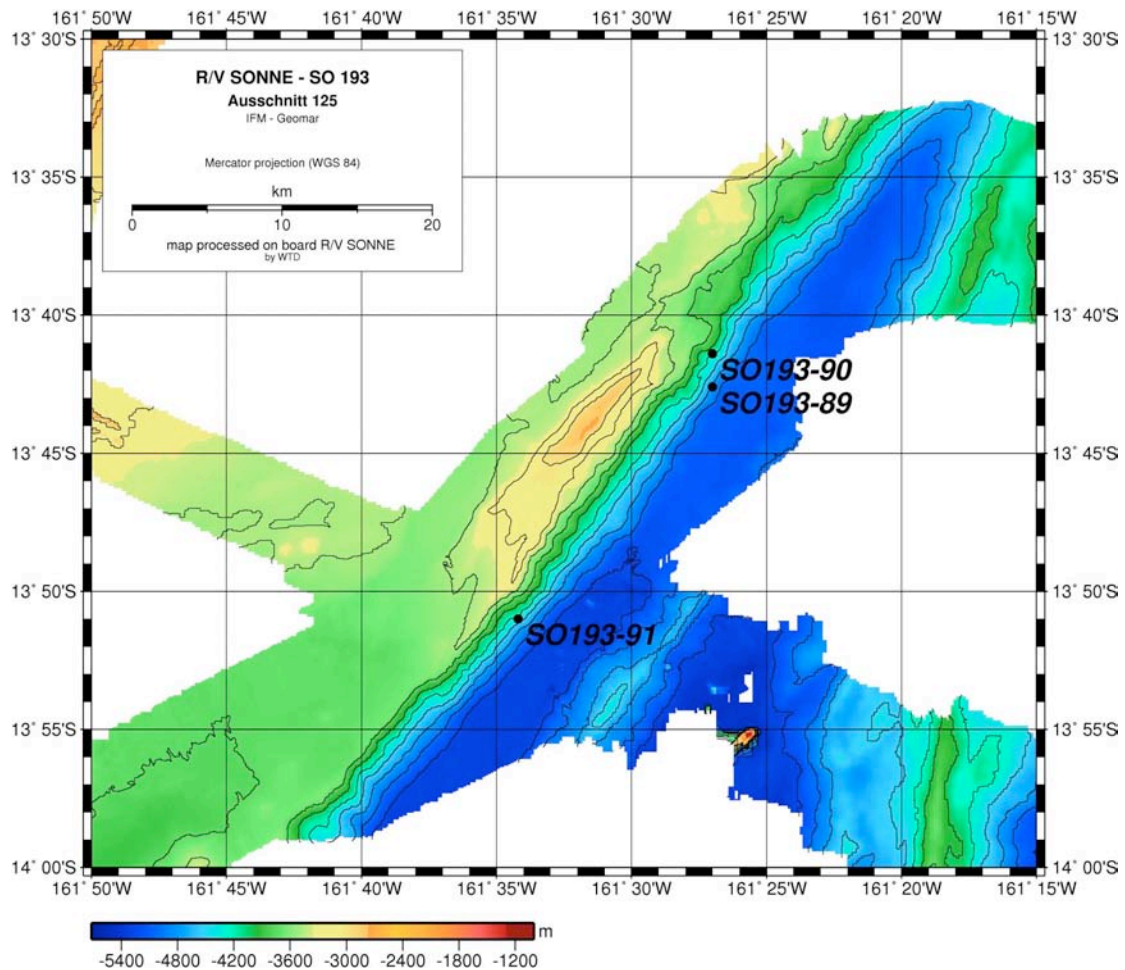


Fig. 5.29.: OFOS profile 89 and dredge sites DR 90 - 91 at High Plateau margin in the southernmost area of the Manihiki Scarp.

In summary, SO193 carried out a total of 12 dredges along the Manihiki Scarp and adjacent features. Three of the dredges were located directly on the “elevated plateau rim”, namely in its northern, central and southern part, respectively. These dredges delivered mostly (pillow-like) lava and volcanoclastic rocks, confirming that at least parts of the ridge are volcanic. The common occurrence of pillow lavas even in the top region of the “elevated plateau rim” indicates that this feature formed in an submarine environment. If the High Plateau had been formed in subaerial or in shallow water conditions as suggested by previous studies (see chapter 3.2.), then the volcanic activity forming the “elevated plateau rim” must have took place after significance subsidence of the High Plateau. From the deeper sections of the Manihiki Scarp and two nearby seamounts, SO193 recovered various lavas, a wide spectrum of volcanoclastic rock, and consolidated and lithified sediment. At some places the dredges may have sampled debris fans deposited at the base of the slopes. However, we are quite confident that some stations also recovered lava from the basement of the High Plateau, thereby achieving a major objective along the Manihiki Scarp.

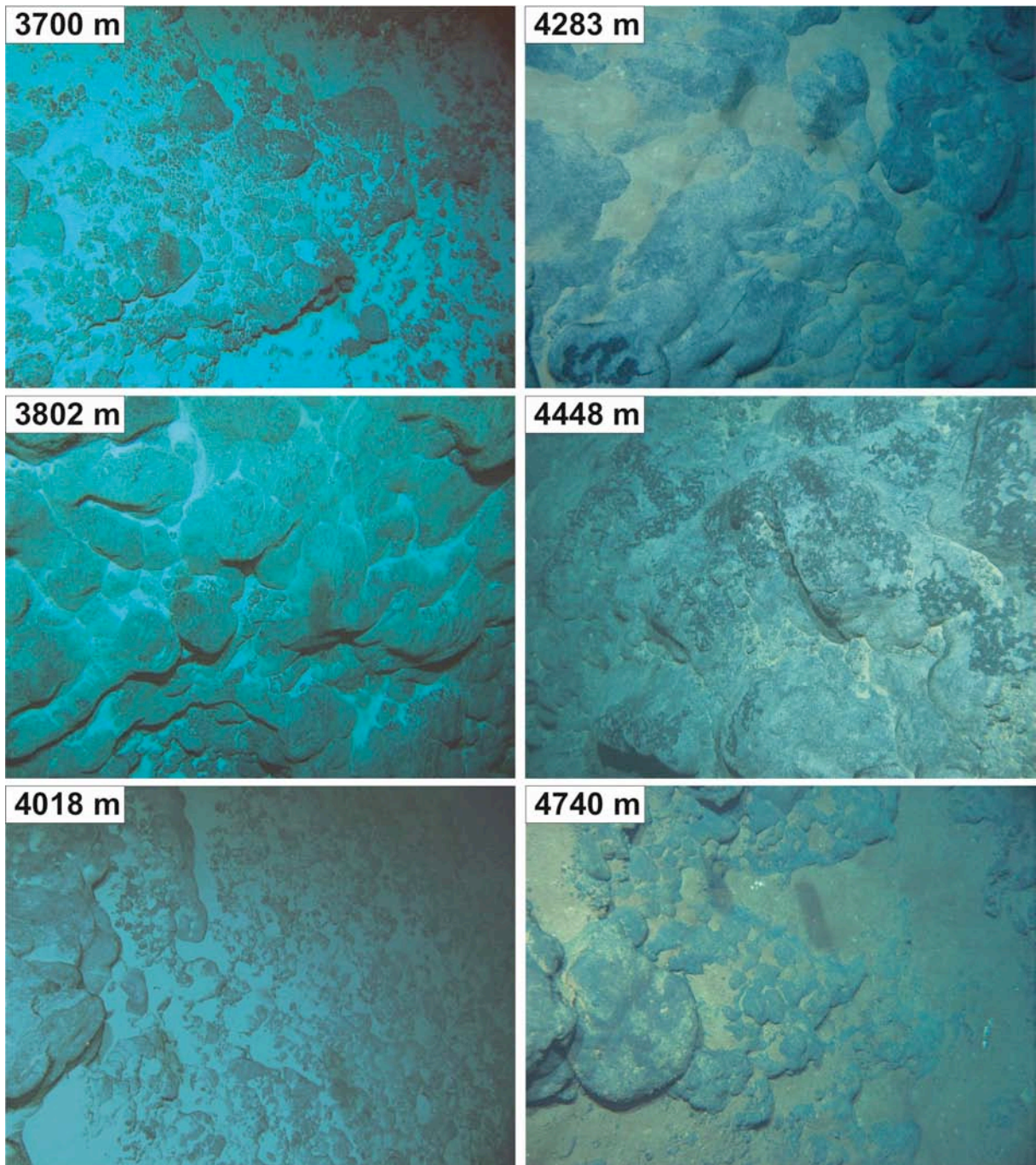


Fig. 5.30.: Pictures of the ocean floor in water depths of ~3,700 and 4,7500 m taken during an OFOS profile 89 across the southeastern margin of the High Plateau. The slope consists mostly of *in-situ* lavas which form partly bizarre cliffs. Between lava outcrops lie debris covered areas and small sediment ponds.

5.2.7. Southern “Apophysis” of the High Plateau (DR 92 - DR 94)

The predicted bathymetry and some KIWI 12 multi beam tracks show an approximately E-W trending step in the southernmost branch of the High Plateau at 13°20’S. At the step, the ocean floor descends relatively gentle (e.g., compared to the Manihiki Scarp) from ~2,500 to ~3,500 m b.s.l., separating the “real” High Plateau from a roughly triangle-shaped apophysis (Fig. 3.2.). The surface of this apophysis is rough at 3,500 - 4,000 m water depth and its margins are formed by steep steps where the ocean floor descends abruptly to abyssal plain depths of 5,200 - 5,500 m b.s.l. (Fig. 5.31.).

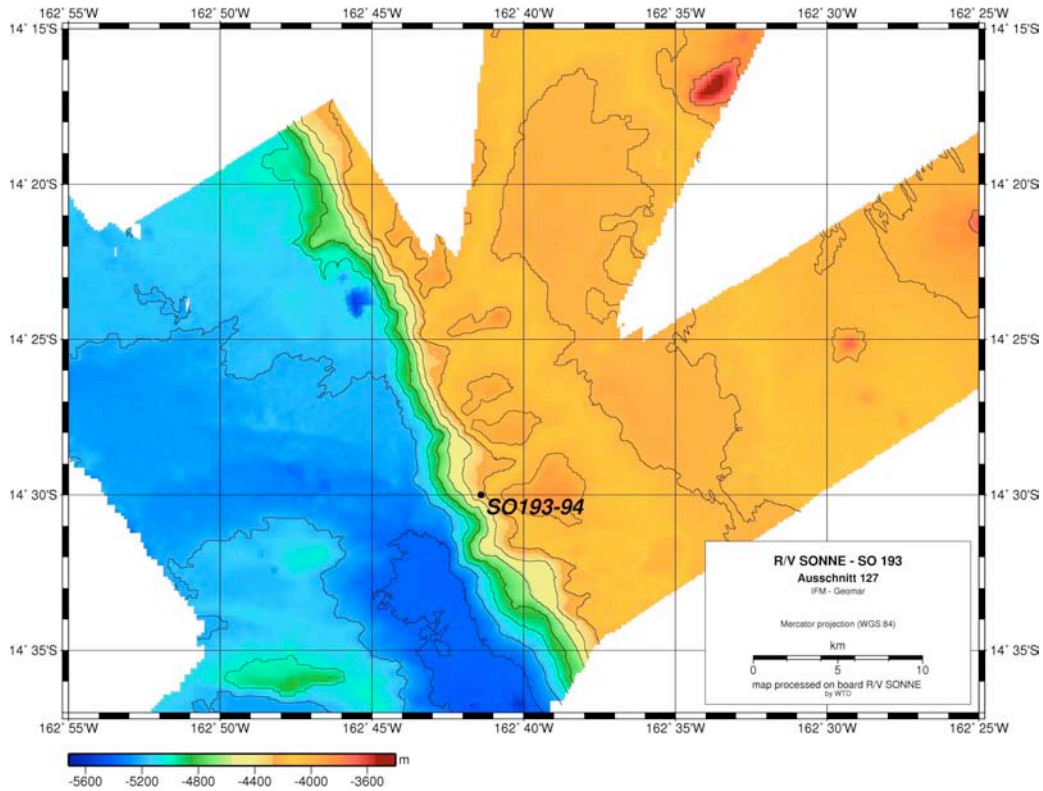


Fig. 5.31.: SO193 and KIWI 12 multi beam bathymetry of the southwestern margin of the southern „Apophysis“ of the High Plateau (including location of dredge site DR 97).

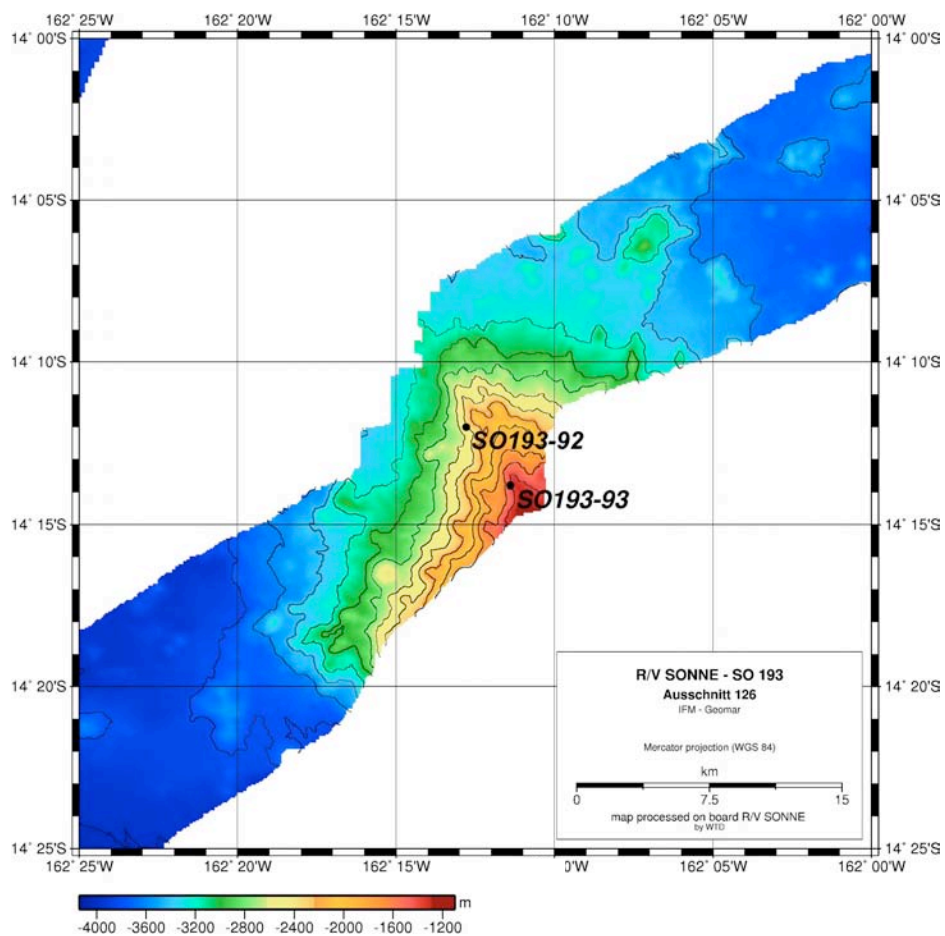


Fig. 5.32.: Dredge sites DR92 and 93 at the large seamount on the southern “Apophysis” of the High Plateau.

A large seamount is situated approximately in the center of the apophysis. This seamount has been sampled by SO193 en route to the Samoan Basin (Fig. 5.32.). It is slightly oval-shaped, approximately 30 km long, and rises from 3,600 m to less than 1,200 m b.s.l. DR 92 yielded only a few pieces of Mn-crusts from a ridge like extension from its northwestern flank at 2,400 m water depth. DR 93 has been carried out 2.5 nm southeast of DR 92 close to the top area of the seamount at 1,800 m water depth and was more successful. The dredge recovered highly vesicular, feldspar phyric pillow lava fragments with up to 10 mm long feldspar phenocrysts, a boulder of a volcanic breccia, and carbonates. Approximately 33 nm southwest of this seamount SO193 passed the southwestern margin of the “High Plateau apophysis” and attempted to sample plateau basement. However, DR 94 yielded exclusively lithified sediment, sedimentary breccias, and compacted clay-like material from this margin at 5,000 m water depth, suggesting that - similar to our observations along the northern margin of the plateau - the directly accessible margin consists primarily of thick sedimentary layers. Considering this result and time constraints, SO193 abandoned further sampling of this margin and headed towards the Samoan Basin.

5.2.8. Samoan Basin Seamounts (DR 96 - DR 99)

Three large seamounts are shown by predicted bathymetry on the abyssal plain of the central Samoan Basin south of the Danger Islands (Fig. 3.2.). These seamounts are roughly aligned in E-W directions and have been surveyed and sampled for the first time by SO193.

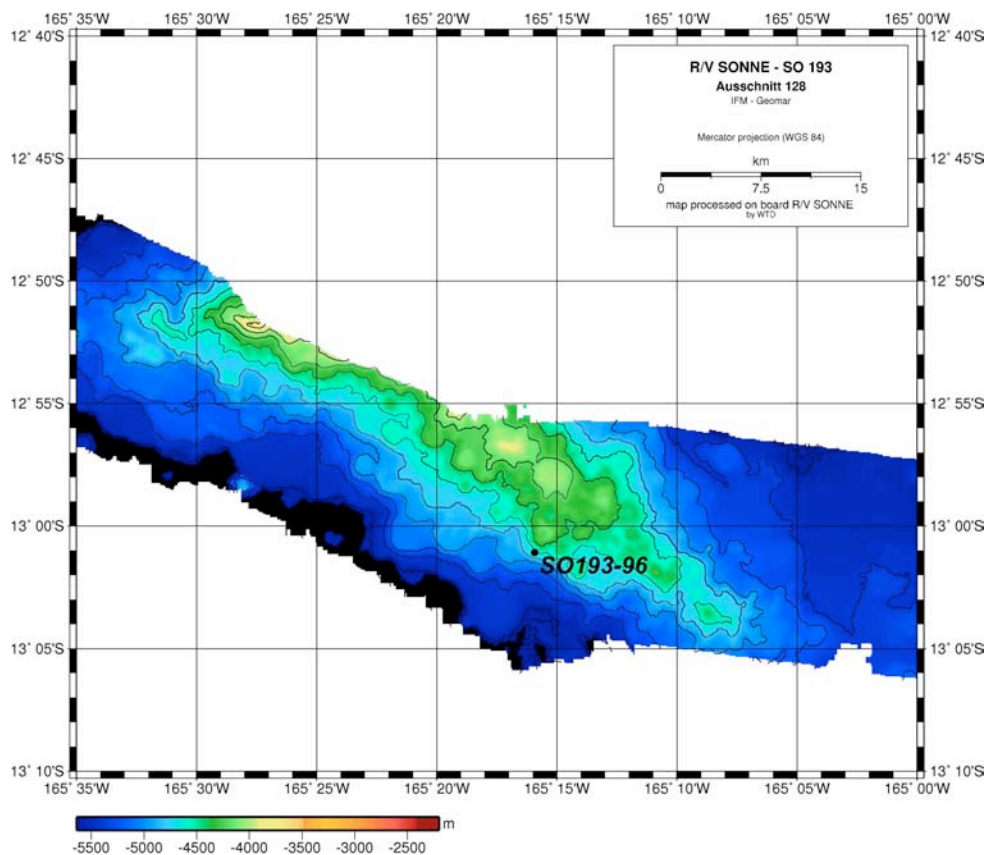


Fig. 5.33.: Dredge site DR 96 at a ridge-like seamount in the central Samoan Basin.

The easternmost of these seamounts proved to be a ~1,500 m high, ESE-WNW trending ridge which measures ~55 x 18 km at its base at ~5,500 m water depth (Fig. 5.33.). DR 96 was made on the southern flank of the ridge at ~5,000 m water and

yielded dense olivine-feldspar phyric lava fragments. Whereas most of these lava fragments contain only low amounts of phenocrysts (i.e. 1 -5%), a few lava boulders consists of 10 - 20% (altered) olivine. The high amounts of olivine may be due to accumulation during outflow of the lava. Apart from these lava, DR 96 recovered altered highly porphyric rocks (dolerite or gabbro?) with up to 40% feldspar and 5% olivine.

The central of the three seamounts is located 60 nm WNW of the ridge. Mapping with the SIMRAD EM120 multi beam system of SONNE revealed a cone-shaped seamount that rises from 5,400 m to 600 m b.s.l., and thus is about 2,000 m shallower than the predicted bathymetry (Fig. 5.34.). Its roughly circular base measures some 30 km in diameter. DR 97, carried out on the southeastern flank of this seamount, was empty. DR 98 sampled two freshly broken, almost aphyric pillow lava fragments, a strongly altered vesicular lava fragment and one piece of a volcanic breccia.

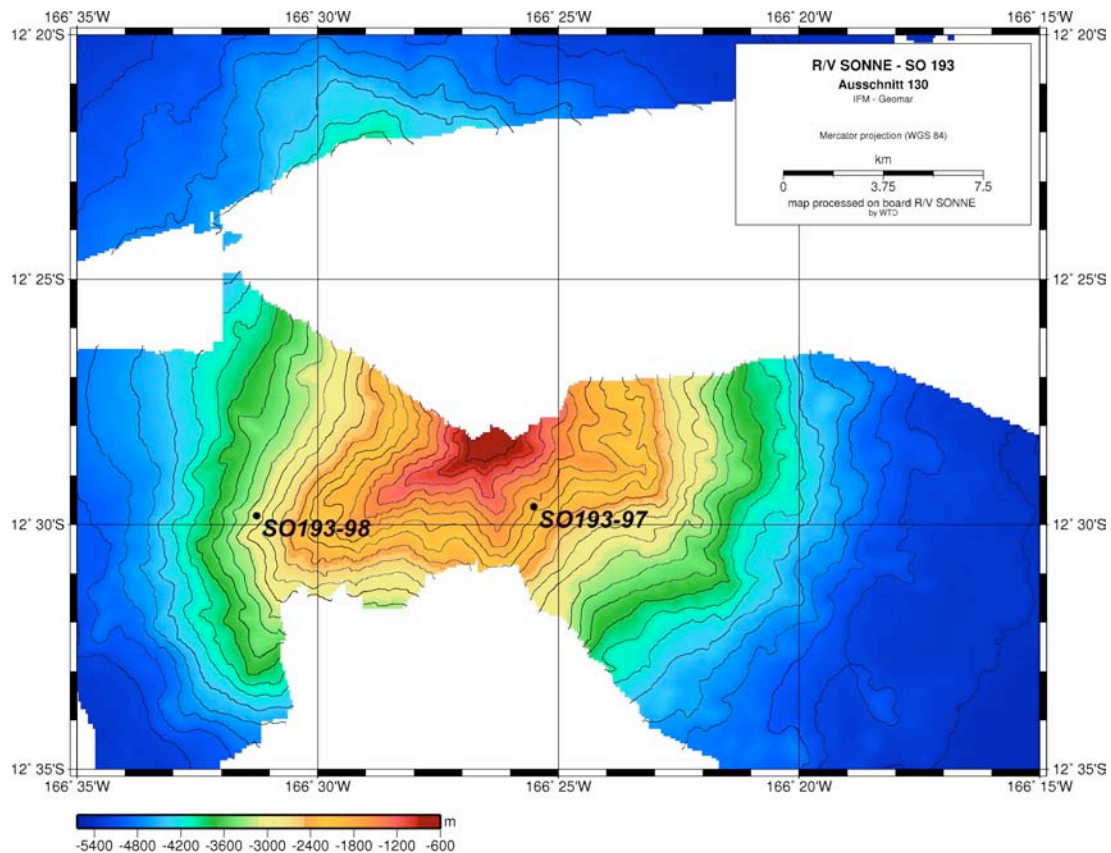


Fig. 5.34.: Dredge sites DR 97 and 98 at the central seamount in the Samoan Basin.

Fifty-five nautical miles farther west, the last seamount surveyed by SO193 is a slightly oval-shaped volcano, 30 x 25 km at its base and elongated in SSE-NNW direction. It rises from abyssal plain depths at ~5,600 m to a flattened (but not plateau-like) top at ~3,000 m b.s.l. (Fig. 5.35.). Several small, up to ~300 m high volcanic cones are constructed all over the seamount and close to its base. DR 99 only returned several pieces of Mn-encrusted sediment and Mn crusts from the southern flank of the seamount at 4,600 m water depth.

Since none of the seamounts south of the Manihiki Plateau that SO193 surveyed has an erosional plateau at its summit, these volcanoes probably never grew above sea level. Considering the large total subsidence on and around the Manihiki Plateau documented by our earlier observations as well as by previous workers (see chapter 3.2.), these seamounts must be significantly younger than the nearby plateau.

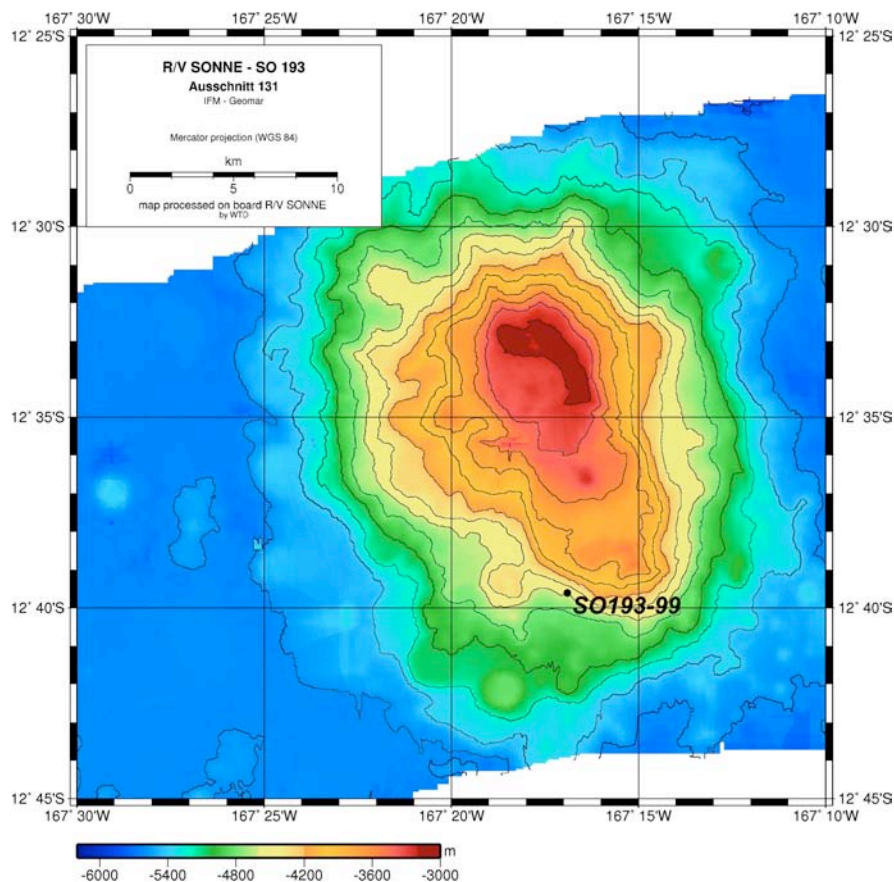


Fig. 5.35.: Dredge site DR 99 at the western seamount in the Samoan Basin.

5.2.9. Bathymetry and Hard Rock Sampling Summary

R/V SONNE cruise SO193 has achieved its major goals, i.e. bathymetric mapping of key areas in the Manihiki Plateau region, and representative hard rock sampling of all major geomorphological units of the plateau as well as of seamounts on adjacent oceanic crust. Igneous and sedimentary section sampling of the Manihiki Plateau probably represents one of most detailed marine sampling of an oceanic Large Igneous Province to date. Complementing 4,671 nm of Simrad EM120 multi beam mapping of the ocean floor and Parasound sub-bottom profiling, a total of 82 dredges, two TV grabs, and two OFOS profiles were carried out during SO193 for mapping and hard rock sampling. Of these deployments, 77 (or 91,6%) recovered magmatic or sedimentary rock.

SO193 recovered a broad variety of magmatic rocks from the Manihiki Plateau and adjacent features. Olivine bearing sheet and pillow lavas dominate among these rocks, but various types of volcanoclastic rocks are also common, some of them indicate subaerial or shallow water volcanic activity and/or deposition (see chapter 5.3.). Minor lithologies include, among others, picrites, serpentinites, evolved lavas (e.g., trachytes?), and coarse-grained magmatic rocks representing most likely subvolcanic intrusiva. The overall degree of alteration of these rocks varies from strongly altered to surprisingly fresh. Although alteration is a well-known problem by (chemical) analyses and dating of magmatic rocks which have been for some 10 Mill. years in a submarine environment, we are confident that SO193 yielded a comprehensive set of samples being suitable for shore-based analyses including methods like Sr-Nd-Pb-Hf isotope and noble gas analyses and single crystal Ar/Ar dating.

The Manihiki Plateau is characterized by several faults systems and scarps (e.g., Danger Island Troughs, Suvorov Trough, Manihiki Scarp and many other, smaller features, see chapter 6.). By contrast to most other oceanic Large Igneous Provinces, these features could grant access to the different units of the Manihiki Plateau basement. Multi beam mapping, dredging, and the two OFOS profiles carried out during SO193 revealed that the fault systems and scarps of Manihiki Plateau are indeed predestinated for stratigraphically controlled sampling of the plateau basement. The almost continuous outcropping of in-situ magmatic rocks across the steep slopes and scarps as shown by the OFOS profiles (e.g., Figs. 5.9. and 5.30.) makes it possible to sample systematically the magmatic succession of the plateau basement using, for example, a remote operate vehicle (ROV) and/or manned submercible. Only this approach can provide the necessary informations and samples to adress, for example, important questions such as the temporal evolution of LIP basement (i.e., formation within a few million years or much longer time intervals) or the compositional homogeneity versus heterogeneity of oceanic LIP basement.

Although the major results of SO193 MANIHIKI are still to be obtained by detailed on-shore analyses of data and samples within the next 2 years, some preliminary conclusions can be drawn right after the cruise (see also chapters 5.3. and 6.). Some of them are summarized in the following paragraphs.

The Manihiki Plateau differs in several ways from the Hikurangi Plateau; the supposed counterpart off the coast of New Zealand (e.g., Billen und Stock 2000, Hoernle et al. 2004b). The interior of the Hikurangi Plateau is characterized by large guyots. The depth of their basis and erosional platforms of the Hikurangi guyots imply similar ages of these volcanoes and uniform subsidence and tilting of the entire plateau basement (e.g., Hoernle et al. 2004b). By contrast, SO193 revealed guyots only in restricted areas of the Manihiki Plateau, namely on the Western Plateaus, in the northeastern part of the High Plateau, and on the abyssal plain of the Central Pacific Basin north of the Manihiki Plateau. On the other hand, seamounts without any visible erosional platform are common at various places on and close to the Manihiki Plateau, whereas on Hikurangi those seamounts mainly occur a ridges extending parallel to the Rapuhia Scarp. By contrast to Hikurangi, the present depths of the erosional plateaus of the Manihiki guyots imply relatively non-uniform ages of the volcanoes or subsidence rates. The guyots surveyed on the Western Plateaus drowned since erosion by about 1,800 and 2,500 m, respectively, those on the northeastern High Plateau by ~1,600 - 1,700 m, and the adjacent guyots in the Central Pacific Basin by ~2,000 m. Notably, a seamount on the southern "apophysis" of the High Plateau rises <1,200 m b.s.l. but does not show any clear evidence for erosion. Taken together, the Manihiki Plateau must have undergone a complex subsidence history and/or volcanism must have occurred over a long time period or during several phases at different places. However, a late stage of activity after erosion and subsidence of the Manihiki guyots - a common feature of the Hikurangi guyots - only occured at one of the guyots in the Central Pacific Basin. Interestingly SO193 mapping revealed that the seamounts in the Samoan Basin south of the Manihiki Plateau must be significantly younger than the nearby plateau. However, it is not clear yet if and how these volcanoes are related to the Manihiki volcanism.

One target of SO193 was to evaluate the nature of the southern margin of the Manihiki Plateau. The major question to be addressed was if the southern margin shows features of a rifted margin and if this margin could be the counterpart of the northern margin of the Hikurangi Plateau (Rapuhia Scarp) where SO168 revealed a rifted margin (Fig. 3.1.). The Manihiki Plateau's southern margin has been surveyed by SO193 in its southwestern, central, and southeastern part. The mapping proved

that the southern margin of the Manihiki Plateau forms relatively gentle slopes in the southwest, whereas in the other areas steep “steps” and relatively plain areas appear to alternate. The few dredge attempts carried out in these areas suggest that the directly accessible margin consists primarily of thick sedimentary layers. In summary, the southern margin of the Manihiki plateau differs morphologically from the Rapuhia Scarp and does not show distinct features of an rifted margin.

By contrast to the southern margin, the ocean floor at the Manihiki Scarp descends abruptly from ca. 2,500 - 3,800 to abyssal plain depths. The complex morphology of this scarp includes steep steps, tectonically tilted units, volcanic ridges, troughs, and individual seamounts. The “elevated plateau rim”, a linear, relatively flat-topped ridge-like structure, stretches for more than 400 km along the upper part of the scarp along the edge of the High Plateau. It is 500 - 600 m higher than the adjacent High Plateau. SO193 revealed that this structure is at least partially volcanic in origin and that pillow lavas dominate even in the top region of the “elevated plateau rim”, i.e. this ridge has been formed in a subaqueous environment. Provided that the High Plateau has been formed in subaerial or in shallow water conditions as suggested by previous studies (see chapter 3.2.), the ridge must be significantly younger than the High Plateau. If the Manihiki Scarp resulted from a rifting event, it is likely that the volcanic activity at the “elevated plateau rim” was related to (the onset) of this rifting. Assuming that this scenario is correct, rifting at the Manihiki Scarp started after significant subsidence of the High Plateau (> 600 m), i.e. a long time period after formation of the plateau.

An unexpected result of SO193 was the predominance of solidified, indurated or lithified sediments in some areas of the Manihiki Plateau, namely the Suvorov Trough, the North Plateau, the NE corner of the High Plateau, and at the southern margin. In these areas, at least the upper directly accessible portions of the dredged features appear to be mainly made up of thick sediment and sedimentary rock layers. The origin and age of these sediments is unclear at this stage, but their partially strong solidification may suggest secondary heating and/or intense tectonic movements. Interestingly, such lithified or strongly compacted sediments are not reported from the sediment sequence drilled at DSDP Site 317. However, Site 317 is located in the central area of the High Plateau which, by contrast to most portions of the Manihiki Plateau, shows a smooth basement structure (Winterer et al. 1974) and no evidence for volcanic activity after the formation of the basement.

Taken together, the preliminary results of mapping and sampling of the Manihiki Plateau suggest a complex geodynamic history for (most portions of) the plateau, including intense tectonic movements and several phases of volcanic activity. Shore-based analyses of rocks and data yielded on SO193 will contribute to a better understanding of these processes and to the relationship of the Manihiki Plateau to the other oceanic LIPs in the Southwest Pacific.

5.3. VOLCANICLASTIC ROCKS (C.I. Schipper)

During the R/V SONNE SO193 cruise, May-June 2007, clastic rocks were successfully recovered from many locations on the Manihiki Plateau. The dredge and TV-grab sampling techniques often obtained samples that were loose on the ocean floor; in the form of rounded cobbles or nodules entirely coated in the ferromanganese crusts that are ubiquitous on deep submarine rocks. According to strict definitions, these are in fact sediments, having experienced histories of weathering, erosion, transportation, and storage that are largely unrelated to the *original* processes (sedimentary or volcanic) by which their constituent clasts came to coexist. We herein focus on the internal textures of these rocks, in an attempt to discern their *original* processes of formation.

Texturally-inferred mechanisms of clast fragmentation, transport, and deposition are used to define four main classes of clastic rocks dredged from the Manihiki Plateau. These classes are: volcanogenic sedimentary rocks; redeposited volcanoclastic rocks; and two general categories of primary volcanoclastic rocks- brecciated and pyroclastic.

The volcanogenic sedimentary rocks are distinguished from volcanoclastic rocks in that they were formed exclusively by sedimentary processes. These are sometimes considered volcanoclastic, since their constituent clasts have a volcanic heritage; however, the constituent clasts in these rocks have been texturally modified (e.g. rounded) by erosion or reworking (McPhie 1995). Polymict clast assemblages are common, and the populations are distinguished by different degrees of weathering, as well as original rock type. At the Manihiki Plateau, these volcanogenic sedimentary rocks are typically volcanogenic conglomerates (Fig. 5.36.), or volcanogenic sandstones, depending on their grain size. The volcanogenic conglomerate shown in figure 5.36., dredged from a seamount on the western margin of the Western Plateaus (location DR 3), has a texturally polymict clast assemblage characteristic of volcanogenic sedimentary rocks.

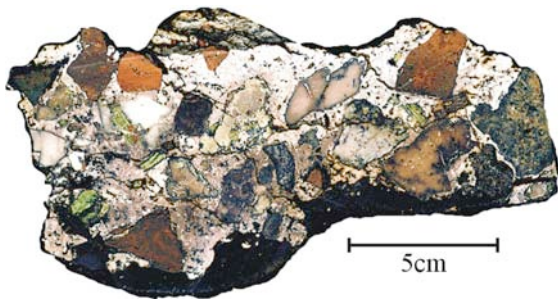


Fig. 5.36.: Volcanogenic sedimentary rock.

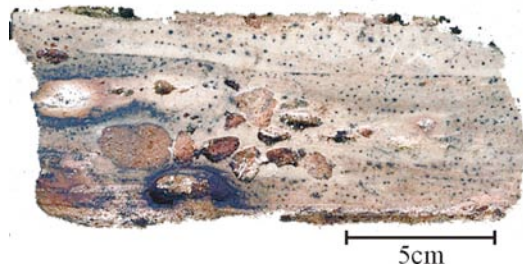


Fig. 5.37.: Redeposited volcanoclastic rock.

Redeposited volcanoclastic rocks are formed by processes intermediate to the volcanogenic sedimentary and primary volcanoclastic rocks. They are distinct from the volcanogenic sedimentary rocks in that their components have not experienced a significant amount of post-eruptive modification during transport and deposition, so that original clast morphologies are still apparent, and they are often monomict. They cannot, however, be considered primary volcanoclastic rocks, since their constituents have been transported and deposited by sedimentary processes- not directly by explosive or effusive eruptions (White and Houghton 2006). Redeposited volcanoclastic rocks are especially common at seamounts, where freshly erupted volcanic material is subject to re-distribution by ocean currents, or gravitational collapse (McPhie 1995). An example is the “redeposited lapilli-tuff” shown in figure 5.37., dredged from a seamount on the northern High Plateau (location DR 63). The rock is monomict vesicular volcanic ash-lapilli. The lapilli are concentrated in coarse lenses ~5cm long, with cross-bedded and rippled lenses of finer volcanic ash and pelagic sediment. Although the volcanic-derived clasts appear to be co-magmatic, with minor post-eruptive textural modification, the lenticular structures and cross-bedding indicate deposition by a moving fluid- the obvious candidate in this case being ocean currents.

There were several varieties of primary volcanoclastic rocks dredged from the Manihiki Plateau. These include all clastic rocks that were deposited directly by volcanic eruptions (White and Houghton 2006). In describing the primary volcanoclastic rocks we distinguish between two groups: 1) brecciated- where clasts have formed by fragmentation of effusive lava (flows and/or pillows), and 2) pyroclastic- where clasts have formed during explosive fragmentation.

Several mechanisms can fragment effusive lava, resulting in a variety of brecciated primary volcanoclastic rocks. Hyaloclastic fragmentation, for example, occurs when lava is chilled in contact with water, inducing cooling-contraction granulation (Kokelaar 1986) - a non-depth-limited mechanism for enhanced fragmentation in the submarine setting. Autoclastic fragmentation occurs by a similar mechanism, but when the surface of a lava flow cools in contact with air (White and Houghton 2006).

The term “hyaloclastic” has been used to describe many occurrences of submarine, volcanic glass-dominated deposits (Batiza et al. 1989, Fisher and Schmincke 1984). In describing primary volcanoclastic rocks of the Manihiki Plateau, we use the term “hyaloclastic” in its broadest definition, as any fragmental material formed when extruding magma or lava is rapidly quenched and fragmented by contact with water (Batiza and White 2000). Several types of hyaloclastites were dredged from the Manihiki Plateau, including sheet hyaloclastites, pillow breccias, and in-situ hyaloclastites.



Fig. 5.38.: Hyaloclastic (sheet).

Sheet hyaloclastites are formed by cooling-contraction granulation (Kokelaar 1986) of thin, fluid, submarine lava flows, when the fragmental material is deposited immediately adjacent to the advancing lava (Batiza and White 2000, Maicher et al. 2000). Sheet hyaloclastites are usually monomict, composed entirely of quenched, glassy material (prior to alteration/ replacement). Only a few examples of this volcanoclastic rock type were dredged from the Manihiki Plateau. One example, from the intersection of the Danger Island and Suvorov Troughs (location DR 20), is shown in figure 5.38. The sheet hyaloclastite is the grey, monomict assemblage of angular, (now altered) glass shards. In this particular sample, the sheet hyaloclastite is overlain by light brown, redeposited volcanoclastic material.

Other hyaloclastic rocks include breccias, which may be found in-situ, or in granular flows emplaced in response to continuing effusive eruption (White and Houghton 2006). This category of primary volcanoclastic rocks includes “pillow breccias” that are very common in most submarine volcanic regions (Furnes and Fridleifsson 1979). An example of lithified, hyaloclastite breccia from a seamount on the Northeast Rift of the Manihiki Plateau (location DR 55), is shown in figure 5.39. Fragments display cusped shapes typical of cooling-contraction-granulation (Kokelaar 1986) during hyaloclastic fragmentation, and are monomict, with occasional jigsaw-fit indicating limited post-fragmentation transportation. Alteration rims on all the fragments within the rock are equal in thickness, and on all sides, except for in the smallest shards, which are completely altered. This indicates that the original flow was fragmented syn-eruptively, and not during subsequent mechanical weathering.

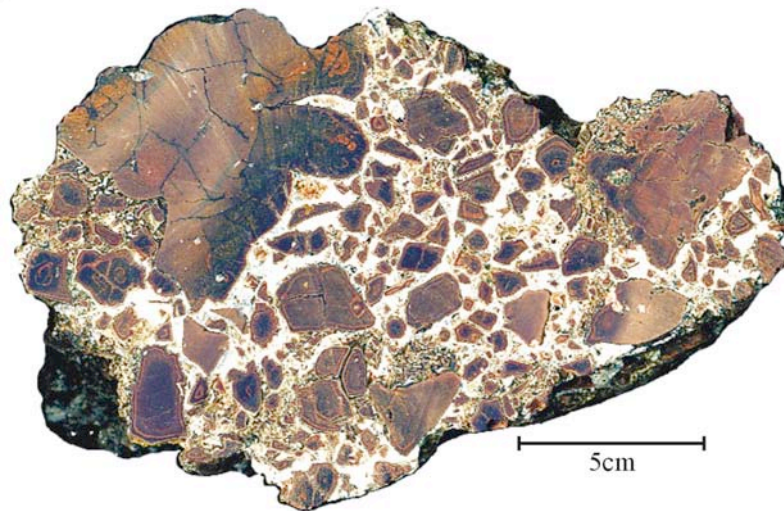


Fig. 5.39.: Hyaloclastic (breccia).

Autoclastic fragmentation often occurs in-situ, at cooling lava flow fronts, producing characteristically monomict, jigsaw-fit, primary volcanoclastic rocks (McPhie 1995). An example of a possibly autoclastic rock, dredged from a seamount on the Western Plateau (location DR 5), is given in figure 5.40. It is often difficult to texturally distinguish between in-situ autoclastic and in-situ hyaloclastic rocks, and the interpretive selection of one fragmentation mechanism over the other is often assisted by information about the regional volcanic setting. There is evidence for both subaerial and submarine volcanism on the Manihiki Plateau, so it is difficult here to make the distinction. The sample shown in figure 5.40. is interpreted to be autoclastic, since it lacks the platy or cusped shards that are often- but not always- the result of hyaloclastic cooling contraction granulation (Kokelaar 1986).

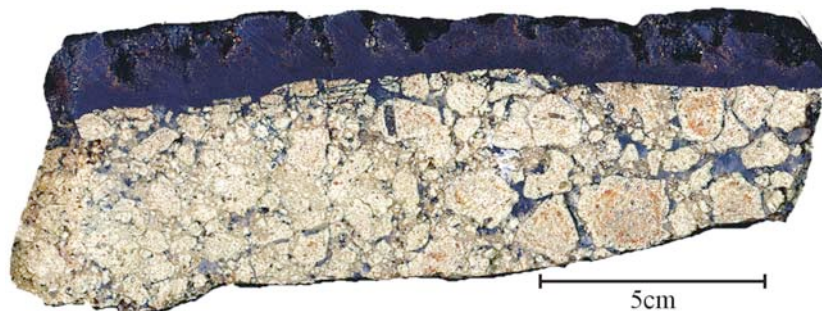


Fig. 5.40.: Autoclastic (in-situ).

The most common primary volcanoclastic rocks dredged from the Manihiki Plateau were pyroclastic- formed as the particles first came to rest from explosive volcanic eruptions (White and Houghton 2006). The primary volcanoclastic tuffs and lapilli-tuffs are composed primarily of highly- and finely- vesicular, juvenile pumiceous or scoriaceous material, altered to a yellowish color. Individual Manihiki Plateau pyroclastic rocks are distinguished by varying grain size, componentry, and degree of induration/lithification. Two examples are given in figure 5.41. Figure 5.41-A, from the middle section of the Danger Island Troughs (location DR 32) shows a moderately fine grained, moderately well-sorted, lithified, lithic-poor, tuff. Post-depositional compaction and lithification have obscured most of the original pyroclast vesicularity and margins in this sample. Figure 5.41-B shows a much coarser grained, poorly sorted, lithic-rich, indurated, lapilli tuff from the northern Danger Island Troughs (location DR 37). Most of the scoriaceous lapilli still show their original vesicularity,

and the main lithic component is altered, angular basalt. These two samples have essentially the same componentry, and were formed by the same process—deposition directly from shallow or emergent explosive volcanic eruptions in which juvenile scoria, along with lithic components entrained from country rock or sediment were deposited together (Beiersdorf et al. 1995, McPhie 1995, White and Houghton 2006). The two samples shown have the same components. They differ only in grain size, sorting, and proportion of lithics. Lapilli-tuffs with the same basic characteristics as the examples given here were the most common volcanoclastic rocks dredged from the Manihiki Plateau, particularly from the High Plateau, where they were often recovered as large $\sim 1 \text{ m}^3$ blocks of indurated or lithified material.

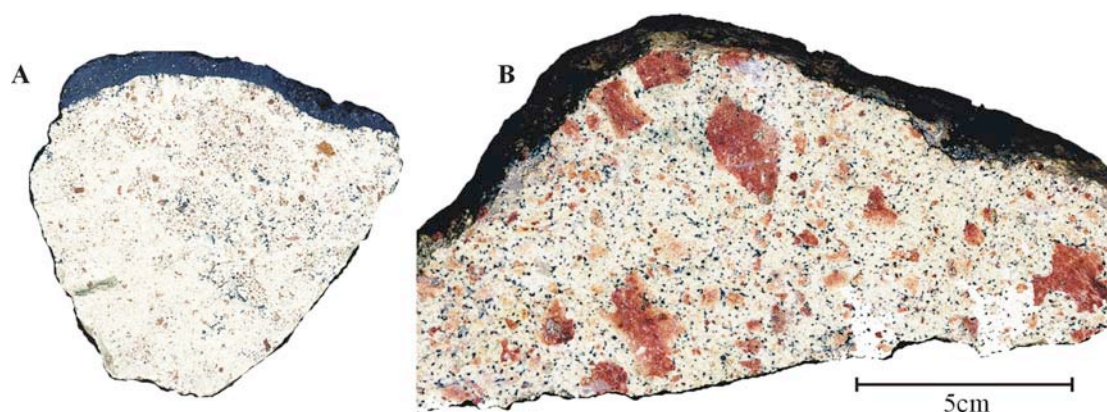


Fig. 5.40.: Pyroclastic (**A:** Tuff; **B:** Lithic rich lapilli-tuff)

The different clastic rock types all appear to be widely dispersed on the Manihiki Plateau; however, a few trends are evident. Pyroclastic tuffs and lapilli-tuffs were the most common and most voluminous primary volcanoclastic rocks found. They were found in most locations. Redeposited volcanoclastics were also found in most areas, but in smaller volumes. Volcanogenic conglomerates and sandstones were mostly found within, and to the west of the Danger Islands/ Suvorov Trough systems— the Suvorov Trough being the only area where pyroclastic material was not recovered. To the east, on the High Plateau, primary hyaloclastic and pyroclastic rocks dominate, with few good examples of volcanogenic sedimentary rocks found in any of the dredges.

The prevalence of pyroclastic (lapilli-tuff) rocks on the High Plateau was previously established in earlier expeditions to the Manihiki Plateau, including the Deep Sea Drilling Project Site 317 (Schlanger et al. 1976) and previous dredging programs (Beiersdorf et al. 1995). Our findings concur with these previous studies; suggesting that the later phases of volcanism on the Manihiki Plateau— especially on the High Plateau in the east— was dominated by explosive, subaerial or shallow submarine activity (Beiersdorf et al. 1995). In-situ hyaloclastic rocks, including pillow breccias were also relatively common in our dredges, but not as extensive as would be expected if the entire Manihiki Plateau had been erupted below sea level. It is likely that there are extensive hyaloclastites preserved in the stratigraphy of the Manihiki Plateau, but especially in the High Plateau ; these have likely been buried by the products of successive pyroclastic deposits.

We are pleased with the diversity and volume of volcanogenic and volcanoclastic rocks recovered from the Manihiki Plateau during the R/V SONNE cruise SO193. The descriptions in this section are but a brief and generalized overview of the rocks that were found. We look forward to post-cruise detailed studies of the samples, and hope that these studies will contribute to a greater understanding of the evolution of the Manihiki Plateau.

6. TECTONICS

(*M.F. Coffin*)

6.1. BACKGROUND

The first focused investigations of the Manihiki Plateau in the 1960s and 1970s addressed its overall morphology, structure, stratigraphy, and age (Heezen et al. 1966, Winterer et al. 1974, Schlanger et al. 1976). Deep ocean basins bound the Early Cretaceous feature (Schlanger et al. 1976) on all sides; the Penrhyn Basin lies to the east, the Samoan Basin to the south, the north Tokelau Basin to the west, and the Central Pacific Basin to the north (Figs. 6.1, 6.2, 6.3.). The Manihiki Plateau consists of three major and distinct morphologic provinces: the High Plateau (east of $\sim 163^{\circ}30'W$), the Western Plateaus (west of $\sim 163^{\circ}30'W$), and the North Plateau (north of $\sim 6^{\circ}15'S$) (Winterer et al. 1974). The High Plateau is the shallowest and flattest portion of the Manihiki Plateau; a thick sedimentary section obscures its basement relief. The North Plateau is dominated by a large central portion shallower than 3,000 m and characterized by rough basement topography. The Western Plateaus lie $\sim 1,000$ m deeper than the High Plateau and North Plateau, and its variable basement relief encompasses seamounts, ridges, troughs, and plateaus. An en echelon, north-south trending series of deep basins, the Danger Islands Troughs within the Western Plateaus, bisects the Manihiki Plateau. A broad basin, herein called the High-North Basin, separates the High Plateau and the North Plateau, and an unnamed trough separates the Western Plateaus and North Plateau. Furthermore, the NW-SE-trending Suvorov Trough, until now considered to be a branch of the Danger Islands Troughs (Winterer et al. 1974) affects the southeastern corner of the Western Plateaus. Approximately one kilometer or more of sediment and sedimentary rock blankets the High Plateau, and, until now, apparently thinner sedimentary sections have been considered to cover the Western Plateaus and North Plateau. Deep Sea Drilling Project (DSDP) Site 317 on the High Plateau (Fig. 6.3.) is the sole drill site on the entire Manihiki Plateau; the shipboard scientific party recovered Quaternary to Middle Eocene foram-nannofossil ooze, chalk and cherty chalk (0 - 425 m); inferred the presence of Paleocene sediment (425 - 554 m); recovered Maastrichtian to Barremian or Aptian foram-nannofossil chalk, cherty limestone, and claystone (554 - 647 m); recovered volcanic sandstone and siltstone of Barremian or Aptian age to 670 m, and unfossiliferous sediment below (647 - 910 m); and penetrated vesicular basalt flows (910 - 944 m) interpreted to represent plateau basement (Schlanger et al. 1976).

Between 1972 and 1998, no marine geological and geophysical data were acquired from the Manihiki Plateau basement, or at least none have been reported in the literature. Over the last decade, however, limited seismic, mapping, and dredging work on the Plateau has yielded new information about its development. The first published radiometric age data ($^{40}Ar/^{39}Ar$) from the Plateau indicate at least two episodes of volcanism, one at 117 ± 3.5 Ma and another at 99.5 ± 0.7 Ma (Ingle et al. 2007). The older age overlaps with the results of unpublished radiometric age data of R. Duncan from DSDP Site 317 basalts that yielded an age of 123 ± 3 Ma (reported in Mahoney et al. 1993), and is consistent with an Aptian microfossil assemblage in sediment near basement at DSDP Site 317 (Bukry 1976). Unusual geochemistry of some of the dredged basalt may have originated from extensive melting of depleted mantle wedge material mixed with small amounts of volcanoclastic sediment (Ingle et al. 2007). The seismic stratigraphy of the High Plateau suggests that significant portions of it formed above sea level and remained there, shedding volcanogenic

sediment into both intra-High Plateau and surrounding lows, until erosion and subsidence resulted in the High Plateau being entirely below sea level by Late Cretaceous time (Ai et al. submitted).

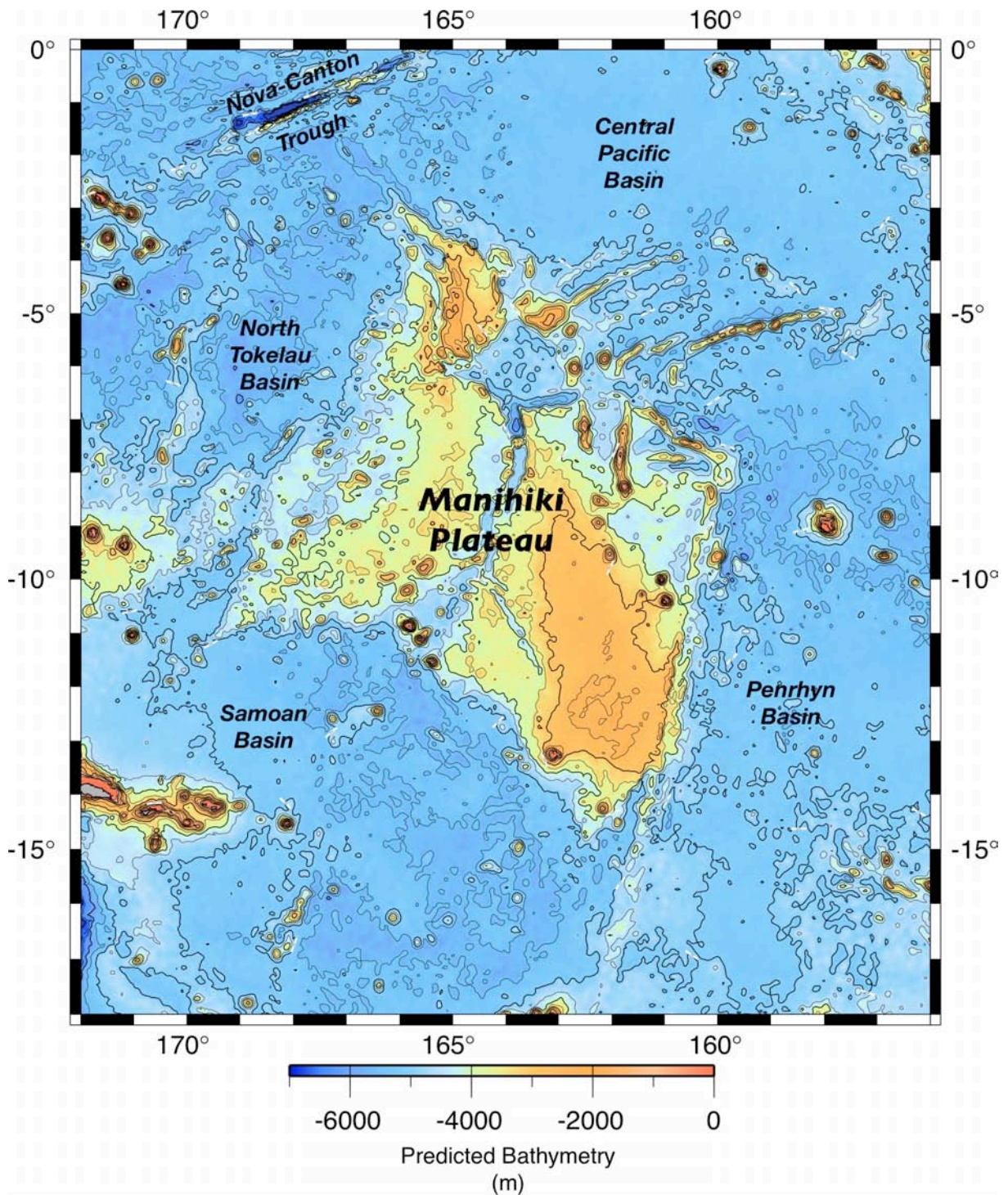


Fig. 6.1.: Predicted bathymetry of the Manihiki Plateau region (after Smith and Sandwell 1997).

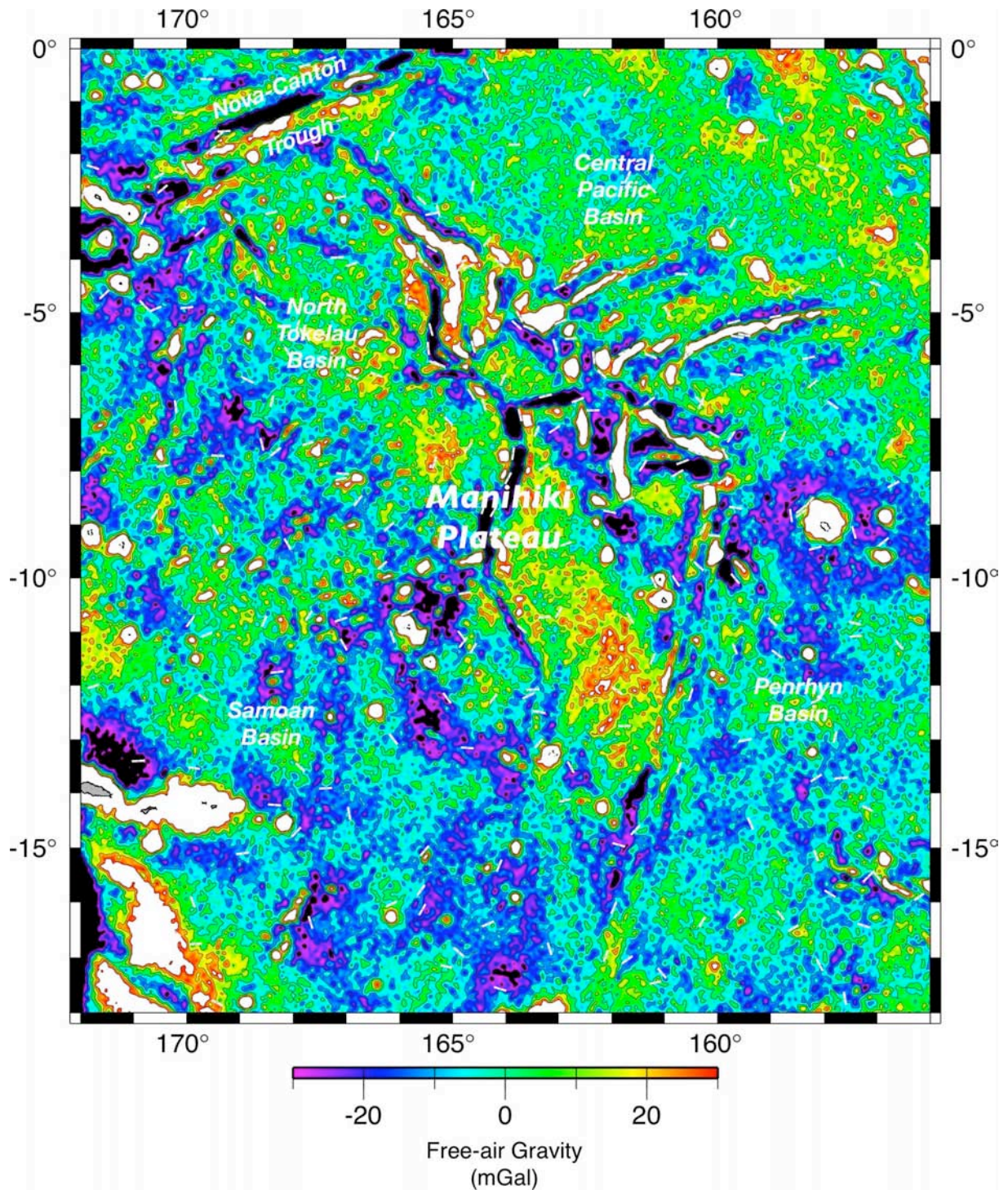


Fig. 6.2.: Satellite-derived, free-air gravity field of the Manihiki Plateau region (after Sandwell and Smith 1997).

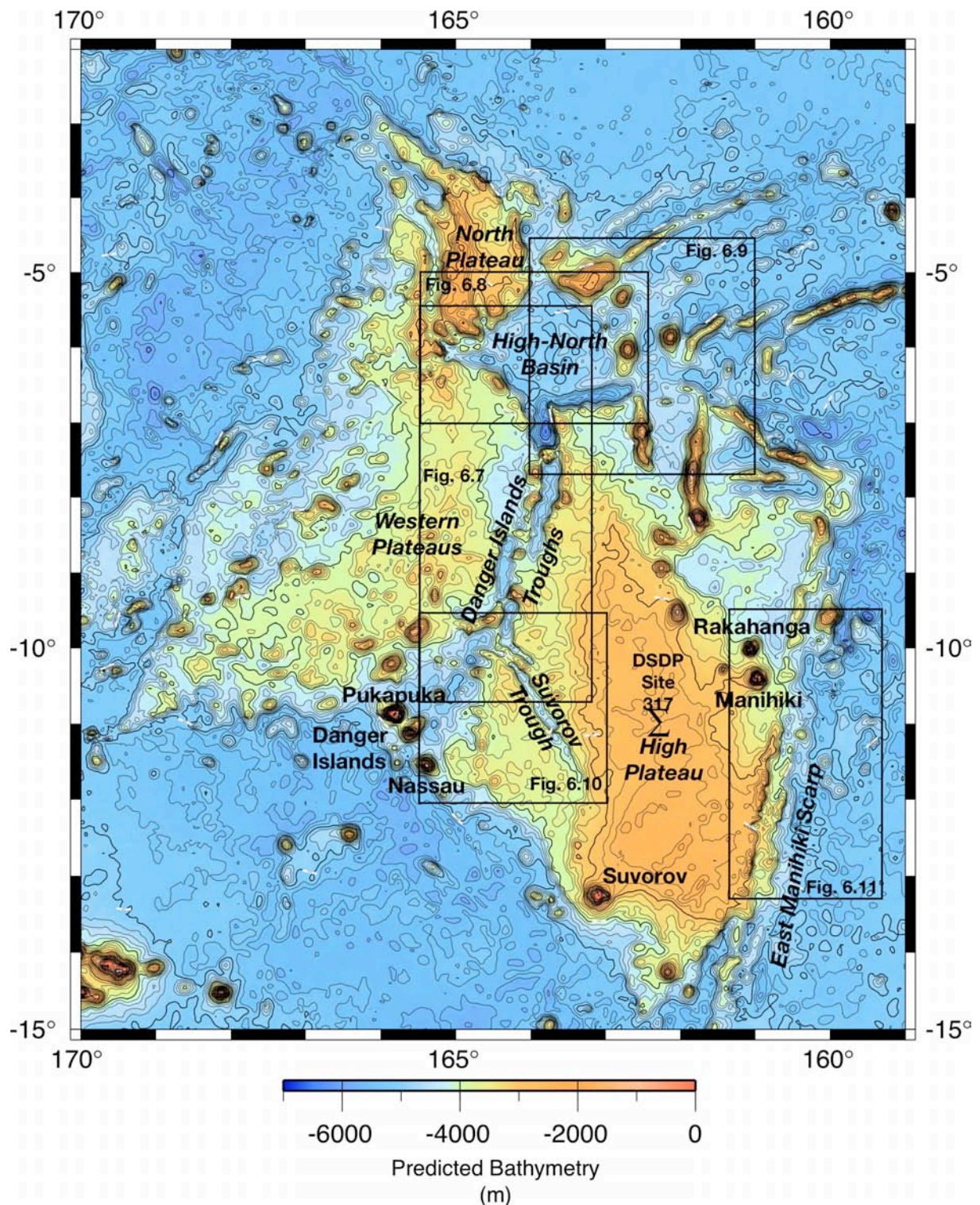


Fig. 6.3.: Predicted bathymetry of the Manihiki Plateau and surrounding seafloor (after Smith and Sandwell 1997). Boxes indicate locations of subsequent figures.

6.2. FORMATION OF THE MANIHIKI PLATEAU

6.2.1. Tectonic Framework

Mesozoic Pacific plate reconstructions are hampered by both the Cretaceous normal magnetic polarity superchron (CNS) and the relative dearth of extant Cretaceous and Jurassic oceanic crust. Nevertheless, at approximately the time of formation of the Manihiki Plateau, it is believed that a rift-rift-rift triple junction of the

Pacific, Farallon, and Antarctic plates was situated nearby (e.g., Winterer et al. 1974, Nakanishi and Winterer 1998, Sutherland and Hollis 2001; Larson et al. 2002; Viso et al. 2005) (Fig. 6.4.). Furthermore, the existence of an extinct seafloor spreading axis, the Osbourn Trough, approximately halfway between the Manihiki and Hikurangi plateaus together with other evidence suggest that the two features formed as one, and subsequently separated (Billen and Stock 2000, Downey et al. 2007) (Fig. 6.5.). Speculation that the Manihiki/Hikurangi and Ontong Java plateaus formed as one and separated shortly thereafter (Taylor 2006) remains controversial, especially in light of new Late Cretaceous radiometric age determinations of rocks along the Nova Canton Trough (Figs. 6.1., 6.2.) (Pyle and Mahoney 2006, D.G. Pyle pers. comm. 2006).

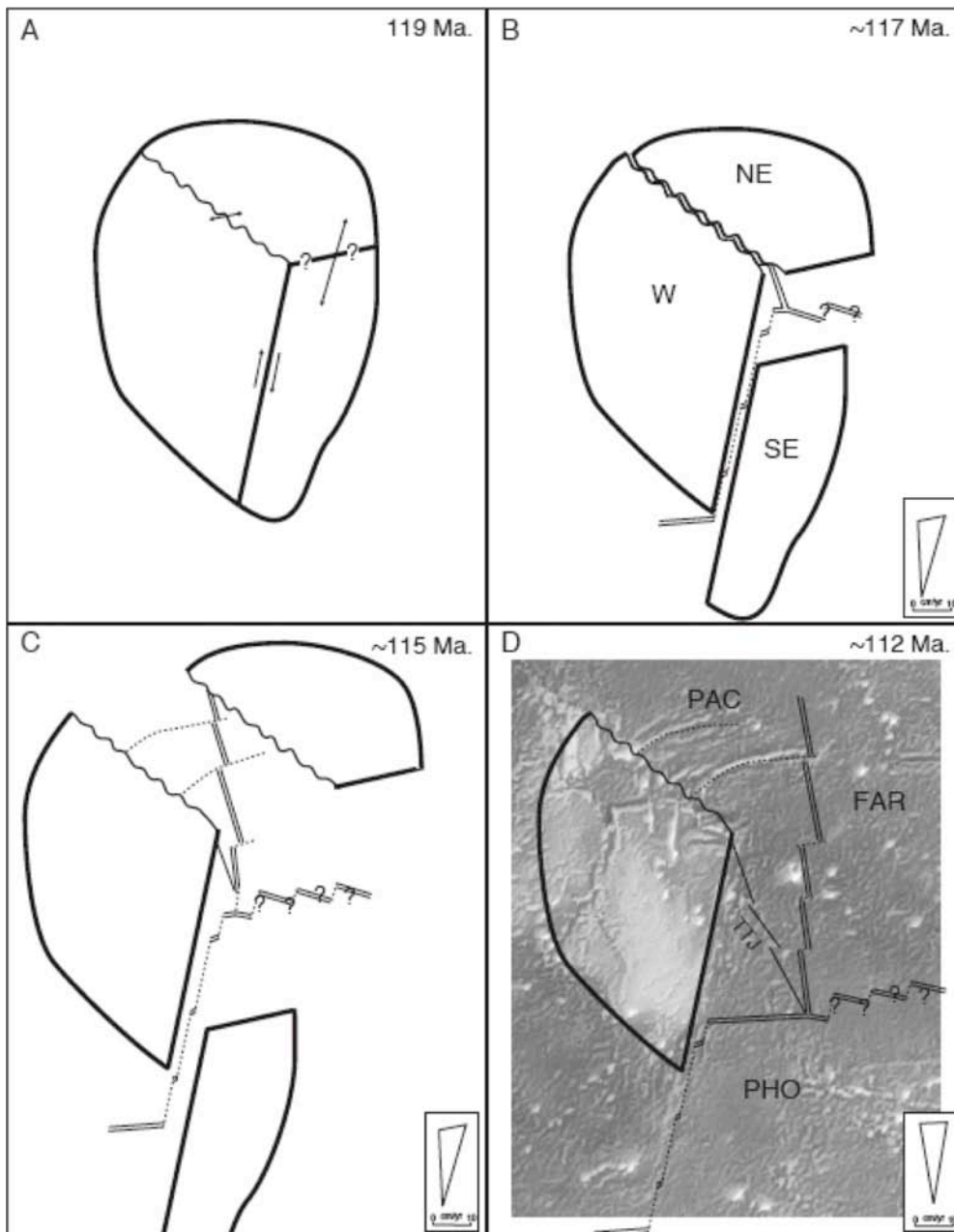


Fig. 6.4.: Plate tectonic model for the breakup of the Manihiki Plateau, formation of the Penrhyn Basin, and propagation of the Tongareva triple junction (TTJ) (Viso et al. 2005). Thick solid lines outline Plateau, thin solid double lines are spreading ridges, dashed lines show transform and higher order discontinuities, and thin solid single lines show the trace of the triple junction. PAC: Pacific plate; FAR: Farallon plate; PHO: Phoenix plate.

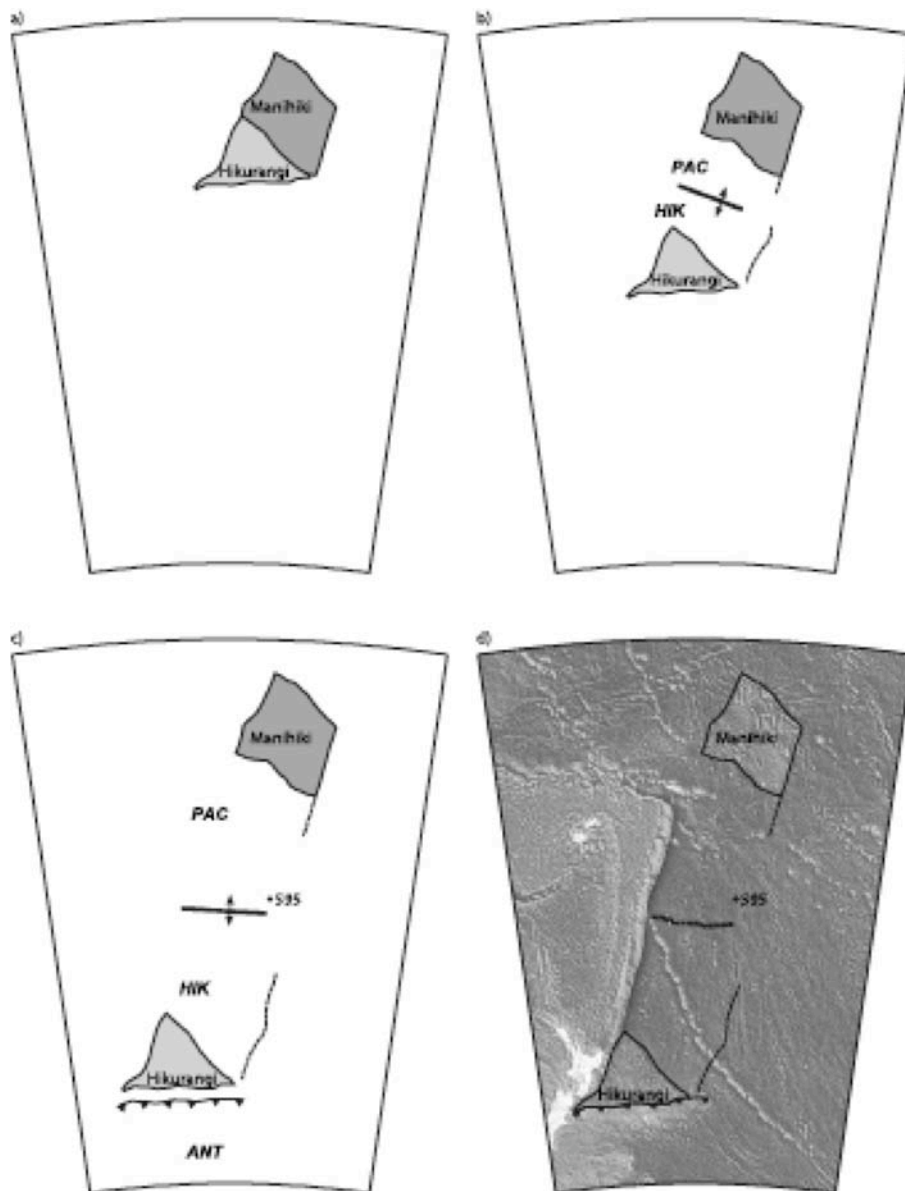


Fig. 6.5.: Tectonic scenario for the breakup and separation of the Manihiki and Hikurangi plateaus (Downey et al. 2007). Spreading directions determined by abyssal-hill strikes are shown as double-headed arrows and locations of the Southeast Manihiki and Western Wishbone Scarps are outlined with dashed lines. PAC: Pacific plate; HIK: Hikurangi plate; ANT: Antarctic sector of Gondwana.

6.2.2. Geodynamic Models

Two types of plume models have been invoked to account for formation of the Manihiki Plateau, a plume head hypothesis and a plume tail, at or near a spreading ridge crest, scenario (Mahoney and Spencer 1991). No currently active Pacific hotspots that plate reconstructions suggest could have been potential sources for the Manihiki Plateau, however, have the geochemical EM-I (enriched mantle type 1) signature of Manihiki rocks. Therefore, either the currently active hotspots were not involved in the formation of the Manihiki Plateau, or if they were, the EM-1 source was volumetrically much more important early in their existence.

The most recent Manihiki-specific geodynamic model of formation employs the plume head hypothesis (Larson 1997). In this scenario, two plumes southeast and northwest of the Pacific-Phoenix spreading ridge created the Manihiki and Ontong Java plateaus, respectively (Fig. 6.6.). The cessation of magmatism on the two

plateaus may have been caused by draining or depressurization of the two coalesced plume heads centered beneath the ridge, which reheated, uplifted, and faulted a broad region of lithosphere, resulting in formation of the Nova Canton Trough. The absence of Manihiki or Ontong Java mantle components in Nova Canton Trough rocks, however, argues against this geodynamic model (Pyle and Mahoney 2006). Alternatively, the Nova Canton Trough has been interpreted as a transform system (Joseph et al. 1992, Taylor 2006).

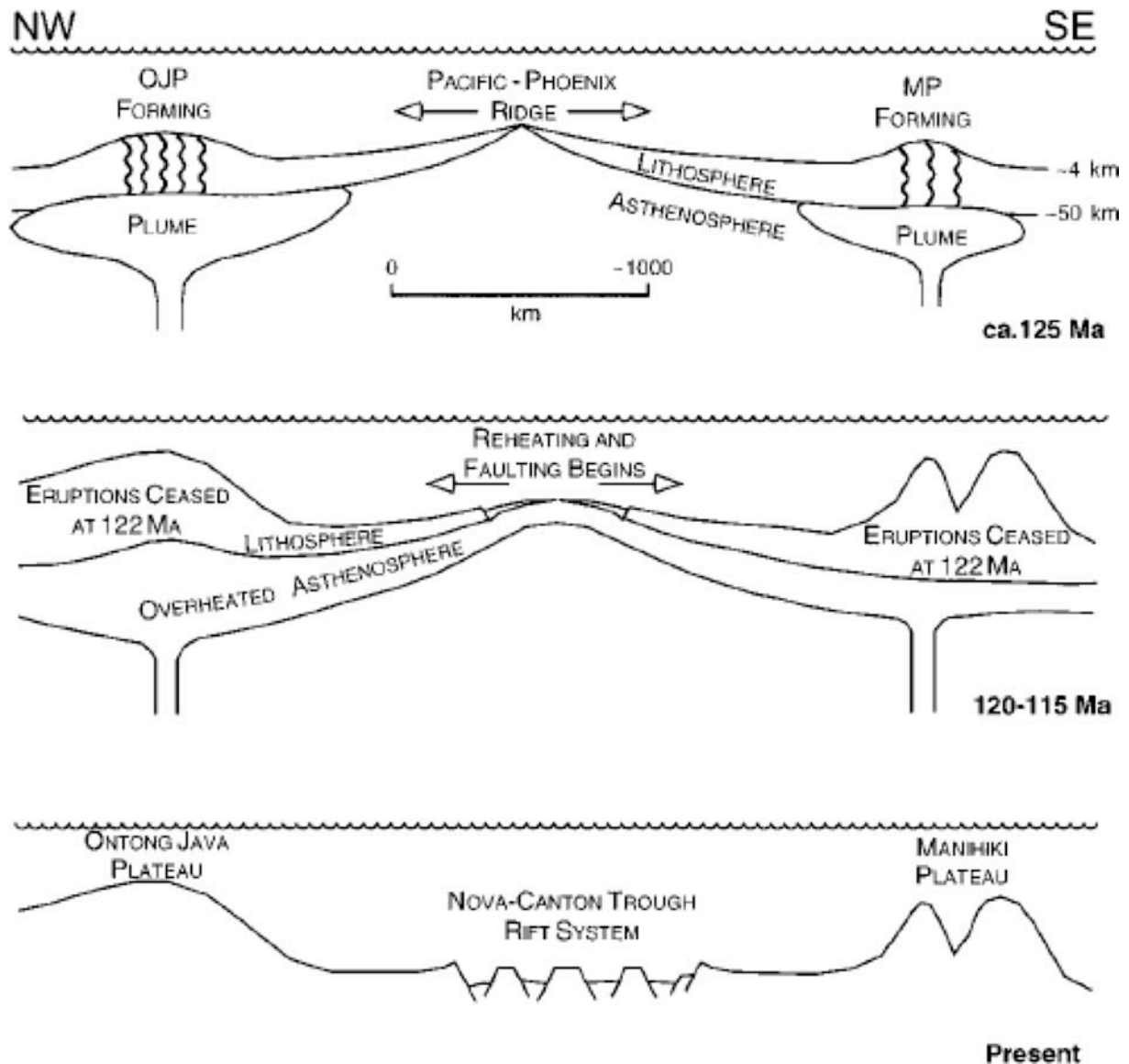


Fig. 6.6.: Model of interactions among the Manihiki Plateau, Ontong Java Plateau, and plumes at the Nova-Canton Trough, interpreted as a rift system (Larson 1997).

6.3. POST-EMPLACEMENT TECTONISM OF THE MANIHIKI PLATEAU

Bathymetry (Figs. 6.1., 6.3.), the free-air gravity field (Fig. 6.2.), and limited seismic reflection data (Winterer et al. 1974) all indicate significant deformation, perhaps accompanied by magmatism, of the Manihiki Plateau following its emplacement. The Danger Islands Troughs essentially bifurcate the Plateau, and associated structures may include the Suvorov Trough, High-North Basin, and ENE-WSW-trending linear ridges and contiguous seamounts to the north of the High Plateau. Furthermore, the Eastern Manihiki Scarp forms a pronounced, linear boundary between the High Plateau and the Penrhyn Basin.

6.3.1. Danger Islands Troughs

The Danger Islands Troughs encompass a series of at least three en echelon, oblong basins that collectively extend for more than 350 km in an approximately north-south direction between 163°30'W and 164°30'W (Winterer et al. 1974) (Fig. 6.7.). The flanks of the three major basins are irregular and steep, with relief exceeding 3,000 m in places. Seafloor of the basins is relatively flat, and in places, channels incise the flanks of each basin, suggesting that turbidities account for the basin fill, at least in part.

The northernmost of the three main basins encompasses the smallest area, and its seafloor is deeper than 5,900 m. Adjacent Manihiki Plateau seafloor is shallower than 3,200 m. The northern main basin is ~85 km long and averages ~20 km in width. To the west lie two smaller en echelon, oblong basins. The southern one, ~45 km long and ~7 km wide, strikes NNW-SSE, and has a linear western flank. Seafloor in this basin is deeper than 5,200 m. The northern basin is incompletely mapped; however, seafloor depths also exceed 5,200 m. Its NW-SE strike resembles that of structural trends in the High-North Basin (see below).

A bathymetric high with a central peak separates the northernmost and central main basins. The central main basin is ~175 km long and its average width tapers from ~22 km in the north to ~15 km in the south. Seafloor in the central main basin is deeper than 4,800 m, and is juxtaposed with Western Plateaus seafloor that is shallower than 2,600 m in places. A relative bathymetric depression lies west of the central main basin, albeit with two intervening bathymetric highs. A curvilinear structural trend more than 85 km long is continuous between the western side of the central main basin and the eastern side of the southern main basin. The southern end of the central main basin and the northern end of the southern main basin overlap, but are separated by a continuous bathymetric high.

The southern main basin consists of two sub-basins with a boundary at 9°20'S. Seafloor in both sub-basins is deeper than 4,800 m; adjacent portions of the Western Plateaus are shallower than 2,500 m. The larger northern sub-basin is ~90 km long and averages ~20 km in width, whereas the smaller southern sub-basin is ~70 km long, and its average width changes from ~17 km in the north to ~9 km in the south. The southern end of the southern main basin is contiguous with a shallower NW-SE trending trough that is en echelon with the Suvorov Trough (see below) to the south and southeast.

To the west of the southern main basin, overlapping slightly with its southern tip, lies a smaller, irregularly-shaped basin characterized by a linear NNE-SSW-trending western flank ~40 km long. Relatively flat seafloor in the basin reaches water depths greater than 5,000 m; flanking Western Plateaus seafloor is shallower than 2,700 m. Another small basin, more circular in shape, lies immediately to the SSW; again, relatively flat seafloor depths in this basin are greater than 5,000 m. Other small basins trending NNE-SSW extend farther south to the Samoan Basin (Figs. 6.1., 6.2., 6.3.).

Two models, pull-apart and rift, have been proposed for the origin of the Danger Islands Troughs (Coffin et al. 2004, Nakanishi et al. 2004, respectively). The new SO193 multi beam data should help to distinguish between these models, in particular through analyses of basin geometries, bounding and intra-basin structural trends, possibly conjugate features (e.g., seamounts, promontories, and reentrants) on the flanks of the system, and relationships to neighboring structures (High-North Basin and linear ridges to the north and northeast, and Suvorov Trough to the southeast). Furthermore, thorough analysis of the many structural trends in the

basins may allow calculation of Euler poles for microplate as well as regional plate motions associated with development of the basins.

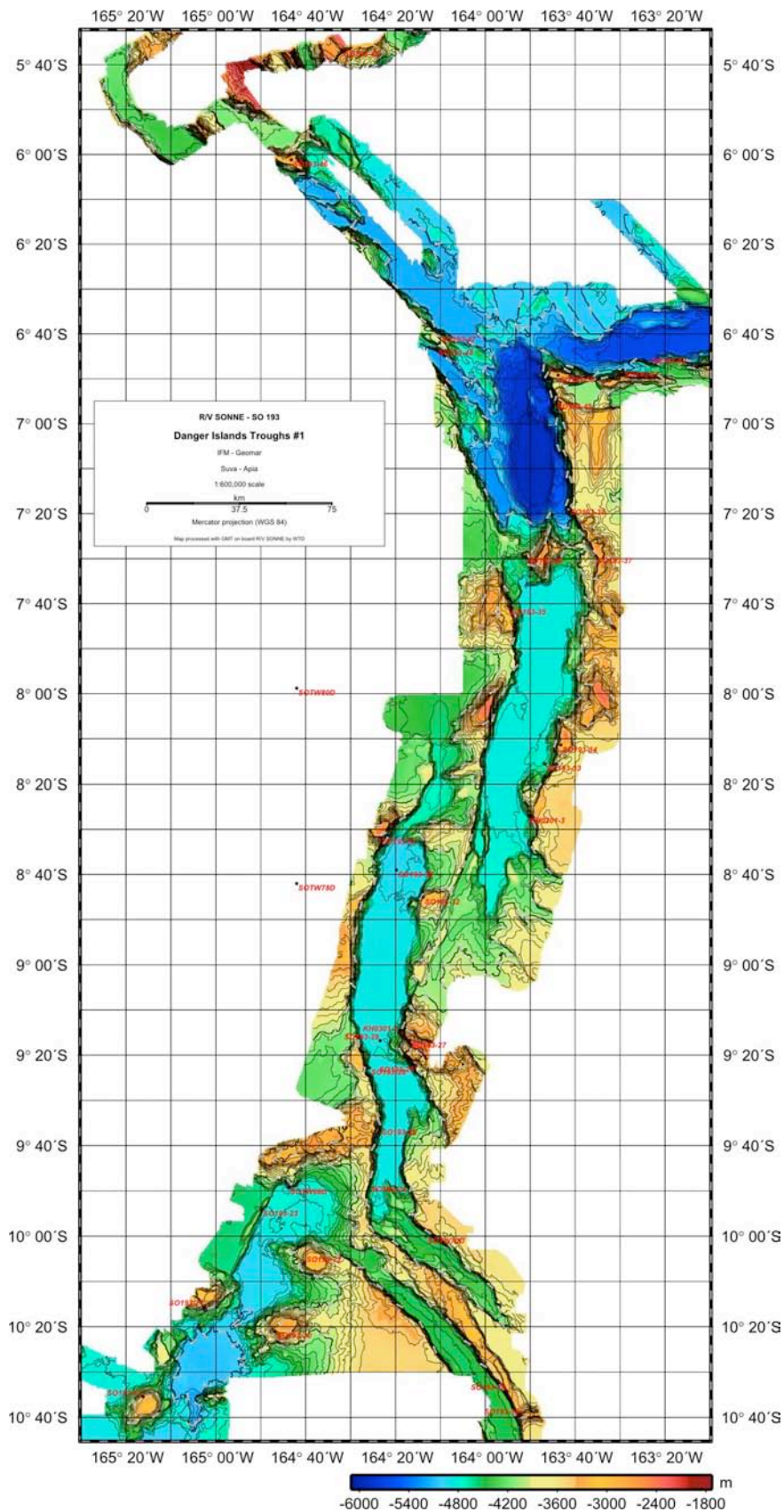


Fig. 6.7.: R/V SONNE SO193 and R/V HAKUHO MARU KH03-01 multibeam bathymetry in the Danger Islands Troughs region. Sampling locations are indicated in red. See figure 6.3 for location.

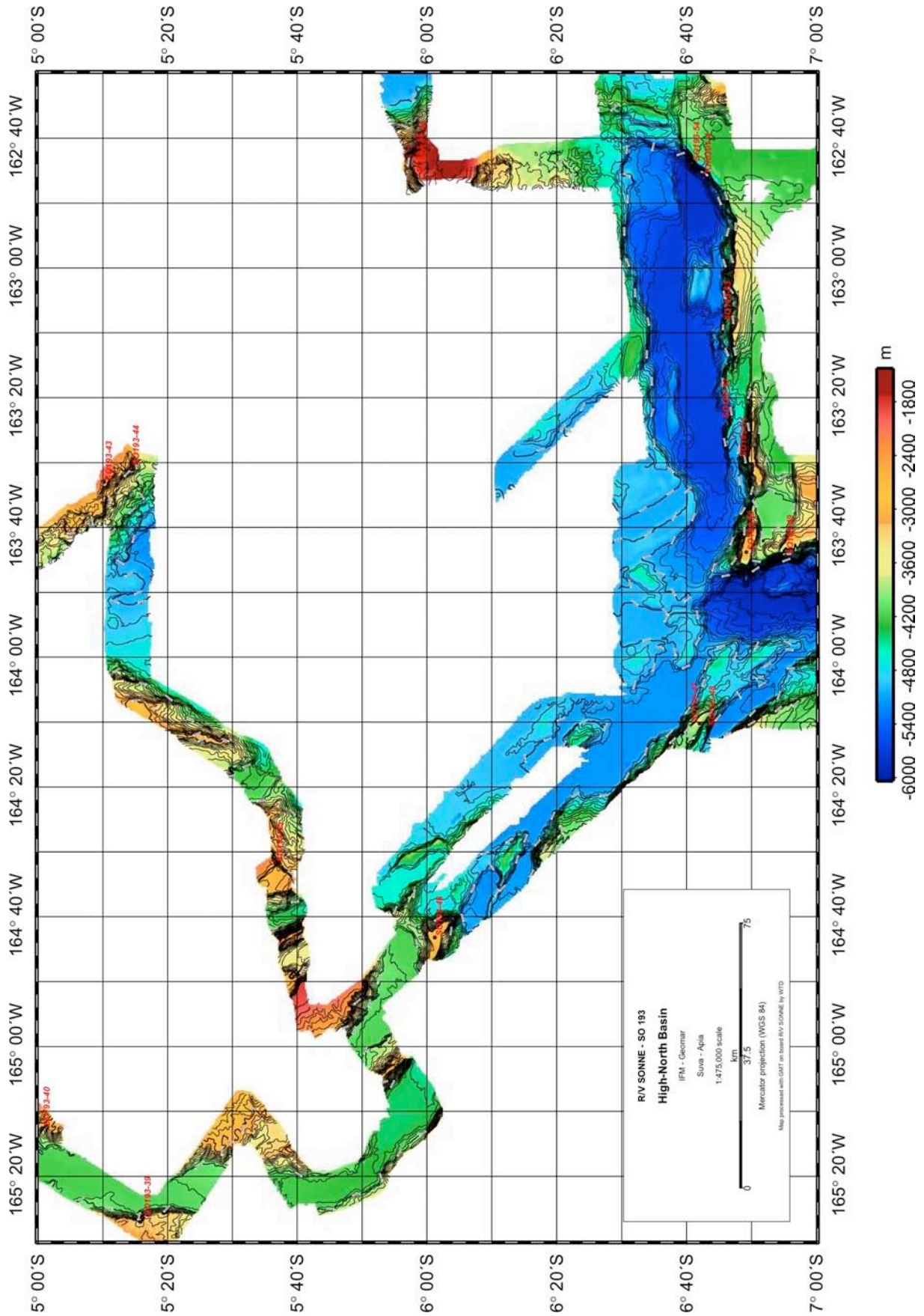


Fig. 6.8.: R/V Sonne SO193 and R/V HAKUHO MARU KH03-01 multibeam bathymetry in the High-North Basin region. Sampling locations are indicated in red. See Figure 6.3 for location.

6.3.2. High-North Basin

The High-North Basin lies between Manihiki's High Plateau and North Plateau, with the Western Plateaus lying to the west, and seamounts and linear ridges of the Central Pacific Basin to the east (Figs. 6.1, 6.2, 6.3). Approximately rhombus in shape, the Basin is characterized by average water depths of ~5,000 m. Bathymetric (Figs. 6.1., 6.3.) and free-air gravity (Fig. 6.2.) troughs juxtaposed with scarps and bathymetric/gravity highs define the edges of the basin on all four sides. A single prominent trough in which seafloor depths exceed 5,700 m marks the southern extent of the Basin, where it abuts portions of the Manihiki Plateau shallower than 3,200 m (Fig. 6.8.). A series of en echelon troughs with seafloor depths of just over 5,100 m characterize the westernmost portion of the Basin, where it is juxtaposed with the northeasternmost Western Plateaus with water depths of less than 3,700 m. Details of the northern and eastern troughs are not known due to a lack of multi beam coverage. Limited multi beam bathymetry within the basin as well as predicted bathymetry (Figs. 6.1., 6.3.) and satellite-derived, free-air gravity (Fig. 6.2.) suggest a preponderance of NW-SE structural trends.

Two models for the origin of the High-North Basin have been proposed, one postulating seafloor spreading that separated the High and North Plateau provinces along a spreading axis oriented approximately NE-SW (Coffin et al. 2004), and one proposing seafloor spreading that separated the Western Plateaus and linear ridges/seamounts to the east (see below) along a spreading axis oriented approximately SE-NW (Nakanishi et al. 2004). Detailed analyses of the new SO193 multi beam data, together with geochronology, petrology, and geochemistry of dredged rocks surrounding the basin, should either help resolve which of these models fit the data better or promote development of one or more new models.

6.3.3. Linear Ridges

In the Central Pacific Basin east of the High-North Basin lie seamounts and linear ridges; in places, the two types of features are contiguous (Figs. 6.1., 6.2., 6.3., 6.9.). The ridges trend ENE-WSW, and the southernmost one consists of three right-stepping, en echelon segments. Situated in presumed normal oceanic crust, they are characterized by significant relief and large positive free-air gravity anomalies. Limited multi beam mapping of one of the ridges shows its minimum water depth to be less than 2,000 m; water depths in the adjacent Central Pacific Basin exceed 5,400 m. As noted previously (Viso et al. 2005), the ENE-WSW trend of the ridges is approximately parallel to the trends of the Nova Canton Trough to the north-northwest, the Clipperton Fracture Zone to the northeast, the Galapagos Fracture Zone to the east-southeast, the Marquesas fracture Zone to the southeast, and other major Pacific fracture zones (e.g., Joseph et al. 1992). However, none of the ridges align with any Pacific fracture zone, major or minor, identified to date to the east.

Between the ENE-NSW-trending ridges and the High Plateau lie linear ridges with three different strikes. Two ridges strike N-S, one E-W, and one ESE/SE-WNW/NW; the last and one of the first were partially mapped during SO193 (Fig. 6.9.). Except for the E-W-trending ridge, they are characterized by high relief and large positive free-air gravity anomalies. The nature of the crust in which these features are situated is ambiguous; the seafloor is more than 1,000 m deeper than that of the High Plateau, and is less than 1,000 m shallower than that in the neighboring Central Pacific Basin.

Limited mapping of the westernmost portion of the ESE/SE-WNW/NW-trending ridge shows minimum water depths to be shallower than 2,400 m, where as adjacent seafloor of the Central Pacific Basin is deeper than 5,400 m (Fig. 6.9.). A regional Early Cretaceous plate reconstruction model assumes that the ESE/SE-WNW/NW-

trending ridge, which aligns with the northeastern flank of the North Plateau (Figs. 6.1., 6.2., 6.3., 6.9.), represents a rifted margin from which a section of the Pacific-Farallon spreading center evolved (Viso et al. 2005).

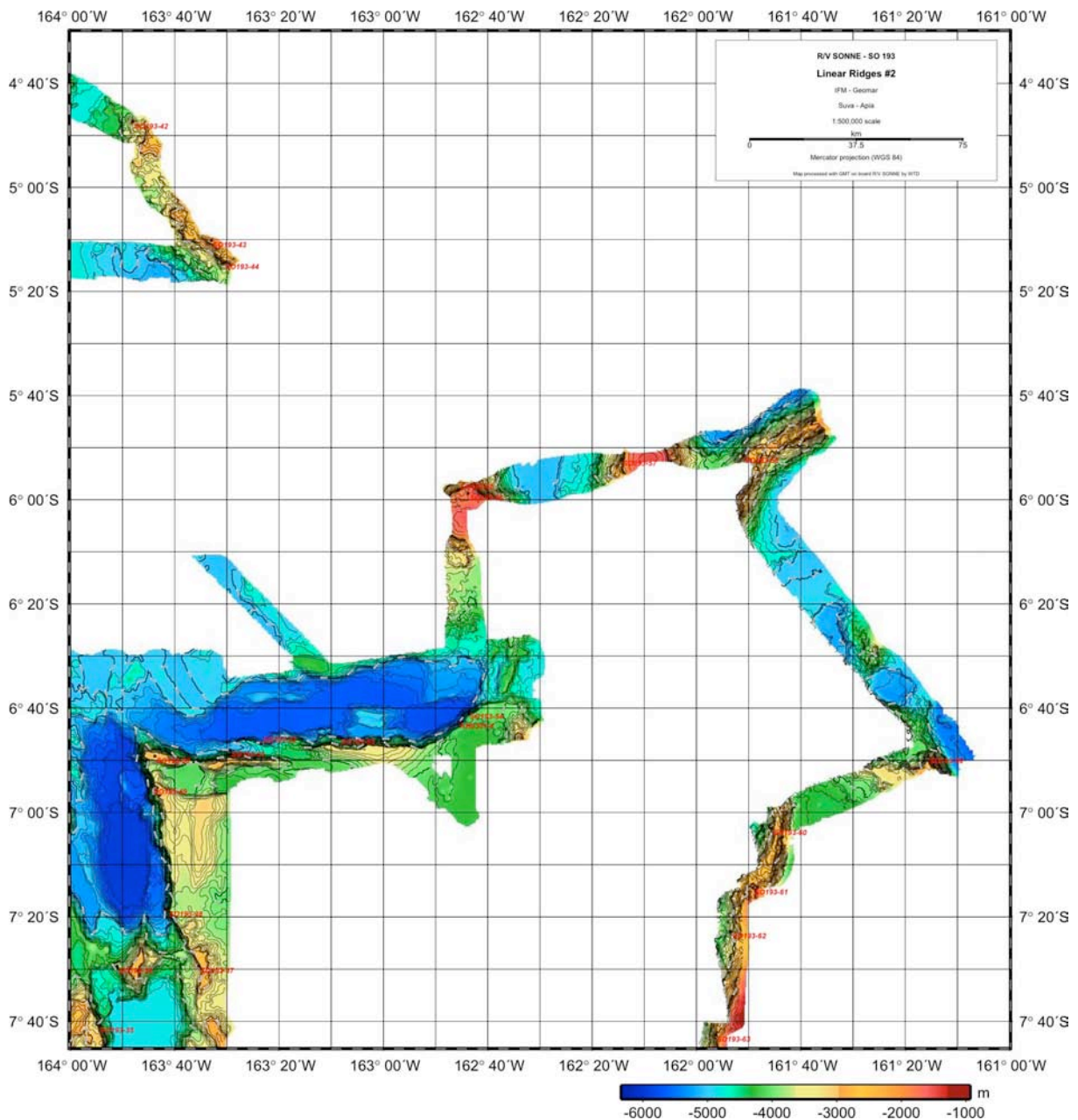


Fig. 6.9.: R/V SONNE SO193 and R/V HAKUHO MARU KH03-01 multibeam bathymetry in the linear ridges region. Sampling locations are indicated in red. See Figure 6.3 for location.

The most prominent linear ridge in the study area, extending from at least $\sim 6^{\circ}55'S$ to $8^{\circ}25'S$, was partially mapped along its length during SO193 (Fig. 6.9.). The shallowest portions of the ridge lie in water depths less than 900 m; flanking seafloor exceeds 4,600 m. A guyot at the ridge's southern end and relatively flat crestal portions of the ridge to the north suggest that at least part of the ridge formed subaerially.

Linear non-spreading ridges are relatively common in ocean basins, and are believed to originate in at least four ways: 1) mantle plumes; 2) intraplate deformation; 3) non-plume-related asthenospheric flow near a mid-ocean ridge; and 4) non-plume-related formation coincident with transform faults and fracture zones. Although the focus of SO193 was the Manihiki Plateau, limited mapping and initial

sampling of both the on- and off-plateau linear ridges should contribute to testing models for their formation as well as developing new models. Furthermore, the SO193 data and samples should set the stage for future shipboard investigations focusing on the linear ridges.

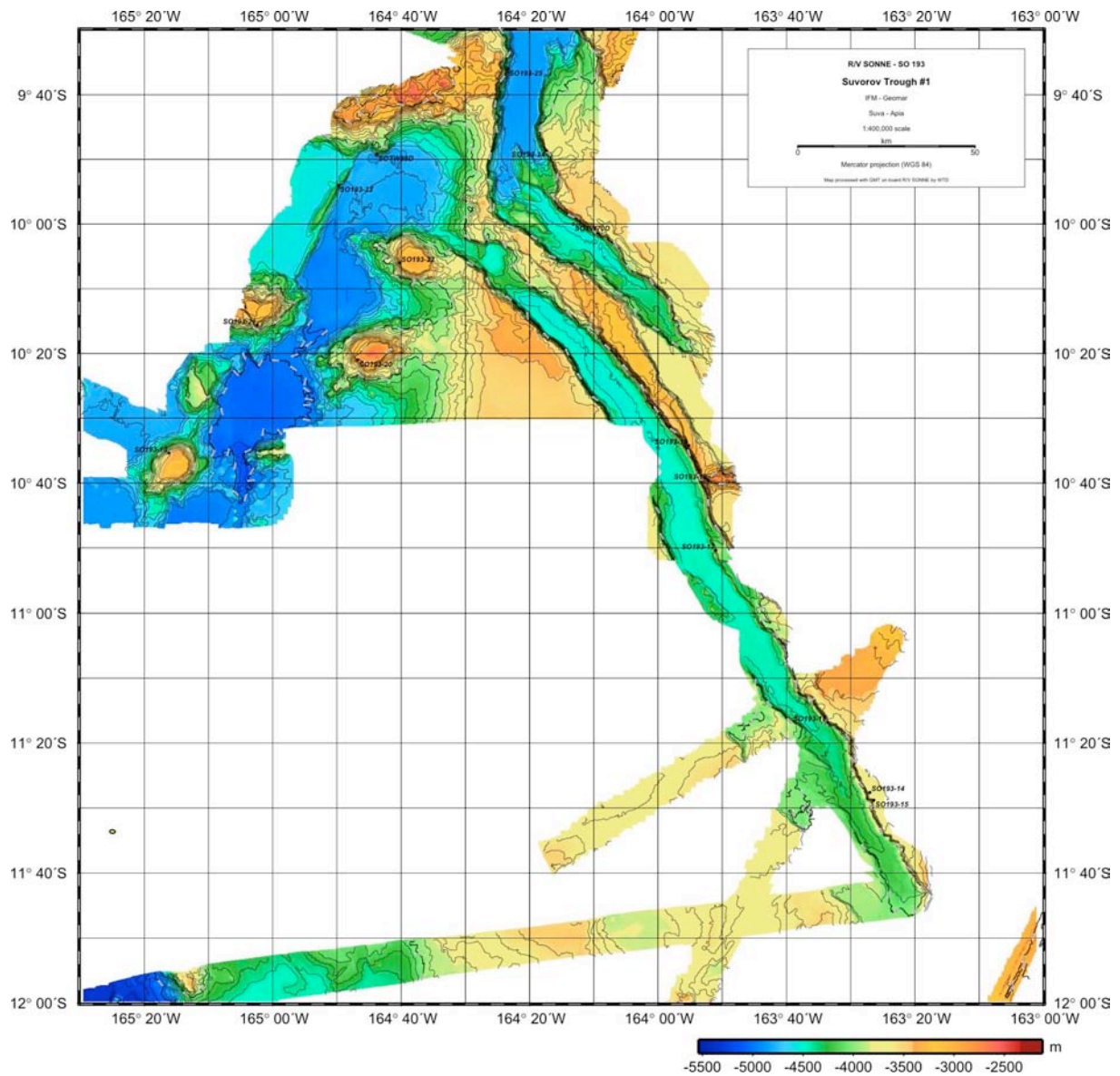


Fig. 6.10.: R/V SONNE SO193, KIWI12 (courtesy J. Stock; Ai et al., submitted), and R/V HAKUHO MARU KH03-01 multibeam bathymetry in the Suvorov Trough region. Sampling locations are indicated in black. See Figure 6.3 for location.

6.3.4. Suvorov Trough

The Suvorov Trough extends for ~240 km in a NW-SE direction within the southeastern Western Plateaus province (Figs. 6.1., 6.2., 6.3., 6.10.). The Trough's width tapers from a maximum of ~13 km in its center towards both the northwest and southeast. The floor of the Trough exceeds 4,500 m in water depth; relief along its margins decreases from ~1,000 m in the northwest to a few hundred meters in the southeast. To the southeast, the Suvorov Trough terminates at the boundary between the Western Plateaus and the High Plateau, and to the northwest, at the Danger Islands Troughs. A parallel, unnamed trough ~75 km long lies 20 - 25 km (axis-to-axis) to the northeast of the Suvorov Trough at its northwestern end. This unnamed trough is contiguous with the southernmost of the main Danger Islands

Troughs; the unnamed trough's width has a maximum value of 11 km at the intersection and tapers to the southeast. The Suvorov Trough appears to be contiguous with the relatively small basin characterized by a linear NNE-SSW-trending western flank that lies to west of, and slightly overlaps with, the southernmost of the main Danger Islands Troughs. The basin floor of the Suvorov Trough is a few hundred m shallower than that of the contiguous southernmost of the Danger Islands Troughs, as is the floor of the Suvorov-parallel trough relative to that of the relatively small basin characterized by a linear NNE-SSW-trending western flank.

To date, no model has been proposed for the origin of the Suvorov Trough and the shorter parallel trough to the northeast. Detailed analyses of the SO193 multi beam bathymetry as well as sediment and rock samples from the Suvorov Trough, especially at the intersection of the Suvorov and Danger Islands troughs, should help illuminate the nature and timing of the deformational event(s) that created both trough systems.

6.3.5. East Manihiki Scarp

The NNE-SSW trending East Manihiki Scarp marks the eastern boundary of the Manihiki Plateau (High Plateau) with the adjacent Penrhyn basin from the Plateau's northeastern corner at $\sim 7^{\circ}30'S$ to just northeast of its southeastern corner at $\sim 13^{\circ}30'S$ (Figs. 6.1., 6.2., 6.3., 6.11.), and extends farther south to a poorly defined area between $18^{\circ}S$ and $20^{\circ}S$ (Viso et al. 2005). A remarkably linear system of scarps, ridges, and troughs, the East Manihiki Scarp truncates the High Plateau, and is therefore believed to post-date construction of the Manihiki Plateau (Viso et al. 2005). Across the Scarp, water depths change from $<3,000$ m on the High Plateau to $>5,000$ m in the main Penrhyn Basin.

Over the 650+ km that the East Manihiki Scarp forms the flank of the Manihiki Plateau, it varies in morphology. At the margin of the High Plateau, it typically consists of multiple, parallel linear escarpments, each with several hundred meters of vertical displacement. The spacing of the escarpments increases with distance away from Plateau into the Penrhyn Basin (Fig. 6.11.). Between strands of the NNE-SSW-trending East Manihiki scarp are short NE/E-SW/W-trending ridges. In some cases, the western tips of the ridges curve southward to join the adjacent East Manihiki Scarp segment, and the eastern tips are truncated, appearing to have been sheared by motion along the East Manihiki Scarp. Although the E-W-trending ridges have been interpreted as abyssal hill fragments created by intra-transform spreading resulting from transtension across the East Manihiki Scarp (Viso et al. 2005), relief of the NE-SW-trending ridges closest to the High Plateau typically exceeds that of abyssal hills. Thorough analysis of SO193 and previous multi beam data along the East Manihiki Scarp should increase understanding of the nature of its tectonic fabric as well as its deformational history.

6.3.6. Seamounts

Seamounts and islands are situated on the edges of the High Plateau, and at the southern end of the Danger Islands Troughs (Figs. 3.2., 6.1., 6.2.). Furthermore, seamounts pervade the Western Plateaus, and are common on presumed normal oceanic crust east of the High-North Basin. Some of the seamounts on the Manihiki Plateau and in the surrounding ocean basins are guyots, and some are not; SO193 and other multi beam bathymetry, but not predicted bathymetry, data permit distinguishing between guyots and seamounts that were never above or at sea level. Combining this information with theoretical and empirical subsidence curves for oceanic plateaus and normal oceanic lithosphere, as well as critical age information

from the guyots and seamounts dredged during SO193, has the potential to reveal relative age relationships and the subsidence histories of the Manihiki Plateau and surrounding deep ocean basins.

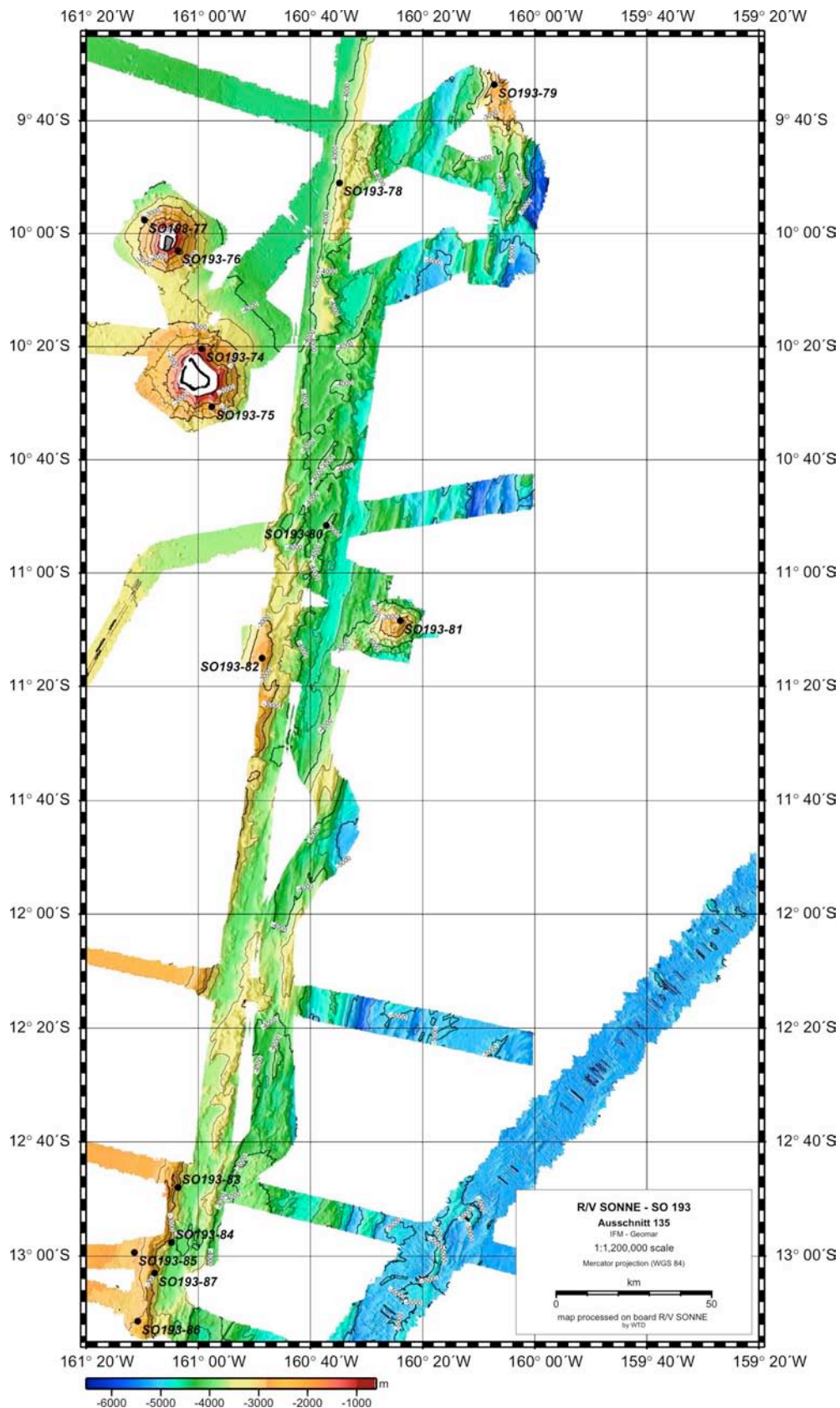


Fig. 6.11.: R/V SONNE SO193, R/V PALMER (various cruises), and KIWI12 (courtesy J. Stock; Ai et al. submitted) multibeam bathymetry in the Eastern Manihiki Scarp region. Sampling locations are indicated in black. See Figure 6.3 for location.

7. BIOLOGY

(C. Lüter, B. Neuhaus, J. Kasper, E. Ullrich)

7.1. METHODS

7.1.1. Shipboard Collecting Procedures

Biological material was collected by deployment of (i) a geological chain bag dredge, (ii) a TV-grab (TVG) and (iii) a multicorer (MUC). All boulders and rocks collected with the dredge were scanned for encrusting benthic invertebrates. Additionally, four sediment trap tubes (length: 21 cm, diameter: 4 cm) were fixed in the dredge to collect a disturbed sediment sample from each dredging site. Ten so-called biological stations were identified using maps of predicted bathymetry by Smith and Sandwell (1997), in order to collect undisturbed sediment samples and the inhabiting meiofaunal community with the MUC. The sites were carefully chosen using PARASOUND and SIMRAD EM 120 profiling to avoid damaging the MUC on hard grounds. For safety reasons, biological stations on top of seamounts were first checked with the TVG over a transect of about 200 m to secure the soft nature of the sea floor. Additionally, the TVG's video-sequence capturing the way down to the sea bed and along the transect allowed for macrofauna observation (planktonic and benthic) and collection. As a side-effect, a disturbed sediment sample could be collected with the TVG, providing additional material for meiofauna investigation. The TVG was also used to collect boulders with encrusting macrofauna in the vicinity of two atolls, Manihiki and Rakahanga, to investigate more shallow water macrofaunal communities. At two sites, the shipboard OFOS was used to observe the volcanic basement of the Southern Danger Islands Trough and the Manihiki Scarp. The video sequence and several hundred digital photographs revealed a rather poor but interesting benthic community showing a very patchy distribution. All video sequences (TVG and OFOS) were recorded using two shipboard LG HDD/DVD recorders (b/w and colour) and subsequently burnt on DVDs for analysis of the sediment/rock structure and the nature of the recorded deep-sea benthos.

7.1.2. Meiofauna

Sediment sampled by four sediment trap tubes (length: 21 cm, diameter: 4 cm) inside the geological chain bag dredges was fixed immediately in cold 6% formaldehyde buffered with buffer tablets for haematology (Merck # 1.09468.10100, pH 7.2). After at least one day of fixation at 4-8° C, the sediment was washed carefully with plenty of tap water on a 40 µm-sieve and centrifuged (THERMO Heraeus Multifuge 3s) three times for 5 minutes with three times the amount of Levasil 200A/40% at 4,000 rpm in order to quantitatively extract the meiofauna. After rinsing with tap water on a 40 µm-sieve, specimens were stored in 75% ethanol.

Sediment was sampled with the TV-grab together with macrofaunal specimens whenever possible. The entire haul from the TV-grab was carefully checked for additional macrofaunal organisms buried in deeper layers of the sediment. About 2-7 kg of near-surface sediment were fixed in cold 6% formaldehyde and processed as described above. From the multicorer, only the upper 5-7 cm of sediment in each core (inner core diameter: 9.5 cm) were taken. Samples were split into three portions: About 100 g of sediment were dried on glass petri dishes in an oven at 50° C for about 2-4 days and stored in plastic bags for later analysis of TOCs (= total organic carbon), TC (total carbon) and grain size. About 1 kg of sediment was fixed

immediately in 1.5% formaldehyde plus 3.75% glutardialdehyde in 0.1 M cacodylate buffer for electron microscopy at 4-8° C for at least one day. This material was later washed with tap water on a 40 µm-sieve, centrifuged for meiofauna, washed with tap water and finally stored in 75% ethanol. The remaining 4-5 kg of the sediment were fixed in cold 6% formaldehyde and processed as described in the previous paragraph.

Meiofaunal organisms were sorted on board R/V SONNE with a dissecting microscope Zeiss Stemi 2000, financial support of which by the “Freunde und Förderer des Museums für Naturkunde e.V.” and the “Johanna und Fritz Buch Gedächtnis-Stiftung” is gratefully acknowledged. We also thank “Thermo Electron Corporation” for special conditions when purchasing the large-volume centrifuge.

7.1.3. Macrofauna

Macrofaunal organisms found on dredged rocks or in TVG samples were picked using scalpel blades and forceps and immediately fixed in (i) 4% formaldehyde buffered with buffer tablets for haematology (Merck # 1.09468.10100, pH 7.2), (ii) 99% pure ethanol or (iii) 2.5% glutaraldehyde buffered in 0.05MPBS/0.3M NaCl phosphate buffer solution stained with ruthenium red (on ice), depending on planned investigation methods. After 24 hrs formaldehyde-fixed organisms were rinsed 2x in tap water for at least 24 hrs each and finally preserved in 80% ethanol. These specimens are mainly voucher specimens for the Museum collection and can be used for histological sectioning and staining procedures. Specimens fixed in pure ethanol will be used for morphological studies (especially hard parts like tests and shells) and their soft tissues will be available for DNA-analysis and –sequencing. Glutaraldehyde fixation was used for specimens to be investigated with scanning or transmission electron microscopy. The fixation process was stopped after 60 min (4° C) by rinsing with 0.05M PBS/0.3M NaCl buffer, pH 7.2 (3x) and subsequent rinsing with PBS buffer solution after 10 min, 1 hr, 4 hrs and 24 hrs (1x each). Specimens were finally stored in storage buffer (0.05M PBS/0.3M NaCl, pH 7.2 plus few crystals of NaN₃ to prevent fungal growth in the vials). Postfixation, embedding and sectioning will be done in Berlin. Spectacular organisms found in the samples were digitally photographed prior to fixation for documentation of original shape and colours.

7.2. PRELIMINARY RESULTS AND DISCUSSION

7.2.1. General Observations and Collecting Report

In contrast to previous expeditions to the Central American East Pacific (SO144-3, SO158) and the Southwest Pacific region around New Zealand (SO168), the deep-sea bed of the Manihiki Plateau proved to be impoverished of both meiofauna and macrofauna. Taxa dominating the benthic communities in other regions such as sponges, hydrozoans, bryozoans or brachiopods were very rare and, if present, extremely small. Although dredge haul samples cannot cover the whole range of species present at a certain site, we also got the impression that the benthic fauna of the Manihiki Plateau is not very diverse. Although the OFOS cameras recorded some stalked and vase-like hexactinellid sponges, bright red shrimps, several dark red ophiuroids, stalked and comatulid crinoids, holothurians, tunicates and traces of burrowing animals on the sediment at one slope in the southern Danger Island Trough (between 3,000 and 5,000 m depth), the overall density of animals was low.

So far, we have no clearcut explanation for this scenario, but there are several possible reasons for this: First of all, most deep-sea hard bottom dwelling invertebrates are filter feeders. They feed on plankton organisms and particles – the so-called marine snow – which they capture with a ciliary coverage of their feeding

organs. Without plankton to prey on they cannot exist. During the whole cruise we did not see much fish or large amounts of surface plankton. Instead, the water was crystal clear down to a depth of about 30 m with a deep blue colour, a sign for very few plankton organisms possibly due to low nutrient concentration in the water. However, the deep-sea fauna depends on the primary production in the photic zone of the water column, i.e. if the surface layer has a low productivity, a rather depleted benthic invertebrate community is to be expected. This may be true for the whole Manihiki Plateau region.

Another explanation is related to the depth of the dredging stations. More than 2/3 of all dredges were deployed at depths below 3,000 m. In the Pacific, the carbonate compensation depth (CCD) lies at about 3,800 m. Most benthic sessile filter feeders, especially sedentary polychaetes, bryozoans and brachiopods, build calcified exoskeletons. Because of the carbonate dissolving character of the deep-sea water, it may be difficult for them to colonize the deep zones of the Manihiki Plateau.

Most boulders and rock collected with the dredge were heavily encrusted with manganese, with some manganese crusts being >10 cm thick. Apart from manganese these crusts contain a variety of metals like Zn, Cu, Co and Ni. They may function as a repellent for metamorphosing larvae of invertebrates searching for a suitable attachment site, either directly or indirectly. A direct effect could be high concentrations of e.g. copper, which is poisonous for invertebrate larvae trying to enter the water layer covering the crust's surface. Another (indirect) effect could be the unsuitability of the bacterial microfilm covering the crusts. For metamorphosis most planktonic larvae of sessile invertebrate taxa need a bacterial microfilm, which attracts and guides them to a suitable attachment site. If this microfilm is either absent or unattractive, the larvae cannot settle.

In comparison to other expeditions, the total number of meiofaunal organisms in the sediment samples was also not very impressive. This again may be due to nutrient depletion in the deep sea of the Manihiki Plateau, which affects not only epifaunal but also infaunal communities. A possible correlation between the amount of total organic carbon (TOC) in definite volumes of sediment and the abundance of meiofaunal organisms will be tested. TOC values of the sediment will also reflect the conditions in the water column and , therefore, may help to explain the scarcity of macrofaunal elements on the Manihiki sea bed.

Macrofaunal organisms were recovered at 51 out of 98 collecting stations (82 geological dredges, 8 TVGs and 8 MUCs). Sixty-seven stations revealed sediment samples (58 sediment traps, 3 TVGs and 6 MUCs). During the cruise, a total of 3.113 meiofaunal organisms could be isolated from about 61 kg of sediment. For a detailed list of the collected taxa and the number of specimens per taxon see Appendix III.

7.2.2. Meiofauna

The sediment samples from the dredge and biological stations revealed species from most marine invertebrate groups of the animal kingdom, and demonstrated the diversity of animal life on the seamounts and plains of the Manihiki Plateau. During the cruise, samples from 58 of 67 hauls (geological dredge, TVG, multicorer) yielding sediment were pre-sorted for meiofauna, 3.113 specimens of the meiofauna were isolated already. Further sorting in Berlin is expected to reveal many more specimens, since it is rather difficult to trace especially the smaller sized meiofauna groups such as Kinorhyncha, Loricifera, and Tardigrada with a stereo microscope at magnifications of 32x on board a moving ship.

Foraminifera and Nematoda outnumbered by far all other meiofaunal groups followed by the Copepoda. Specimens of several other taxa have been recovered occasionally in the pre-sorted samples. Tardigrada, Loricifera and Kinorhyncha

(probably species of the genera *Echinoderes*, *Kinorhynchus* and *Zelinkaderes*) were found at stations of 1,900-4,900 m depth.

Regularly, worm-like organisms were discovered but could not be identified with certainty under the stereo microscope. Probably, these animals belong to the Gastrotricha and Plathelminthes. Both groups are rarely reported from the deep sea (Gambi and Danovaro 2006, Higgins and Thiel 1988, Schewe 2001, Soltwedel et al. 2000).

The number of meiofaunal specimens found in the sediment samples on this cruise is due mainly to the four sediment traps mounted in each geological dredge revealing some 29 kg of sediment and to the extensive usage of the density centrifugation method. This latter technique is supposed to recover meiofaunal organisms quantitatively from any kind of sediment be it mud or deep-sea clay or sand (Higgins and Thiel 1988). The THERMO Heraeus Multifuge 3s with its large centrifugation volume of 4 x 600 ml (taking 4 x 150 ml of sediment at a time) allowed to process the enormous amount of about 55 kg of sediment on board of R/V SONNE in a reasonable amount of time.

7.2.3. Macrofauna

The benthic communities found on the dredged boulders and rocks and on hard substrate collected with the TVG consisted of small to very small sessile and hemisessile invertebrates. Species composition was dominated by tiny sponges, polyps of coronate cnidarians, hydrozoans and sedentary polychaetes. Bryozoans, which were very abundant also at deep stations of a previous cruise in the SW-Pacific (New Zealand), were found in surprisingly low numbers. Living brachiopods were completely absent, so were gastropod molluscs. Bivalves were only found at two dredging stations on the North Plateau in depths above the CCD. Shell remains of a subfossil community of invertebrates were recovered from the shallowest collecting station (TVG, depth: 975 m) on top of a large seamount on the High Plateau. Shells of Brachiopoda (*Macandrevia* sp.), three different species of snails, verrucosomorph Cirripedia, Scaphopoda and Mn-encrusted pieces of gorgonian corals could be isolated from the collected sediment. Morphology of the snail shells resembles that of recent *Gibbula* species, which can be found exclusively in intertidal to upper subtidal habitats. If this preliminary identification is correct, the subfossil community may have lived at a time, when the top of the seamount was still above sea level. Unfortunately, several otoliths found in the same sediment are heavily worn, so that identification of the fish species may be impossible. However, they may as well turn out to origin from shallow water/coral reef fishes.

One dredge hit into a patch of gorgonian corals at about 2,000 m depth on the flank of a seamount on the High Plateau. Three different species could be distinguished, one of which belonging to isidiid or "bamboo"-corals. Associated with these corals were larger hexactinellid sponges, crinoids and ophiuroids, pieces of which were also found in the dredge. Presumably, the collected specimens belonged to a rather diverse benthic community with a very local distribution. From TVG and OFOS observation of the sea floor it became clear that larger animals if at all present have a patchy distribution on the entire plateau.

7.2.4. TV-Observation of the Sea Floor

During the cruise we used 8 TV-grab and 2 OFOS transects for sea floor observation and recording. On their way down to the sea bed, both TV-grab and OFOS additionally recorded plankton organisms in the water column. Plankton was rare at all stations; sometimes we could observe large siphonophores, tunicate colonies, single jellyfish, copepod crustaceans and shrimps. Marine snow, which

consists of all sorts of organic detritus from the photic zone, was hardly visible. Only the near-bottom water layer contained slightly higher concentrations of this typical deep-sea food source.

Especially during the OFOS tracks, each of which lasted about 3-4 hours covering a depth range from 3,000 to 4,700 m we observed quite a variety of deep-sea animals in low numbers: Stalked, umbrella-like and vase-like hexactinellid sponges (*Hyalonema* sp., *Caulophacus?* sp.), bright red ophiurids, pink sea cucumbers and some comatulid crinoids were found sitting on boulders and rock. During both tracks the sediment colour changed from whitish to yellowish-brown between 3,500-4,000 m, once the OFOS was lowered below the carbonate compensation depth (CCD). Sub-CCD hard bottom was almost free of benthic animals. Only a few sponges and crinoids could be observed. However, the sediment seemed to be bioturbated. We found rather large and accurately formed sediment spirals preliminarily interpreted as strings of gelatinous egg capsules covered with sediment. Fish were completely absent, apart from a few small rat tails and one eel-like fish, which we shall identify later from the DVD records. A highlight was the observation of the deep-sea “flying” holothurian *Enypniastes* in 4,243 m depth. Unfortunately, it was crawling on the sea bed and not lifting up at the time we took the photograph.

Two TV-grabs were deployed to collect benthic invertebrates in the vicinity of the atolls Manihiki and Rakahanga. As expected, the picture there was different: Both transects covered rather shallow depths (1,100-1,440 m) of the Eastern slopes of the islands, directly exposed to the prevailing currents. The rocky sea bed was inhabited by a diverse fauna, dominated by gorgonian octocorals. The ground was covered with coral rubble. The slightly deeper transect at Rakahanga also revealed a substantial number of stalked crinoids, which we unsuccessfully tried to collect with the TVG. Unfortunately, the morphology of the sea floor around both atolls with rather steep slopes, large boulders and outcropping rock turned out to be rather unsuitable for successful deployment of the TVG.

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APPENDICES:

- I. Sampling Summary
- II. Rock Description (dredge station locations and rock sample descriptions)
- III. Biological Sampling (station locations and biological sample descriptions)
- IV. Overview Map I (locations of map sections presented in chapter 5)
- V. Overview map II (SO193 sampling sites)

Appendix I (Rock Sampling Summary)

Type	Station	Location	total volume	Rock summary	on bottom lat	on bottom long	off bottom lat	off bottom long	depth (m) max	depth (m) min	Mag rock	Mn	Sed	Volcani- clastic
DR	1	SW-corner of western plateau	few	Mn encrusted sediment boulders, yellow to brownish sediment	10,809	168,746	10,799	168,747	4063	3672	n	y	y	n
DR	2	SW-corner of western plateau	few	few crusts, very little manganese crusts	10,639	168,509	10,633	168,513	4777	4380	n	y	n	n
DR	3	SW-corner of western plateau	1/3 full	Mn-encrusted lava fragments from talus deposit + volcanoclastic material	10,621	168,551	10,622	168,553	3596	3310	y	y	y	y
DR	4	W-plateau, western most seamount	few	few rocks and crusts; basalt clast with Mn-coating but no Mn-crusts; yellow rocks of light vesicular material	9,825	168,721	9,826	168,722	2928	2940	y	n	?	?
DR	5	Western plateau	1/3 full	2 large pillows, several rocks of volcanoclastic material, Mn-crusts	9,715	168,774	9,719	168,767	2861	2440	y	y	n	y
TVG	6	Western plateau	x	x	9,273	168,027	9,273	168,027	3076	3073	n	n	n	n
MUC	7	Western plateau	x	x	9,272	168,024	9,272	168,024	3080	3080	n	n	n	n
DR	8	SW-end of the western plateau	almost empty	one very small piece of highly vesicular basalt	9,273	168,008	9,277	168,002	3012	2747	y	n	n	n
DR	9	Western plateau	full	pillows, Mn-crusts, volcanoclastic material	9,283	168,036	9,288	168,025	2860	2780	y	y	n	y
TVG	10	Western plateau toward Danger Islands Troughs	x	x	9,664	167,001	9,647	167,001	3656	3656	n	n	n	n
MUC	11	Western plateau toward Danger Islands Troughs	11 tubes		9,666	167,000	9,666	167,000	3654	3652	n	n	n	n
DR	12	western plateau	1/3 full	totally empty	10,170	165,995	10,171	165,994	3330	3200	n	n	n	n
DR	13	western plateau	1/8 full	basalt, Mn-crusts, volcanoclastica	10,581	165,273	10,586	165,269	3740	3471	y	y	n	y
DR	14	Suvorov trough	several rocks	several in situ samples; looks like sedimentary rocks, well compacted	11,462	163,451	11,462	163,450	3970	3651	n	n	y	n
DR	15	Suvorov trough	almost empty	a few pieces of sedimentary rocks	11,481	163,439	11,481	163,438	3940	3650	n	n	y	n
DR	16	Suvorov trough	few rocks	solidified Mn-encrusted sediment, no volcanics	11,285	163,564	11,275	163,556	4295	3617	n	y	y	n
DR	17	Suvorov trough, central area	few	few crusts, sediments covered with Mn-crust	10,842	163,856	10,839	163,847	4447	3966	n	y	y	n
DR	18	Suvorov trough, central area	1/5 full	several blocks of ultramafic (?) volcanic rocks, serpentinit breccia	10,655	163,878	10,655	163,870	3360	2764	y	n	n	n
DR	19	Suvorov Trough, Mid Suvorov Trough, Upper Western Flank of the NW-SE trending ridge-like structure	1/2 full	lots of solidified sediment boulders, light brown, and red. Few magmatic rocks as angular boulders mixed within the sediments. Dredge probably sampled talus deposit	10,574	163,925	10,569	163,918	3645	3124	y	n	y	n
DR	20	Danger Island Trough, Triple junction	1/8 full	several rocks of volcanoclastic material with fragments of basaltic rocks- looks like flow debris	10,355	164,786	10,345	164,784	3377	2959	y	y	n	y
DR	21	Danger Island Trough, Triple junction	1/4 full	lots of various volcanic rocks, probably reflecting slope debris	10,266	165,047	10,259	165,043	3835	3380	y	n	y	y
DR	22	Danger Island Trough, Triple junction	few rocks	Mn crusts with greenish coarse grained sediment	10,103	164,676	10,101	164,668	3519	3158	n	y	n	y
DR	23	Danger Island Trough, Triple junction	few rocks	Mn encrusted cobbles of possible magmatic origin	9,909	164,829	9,900	164,831	4760	4283	y	n	n	y

Appendix I (Rock Sampling Summary)

Type	Station	Location	total volume	Rock summary	on bottom lat	on bottom long	off bottom lat	off bottom long	depth (m) max	depth (m) min	Mag rock	Mn	Sed	Volcani- clastic
DR	24	Danger Island Trough, Triple junction	few rocks	sediment boulders light brown and red clay-rich solidified sediments	9,812	164,293	9,806	164,285	4236	3511	n	n	y	n
DR	25	Danger Islands Troughs, southernmost trough	2 pieces	Two rock fragments of probable magmatic origin	9,615	164,387	9,604	164,390	4737	4237	y	n	n	?
DR	26	Danger Islands Troughs	full	basaltic cobbles and two pillows	9,379	164,268	9,373	164,260	4025	3367	y	n	n	y
DR	27	Danger Islands Troughs	few rocks	Volcaniclastic material with clasts of volcanic rocks covered with Mn-crusts	9,280	164,286	9,280	164,451	3060	2748	n	y	n	y
OFOS	28	Danger Islands Troughs	-	-	9,377	164,465	9,377	164,435	2987	4785	-	-	-	-
MUC	29	Danger Islands Troughs	sediment	-	9,279	164,391	9,279	164,392	4861	4854	-	-	y	-
MUC	30	Danger Islands Troughs	sediment	-	8,653	164,333	8,653	164,333	4925	4925	-	-	y	-
TVG	31	Danger Islands Troughs, third basin from N	half full	Volcanic rocks, Mn-crusts and nodules, sediments	8,530	164,391	8,530	164,391	2911	2911	y	y	y	y
DR	32	Danger Islands Troughs, where the two DITS are overlapping	?	several rocks of possible magmatic and volcanic origin	8,744	164,241	8,749	164,234	4650	3779	y	n	n	y
DR	33	Danger Islands Troughs, middle trough	1/4 full	mainly volcaniclastic, few angular basalt clasts	8,324	163,784	8,259	163,776	3834	3429	y	y	n	y
DR	34	Danger Islands Troughs, middle trough	few rocks	several pieces of volcanic rocks, yellow volcaniclastic material and Mn crusts	8,184	163,728	8,185	163,721	3402	2853	y	n	n	y
DR	35	Danger Islands Troughs, northern trough	few rocks	Volcanic rocks, Mn-crusts and nodules, sediments	7,673	163,912	7,683	163,912	3829	3312	y	n	y	y
DR	36	Danger Islands Troughs, northern trough	few rocks	large bloc of yellowish volcaniclastics and pillow basalt fragments	7,496	163,851	7,487	163,846	4009	3538	y	n	n	y
DR	37	Danger Islands Troughs, northern trough	few rocks	two basalt clasts, huge yellow volcaniclastic bloc containing basalt fragments up to 25cm across	7,489	163,589	7,489	163,590	3126	159???	y	n	n	y
DR	38	Danger Islands Troughs, northern trough	1/8 full	Mostly sediment, but 1-2 pieces of volcanic rocks	7,318	163,695	7,314	163,688	4666	4077	y	n	y	n
DR	39	Northern Plateau	empty	-	5,266	165,444	5,270	165,442	3805	3226	-	-	-	-
DR	40	Northern Plateau	few rocks	subrounded sediment clasts	5,013	165,214	5,009	165,207	3555	3053	n	n	y	n
DR	41	Northern Plateau	3 pieces	two large pieces of probably pillow basalts and a sediment boulder	4,620	164,142	4,625	164,140	37873	3577	y	n	y	n
DR	42	Northern Plateau	1 piece	one small cobble of basalt encrusted with few cm Mn crust	4,792	163,807	4,794	163,799	3355	2913	y	n	n	n
DR	43	Northern Plateau	half full	Mn encrusted volcaniclastic material with enclosed basalt clasts	5,175	163,560	5,172	163,554	2270	1845	y	y	n	y
DR	44	Northern Plateau	empty	-	5,246	163,520	5,243	163,514	3342	2960	-	-	-	-
DR	45	Northern Plateau	almost full	all sedimentary material	5,620	164,531	5,612	164,528	2846	2405	n	y	y	n
DR	46	Northern Plateau	1/4 full	predominately Mn crusts plus 2 pieces of basalt and some volcaniclastic material	6,031	164,721	6,022	164,719	2862	2369	y	y	y	y
DR	47	Ridge between Danger Islands Troughs and Northern Plateau	very few rocks	volcaniclastic material encrusted with Mn-crusts containing basalt clasts	6,708	164,171	6,703	164,165	4046	3491	y	y	n	y
DR	48	NE edge of Western Plateau between DITS and Western Plateau	1/10 full	Predominantly volcanic rocks, probably basalt and some volcaniclastic material encrusted with Mn crust	6,726	164,184	6,717	164,181	4910	4325	y	y	n	y

Appendix I (Rock Sampling Summary)

Type	Station	Location	total volume	Rock summary	on bottom lat long	off bottom lat long	depth (m) max min	Mag Mn Sed rock	Volcani- clastic
DR	49	Danger Islands Troughs, NE edge of Western Plateau	few rocks	all sedimentary material	6,918 163,747	6,915 163,740	4715 4063	n n y	n
DR	50	Danger Islands Troughs, NE edge of Western Plateau	1/4 full	Mn crusts and solidified sediments	6,827 163,737	6,820 163,735	2978 2473	n n y	n
DR	51	Danger Islands Troughs, northern margin of High Plateau	empty		6,808 163,496	6,818 163,492	4554 3934	- - -	-
DR	52	Danger Islands Troughs, northern margin of High Plateau	few rocks	Big block of pillow basalt with glass and several small basalt pieces	6,773 163,395	6,781 163,393	5368 4824	y n n	n
DR	53	Danger Islands Troughs, northern margin of High Plateau	3 pieces	three cobbles, probably basaltic	6,754 163,143	6,763 163,142	5485 4877	y n n	n
DR	54	Danger Islands Troughs, northern margin of High Plateau	few rocks	mostly Mn crusts and few angular fist sized basaltic rocks	6,675 162,740	6,683 162,734	5350 4760	y n n	n
DR	55	NE rift, seamount between High Plateau and Northern Plateau	few rocks	all magmatic rocks with flow top breccia	5,967 162,767	5,974 162,764	2403 1949	y n n	n
DR	56	Seamount N of DITS at NE rift	few rocks	two big blocks of pillow basalt plus several small pieces of volcanic rocks	5,980 162,731	5,978 162,727	1698 1433	y n n	y
DR	57	Seamount N of DITS at NE rift	3 pieces	three small angular pieces of basaltic rock	5,870 162,239	5,869 162,242	2300 1505	y n n	n
DR	58	NE rift at southern part of presumed spreading ridge	1/3 full	predominantly volcaniclastic material, basalt clasts and fragments of pillow basalt, some with altered chilled margin	5,850 161,860	5,858 161,853	3452 2969	y y n	y
DR	59	NE-SW trending ridge structure, N of High Plateau	3/4 full	fragments of pillow basalts with altered chilled margin and some volcanoclastic material	6,809 161,260	6,817 161,256	3662 3269	y y n	y
DR	60	NE-SW trending ridge structure, N of High Plateau	few rocks	one piece of Mn crust and a fish	7,048 161,771	7,045 161,762	3142 2565	n y n	n
DR	61	High Plateau	few rocks	one large piece of Mn crust (20 cm thick) containing volcanoclastic material	7,248 161,829	7,244 161,823	1939 1737	n y n	y
DR	62	High Plateau at N-S trending ridge	few rocks	angular basalt cobble	7,386 161,896	7,383 161,889	3442 3021	y n n	n
DR	63	High Plateau	1/12 full	mixture of volcanic rocks and volcaniclastics plus some carbonate aggregates; probably reflecting slope debris	7,717 161,948	7,715 161,940	2558 2099	y n n	y
TVG	64	High Plateau at N-S trending ridge, top of the southern seamount	almost empty	some sediment	8,301 161,770	8,301 161,769	975 976	n n y	n
DR	65	High Plateau at N-S trending ridge, top of the southern seamount	few rocks	Mn encrusted basalt fragments	8,289 161,869	8,291 161,862	1780 1351	y n n	n
DR	66	High Plateau at N-S trending ridge, top of the southern seamount	empty	dreigde got stuck, weak link broken	8,318 161,854	8,318 161,854	1964 1575	- - -	-
DR	67	High Plateau, seamount chain W of N-S trending ridge	few rocks	Mn encrusted basalt fragments and pillows	8,564 162,297	8,557 162,288	1964 1575	y y y	n
DR	68	High Plateau, seamount chain W of N-S trending ridge	few rocks	Basaltic fragments and some volcanoclastic material	8,950 162,336	8,945 162,334	2455 1982	y y n	y

Appendix I (Rock Sampling Summary)

Type	Station	Location	total volume	Rock summary	on bottom lat long	off bottom lat long	depth (m) max min	Mag rock	Mn	Sed	Volcani- clastic
DR	69	High Plateau, seamount chain W of N-S trending ridge	1/2 full	large fragments of carbonate crust	8,976 162,302	8,972 162,294	2148 1769	n	n	y	n
MUC	70	Plane between 3rd and 4th seamount	filled with 1/3	sediment	9,211 162,209	9,211 162,209	3153	n	n	y	n
TVG	71	High Plateau on top of the 4th seamount	1/5 full	Mn nodules	9,500 162,074	9,500 162,074	1222 1223	y	y	n	n
DR	72	High Plateau, southernmost of the three solitaire interior seamounts	1/3 full	Mn crusts and one piece of basalt plus various biology	9,448 162,122	9,448 162,114	2323 1898	y	n	y	n
MUC	73	High Plateau, between southernmost solitaire seamount and Mt Eddie	filled with 1/3	sediment	9,970 161,819	9,970 161,819	3280 3280	n	n	y	n
TVG	74	NE flank of Manihiki Atoll	empty	basalt cobbles and hyaloclastite	10,341 160,992	10,341 160,988	1174 1389	-	-	-	-
DR	75	High Plateau, Manihiki Atoll	few rocks	-	10,514 160,964	10,508 160,962	2431 1950	y	n	n	y
TVG	76	Rakahanga, SE slope of Rakahanga Atoll	-	-	10,048 161,063	10,049 161,061	1474 1467	y	n	y	y
DR	77	Rakahanga Atoll, NW-slope	full	rounded basalt boulders and beach cobbles, volcanoclastic material, basalt breccias	9,953 161,176	9,955 161,165	3372 2682	y	n	n	y
DR	78	High Plateau, NE-margin	few rocks	two pieces of basalt, encrustet with Mn, several pieces of Mn-crust	9,843 160,584	9,855 160,579	3499 3150	y	y	n	n
DR	79	NE of Rakahanga Atoll, NE-margin	3/4 full	pillow basalt fragment and volcanoclastic material. Some are encrusted with Mn-crust-boles like slope debris	9,557 160,124	9,565 160,121	2958 2548	y	?	y	y
DR	80	Manihiki Scarp, west facing slope of ridge	-	sediments and sedimentary breccias	10,856 160,624	10,859 160,616	4186 3791	n	y	y	n
DR	81	N of Manihiki Scarp	few rocks	two small fragments of highly altered basalt and several larger pieces of yellow volcanoclastics encrusted with few cm of Mn-crust	11,131 160,404	11,140 160,404	2845 2279	y	y	n	y
DR	82	Manihiki Scarp	1/4 full	Mn encrusted pillows and pillow fragments, carbonate breccias	11,241 160,817	11,249 160,814	2592 2138	y	n	y?	n
DR	83	Eastern Manihiki Scarp	almost empty	-	12,807 161,062	12,798 161,060	3268 2925	n	n	y	n
DR	84	Manihiki Scarp	1/6 full	variety of volcanic rocks and sediments encrusted with Mn crust	12,956 161,083	12,958 161,082	3663 3455	y	y	y	y
MUC	85	SE of High Plateau, directly W of Manihiki	empty	-	12,994 161,194	12,994 161,194	2870 2870	-	-	-	-
DR	86	Eastern Manihiki Scarp	1/3 full	mostly large boulders of lapilli-tuff and pillow basalt fragments	13,181 161,184	13,185 161,177	2704 2307	y	n	n	y
DR	87	Manihiki Scarp	1/5 full	solidified sediment boulders, Mn-encrusted breccias and a few rounded boulder of possible basaltic composition	13,055 161,127	13,048 161,125	3225 2842	y	n	y	y?
DR	88	Middle Manihiki Scarp	3/4 full	variety of magmatic rocks and probably volcanoclastic material	13,671 160,769	13,659 161,770	5477 5127	y	n	n	n
OFOS	89	Manihiki Scarp	-	-	13,696 161,467	13,710 161,450	3521 4792	-	-	-	-

Appendix I (Rock Sampling Summary)

Type	Station	Location	total volume	Rock summary	on bottom lat long	off bottom lat long	depth (m) max min	Mag Mn rock	Sed	Volcani- clastic	
DR	90	Manihiki Scarp	few rocks	one basalt and some volcanoclastica encrusted with Mn crusts	13,696 161,455	13,686 161,452	4237 3979	y y	n n	y y	
DR	91	Manihiki Scarp	few rocks	several small blocks and cobbles of brownish altered basalt partly encrusted with few cm of Mn crust	13,858 161,571	13,848 161,570	4617 4239	y y	n n	n n	
DR	92	Seamount S of High Plateau	1 piece	Mn crust	14,200 162,214	14,197 162,207	2458 1992	n y	n n	n n	
DR	93	Same seamount as DR92	1/6 full	Mn encrusted pillow, several basalt cobbles, breccia and several pieces of carbonate	14,225 162,197	14,228 162,188	1823 1323	y y	y y	y y	
DR	94	Southern margin of High Plateau	1/4 full	Large block of Mn crust with sediment attached and several smaller boulder of sediments	14,510 162,702	14,504 162,695	5050 4452	n y	y y	n n	
MUC	95	High Plateau, southern margin, W of Suvorov	empty	-	13,217 163,531	13,217 163,531	3937 3937	- -	- -	- -	
DR	96	Samoa Basin, seamount S of Nassau Atoll	1/3 full	volcanic rocks and volcanoclastic material, partly encrusted with few cm Mn crust	13,026 165,266	13,015 165,262	5033 4439	y n	n n	n n	
DR	97	Samoa Basin, seamount SW of Danger Islands	1/5 full	carbonate boulders	12,489 166,408	12,480 166,405	2199 1672	n y	n n	n n	
DR	98	Samoa Basin, seamount SW of Danger Islands	very few rocks	two small pieces of pillow basalt Mn encrusted but one side freshly broken, one altered basalt fragment and a basalt breccia encrusted with Mn crust	12,498 166,525	12,500 166,519	3144 2960	y n	n n	n n	
DR	99	Samoa Basin, seamount SW of Danger Islands	very few rocks	three pieces of Mn encrusted sedimentary rock and one piece with lithoclasts	12,661 167,282	12,653 167,276	4544 4019	n y	y y	y y?	
MUC	100	Samoa Basin W of Iris Seamount	8 tubes filled	brown clay like sediments	12,751 167,662	12,751 167,662	5506 5505	n n	n y	n n	
Total:								58	35	37	37

DR Stations: 82
TVG Stations: 8
MUC Stations: 8
OFOS Tracks: 2

Appendix II (Rock Description)

SO193 - DR1											
SW corner of Western Plateau; southern slope of the ridge at Plateau edge; slope possible presents a scarp of a slope failure/landslide. Dredge on bottom UTC 22/05/07 0855hrs, lat 10°48.52'S, long 168°44.75'W, depth 4063m Dredge off bottom UTC 22/05/07 1010hrs, lat 10°47.96'S, long 168°44.82'W, depth 3672m total volume: few; Mn-encrusted sediment boulders; yellow to brownish sediment Comments: no bites											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR1-1	1. Rock Type: 5 samples of compacted sediment 2. Size: max. 15cm diameter 3. Shape/Angularity: 4 angular, 1 rounded 4. Encrustation: black Mn-crusts, thickness up to 20mm 5. Colour: yellow-brownish									Y	

SO193 - DR2											
SW corner of Western Plateau; lower slope of NS-trending ridge Dredge on bottom UTC 23/05/07 1644hrs, lat 10°38.35'S, long 168°30.56'W, depth 4777m Dredge off bottom UTC 23/05/07 1807hrs, lat 10°37.97'S, long 168°30.80'W, depth 4380m total volume: few crusts; very little Mn-crusts Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR2-1	1. Rock Type: few very little Mn-crusts									Y	

SO193 - DR3											
SW corner of Western Plateau; upper small cone NW of NS-trending ridge Dredge on bottom UTC 23/05/07 2133hrs, lat 10°37.26'S, long 168°33.06'W, depth 3596m Dredge off bottom UTC 23/05/07 2247hrs, lat 10°37.32'S, long 168°33.20'W, depth 3310m total volume: 1/3 full; Mn-encrusted lava fragments from talus deposit + volcanoclastic material Comments: 1 bite (tension: 6.4t)											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR3-1	1. Rock Type: basalt-tephrite? 2. Size: 16.5x7x7cm 3. Shape/Angularity: slightly rounded 4. Encrustation: 0.5cm Mn-crust 5. Vesicularity: slightly vesicular 6. Vesicle Fillings: white, yellow, greenish fillings (up to 2mm) 7. Matrix Colour: grey-brownish matrix 8. Primary Minerals: olivine (diameter: up to 2mm, iddingsided), feldspar (diameter: 1-2mm) 9. Secondary Minerals: calcite, zeolithe 10. Overall Degree of Alteration: moderately altered	Y	Y								
DR3-2	1. Rock Type: basalt 2. Size: 9x8x2.5cm 3. Shape/Angularity: slightly rounded 4. Encrustation: 1cm Mn-crust 5. Vesicularity: slightly, moderate vesicular 6. Vesicle Fillings: white, yellow, greenish (up to 5mm) 7. Matrix Colour: dark grey-brownish 8. Primary Minerals: olivine (diameter: <1mm), feldspar (diameter: <1mm) 9. Secondary Minerals: calcite, ± zeolithe 10. Overall Degree of Alteration: moderately altered	Y	Y								
DR3-3	1. Rock Type: basalt 2. Size: 9x8x7cm 3. Shape/Angularity: moderately rounded 4. Encrustation: few cm Mn-crust 5. Vesicularity: slightly vesicular 6. Vesicle Fillings: white, yellow, greenish fillings (up to 1.5mm) 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: olivine (diameter: up to 5mm, --> iddingsided); feldspar? 9. Secondary Minerals: calcite, zeolithe 10. Overall Degree of Alteration: slightly-moderately altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR3-4	1. Rock Type: basalt 2. Size: 8x6x6cm 3. Shape/Angularity: moderately rounded 4. Encrustation: several cm of Mn-crust 5. Vesicularity: slightly-moderately vesicular 6. Vesicle Fillings: white, yellow, greenish 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: olivine (diameter: up to 5mm, --> iddingsided) 9. Secondary Minerals: calcite, zeolithe 10. Overall Degree of Alteration: moderately altered	Y	Y								
DR3-5	1. Rock Type: basalt 2. Size: 10x9x6cm 3. Shape/Angularity: moderately rounded 4. Encrustation: few cm Mn-crust 5. Vesicularity: moderately vesicular 6. Vesicle Fillings: white, yellow, greenish to brownish 7. Matrix Colour: dark grey-brownish 8. Primary Minerals: olivine (diameter: up to 5mm) 9. Secondary Minerals: calcite, zeolithe 10. Overall Degree of Alteration: moderately altered	Y	Y								
DR3-6	1. Rock Type: basalt 2. Size: 10x7x6cm 3. Shape/Angularity: slightly rounded 4. Encrustation: Mn-crust, 10mm thick 5. Vesicularity: slightly to moderately vesicular 6. Vesicle Fillings: brown, white, greenish fillings 7. Matrix Colour: dark grey-brownish 8. Primary Minerals: olivine (diameter: up to 5mm), feldspar? 9. Secondary Minerals: calcite, zeolithe 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y								
DR3-7	1. Rock Type: basalt 2. Size: 15x10x8cm 3. Shape/Angularity: round 4. Encrustation: 15mm Mn-crust 5. Vesicularity: slightly to moderately vesicular 6. Vesicle Fillings: brown, white, greenish 7. Matrix Colour: grey 8. Primary Minerals: olivine (diameter: up to 7mm), feldspar? 9. Secondary Minerals: calcite, zeolithe 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y								
DR3-8	see DR3-9 6. Vesicle Fillings: vesicles are not completely filled, 20-30% open	Y	Y		Y						
DR3-9	1. Rock Type: basalt fragment 2. Size: 10x10x8cm 3. Shape/Angularity: subrounded-rounded 4. Encrustation: 3mm Mn-crust 5. Vesicularity: filled vesicles, amount: 5%, diameter: 0.5-1mm 6. Vesicle Fillings: calcite? zeolithe? 7. Matrix Colour: grey to brown 8. Primary Minerals: olivine (diameter: 3-4mm, completely altered, amount: 15%) 9. Secondary Minerals: iddingsite, calcite? zeolithe? 10. Overall Degree of Alteration: strongly altered	Y	Y								
DR3-10	1. Rock Type: basalt clasts (4 pieces), all phyric, similar to DR3-8 & DR3-9 2. Size: <10x10x10cm 3. Shape/Angularity: rounded 4. Encrustation: 0.5-1cm Mn-crust 5. Vesicularity: amount: 5%, diameter: <1mm 6. Vesicle Fillings: filled with white mineral, calcite, zeolithe 7. Matrix Colour: dark grey to brown 8. Primary Minerals: olivine (altered, diameter: 3-4mm, amount: 10%) 9. Secondary Minerals: iddingsite, calcite, zeolithes 10. Overall Degree of Alteration: very strongly altered				Y						not good for geochemistry; all pieces taken as sample

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR3-11	<ol style="list-style-type: none"> 1. Rock Type: basalt, light coloration may indicate more evolved composition 2. Size: 10x10x10cm 3. Shape/Angularity: round 4. Encrustation: <0.5mm Mn-crust 5. Vesicularity: dense, amount: <1% 6. Vesicle Filling: not clear 7. Mtrix Colour: light grey to green 8. Primary Minerals: olivine (diameter: 2-3mm, amount: 4%, altered to iddingsite and green smectite), feldspar (amount: <1%, ±ok) 9. Secondary Mineral: see 8. 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR3-12	<ol style="list-style-type: none"> 1. Rock Type: basalt, aphyrric 2. Size: 8x8x8cm 3. Shape/Angularity: round 4. Encrustation: 5mm Mn-crust 5. Vesicularity: amount: 3% 6. Vesicle Fillings: smectite filling 7. Matrix Colour: dark grey 8. Primary Minerals: aphyrric 9. Secondary Minerals: smectite 10. Overall Degree of Alteration: strongly altered 	Y	Y								
DR3-13	<ol style="list-style-type: none"> 1. Rock Type: basalt, aphyrric, sample taken from a volcanoclastic breccia 2. Size: 17x11cm 3. Shape/Angularity: round 4. Encrustation: Mn-crust: <0.1cm, carbonate crust: 1mm 5. Vesicularity: amount: <5% 6. Vesicle Fillings: dark grey, not completely filled, diameter: <1.5mm 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR3-14	<ol style="list-style-type: none"> 1. Rock Type: volcanoclastica 2. Size: 12x5cm 3. Shape/Angularity: round 4. Encrustation: 0.4-1.5cm Mn-crust 5. Colour: matrix: grey, yellow, black; clasts: black, green 6. Internal Structure: - 7. Texture a) Clasts: size of clasts: diameter: <1cm, amount: 5% b) Matrix: - 8. Overall Degree of Alteration: - 							Y			reference sample IFM-Geomar
DR3-15	<ol style="list-style-type: none"> 1. Rock Type: volcanoclastica 2. Size: 20x11x10cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust, 8-10mm thick 5. Colour: matrix yellow grey 6. Internal Structure: - 7. Texture a) Clasts: diameter: 0.5-2.5cm, amount: 60% b) Matrix: - 8. Overall Degree of Alteration: - 							Y			reference sample IFM-Geomar
DR3-16	<ol style="list-style-type: none"> 1. Rock Type: rounded Mn-nodule 2. Size: 18x10x8cm 									Y	
DR3-17	<ol style="list-style-type: none"> 1. Rock Type: Mn-crust 2. Size: 22x9x6cm 									Y	

Appendix II (Rock Description)

SO193 - DR4											
Western Plateau, westernmost seamount; southern slope of cone located at southern rim of volcanic ridge											
Dredge on bottom UTC 23/05/07 0740hrs, lat 9°49.50'S, long 168°43.28'W, depth 2928m											
Dredge off bottom UTC 23/05/07 1126hrs, lat 9°49.55'S, long 168°43.34'W, depth 2940m											
total volume: few rocks and crusts; basalt clast with Mn-coating but no Mn-crusts; yellow rocks of light vesicular material; most material in the dredge contained clast clasts of sulfur-yellow material; highly vesicular with round open vesicles; core of the biggest clast (size: 50x50cm) contains dark vesicular clast (volcanic); not clear whether this represents volcanoclastic rock											
Comments: dredge got stuck at 2900 m wire length (max. tension: 9,4t), after appr. 2h dredge was relieved by vessel at starting point; 2x max. tension: 14t --> safety wire crushed and exchanged											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR4-1	1. Rock Type: basalt clast 2. Size: 8x5x5cm 3. Shape/Angularity: subangular 4. Encrustation: <1mm Mn-crust 5. Vesicularity: amount: 20%, diameter: <0.3mm 6. Vesicle Fillings: white mineral, calcite 7. Matrix Colour: brownish-grey matrix 8. Primary Minerals: no phenocrysts visible except minor totally olivine 9. Secondary Minerals: - 10. Overall Degree of Alteration: very strongly altered basalt	Y	Y		Y						
DR4-2	1. Rock Type: basalt clast 2. Size: 8x6x8cm 3. Shape/Angularity: rounded 4. Encrustation: - 5. Vesicularity: amount: 15%, diameter: up to several mm 6. Vesicle Fillings: 5mm vesicles filled with calcite, zeolithe? 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: phenocrysts not visible or preserved 9. Secondary Minerals: - 10. Overall Degree of Alteration: very strongly altered vesicular basalt	Y			Y						geochemistry: no cut sample available --> too small
DR4-3	similar to DR4-2 10. Overall Degree of Alteration: more altered than DR4-2				Y						sample useless for geochemistry & dating
DR4-4	1. Rock Type: basalt clast 2. Size: 30x30cm 3. Shape/Angularity: subangular 4. Encrustation: - 5. Vesicularity: highly vesicular, amount: 40% 6. Vesicle Fillings: calcite; outer rim partly without filled vesicles 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: very strongly altered vesicular basalt	Y	Y		Y						chemistry?
DR4-5	1. Rock Type: volcanic clast 2. Size: 50x50cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: highly vesicular, round vesicles 6. Vesicle Fillings: open 7. Matrix Colour: dark? 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -										2 pieces for reference IFM-GEOMAR; most material in the dredge contained clasts of sulfur - yellow material; core of the biggest clast (size: 50x50cm) contains dark vesicular clast (volcanic); not clear whether this represents volcanoclastic rock
DR4-6	1. Rock Type: carbonate; looks like dead coral 2. Size: 6x6x6cm 3. Shape/Angularity: rounded										

Appendix II (Rock Description)

SO193 - DR5											
Western Plateau; westernmost seamount, northern ridge structure, NW-facing slope of shallowest cone											
Dredge on bottom UTC 24/05/07 1541hrs, lat 9°42.88'S, long 168°46.43'W, depth 2861m											
Dredge off bottom UTC 24/05/07 1655hrs, lat 9°43.12'S, long 168°46.01'W, depth 2440m											
total volume: 1/3 full; 2 large pillows, several rocks of volcanoclastic material, Mn-crusts											
Comment: at first 200m of heaving several bites (tension: 4-6t), then bites between 6-8t tension											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR5-1	1. Rock Type: pillow basalt 2. Size: 3 pieces, ≤14x11x8cm 3. Shape/Angularity: angular 4. Encrustation: ≤2mm Mn-crust 5. Vesicularity: amount: 5%, diameter: up to 5mm 6. Vesicle Fillings: few are partly filled with calcite, zeolithe? 7. Matrix Colour: dark grey - slightly brownish 8. Primary Minerals: olivine (amount: <1%, altered, diameter: <1mm) 9. Secondary Minerals: iddingsite, zeolithe 10. Overall Degree of Alteration: fairly fresh	Y	Y				Y				archive sample: DR5-1x, same as DR5-1; two pieces, size: ≤17x13x11cm
DR5-2	1. Rock Type: pillow basalt 2. Size: 2 pieces; ≤16x12x10cm 3. Shape/Angularity: angular 4. Encrustation: ~1mm Mn-crust 5. Vesicles: amount: 5-10%; diameter: >1cm 6. Vesicle Fillings: few % filled with zeolithes; coatings 7. Matrix Colour: dark grey - slightly brownish 8. Primary Minerals: olivine (amount: <1%, altered, diameter: <1mm) 9. Secondary Minerals: iddingsite, zeolithes (increasing towards the rim) 10. Overall Degree of Alteration: fairly fresh	Y	Y				Y				archive sample: DR5-2x, same as DR5-2; two pieces, size: ≤18x18x13cm
DR5-3	1. Rock Type: basalt fragment 2. Size: 13x14x8cm 3. Shape/Angularity: subangular 4. Encrustation: <1mm Mn-crust (coating) 5. Vesicles: amount: 5-8%; diameter: ≤1cm 6. Vesicle Fillings: partly filled with calcite, zeolithes 7. Matrix Colour: dark grey - slightly brownish 8. Primary Minerals: olivine (amount: <1%, altered, diameter: <1mm); feldspar microliths (±ok) 9. Secondary Minerals: iddingsite, zeolithes, calcite, smectite 10. Overall Degree of Alteration: slightly altered	Y	Y								
DR5-4	1. Rock Type: basalt fragment 2. Size: 10x11x6cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicles: amount: 30-40%, diameter: ≤3mm 6. Vesicle Fillings: calcite, zeolithes in vesicles 7. Matrix Colour: dark grey - brownish 8. Primary Minerals: olivine (amount: 1-5%, altered, diameter: <1mm); feldspar microliths 9. Secondary Minerals: iddingsite, zeolithe, calcite, smectite 10. Overall Degree of Alteration: slightly altered	Y	Y								
DR5-5	1. Rock Type: volcanoclastic fragments 2. Size: 2 pieces ≤15x10x5cm; clasts: ≤2cm 3. Shape/Angularity: subangular 4. Encrustation: 1.5cm Mn-crust 5. Vesicularity: no vesicles 6. Vesicle Fillings: - 7. Matrix Colour: yellow - ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: ?							Y		Y	reference sample IFM-GEOMAR
DR5-6	similar to DR5-5 1. Rock Type: volcanoclastic fragment 2. Size: 17x13x8cm									Y	
DR5-7x	similar to DR5-3; one piece 2. Size: ≤18x18x13cm; but different sample						Y				archive sample
DR5-8x	similar to DR5-3; one piece 2. Size: ≤18x18x13cm; but different sample						Y				archive sample

Appendix II (Rock Description)

SO193 - DR8 SW end of the Western Plateau; northeastern cone of NE-SW-trending Foram-Seamount Dredge on bottom UTC 25/05/07 0640hrs, lat 9°16.33'S, long 168°00.49'W, depth 3012m Dredge off bottom UTC 25/05/07 0749hrs, lat 9°16.63'S, long 168°00.15'W, depth 2747m total volume: one very small piece of basalt; highly vesicular basalt piece Comments: two bites (tension: 7t)											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR8-1	1. Rock Type: basalt 2. Size: 4x5x5cm 3. Shape/Angularity: subrounded 4. Encrustation: no coatings 5. Vesicularity: amount: 15%, diameter: 0.5-2mm 6. Vesicle Fillings: mostly filled with orange - light brown material (dolomite?) 7. Matrix Colour: - 8. Primary Minerals: not visible 9. Secondary Minerals: orange - light brown material (dolomite?) 10. Overall Degree of Alteration: strongly altered	Y	Y								piece for geochemistry: uncut, because too small
SO193 - DR9 Western Plateau; Foram-Seamount, 2 miles SW of DR8. NW-facing slope of cone situated on northern boundary of the seamount Dredge on bottom UTC 25/05/07 1025hrs, lat 9°16.96'S, long 168°2.16'W, depth 2860m Dredge off bottom UTC 25/05/07 1134hrs, lat 9°17.28'S, long 168°1.51'W, depth 2780m total volume: full; pillows, Mn-crusts, volcanoclastic material Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR9-1	1. Rock Type: pillow fragment 2. Size: original size: diameter 40-50cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust, 3-4cm thick 5. Vesicularity: amount: 5-10%, diameter: ranging from 1.5-15mm, reflecting radial variation within pillow 6. Vesicle Filling: mostly filled with calcite, if open: lined with foram ooze or unknown secondary minerals 7. Matrix Colour: dark grey 8. Primary Minerals: abundant plag-laths (needles) within the matrix (amount: ~20%, size: ~1mm long & 0.3mm thick, appears fresh) olivine (amount: <5%, altered, size: 1-2mm) 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered plag phyrriic vesicular basalt	Y	Y		Y		Y				archive sample: 3 pieces of sample DR9-1x, size all: 30x30x30cm
DR9-2	similar to DR9-1 5. Vesicularity: less vesicles than DR9-1, <<5% 6. Vesicle Filling: vesicles are mostly unfilled 7. Matrix Colour: dark grey 8. Primary Minerals: in contrast to DR9-1 plag-microphenocrysts are <<1mm & olivines are <<0.5mm; both phenocryst phases are less abundant 10. Overall Degree of Alteration: medium to strongly altered basalt	Y	Y		Y						this is probably the best sample for geochemistry
DR9-3	similar to DR9-1 1. Rock Type: basalt, this piece comes from large pillow, diameter: 1m 8. Primary Minerals: feldspar microphenocrysts (amount: ~3%, diameter: 1-2mm) olivine (amount: 2%, completely altered, diameter: 2-3mm) 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR9-4	1. Rock Type: two pieces of Mn-crust 2. Size: original size: 20x20cm, ~4cm thick									Y	
DR9-5	not existing, because # was not distributed by mistake										
DR9-6	1. Rock Type: volcanoclastic material, consisting of highly vesicular pumice 2. Size: - 3. Shape/Angularity: - 4. Encrustation: Mn-crust 5. Vesicularity: - 6. Vesicle Filling: diameter: 0.5-1mm, open 7. Matrix Colour: yellow --> may reflect palagonitization 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -							Y			reference sample for IFM-GEOMAR

Appendix II (Rock Description)

SO193 - DR12
Western Plateau, cone at NW base of seamount, probably formed at late stage
Dredge on bottom UTC 26/05/07 1157hrs, lat 10°10.21'S, long 165°59.68'W, depth 3330m
Dredge off bottom UTC 26/05/07 1415hrs, lat 10°10.24'S, long 165°59.63'W, depth 3200m
total volume: empty dredge, there was probably a huge rock blocking the dredge and fell of at 1000m when tension suddenly dropped from 2t --> 1t
Comments: max. wire length: 3650m; during first 100s of m several bites of up to 7t tension, dredge got stuck at a wore length of 3560m at ca. 12:45. After 3 tries of lowering 50m handover to bridge. Dredge was relieved by vessel in 100 m distance from starting point. During heaving at 1000m sudden tension relief from 2t to <1t

SO193 - DR13
Western Plateau, NW flank of seamount, NW of the SW arm of the Danger Islands Trough
Dredge on bottom UTC 27/05/07 0020hrs, lat 10°34.88'S, long 165°16.36'W, depth 3740m
Dredge off bottom UTC 27/05/07 0130hrs, lat 10°35.17'S, long 165°16.14'W, depth 3471m
total volume: 1/8 full; basalt, Mn-crusts, volcanoclastica
Comments: no bites

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR13-1	1. Rock Type: basalt fragment 2. Size: 22x12x11cm 3. Shape/Angularity: angular 4. Encrustation: black Mn-coating 5. Vesicularity: amount: ~10%, diameter: up to 1mm 6. Vesicle Filling: along rim filled with Cc 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: 1-2%, diameter: ≤0.5mm) 9. Secondary Minerals: iddingsite, Cc 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR13-2	1. Rock Type: basalt fragment 2. Size: 10x9x4cm 3. Shape/Angularity: subangular 4. Encrustation: black Mn-coating 5. Vesicularity: amount: 10-15%, diameter: ≤2mm 6. Vesicle Fillings: along rim filled with Cc 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: 1-2%, diameter: ≤0.5mm) 9. Secondary Minerals: iddingsite, Cc 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR13-3	1. Rock Type: basalt fragment _ out of breccia? 2. Size: 18x14x11cm 3. Shape/Angularity: subangular-subrounded 4. Encrustation: Mn-crust, 0.5-4cm thick 5. Vesicularity: amount: ~10%, diameter: ≤0.2mm 6. Vesicle Fillings: mostly filled with Cc 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: ~1%, diameter: ≤0.5mm), feldspar (suitable for age dating, looks fresh, diameter: ≤0.2mm, amount: <1%) 9. Secondary Minerals: iddingsite, Cc 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR13-4	1. Rock Type: basalt fragment 2. Size: 9x6x7cm 3. Shape/Angularity: subangular 4. Encrustation: black Mn-coating 5. Vesicularity: amount: ~30%, diameter: ≤4mm 6. Vesicle Fillings: zeolithes, Cc? partly black coating 7. Matrix Colour: dark grey, brownish 8. Primary Minerals: olivine (altered, amount: <1%, diameter: ≤0.5mm) 9. Secondary Minerals: iddingsite, zeolithe 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR13-5	1. Rock Type: basalt fragment from breccia 2. Size: 11x4x5cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating, up to 0.8mm; crust of volcanoclastic rocks + Mn 5. Vesicularity: amount: varies, up to 40% in some parts, diameter: ≤1mm 6. Vesicle Fillings: brownish coatings, black coatings 7. Matrix Colour: grey 8. Primary Minerals: olivine (altered, amount: 2-5%, diameter: ≤0.5mm) 9. Secondary Minerals: iddingsite; see DR13-6 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR13-6	1. Rock Type: basalt clasts in volcanoclastic breccia 2. Size: up to 3x2cm (clasts) 3. Shape/Angularity: angular clasts 4. Encrustation: - 5. Vesicularity: highly vesicular 6. Vesicle Fillings: - 7. Matrix Colour: dark grey-brown 8. Primary Minerals: olivine (diameter: <<0.5mm) 9. Secondary Minerals: ? 10. Overall Degree of Alteration: slightly-strongly altered (clasts)				Y			Y			reference sample IFM-GEOMAR
DR13-7	1. Rock Type: Mn-crust									Y	
DR13-8	1. Rock Type: Mn-crust									Y	
DR13-9	1. Rock Type: Mn-crust, 3 pieces of reference samples				Y						reference sample

SO193 - DR 14

Suvorov Trough, near SE end of the Suvorov Trough, SW-facing slope of eastern scarp

Dredge on bottom UTC 30/05/07 2120hrs, lat 11°27,73'S, long 163°27,04'W, depth 3970m

Dredge off bottom UTC 30/05/07 2220hrs, lat 11°27,72'S, long 163°27,00'W, depth 3651m

total volume: several insitu samples, look like sedimentary rocks, well compacted

Comments: bite of 9.6t of tension

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR14-1	1. Rock Type: sediment 2. Size: 12x10x9cm 3. Shape/Angularity: angular 4. Encrustation: few mm of Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brownish to ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -				Y						reference sample IFM-GEOMAR
DR14-2	1. Rock Type: sediment 2. Size: 8x8x7cm 3. Shape/Angularity: slightly rounded 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Filling: - 7. Matrix Colour: brown to ocre 8. Primary Minerals: - 9. Secondary Minerals: calcite (in veins) 10. Overall Degree of Alteration: -				Y						reference sample IFM-GEOMAR

SO193 - DR 15

Suvorov Trough, about 13miles from DR14. SW-facing slope of eastern scarp

Dredge on bottom UTC 30/05/07 0142hrs, lat 11°28,87'S, long 163°26,31'W, depth 3940m

Dredge off bottom UTC 30/05/07 0225hrs, lat 11°28,84'S, long 163°26,25'W, depth 3650m

total volume: almost empty, a few pieces of sedimentary rocks

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR15-1	1. Rock Type: sediment 2. Size: 10x8x4.5cm 3. Shape/Angularity: angular 4. Encrustation: few mm Mn-crust 5. Colour: brown to ocre				Y						

Appendix II (Rock Description)

SO193 - DR 16											
Suvorov Trough, near mid Suvorov Trough, nose-structure, SW flank											
Dredge on bottom UTC 31/05/07 0740hrs, lat 11°17,08'S, long 163°33,85'W, depth 4295m											
Dredge off bottom UTC 31/05/07 0910hrs, lat 11°16,51'S, long 163°33,34'W, depth 3617m											
total volume: few rocks; solidified Mn-encrusted sediment; no volcanics											
Comments: end point at 3625m depth, 11°16.56'S, 163°33.41'W; max. wire length: 4600m. During first 500m several bites of up to 9t tension. 1x bite with a tension of 10t. at 7t tension dredge relieved.											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR16-1	1. Rock Type: sediment 2. Size: 18x9x11cm 3. Shape/Angularity: angular 4. Encrustation: <1cm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown to grey matrix with greenish clasts 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -				Y						
DR16-2	1. Rock Type: sediment 2. Size: 12x9x14cm 3. Shape/Angularity: angular 4. Encrustation: few mm Mn-crust				Y						
DR16-3	1. Rock Type: Mn-crust									Y	

SO193 - DR 17											
Suvorov Trough, central area, SW-facing slope of eastern scarp											
Dredge on bottom UTC 31/05/07 1659hrs, lat 10°50,49'S, long 163°51,35'W, depth 4447m											
Dredge off bottom UTC 31/05/07 1825hrs, lat 10°50,35'S, long 163°50,82'W, depth 3966m											
total volume: few crusts; sediments covered with Mn-crust											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR17-1	1. Rock Type: sediment (clastic) 2. Size: 20x13x11cm 3. Shape/Angularity: angular 4. Encrustation: 2.5cm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: red brown, ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: ?				Y						reference sample IFM-GEOMAR
DR17-2	1. Rock Type: sediment 2. Size: 10x9x8cm 3. Shape/Angularity: rounded 4. Encrustation: few mm of Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: red brown 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: ?				Y						reference sample IFM-GEOMAR
DR17-3	1. Rock Type: sediment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: 3.5cm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -									Y	

Appendix II (Rock Description)

SO193 - DR 18											
Suvorov Trough, central area, mid Suvorov Trough, upper western flank of the EW-trending ridge structure											
Dredge on bottom UTC 01/06/07 0203hrs, lat 10°39,28'S, long 163°52,68'W, depth 3360m											
Dredge off bottom UTC 01/06/07 0315hrs, lat 10°39,31'S, long 163°52,19'W, depth 2764m											
total volume: 1/5 full; several blocks of ultramafic (?) volcanic rocks											
Comment: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR18-1	<p>1. Rock Type: cobble of magmatic rock, very heavy This rock represents an ultramafic to mafic rock, possibly picrit of mafic gabbro or dike. There is no obvious criteria to determine whether this is a volcanic or intrusive rock.</p> <p>2. Size: 10x5x8cm</p> <p>3. Shape/Angularity: subangular</p> <p>4. Encrustation: very minor Mn-coating on outside of piece</p> <p>5. Vesicularity: no vesicles visible</p> <p>6. Vesicle Fillings: -</p> <p>7. Matrix Colour: light grey, fresh</p> <p>8. Primary Minerals: abundant fresh olivine (amount: 15%, diameter: <1mm, some larger aggregates up to 3mm) --> saved cuttings for mineral separation of olivine pyroxene (amount: <1%, diameter: <0.5mm)</p> <p>9. Secondary Minerals: no secondary minerals in cut rock</p> <p>10. Overall Degree of Alteration: no alteration visible in cut rock</p>	Y	Y								
DR18-2	<p>1. Rock Type: block of magmatic rock, also very heavy due to abundant olivine; medium altered picritic? basalt</p> <p>2. Size: 30x30cm</p> <p>3. Shape/Angularity: subangular to angular</p> <p>4. Encrustation: on the outside the sample is covered with <1mm Mn-crust</p> <p>5. Vesicularity: amount: 2%, diameter: 1mm; vesicles are not evenly distributed, may reflect zonation within lava flow</p> <p>6. Vesicle Fillings: filled with Cc- or Fe-hydroxide</p> <p>7. Matrix Colour: grey, fine-grained, appears fresh</p> <p>8. Primary Minerals: olivine (amount: 5-10%, average diameter: 1mm, mostly altered to iddingsite, but in places still fresh)</p> <p>9. Secondary Minerals: iddingsite, Cc, Fe-hydroxide</p> <p>10. Overall Degree of Alteration: -</p>	Y	Y		Y						
DR18-3	<p>very similar to DR18-2</p> <p>2. Size: 8x8cm</p> <p>3. Shape/Angularity: subangula</p> <p>8. Primary Minerals: more fresh olivine than DR18-2</p>	Y	Y								
DR18-4	<p>similar to sample DR18-2 and DR18-3</p> <p>2. Size: 10x10cm</p> <p>3. Shape/Angularity: subangular</p> <p>5. Vesicularity: 3%, Ø 1mm</p> <p>6. Vesicle Fillings: vesicles are unfilled</p> <p>7. Matrix Colour: light grey</p> <p>8. Primary Minerals: olivine (amount: 5%, completely altered)</p> <p>10. Overall Degree of Alteration: matrix still fresh</p>	Y	Y								
DR18-4B	see DR18-4 but separate piece	Y	Y								
DR18-5	<p>see sample DR18-4</p> <p>8. Primary Minerals: slightly more olivine</p>	Y	Y								
DR18-6A	<p>1. Rock Type: vesicular volcanoclastica, most of the dredge contained this type of rock</p> <p>2. Size: -</p> <p>3. Shape/Angularity: -</p> <p>4. Encrustation: -</p> <p>5. Vesicularity: amount: 10-20%, diameter: <1mm</p> <p>6. Vesicle Fillings: for the most part unfilled, where filled _ Mn (black) or Cc (white)</p> <p>7. Matrix Colour: orange-brown (ocre)</p> <p>8. Primary Minerals: in contrast to previous sample no olivine visible</p> <p>9. Secondary Minerals: no secondary minerals macroscopically visible</p> <p>10. Overall Degree of Alteration: completely altered</p>	Y	Y								
DR18-6B	<p>similar to DR18-6A</p> <p>5. Vesicularity: vesiclés are slightly bigger (1-2mm) than in DR18-6A</p> <p>8. Primary Minerals: in the less altered parts olivine is still visible, but 100% altered</p> <p>10. Overall Degree of Alteration: this piece is less pervasively altered than DR18-6A. The less altered parts are similar to sample DR18-2 to DR18-5</p>	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR18-7	1. Rock Type: serpentinite breccia, occurring as rounded clasts, this group of serpentinite breccias appear to be clast supported, total ca. 7 clasts 2. Size: <10x10cm (clasts), serpentinite clasts range from 1mm to several cm 3. Shape/Angularity: serpentinite clasts are angular 4. Encrustation: no encrustation, at places minor Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: serpentinite clasts are dark green 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y (total 6 pieces)			Y						
DR18-8	similar to sample DR18-7 except for 5-10mm thick anhydrite or gypsum veins cutting irregularly through serpentinite breccia, total: 3 clasts	Y (not from vein material)			Y						
DR18-9	1. Rock Type: block of vesicular basalt 2. Size: 40x40cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, 1cm thick 5. Vesicularity: amount:10-15%, diameter: 1-2mm 6. Vesicle Fillings: in places open, but for the most part filled with Mn and a white mineral --> possibly Cc 7. Matrix Colour: light grey, appears fresh in 1-2mm scale 8. Primary Minerals: olivine (totally altered, amount: <2%, diameter: <1mm, unevenly distributed --> sorting within cooling lava unit?) 9. Secondary Minerals: see vesicle filling 10. Overall Degree of Alteration: medium to strongly altered basalt	Y	Y		Y 2x						
DR18-10	similar to DR18-6A 5. Vesicle Fillings: vesicles are filled with Cc	Y	Y		Y 1x						
DR18-11x	3 pieces of totally altered vesicular basalt similar to DR18-6A and DR18-10						Y				archive sample

SO193 - DR19

Suvorov Trough, mid Suvorov Trough, upper western flank of the NW-SE trending ridge-like structure

Dredge on bottom UTC 01/06/07 0743hrs, lat 10°34.42'S, long 163°55.51'W, depth 3645m

Dredge off bottom UTC 01/06/07 0851hrs, lat 10°34.12'S, long 163°55.08'W, depth 3124m

total volume: 1/2 full, lots of solidified sediment boulders, light brown, dark brown, and red. Few magmatic rocks as angular boulders mixed within the sediments. Dredge probably sampled talus deposit

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR19-1	1. Rock Type: volcanic ? clast 2. Size: 20x20x8cm 3. Shape/Angularity: subangular 4. Encrustation: thin <0.5mm Mn-coating 5. Vesicularity: no round vesicles, but irregular shaped amygdules, amount: ~3%, diameter: 1-4mm 6. Vesicle Fillings: some filled with black material (Mn?); some filled with yellow material and lined with Mn; dark red mineral occurs as round shaped filling ? possibly Fe-oxyhydroxide (amount: ~1%) 7. Matrix Colour: light purple 8. Primary Minerals: dark red mineral? --> see 6. 9. Secondary Minerals: dark red mineral? --> see 6. 10. Overall Degree of Alteration: matrix appears medium altered; medium altered volcanic rock	Y	Y								
DR19-2	similar to sample DR19-1 2. Size: 30x30x30cm 3. Shape/Angularity: radial mineral shape 5. Vesicularity: this sample has irregular shaped vesicles, diameter: from 1mm up to 15mm 6. Vesicle Fillings: filled with white zeolithe 10. Overall Degree of Alteration: overall sample is more strongly altered than sample DR19-1	Y	Y		Y 1x						
DR19-3	similar to sample DR19-1 2. Size: 25x25x5cm 7. Matrix Colour: yellowish-brown 10. Overall Degree of Alteration: strongly altered	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR19-4	1. Rock Type: 3 pieces of rounded highly vesicular volcanic rock 2. Size: 10x10x10cm 3. Shape/Angularity: rounded 4. Encrustation: thin Mn-coating 5. Vesicularity: highly vesicular, very irregularly shaped vesicles, amount: 10-15%, diameter: 1-15mm 6. Vesicle Fillings: 30% open or partially filled with white to yellow material 7. Matrix Colour: brown 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: matrix totally altered to clay, extremely altered vesicular basalt	Y	Y		Y 1x						
DR19-5	see sample DR19-2, serves as backup 2. Size: 10x8x5cm 3. Shape/Angularity: subangular	Y			Y 1x						
DR19-6	see sample DR19-2 2. Size: 40x40x10cm 10. Overall Degree of Alteration: slightly less altered than DR19-2	Y			Y 2x						
DR19-7	similar to sample DR19-1 to DR19-3 1. Rock Type: ca. 10 pieces of rock 2. Size: diameter: <8cm serves as backup				Y 1x						
DR19-8	1. Rock Type: pieces of solidified red deep-sea clay				Y						
DR19-9	1. Rock Type: piece of solidified yellow-brown clay				Y						

SO193 - DR20

Danger Island Trough, Triple Junction; southern flank of upper seamount structure within DIT and ST

Dredge on bottom UTC 01/06/07 2328hrs, lat 10°21.30'S, long 164°47.14'W, depth 3377m

Dredge off bottom UTC 02/06/07 0047hrs, lat 10°20.70'S, long 164°47.01'W, depth 2959m

total volume: 1/8 full; several rocks of volcanoclastic material with fragments of basaltic rocks - looks like flow debris

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR20-1	1. Rock Type: basalt fragment 2. Size: 13x9x8cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: amount: ~10%; diameter: ≤2mm 6. Vesicle Fillings: partly filled with Cc, smectite and Mn-coatings 7. Matrix Colour: dark grey - brownish 8. Primary Minerals: olivine (amount: <1%, diameter: ≤1mm, altered) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR20-2	1. Rock Type: basalt fragment 2. Size: 12x11x5cm 3. Shape/Angularity: subrounded 4. Encrustation: few mm Mn-coating 5. Vesicularity: amount: ~5%, diameter: ≤5mm 6. Vesicle Fillings: partly filled with Cc, zeolithe 7. Matrix Colour: dark grey - brownish 8. Primary Minerals: olivine (amount: ~20%, diameter: ≤2mm, altered) 9. Secondary Minerals: iddingsite, smectite, Cc, zeolithe 10. Overall Degree of Alteration: moderately altered --> looks similar to DR20-1, but more olivine	Y	Y		Y						
DR20-3	similar to DR20-3, but out of breccia 1. Rock Type: basalt fragment out of volcanic breccia 2. Size: 7x13x7cm 3. Shape/Angularity: subangular	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR20-4	1. Rock Type: volcanoclastic breccia, looks like altered pumice, compacted with Cc 2. Size: 17x8x10cm 3. Shape/Angularity: angular 4. Encrustation: none 5. Vesicularity: pumice is highly vesicular 6. Vesicle Filling: partly filled with Cc, zeolithe, Mn-coatings 7. Matrix Colour: greenish - yellow 8. Primary Minerals: ? 9. Secondary Minerals: zeolithe, Cc 10. Overall Degree of Alteration: altered	Y			Y						
DR20-5	similar to DR20-4, but bigger fragment with black veins 1. Rock Type: pumice fragment with black veins 2. Size: 8x4x6cm				Y						
DR20-6	similar to DR20-1 and DR20-2 1. Rock Type: severals pieces of basalt 2. Size: ≤10x7x5cm				Y						taken as backup
DR20-7	1. Rock Type: Mn-crust 2. Size: 4.5cm									Y	
DR20-8	1. Rock Type: piece with ~5cm Mn-crust 2. Size: ~5cm									Y	

SO193 - DR21

Triple Junction area; volcano on western half of Danger Islands Trough, opposite of DR20

Dredge on bottom UTC 02/06/07 1651hrs, lat 10°15.94'S, long 165°02.83'W, depth 3835m

Dredge off bottom UTC 02/06/07 1825hrs, lat 10°15.55'S, long 165°02.55'W, depth 3380m

total volume: 1/3 - 1/4 full; lots of various volcanic rocks, probably slope debris

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR21-1A	1. Rock Type: basalt fragment 2. Size: ~9x7x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: amount: 10%, diameter: ≤1mm 6. Vesicle Fillings: Cc; along the rim partly filled with black coating; zeolithe 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: 5%, diameter: ≤2mm, altered) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR21-1B	similar to DR21-1A 1. Rock Type: basalt fragment 2. Size: 15x9x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: amount: 5-10%, diameter: ≤1mm 6. Vesicle Fillings: Cc; zeolithe 7. Matrix Colour: grey-brownish 8. Primary Minerals: olivine (amount: 2-3%, diameter: ≤2mm, altered) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: more altered than DR21-1A	Y	Y		Y						
DR21-2A	1. Rock Type: basalt fragment 2. Size: 12x10x4cm 3. Shape/Angularity: subangular 4. Encrustation: 3mm Mn-crust 5. Vesicularity: amount: ~2%, diameter: up to 1mm 6. Vesicle Fillings: Cc (also as thin veins), zeolithe 7. Matrix Colour: slightly darker than DR21-1A 8. Primary Minerals: olivine (amount: ~1%, diameter: ≤1mm, altered) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: altered	Y	Y		Y						
DR21-2B	1. Rock Type: basalt fragment 2. Size: 8x10x4cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating 5. Vesicularity: amount: 2%, diameter: ≤1mm 6. Vesicle Fillings: Cc, zeolithe, Mn-coatings 7. Matrix Colour: grey - brownish 8. Primary Minerals: olivine (amount: ≤1%, diameter: ≤1mm, altered) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR21-3A	1. Rock Type: basalt fragment 2. Size: 7.5x6x3.5cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating 5. Vesicularity: amount: <1%, diameter: 1mm 6. Vesicle Fillings: Cc 7. Matrix Colour: grey - brownish 8. Primary Minerals: olivine (amount: ~1%, diameter: 1mm, altered) 9. Secondary Minerals: iddingsite, Cc, Mn-coatings within vesicles 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR21-3B	similar to DR21-3A 1. Rock Type: basalt fragment 2. Size: 6.5x6x4cm 3. Shape/Angularity: subrounded 10. Overall Degree of Alteration: more altered than DR21-3A				Y						
DR21-3C	similar to DR21-3A and DR21-3B 1. Rock Type: basalt fragment 2. Size: 8x5x5cm 3. Shape/Angularity: subrounded 10. Overall Degree of Alteration: also strongly altered with brown veins				Y						
DR21-4A	1. Rock Type: basalt fragment 2. Size: 12x6x6cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: <1%, diameter: ≤1mm 6. Vesicle Fillings: Cc, Mn-coating 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: ≤2%, diameter: ≤2mm, altered) 9. Secondary Minerals: iddingsite, Cc, Mn-coating 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						several pieces have been taken as backup
DR21-4B	similar to DR21-4A, but got Mn- and Cc-veins 1. Rock Type: basalt fragment 2. Size: 11x4x6cm 3. Shape/Angularity: subrounded 10. Overall Degree of Alteration: more altered than DR21-4A	Y	Y		Y						several pieces have been taken as backup
DR21-5A	1. Rock Type: basalt fragment 2. Size: 9x7x7cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating 5. Vesicularity: amount: 2-3%, diameter: ≤1mm 6. Vesicle Fillings: Cc, Mn-veins 7. Matrix Colour: grey - brownish 8. Primary Minerals: olivine (amount: ~10%, altered, diameter: <2mm) 9. Secondary Minerals: zeolithes, Cc, Mn-veins 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR21-5B	similar to DR21-5A 1. Rock Type: basalt fragment 2. Size: 13x13x9cm 3. Shape/Angularity: subrounded 10. Overall Degree of Alteration: more altered than DR21-5A	Y	Y		Y						
DR21-6A	1. Rock Type: basalt fragment 2. Size: 10x8x7cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating; partly thin Mn-crust ≤1mm 5. Vesicularity: amount: 10-15%, diameter: ≤5mm 6. Vesicle Fillings: Cc, smectite, ± zeolithes? 7. Matrix Colour: grey - slightly brownish 8. Primary Minerals: olivine (amount: ~10%, altered, diameter: ≤2mm) 9. Secondary Minerals: iddingsite, Mn, Cc veins, Cc, smectite, zeolithe 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR21-6B	similar to DR21-6A 1. Rock Type: basalt fragment 2. Size: 7x6x5cm 3. Shape/Angularity: subrounded 8. Primary Minerals: less olivine 10. Overall Degree of Alteration: strongly altered				Y						several pieces have been taken as backup

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR21-7	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 9x9x5cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating 5. Vesicularity: amount: 15-20%; diameter: ≤2-5mm 6. Vesicle Fillings: partly filled with Smectite and Mn-coatings 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: ~2%, altered, diameter: ≤1mm) 9. Secondary Minerals: iddingsite, Smectite, Mn-coating 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR21-8	<ol style="list-style-type: none"> 1. Rock Type: 3 pieces of basalt fragments 2. Size: - 3. Shape/Angularity: subrounded to rounded 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown - ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: highly altered 				Y						for alteration studies
DR21-9	<ol style="list-style-type: none"> 1. Rock Type: chert sample + one piece of altered basalt with broad green rim and red-brown colour 2. Size: 9x7.5x2cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: white - bright brown 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: fairly fresh 				Y						
DR21-10	<ol style="list-style-type: none"> 1. Rock Type: 3 pieces of basalt fragments 2. Size: - 3. Shape/Angularity: subrounded 4. Encrustation: few mm of Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: partly the rim shows green colour, overall colour is red - brown 8. Primary Minerals: - 9. Secondary Minerals: various veins of Cc and Mn-coating 10. Overall Degree of Alteration: totally altered 				Y						
DR21-11x	<ol style="list-style-type: none"> 1. Rock Type: several pieces of basalt fragments 2. Size: - 3. Shape/Angularity: subrounded - rounded 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: altered 						Y				archive sample
DR21-12x	<ol style="list-style-type: none"> 1. Rock Type: piece out of boulder showing different degrees of alteration within the piece 						Y				archive sample

Appendix II (Rock Description)

SO193 - DR 22											
Triple Junction, volcanic edifice at eastern side of DITs (SW branch of DITs), west-facing slope beneath Plateau; Plateau is flat, but relatively small											
Dredge on bottom UTC 03/06/07 1007hrs, lat 10°6.20'S, long 164°40.58'W, depth 3519m											
Dredge off bottom UTC 03/06/07 1118hrs, lat 10°6.09'S, long 164°40.05'W, depth 3158m											
total volume: few rocks , Mn-crusts with greenish coarse grained sediment											
Comments: max. rope length 3900m											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR22-1	1. Rock Type: volcaniclastic material 2. Size: 10x10cm 3. Shape/Angularity: subrounded 4. Encrustation: 1cm thick Mn-crust 5. Vesicularity: no vesicles 6. Vesicle Fillings: - 7. Matrix Colour: green 8. Primary Minerals: medium grained green minerals (diameter: 1-3mm) --> really primary? 9. Secondary Minerals: - 10. Overall Degree of Alteration: -				Y			Y			reference sample for IFM-GEOMAR
DR22-2	1. Rock Type: Mn-crust 2. Size: 20x15x5cm 3. Shape/Angularity: - 4. Encrustation: 5cm thick									Y	

SO193 - DR 23											
Triple Junction area, western scarp of DITs, SE-trending flank											
Dredge on bottom UTC 04/06/07 0302hrs, lat 9°54.54'S, long 164°49.71'W, depth 4760m											
Dredge off bottom UTC 04/06/07 0445hrs, lat 9°54.02'S, long 164°49.86'W, depth 4283m											
total volume: few rocks Mn-encrusted, cobbles of possible magmatic origin											
Comments: one bite of 8.2t tension											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR23-1	1. Rock Type: basalt clast? small 2cm wide cataclastic zone on one side of geochemistry samples is filled with angular fragments _ samples were internally deformed 2. Size: 10x15x5cm 3. Shape/Angularity: subangular 4. Encrustation: ~5mm thick Mn-crust 5. Vesicularity: no vesicles 6. Vesicle Fillings: - 7. Matrix Colour: overall matrix is medium grey, but along veins stained to yellowish green 8. Primary Minerals: totally aphyric 9. Secondary Minerals: abundant veins are less than 0.5mm wide and filled with Cc; red Fe-hydroxides occur as dark red dots frequently at the intersection of veins 10. Overall Degree of Alteration: medium altered	Y	Y								check thin section whether this is really a magmatic rock
DR23-2	similar to sample DR23-1 1. Rock Type: basalt clast; <0.5mm veins dissect the sample in a regular geometry suggesting that the veins formed due to deformation 2. Size: 8x5cm 3. Shape/Angularity: rounded 4. Encrustation: up to 1cm Mn-crust 5. Vesicularity: dense, no vesicles 6. Vesicle Fillings: - 7. Matrix Colour: appears slightly more fresh than in sample DR23-1 and is light grey 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Overall Degree of Alteration: medium to weakly altered	Y	Y								
DR23-3	1. Rock Type: clast of fine-grained breccia; this rock could represent a fault breccia/cataclasite 2. Size: 5x5cm, clasts: range from 0.5 to 5mm 3. Shape/Angularity: subrounded 4. Encrustation: 1.5cm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: blueish to green matrix 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR23-4	<ol style="list-style-type: none"> 1. Rock Type: breccia clast 2. Size: 8x8cm, breccia clasts: range from 0.5cm to several cm 3. Shape/Angularity: - 4. Encrustation: 2cm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown 8. Primary Minerals: - 9. Secondary Minerals: abundant veins are up to 2mm wide and filled with calcite 10. Overall Degree of Alteration: matrix appears strongly weathered 	Y	Y								
DR23-5	<ol style="list-style-type: none"> 1. Rock Type: clast of aphyric rock, unclear whether this represents basalt 2. Size: 5x5cm 3. Shape/Angularity: - 4. Encrustation: 1cm thick Mn-crust 5. Vesicularity: dense matrix without vesicles 6. Vesicle Fillings: - 7. Matrix Colour: greenish - grey 8. Primary Minerals: aphyric matrix 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	Y	Y								thin section needed to determine the origin of this rock
DR23-6	<ol style="list-style-type: none"> 1. Rock Type: clast of fault ? breccia; chaotic assemblage of rock fragments; overall the rock resembles marble-like fault breccia 2. Size: 20x20cm; size of fragments: 1mm-3cm 3. Shape/Angularity: subrounded 4. Encrustation: 2-3cm thick Mn-crust 5. Colour: fragments are greenish-grey 6. Internal Structure: - 7. Texture a) Clasts: clasts appear matrix-supported b) Matrix: - 8. Overall Degree of Alteration: - 	Y	Y								
DR23-7	<p>similar to all other samples of this dredge it is not clear whether this sample was originally a magmatic rock</p> <ol style="list-style-type: none"> 1. Rock Type: clast recovered from Mn-encrusted breccia 2. Size: diameter: 4cm (clast) 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey, reddish discoloration in places 8. Primary Minerals: aphyric 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	Y			Y						

SO193 - DR 24

Triple Junction, SW-facing slope of volcanic cone on the eastern scarp of the NW Suvorov Trough

Dredge on bottom UTC 04/06/07 1344hrs, lat 9°48.714'S, long 164°17.578'W, depth 4236m

Dredge off bottom UTC 04/06/07 1507hrs, lat 9°48.377'S, long 164°17.124'W, depth 3511m

total volume: few rocks, sediment boulders light brown and red clay rich solidified sediments.

Comments: Dredge damaged because of material weakness; max. tension: 8.1t

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES	
DR24-1	<ol style="list-style-type: none"> 1. Rock Type: 2 pieces of slightly consolidated sandy sediment; in 5 smaller pieces (for HU) are relics of mussel shells, perhaps wood fragments and silica needles 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 											HU1-HU5/ HU-Berlin

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR24-2	<ol style="list-style-type: none"> 1. Rock Type: 3 pieces of consolidated clay-sand deposits, presumably representing slump sediments 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Colour: matrix: red-brownish to ocre 6. Internal Structure: decreasing grain size 7. Texture <ol style="list-style-type: none"> a) Clasts: - b) Matrix: - 8. Overall Degree of Alteration: - presumably fragments of slump deposits 				Y						reference sample IFM-GEOMAR
DR24-3	<ol style="list-style-type: none"> 1. Rock Type: 2 pieces of a slope breccia, including fragments from DR24-2, which presumably got consolidated 				Y						reference sample IFM-GEOMAR

SO193 - DR25

Danger Islands Troughs, southernmost Trough of the real DITs, western slope, lower part

Dredge on bottom UTC 05/06/07 0243hrs, lat 9°36.88'S, long 164°23.19'W, depth 4737m

Dredge off bottom UTC 05/06/07 0355hrs, lat 9°36.25'S, long 164°23.42'W, depth 4237m

total volume: 2 pieces, look like volcanic rocks

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR25-1	<ol style="list-style-type: none"> 1. Rock Type: rock fragment, probably volcanic origin? 2. Size: 10x6x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: numerous black round components which might represent vesicles, diameter <2mm, amount: 30% 6. Vesicle Fillings: ? black fillings 7. Matrix Colour: dark grey 8. Primary Minerals: white-greenish minerals, angular _ primary?, diameter: <2mm, amount: ca. 1% 9. Secondary Minerals: ? 10. Overall Degree of Alteration: slightly to moderately altered 	Y	Y								
DR25-2	<p>similar to DR25-1</p> <ol style="list-style-type: none"> 1. Rock Type: rock fragment, probably volcanic origin? 2. Size: 8x6x5cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: more altered than DR25-1 	Y	Y								

SO193 - DR26

Danger Islands Troughs, SW-facing slope of volcano on the east side of DITs, beneath flat Plateau in the middle

Dredge on bottom UTC 05/06/07 1455hrs, lat 9°22.75'S, long 164°16.05'W, depth 4025m

Dredge off bottom UTC 05/06/07 1635hrs, lat 9°22.41'S, long 164°15.62'W, depth 3367m

total volume: full, basalt cobbles and two pillows

Comments: max. wire length: 4400m at 3360m depth (UTC 15:42)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR26-1	<ol style="list-style-type: none"> 1. Rock Type: fragment of pillow basalt 2. Size: 60x40x25cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, approx. 2.5cm thick 5. Vesicularity: amount: up to 10% depending on the part of the rock 6. Vesicle Fillings: black filling, Cc?, zeolithe? 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 10-15%, diameter: up to 5mm, moderately fresh); pyroxene (amount: 2%, diameter <2mm, moderately altered) 9. Secondary Minerals: Cc, zeolithe 10. Overall Degree of Alteration: slightly to moderately altered, more altered few cm along the rim, many veins partly filled with zeolithe?; partly glass along the rim, up to 5cm 	Y	Y		Y	Y					

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR26-1x	see sample DR26-1						Y				archive sample
DR26-2	<ol style="list-style-type: none"> 1. Rock Type: pillow basalt 2. Size: 60x40x25cm 3. Shape/Angularity: angular 4. Encrustation: up to 8mm Mn-crust 5. Vesicularity: amount: ~15% 6. Vesicle Fillings: black coating, greenish coating 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: ~15%, diameter up to 5mm, slightly to moderately altered); pyroxene (amount: ~10%, diameter: <3mm, slightly altered) 9. Secondary Minerals: see 6. 10. Overall Degree of Alteration: slightly to moderately altered 	Y	Y		Y						
DR26-2x	see sample DR26-2						Y				archive sample
DR26-3	<p>similar to DR26-2</p> <ol style="list-style-type: none"> 1. Rock Type: pillow basalt 2. Size: 35x25x20cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: olivine (a little less than DR26-2, diameter: <3mm (smaller than DR26-2), moderately fresh) 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	Y	Y		Y						
DR26-3x	see sample DR26-3						Y				archive sample
DR26-4	<p>similar to DR26-2 and DR26-3</p> <ol style="list-style-type: none"> 1. Rock Type: pillow basalt; veins along the rim _ disrupted? 2. Size: 35x25x20cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: olivine (more altered than in DR26-2 and DR26-3), pyroxene (more altered than in DR26-2 and DR26-3) 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	Y	Y		Y						
DR26-4x	see sample DR26-4						Y				archive sample
DR26-5	<p>similar to DR26-1 to DR26-4</p> <ol style="list-style-type: none"> 1. Rock Type: brecciated basalt fragments 2. Size: 35x25x20cm 4. Encrustation: up to 2cm Mn-crust 	Y	Y								
DR26-5x	see sample DR26-5						Y				archive sample
DR26-6	<ol style="list-style-type: none"> 1. Rock Type: pillow basalt, fragmented breccia 2. Size: 35x35x20cm 3. Shape/Angularity: angular 4. Encrustation: up to 4cm Mn-crust 5. Vesicularity: amount: ~5% 6. Vesicle Fillings: black coating, greenish coating 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: 5%, diameter: <2mm, slightly altered); pyroxene (amount: 5-7%, diameter: <3mm, slightly altered) 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	Y	Y		Y						
DR26-6x	see sample DR26-6						Y				archive sample
DR26-7	<ol style="list-style-type: none"> 1. Rock type: part of pillow - seems to be a up to 10cm thick hyaloclastite with fresh glass 2. Size: 20x18x14cm 3. Shape/Angularity: angular boulder 4. Encrustation: 1-3cm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brownish, greenish and black 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	Y			Y						some parts of the glass are suitable for EMPA-analysis

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR26-8	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 14x10x8cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: ~5%, diameter: up to 1mm 6. Vesicle Fillings: partly filled with zeolithes and black Mn-coatings 7. Matrix Colour: dark grey 8. Primary Minerals: shows dendritic mineral structures --> primary?; olivine (amount: ~2%, diameter: <1.5mm, fresh) 9. Secondary Minerals: zeolithes 10. Overall Degree of Alteration: slightly altered 	Y	Y		Y						
DR26-9	<ol style="list-style-type: none"> 1. Rock Type: part of pillow basalt; the sample has ~2cm glass rim, which has been sampled 2. Size: 22x16x11cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: amount: ~15-20%, diameter: up to 4mm 6. Vesicle Fillings: partly filled with zeolithes and black fillings 7. Matrix Colour: dark grey 8. Primary Minerals: pyroxene (amount: ~5%, diameter: 2mm, fresh) 9. Secondary Minerals: several brown veins --> probably also consisting of zeolithe 10. Overall Degree of Alteration: moderately altered 	Y	Y	Y	Y						
DR26-10	<ol style="list-style-type: none"> 1. Rock Type: pillow fragment, olivine-basalt; 1.5cm thick chilled margin with partly fresh glass but also lots of palagonite 2. Size: originally 15x15cm 3. Shape/Angularity: subangular 4. Encrustation: 1.5cm thick chilled margin 5. Vesicularity: amount: 3%, diameter: <1mm 6. Vesicle Fillings: partly open, but mostly filled with secondary minerals 7. Matrix Colour: greyish - brown 8. Primary Minerals: olivine (amount: 5-7%, diameter: 1mm, altered); pyroxene (amount: <2%) 9. Secondary Minerals: - 10. Overall Degree of Alteration: medium altered 	Y			Y	Y check qua- lity in TS					chilled margin _ made 2x TS for EMP etc.; glass is most relevant
DR26-11	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, olivine phyric basalt 2. Size: 10x10cm 3. Shape/Angularity: relatively rounded 4. Encrustation: thin <0.5mm Mn-coating 5. Vesicularity: amount: 5-7%, diameter: <0.5mm 6. Vesicle Fillings: open in the inner part of sample; lined with secondary minerals; on outer margin vesicles are filled with calcite 7. Matrix Colour: dark grey 8. Primary Minerals: olivine: olivine (amount: 7-10%, relatively fresh olivine, diameter: 1-2mm); black minerals --> probably Cpx (amount: 2%, diameter: 1mm) 9. Secondary Minerals: calcite 10. Overall Degree of Alteration: weakly altered; matrix quite fresh 	Y	Y								
DR26-12	<ol style="list-style-type: none"> 1. Rock Type: pillow basalt fragment, olivine-basalt 2. Size: 20x20cm 3. Shape/Angularity: - 4. Encrustation: <1mm Mn-encrustation; 1cm thick glassy margin on one side of sample 5. Vesicularity: amount: 3-5%, diameter: 1mm 6. Vesicle Fillings: filled with white secondary minerals (zeolithes?, Cc?) 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 10%, diameter: 1-5mm, altered); clinopyroxene (diameter: small, <1mm) 9. Secondary Minerals: zeolithes?, Cc? 10. Overall Degree of Alteration: strongly altered; matrix appears fresh 	Y	Y		Y						glass for spot analysis; use glass for geochemistry made TS for spot analysis
DR26-13	<p>similar to DR26-12, without chilled margin or glass</p> <ol style="list-style-type: none"> 1. Rock Type: pillow basalt fragment 10. Overall Degree of Alteration: slightly fresh matrix 	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR26-14	<ol style="list-style-type: none"> 1. Rock Type: pillow fragment, basalt 2. Size: 20x20x10cm 3. Shape/Angularity: - 4. Encrustation: 2mm Mn-crust 5. Vesicularity: amount: 7-10% 6. Vesicle Fillings: mostly filled with black secondary material (Mn?); when open, lined with Mn 7. Matrix Colour: grey-brow 8. Primary Minerals: clinopyroxene (amount: <1%) 9. Secondary Minerals: - 10. Overall Degree of Alteration: very strongly altered; matrix overall strongly altered with altered 2cm chilled margin; may contain fresh glass; in contrast to other samples of this dredge no olivine visible 	Y			Y	check ts for fresh glass					chemistry might be possible on fresh glass, if present.
DR26-15	<p>similar to sample DR26-14 but without glassy margin Possibly good for geochemistry since sample differ from other by absence of olivine</p>	Y	Y								possibly good for geochemistry since sample differs from others by absence of olivine
DR26-16	<ol style="list-style-type: none"> 1. Rock Type: hyaloclastite cobble; containing several cm-sized oval black glass fragments; glass fragments are surrounded by palagonite layers 2. Size: 10x7x3cm 3. Shape/Angularity: oval shaped 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: 1-2mm thick calcite veins cross sample 10. Overall Degree of Alteration: - 	Y			Y	check TS for glass	Y			glass may be good for spot analysis	
DR26-17	<ol style="list-style-type: none"> 1. Rock Type: breccia cobble; matrix supported clasts appear amorphous 2. Size: 7x7cm; size of clasts varies from <1mm up to 2cm 3. Shape/Angularity: rounded; clasts mostly angular 4. Encrustation: - 5. Colour: white; clasts: most clasts have olive green colour 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: mostly angular and on the average 3-4mm in diameter b) Matrix: white sugary and could be calcite 8. Overall Degree of Alteration: - 	Y			Y						
DR26-18	<ol style="list-style-type: none"> 1. Rock Type: several pieces of serpentinite clasts; not clear whether this is really serpentinite; at least it is quite soft and fresh greasy 2. Size: - 3. Shape/Angularity: clasts: rounded 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Colour: clasts: olive green 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 	ts not possible, need special saw			Y						check TS in order to determine mineralogy
DR 26-19	<p>similar to sample 26-18</p> <ol style="list-style-type: none"> 1. Rock Type: breccia clast; clast supported; clasts are mostly altered olivine basalt; one clast is serpentinite 2. Size: 20x20x10cm; diameter of clasts: 4-5cm 3. Shape/Angularity: clasts are angular 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: clasts contain olivine 9. Secondary Minerals: - 10. Overall Degree of Alteration: clasts are mostly altered olivine basalt 				Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR26-20	1. Rock Type: 3 different basalt cobbles 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: altered to different degrees				Y						reference samples for possible alteration study

SO193 - DR27

Danger Islands Troughs, SW-facing slope further up section from DR26, 3000-2400m. About 5nm north, testing internal variation in age and composition within the "stratiraohv"

Dredge on bottom UTC 05/06/07 2035hrs, lat 9°16.81'S, long 164°17.13'W, depth 3010m

Dredge off bottom UTC 05/06/07 2220hrs, lat 9°16.82'S, long 164°17.07'W, depth 2748m

total volume: 4 pieces, volcanoclastic material with clasts of volcanic rock, covered with Mn-crust

Comments: Dredge got stuck. 3 bites were around 9.8t. Off-bottom position not the same, ship was moved to pull out the dredge

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR27-1	1. Rock Type: tuff 2. Size: - 3. Shape/Angularity: - 4. Encrustation: 1.5cm Mn-crust 5. Vesicularity: highly vesicular, amount: 30%, diameter: 0.5-2mm 6. Vesicle Fillings: unfilled when freshly broken 7. Matrix Colour: reddish - brown --> oxidized --> subaerial deposition? 8. Primary Minerals: none visible 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered	Y			Y						questionable whether this sample works for geochemistry
DR27-2	1. Rock Type: block of coarse-grained sediment?; not clear what kind of rock this represents 2. Size: green grains: diameter 0.5-1mm 3. Shape/Angularity: green grains: angular 4. Encrustation: Mn-encrusted 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greenish 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y			Y						entire sample taken for reference

SO193 - TVG31

Danger Islands Troughs, third basin from north, volcanic (?) structure on northern part of W margin ± top area

Dredge on bottom UTC 06/06/07 2312hrs, lat 8°31.77'S, long 164°23.47'W, depth 2911m

Dredge off bottom UTC 06/06/07 2328hrs, lat 8°31.77'S, long 164°23.47'W, depth 2915m

total volume: half full, Rocks, Mn-crusts and nodules, sediments

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
TVG31-1	1. Rock Type: basalt fragment out of breccia; looks like front breccia 2. Size: 50x35x20cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust up to 3cm 5. Vesicularity: amount: 15-20%, diameter: <2mm 6. Vesicle Fillings: Cc, zeolithes? 7. Matrix Colour: dark grey-brownish 8. Primary Minerals: olivine (diameter: <0.4mm, altered, amount: ~2%); pyroxene (size: <4mm, fairly fresh, amount: ~1%) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: many veins filled with Cc, strongly altered	Y	Y		Y						
TVG31-1x	several pieces						Y				archive sample

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
TVG31-2	1. Rock Type: basalt fragment 2. Size: 12.5x9x7cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-crust up to 3cm 5. Vesicularity: amount: ~10%, diameter: up to 2mm 6. Vesicle Fillings: Cc, zeolithe 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: ~5%, diameter: up to 4mm); green mineral (altered, diameter: up to 5mm), feldspar-microlithes? (amount: ~2%) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: strongly altered, many veins filled with Cc, zeolithe, Mn	Y	Y		Y						
TVG31-2x							Y				archive sample
TVG31-3	1. Rock Type: basalt fragment 2. Size: 10x8x8cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-crust up to 2cm 5. Vesicularity: amount: ~40%, diameter: up to 8mm 6. Vesicle Fillings: Cc, zeolithe? 7. Matrix Colour: dark grey-brownish 8. Primary Minerals: olivine (amount: 3-5%, altered, diameter: <5mm); pyroxene (amount: ~3%, slightly altered, diameter: <5mm) 9. Secondary Minerals: iddingsite, Cc, zeolithe 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
TVG31-4	1. Rock Type: breccia with basalt fragments, volcanoclastic? 2. Size: 38x25x17cm, basalt fragments: ~2x1.5cm 3. Shape/Angularity: angular - subangular 4. Encrustation: Mn-crust up to 0.5cm 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greenish 8. Primary Minerals: pyroxene; olivine (altered)?, feldspar? 9. Secondary Minerals: - 10. Overall Degree of Alteration: basalt fragments partly strongly altered	Y			Y						
TVG31-5	1. Rock Type: breccia with basalt fragments --> volcanoclastic? 2. Size: 10x8x9cm, basalt fragments: 2.5x2cm 3. Shape/Angularity: basalt fragments: angular 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greenish 8. Primary Minerals: basalt fragments: contains green mineral; matrix: palagonite? 9. Secondary Minerals: breccia: many veins filled with Cc? 10. Overall Degree of Alteration: -	Y			Y						
TVG31-6	1. Rock Type: Mn-crust									Y	
TVG31-7	1. Rock Type: Mn-crust									Y	

SO193-DR32

Danger Islands Troughs, lower flank with the seamount where the two DITs are overlapping

Dredge on bottom UTC 07/06/07 0405hrs lat 8°44.61'S, long 164°14.54'W, depth 4550m

Dredge off bottom UTC 07/06/07 0609hrs, lat 8°44.91'S, long 164°14.01'W, depth 3779m

total volume: some rocks

Comments: By mistake wrong track (appr. parallel to the slope). At 8°42.62'S and 164°14.24'W new direction: 140° (new depth: ca. 4400m)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR32-1	1. Rock Type: basalt fragment, single basalt layers with thin chilled margin 2. Size: 15x15x4cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 5%, diameter 1-5mm 6. Vesicle Fillings: greenish-yellow clay minerals? Cc? 7. Matrix Colour: dark grey 8. Primary Minerals: feldspar (diameter: <1mm, amount: ~1%); black minerals (pyroxene?, diameter: 0.5mm-1mm, amount: ~2%); metallic shining particles _may stem from sawing blade? 9. Secondary Minerals: - 10. Overall Degree of Alteration: medium-strongly altered	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR32-2	see sample DR32-1 2. Size: 5x5 cm 5. Vesicularity: amount: 2%, vesicles are smaller than sample DR32-1, diameter: 1-3mm 10. Overall Degree of Alteration: more altered than DR32-1	Y			Y						
DR32-3	1. Rock Type: pyroclastic (pumice) 2. Size: 10x15cm 3. Shape/Angularity: rounded 4. Encrustation: 5-10mm thick Mn-crust 5. Vesicularity: amount: 15-20%, diameter: 0.5-1mm 6. Vesicle Fillings: some vesicles are filled with Mn 7. Matrix Colour: yellow-greenish 8. Primary Minerals: brown minerals (primary or secondary?) _ ironhydroxide (amount: 2-3%, diameter: 0.5-3mm)? 9. Secondary Minerals: - 10. Overall Degree of Alteration:-	Y			Y			Y			
DR32-4	1. Rock Type: lapillituff with angular clasts 2. Size: 10x5cm, size of clasts: 5-20mm 3. Shape/Angularity: subangular 4. Encrustation: <1mm thick Mn-crust 5. Vesicularity: clasts contain vesicles, diameter: <1mm 6. Vesicle Fillings: vesicles of clasts are unfilled 7. Matrix Colour: yellow-greenish, clasts: brown to ocre 8. Primary Minerals: brown minerals _ Fe-hydroxide (size: 0.5mm up to 2mm, amount: 1-2%)? 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y			Y			Y			
DR32-5	see sample DR32-3 1. Rock Type: see sample DR32-3 with 1 vesicular clast 2. Size: 10x10x5cm; size of clast: diameter 2cm 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: <1%; clast vesicular 6. Matrix Fillings: - 7. Matrix Colour: slightly darker (--> more green); clast: brown 8. Primary Minerals: - 9. Secondary Minerals: red veins from 1cm up to several cm filled with unknown material 10. Overall Degree of Alteration: -	Y			Y						
DR32-6x	similar to sample DR32-3, DR32-4 and DR32-5 1. Rock Type: 6 (<10cm) clasts of yellowish volcanoclastics 2. Size: <10cm						Y				archive sample, kept for reference

SO193 - DR33

Danger Islands Troughs, eastern scarp in southern half of the Middle Trough. Map implies that the Plateau edge could be exposed here. No volcanic structure present at higher levels

Dredge on bottom UTC 07/06/07 1359hrs, lat 8°19.42'S, long 163°47.02'W, depth 3834 m

Dredge off bottom UTC 07/06/07 1511hrs, lat 8°19.54'S, long 163°46.57'W, depth 3429m

total volume: 1/4 full, mainly volcanoclastica, few small angular basalt clasts

Comments: max. wire length: 4150m

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR33-1	1. Rock Type: phyric basalt fragment 2. Size: original size less than 10cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 2%, diameter: 0.5mm-2mm 6. Vesicle Fillings: open vesicles for the most part, in places filled 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, diameter: 0.5-2mm, amount: 5%) 9. Secondary Minerals: 10. Overall Degree of Alteration: relatively fresh	Y	Y		Y						
DR33-2	see sample DR33- 1	Y	Y		Y						
DR33-3	see sample DR33-1 6. Vesicle Fillings: calcite, more vesicles are filled than in DR33-1 7. Matrix Colour: greyish to brown 10. Overall Degree of Alteration: slightly more altered than DR33-1	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR33-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: <10cm 3. Shape/Angularity: - 4. Encrustation: Mn-coating 5. Vesicularity: amount: 7%, diameter: 1-3mm 6. Vesicle Fillings: open, however lined with bright secondary minerals, Cc 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 8-10%, diameter: 0.5 to 3mm); feldspar-laths (amount: 3%, diameter: <3mm); pyroxene (green, amount: 2%, diameter: <1mm) 9. Secondary Minerals: Cc in vesicles, see 6. 10. Overall Degree of Alteration: medium altered basalt 	Y	Y		Y						
DR33-5	see sample 1	Y	Y		Y						
DR33-6	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: <10 cm 3. Shape/Angularity: - 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 3%, diameter: 0.5-2mm 6. Vesicle Fillings: Cc? clay minerals? 7. Matrix Colour: grey to brownish 8. Primary Minerals: olivine (amount: 1%, diameter: <1mm) 9. Secondary Minerals: - 10. Overall Degree of Alteration: medium to strongly altered 	Y	Y		Y						
DR33-7	<ol style="list-style-type: none"> 1. Rock Type: dense aphyric basalt fragment 2. Size: <6cm 3. Shape/Angularity: - 4. Encrustation: thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light grey --> matrix could be suitable for Ar/Ar-dating; matrix: microcrystalline and consisting of feldspar and pyroxene 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: appears relatively fresh --> slightly altered dolerite. 	Y			Y						matrix could be suitable for Ar/Ar-dating
DR33-8	<ol style="list-style-type: none"> 1. Rock Type: breccia (volcaniclastic?) 2. Size: 15x8x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: greenish pumice fragment: amount: 30-40% 6. Vesicle Fillings: vesicles in pumice fragment is partly filled with zeolithe? 7. Matrix Colour: - 8. Primary Minerals: olivines (along the rim, altered, diameter: up to 3mm) 9. Secondary Minerals: zeolithe, iddingsite? Many veins, filled with zeolithe and Mn 10. Overall Degree of Alteration: - 	Y			Y						
DR33-9	similar to DR33-8	Y			Y						
DR33-10	<ol style="list-style-type: none"> similar to DR33-8 and DR33 -9 4. Encrustation: Mn-crust up to 7mm 7. Matrix Colour: lighter colour than DR33-8 	Y			Y						
DR33-11	<ol style="list-style-type: none"> 1. Rock Type: fine-grained volcaniclastic material with small pumice fragments 2. Size: 10x9x8cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: brown minerals possible? 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR33-12	<ol style="list-style-type: none"> similar to sample DR33-8 7. Matrix Colour: lighter in colour than DR33-8 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR33-13	1. Rock Type: breccia (volcaniclastic?), pumice fragments in greenish matrix 2. Size: size of fragments ~2.5x1.5cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greenish 8. Primary Minerals: pumice contains altered olivine 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y			Y						
DR33-14	similar to DR33-8 1. Rock Type: piece of basalt next to a piece of breccia, volcaniclastic? 4. Encrustation: 4cm Mn-crust				Y						IFM-GEOMAR
DR33-15x	archive sample, several rock fragments						Y				archive sample
DR33-16x	1. Rock Type: basalt fragment 2. Size: size of rock fragment: 10x10x8cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: strongly vesicular, amount: 30-40%; diameter: up to 4mm 6. Vesicle Fillings: open vesicles along the rim, in the middle filled with calcite 7. Matrix Colour: - 8. Primary Minerals: olivine (altered, diameter: <3mm, amount: 3%) 9. Secondary Minerals: - 10. Overall Degree of Alteration: -						Y				archive sample
DR33-17	1. Rock Type: Mn-crust									Y	

SO193 - DR34

Danger Islands Troughs, map see DR33; west-facing slope (mid section) of volcanic structure on east side of Middle Trough, 8nm north of DR33

Dredge on bottom UTC 07/06/07 1902hrs, lat 8°11.05'S, long 163°43.69'W, depth 3402m

Dredge off bottom UTC 07/06/07 2016hrs, lat 8°11.10'S, long 163°43.25'W, depth 2853m

total volume: several volcaniclastic rocks and basalt fragments; several pieces of volcanic rocks and yellow volcanoclastic material and Mn-crusts

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR34-1	1. Rock Type: basalt fragment 2. Size: 19x12x7cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust up to 1cm thick 5. Vesicularity: amount: 1-2%, diameter: <2mm 6. Vesicle Fillings: none 7. Matrix Colour: dark grey-slightly brownish 8. Primary Minerals: light mineral _ plag-microlithes? _ sparkles; Microlithes (fine-grained)! 9. Secondary Minerals: brownish-green mineral, diameter <1mm; Cc? 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR34-2	1. Rock Type: basalt fragment 2. Size: 18x15x9cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-coating, partly Mn-crust up to 4mm 5. Vesicularity: amount: 2%, diameter: <4mm 6. Vesicle Fillings: partly zeolithes? partly none 7. Matrix Colour: dark grey-slightly brownish 8. Primary Minerals: olivine (slightly to moderately altered), microlithes 9. Secondary Minerals: iddingsite, zeolithes?, Cc? 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR34-3	1. Rock Type: basalt fragment, coarser-grained than DR34-1 und DR34-2 2. Size: 12x7.5x7cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating, partly Mn-crust up to 4mm 5. Vesicularity: ? 6. Vesicle Fillings: zeolithes, Cc 7. Matrix Colour: grey-brownish, partly black 8. Primary Minerals: microlithes, pyroxenes (black mineral?), olivine (greenish mineral) 9. Secondary Minerals: iddingsite + see 6. 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR34-4	1. Rock Type: basalt fragment 2. Size: 14x13x6cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating and Mn-crust up to 3cm 5. Vesicularity: amount: ~3-5%, diameter: <1mm 6. Vesicle Fillings: partly none, partly zeolithes? 7. Matrix Colour: grey-brownish 8. Primary Minerals: microlithes 9. Secondary Minerals: ? 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR34-5	1. Rock Type: basalt fragment (several pieces) 2. Size: all about 11x7x6cm 3. Shape/Angularity: most pieces angular, some subrounded 4. Encrustation: most pieces: Mn-coating; some pieces: Mn-crust up to 3mm 5. Vesicularity: amount: ~1%, diameter: <3mm 6. Vesicle Fillings: zeolithes? 7. Matrix Colour: dark grey to dark brown 8. Primary Minerals: green mineral 9. Secondary Minerals: zeolithes? 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						there are two different pieces for geochemistry and thin section (A+B)
DR34-5x							Y				archive sample
DR34-6	1. Rock Type: volcanoclastic material; several pieces 2. Size: about 9x7x6cm and smaller 3. Shape/Angularity: rounded 4. Encrustation: partly Mn-coating 5. Vesicularity: partly vesicular; diameter: <1mm, amount: ~30-40% 6. Vesicle Fillings: none 7. Matrix Colour: light green 8. Primary Minerals: olivine (strongly altered, diameter: <3 mm, amount: ~1-2%) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR34-7x							Y				archive sample

SO193 - DR35

Northern part of Danger Islands Troughs, northern flank of a small ridge-like structure on the flank of a seamount at the western flank of the DIT

Dredge on bottom UTC 08/06/07 0214hrs, lat 7°40.39'S, long 163°54.71' W, depth 3829m

Dredge off bottom UTC 08/06/07 0323hrs, lat 7°41.01'S, long 163°54.75'W, depth 3312m

total volume: ?

Comments: 1 bite of 7.5 t tension

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR35-1	1. Rock Type: basalt fragment 2. Size: 17x11x11cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust up to 1cm thick 5. Vesicularity: amount: 1-2%, diameter: <1mm 6. Vesicle Fillings: partly zeolithes, Cc? 7. Matrix Colour: dark grey 8. Primary Minerals: many white microlithes; olivine (relatively fresh, amount: ~10%, diameter: <1mm) 9. Secondary Minerals: Cc? zeolithes? 10. Overall Degree of Alteration: fairly fresh	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR35-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment (several pieces) 2. Size: 11x11x 9cm (all pieces about that size) 3. Shape/Angularity: angular 4. Encrustation: partly Mn- coating 5. Vesicularity: amount: ~1%, diameter: up to 0.5mm 6. Vesicle Fillings: none 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: microlithes (altered and brown) (black and not altered) 9. Secondary Minerals: ? (see 8.) 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						
DR35-2x							Y				archive sample
DR35-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment (several pieces) 2. Size: all about 12x9x5cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-crust up to 2mm 5. Vesicularity: amount: ~3%, diameter: up to 1mm 6. Vesicle Fillings: partly zeolithes? mostly none 7. Matrix Colour: brownish (dark) with zonations of lighter and darker colour; may be zonation of different alteration 8. Primary Minerals: microlithes; feldspar; all more altered than sample DR35-1 and sample DR35-2 9. Secondary Minerals: Cc, zeolithes 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						
DR35-3x							Y				archive sample
DR35-4	<ol style="list-style-type: none"> 1. Rock Type: fine-grained brownish sediment 2. Size: 17x11x11 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating, contains white minerals (diameter up to 1cm) 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 				Y						
DR35-5	<ol style="list-style-type: none"> 1. Rock Type: fine-grained greenish to ocre sediment; varying grain size within the sediments; several layers of chert (clay)-like sediments. 2. Size: 20x22x13cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greenish to ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 				Y						
DR35-6	<ol style="list-style-type: none"> 1. Rock Type: fine-grained light-greenish sediment, much finer than DR35-5 2. Size: - 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greenish 8. Primary Minerals: black and white minerals 9. Secondary Minerals: - 10. Overall Degree of Alteration: - 				Y						
DR35-7x							Y				archive sample

Appendix II (Rock Description)

SO193 - DR36											
Danger Islands Troughs, small cone between the middle and the northern DITs, in the west of main central seamount											
Dredge on bottom UTC 08/06/07 0751hrs, lat 7°29.73'S, long 163°51.07'W, depth 4009m											
Dredge off bottom UTC 80/06/07 0905hrs, lat 7°29.23'S, long 163°50.76'W, depth 3538m											
total volume: few rocks, large block of yellowish volcanoclastics + pillow basalt fragments											
Comments: Dredge got stuck at 4050m wire length, max. tension: 9.6t. After two tries of lowering dredge relieved. Afterwards several bites with atension of up to 6-9t.											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR36-1	1. Rock Type: basalt fragment 2. Size: 30x30cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 15%, diameter: 1-3mm 6. Vesicle Fillings: unfilled for the most part, in some areas filled with soft sediment 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, diameter: 0.5-2mm, amount: 3%); feldspar-laths (amount: 2%, diameter: <1mm) 9. Secondary Minerals: - 10. Overall Degree of Alteration: medium altered	Y	Y		Y						
DR36-2	see sample DR36-1 2. Size: 20x15cm 5. Vesicularity: more vesicles are filled with calcite and greenish clay minerals (?) than in DR36-1	Y	Y		Y						
DR36-3	see sample DR36-1 2. Size: 25x10cm 5. Vesicularity: larger vesicles than DR36-1, diameter: 1-5mm 8. Primary Minerals: olivine (amount: less than DR36-1, 1-2%)	Y	Y		Y						
DR36-4	1. Rock Type: breccia, yellow to greenish vesicular lapilli, several lithic fragments have basaltic composition 2. Size: 20x15cm 3. Shape/Angularity: subangular 4. Encrustation: 3 mm thick Mn-crust 5. Vesicularity: lapilli: amount: ~30%, diameter: <30mm, lithic fragments: amount: 15%, diameter: <1mm 6. Vesicle Fillings: vesicles in the matrix are filled with Mn and zeolithe, lithic fragments: unfilled 7. Matrix Colour: yellow-greenish, several lithic fragments are greyish-brown, lithic fragments are greyish-brown 8. Primary Minerals: brown minerals _ Fe-hydroxide ? (amount: 3-4%, diameter: 0.5 bis 2mm), lithic fragments: olivine (altered, diameter: 0.5 bis 2mm, amount: 1%) 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y			Y						
DR36-5x	similar to sample DR36-1 up to DR36-3 1. Rock Type: 12 basalt fragments 2. Size: ranging from diameter 5-20cm						Y				archive sample
DR36-6x							Y				archive sample

Appendix II (Rock Description)

SO193 - DR37											
Danger Islands Troughs, SW slope of volcano on eastern side of DITs. At the southernmost end of the Northern Trough											
Dredge on bottom UTC 08/06/07 1345hrs, lat 7°29.34'S, long 163°35.28'W, depth 3126m											
Dredge off bottom UTC 08/06/07 1550hrs, lat 7°29.31'S, long 163°35.37'W, depth 3175m											
total volume: few rocks; 2 basalt clasts, huge yellow volcanoclastic block, another volcanoclastic block contained Ø 25cm basalt fragment											
Comments: 4x 9-10t. UTC: 14:27, 14:31, 14:35, 14:39 --> dredge got stuck. Bridge took over at 14:40. dredge free 15:50.											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR37-1	1. Rock Type: basalt fragment, embedded as rounded clast in yellow volcanoclastic sediment 2. Size: 25x25cm 3. Shape/Angularity: subangular, clasts: rounded 4. Encrustation: - 5. Vesicularity: amount: 15-20%, diameter: 0.5-2mm, single vesicles 20mm 6. Vesicle Fillings: partly filled with unknown mineral (Cc or zeolithe?); open vesicles for the most part, in places filled with calcite 7. Matrix Colour: volcanoclastic sediment: yellow, basalt fragments: dark grey 8. Primary Minerals: olivine (amount: 3-4%, altered, diameter: 0.5-2mm); pyroxene (amount: 1%, surrounded by a green rim (secondary mineral?), diameter: 1-5 mm); feldspar (amount: <1%, diameter: <1-2mm, altered) 9. Secondary Minerals: see 6. and 8. 10. Overall Degree of Alteration: medium to strongly altered	Y	Y		Y						
DR37-2	see sample DR37-1 2. Size: 5x5cm 5. Vesicularity: less vesicles than DR37-1, 7% 8. Primary Minerals: olivine (amount: more than DR37-1, 5-6%)	Y	Y		Y						
DR37-3	see sample DR37-1 2. Size: 5x5cm 5. Vesicularity: less than DR37-1, 7% 8. Primary Minerals: olivine (more than DR37-1, amount: 5-6%)	Y	Y		Y						
DR37-4	1. Rock Type: breccia, brown vesicular lapilli 2. Size: 25x20cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: Lapilli: ~10%, diameter: 1-15mm 6. Vesicle Fillings: vesicles in lapilli are partly filled with Cc and green material (?) 7. Matrix Colour: breccia: yellow to greenish, Lapilli: brown 8. Primary Minerals: - 9. Secondary Minerals: Mn-spots in lapilli and matrix 10. Overall Degree of Alteration: -	Y			Y						
DR37-5x	similar to DR37-1 to DR37-3 1. Rock Type: 6 basalt fragments 2. Size: diameter ranging from <5cm to 20cm						Y				archive sample
DR37-6x	similar to DR37-1 to DR37-3 1. Rock Type: 1 breccia with basalt clasts 2. Size: 13x11x7cm; diameter basalt clasts: 4cm						Y				archive sample

SO193 - DR38											
DITs, West-facing slope of Eastern scarp at the Southeastern end of the Northern Trough											
Dredge on bottom UTC 08/06/07 2021hrs, lat 7°19.08'S, long 163°41.70'W, depth 4666m											
Dredge off bottom UTC 08/06/07 2123hrs, lat 7°18.83'S, long 163°41.28'W, depth 4077m											
total volume: 1/8 full; mostly sediment, but 1-2 small pieces of volcanic rock											
Comments: 1 bite with 7.1t tension											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR38-1	1. Rock Type: basalt fragment 2. Size: 6x5x4cm 3. Shape/Angularity: Subangular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: 3-5%; diameter: ≤1mm 6. Vesicle Fillings: Cc, zeolithes? 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: ~3%, altered, diameter: ≤2mm); Plg (amount: ~1%, diameter: ≤2mm); pyroxene? 9. Secondary Minerals: iddingsite, Cc, zeolithes? 10. Overall Degree of Alteration: moderately altered				Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR38-2	1. Rock Type: basalt fragment 2. Size: 9x7x4cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: <1%; diameter: ≤1mm 6. Vesicle Fillings: none 7. Matrix Colour: grey to brownish and dark green 8. Primary Minerals: olivine (amount: ~7%, strongly altered, diameter: ≤1mm) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR38-3	1. Rock Type: 3 pieces of sediment with dark red to brownish parts 2. Size: 35x20x18cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Colour: dark red o brownish --> red part looks like deep-sea clay 6. Internal Structure: decreasing grain size towards the top --> gradation 7. Texture: fine-grained 8. Overall Degree of Alteration: -				Y						
DR38-4	1. Rock Type: 3 pieces of sediment 2. Size: 20x18x10cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Colour: ocre 6. Internal Structure: - 7. Texture: fine-grained; sand-silt grain size, weak consolidated 8. Overall Degree of Alteration: -				Y						
DR38-5	1. Rock Type: 1 piece of sediment 2. Size: 25x20x10cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Colour: dark grey to greenish 6. Internal Structure: - 7. Texture: less consolidated than DR38-4 8. Overall Degree of Alteration: -				Y						

SO193 - DR39

North Plateau, canyons at western slope of Trough cutting (?) the North Plateau

Dredge on bottom UTC 09/06/07 2220hrs, lat 5°15.97'S, long 165°26.64'W, depth 3805m

Dredge off bottom UTC 09/06/07 2336hrs, lat 5°16.20'S, long 165°26.52'W, depth 3226m

total volume: empty

Comments: -

SO193 - DR40

North Plateau, Northern Trough, middle eastern flank --> within flank of Northern Plateau

Dredge on bottom UTC 10/06/07 0653hrs, lat 5°00.80'S, long 165°12.81'W, depth 3555m

Dredge off bottom UTC 10/06/07 0755hrs, lat 5°00.56'S, long 165°12.42'W, depth 3053m

total volume: few rocks; subrounded sediment clasts

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR40-1x	1. Rock Type: 1 piece of sediment 2. Size: 19x12x10cm 3. Shape/Angularity: 4. Encrustation: partly Mn-coating 5. Colour: red 6. Internal Structure: veins filled with Cc, 1-2mm thick 7. Texture: fine-grained, grain sizes vary from place to place 8. Overall Degree of Alteration:						Y				archive sample
DR40-2x	1. Rock Type: 1 piece of sediment 2. Size: 16.5x13.5x6cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Colour: green 6. Internal Structure: - 7. Texture: fine-grained, silt grain size 8. Overall Degree of Alteration: -						Y				archive sample

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR40-3x	1. Rock Type: 1 piece of sediment 2. Size: 11x10x5.5cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Colour: brown 6. Internal Structure: - 7. Texture: fine-grained 8. Overall Degree of Alteration: -						Y				archive sample

SO193 - DR41

North Plateau; eastern side of North Plateau, in general east-facing slope with small ridge where dredging towards 160° is possible

Dredge on bottom UTC 10/06/07 1754hrs, lat 4°37.17'S, long 164°8.54'W, depth 3773m

Dredge off bottom UTC 10/06/07 1845hrs, lat 4°37.52'S, long 164°8.40'W, depth 3638m

total volume: 3 pieces; two large pieces of volcanic rock, 1 piece of sediment

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR41-1	1. Rock Type: pillow basalt fragment 2. Size: 40x40cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating; 7mm glass rim (palagonite) 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: ~10%, altered, diameter: 0.5-3mm) 9. Secondary Minerals: in vugs are dolomite (?) and in veins zeolithe? dolomite? diameter of veins: <3mm 10. Overall Degree of Alteration: medium to strongly altered	Y ; Y (glass rim)	Y		Y						
DR41-1x	see DR41-1						Y				archive sample
DR41-2	see sample DR41-1, but no veins and vugs 2. Size: 25x20cm 5. Vesicularity: amount: in the outer part max. 0.5%, diameter: up to 1mm 8. Primary Minerals: less olivine than DR41-1 (amount: 3%, diameter: 0.5-2mm) 10. Overall Degree of Alteration: altered (similar to "Sonnenbrand-Basalt")	Y	Y		Y						
DR41-2x							Y				archive sample
DR41-3	1. Rock Type: fine-grained volcanoclastic (?) sediment, 1 piece 2. Size: 15x10cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 5-7%, diameter: <1mm 6. Vesicle Fillings: Cc? 7. Matrix Colour: brown to ocre 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -				Y						reference

Appendix II (Rock Description)

SO193 - DR42											
North Plateau; smaller cone of seamount structure east of North Plateau											
Dredge on bottom UTC 10/06/07 2341hrs, lat 4°47.49'S, long 163°48.39'W, depth 3355m											
Dredge off bottom UTC 10/06/07 0049hrs, lat 4°47.62'S, long 163°47.91'W, depth 2938m											
total volume: 1 piece; basalt											
Comments: 3 bites (tensions of 6.0t, 6.5t, 9.6t)											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR42-1	<ol style="list-style-type: none"> 1. Rock Type: looks like fragment of breccia, basaltic clasts (strongly altered ol-basalt) 2. Size: basalt clast: 5x4cm 3. Shape/Angularity: basalt clast: subangular 4. Encrustation: basalt clast: 1.5cm thick Mn-crust 5. Vesicularity: glass: amount: ~5-10%, diameter: 2-5mm; basalt clasts: amount: 5-7%, diameter: <1mm 6. Vesicle Fillings: not filled in "glass", basalt clast: filled with Cc 7. Matrix Colour: the gap between the clasts is filled with brown glass-like palagonized substance; basalt clast: dark grey 8. Primary Minerals: basalt clast: olivine (amount: 2-3%, altered, diameter: 0.1-4mm) 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: basalt clast: strongly altered 				Y						thin section should be made

SO193 - DR43											
North Plateau; lower big seamount east of North Plateau											
Dredge on bottom UTC 11/06/07 0605hrs, lat 5°10.51'S, long 163°33.62'W, depth 2270m											
Dredge off bottom UTC 11/06/07 0706hrs, lat 5°10.29'S, long 163°33.26'W, depth 1845m											
total volume: half full; Mn-encrusted volcanoclastic material with enclosed basalt clasts, all basalt samples were present on rounded clasts within lapilli tuff											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR43-1	<ol style="list-style-type: none"> 1. Rock Type: largest basalt fragment recovered from lapilli tuff 2. Size: original size: 40x40cm, 7.5x7x4.5cm --> refers to GC sample 3. Shape/Angularity: original shape: rounded 4. Encrustation: Mn-crust up to 1cm 5. Vesicularity: amount: 15%, diameter: ≤1mm 6. Vesicle Fillings: in places Ca? mostly open 7. Matrix Colour: brownish-grey 8. Primary Minerals: aphyrric 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: altered (moderately to strongly) 	Y	Y								
DR43-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: original size: diameter 15cm; 6.5x7x5.5cm = GC sample 3. Shape/Angularity: rounded 5. Vesicularity: amount: 10-15%; diameter: 1-2mm on the average 6. Vesicle Fillings: vesicles are mostly open but lined with yellowish secondary minerals; zeolithes? 7. Matrix Colour: brownish - grey 8. Primary Minerals: aphyrric 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: moderately altered, overall sample is very similar to DR43-1 except vesicle size 	Y			Y						
DR43-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment (several pieces) 2. Size: original size: diameter 30cm; 8x6x6.5cm = GC sample 3. Shape/Angularity: subangular to rounded 4. Encrustation: Mn-crust up to 1cm 5. Vesicularity: amount: 7-10%; diameter: 0.5cm 6. Vesicle Fillings: partly Cc? Mn? zeolithe; most vesicles are however open or are lined with secondary minerals 7. Matrix Colour: greyish to brown 8. Primary Minerals: olivine (? , diameter: <1mm, totally altered) 9. Secondary Minerals: Cc?, zeolithe 10. Overall Degree of Alteration: strongly altered 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR43-4A	1. Rock Type: basalt fragment 2. Size: original size: 30x20x13cm 3. Shape/Angularity: subangular to angular 4. Encrustation: 2cm thick Mn-crust 5. Vesicularity: amount: 5%, diameter: <1mm 6. Vesicle Fillings: mostly open 7. Matrix Colour: greyish 8. Primary Minerals: olivine (amount: 7%, diameter: 0.5-1mm) 9. Secondary Minerals: Cc fillings of vesicles in places moderately altered 10. Overall Degree of Alteration: this appears to be the freshest sample of the dredge	Y			Y						
DR43-4B	recovered together with DR 43-4A from same lapilli tuff; overall very similar to sample DR43-1 to DR43-3 3. Shape/Angularity: rounded 10. Overall Degree of Alteration: strongly altered --> only taken for reference				Y						only taken for reference
DR43-5	See sample DR43-1 2. Size: original size: 10x15cm 5. Vesicularity: slightly more vesicles than DR43-1 6. Vesicle Fillings: vesicles appear less filled than DR43-1	Y			Y						
DR43-6	see sample DR43-4A	Y			Y						
DR43-7	1. Rock Type: 2 basalt clasts embedded within lapilli tuff 2. Size: 15x15cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: the two clasts have different vesicularity										reference sample
DR43-8	1. Rock Type: block of yellowish lapilli tuff 2. Size: 20x20x10cm, lapilli: 0.5-3cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: amount: 10%, diameter: <0.5mm 6. Vesicle Fillings: - 7. Matrix Colour: lapilli tuff: yellowish, lapilli: brownish-red 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y			Y		Y				reference sample
DR43-9	similar to DR43-8 1. Rock Type: rounded clast of lapilli tuff 2. Size: 8x8x4cm 3. Shape/Angularity: rounded				Y						
DR43-10	Mn-crust up to 5cm									Y	
DR43-11x	similar to sample DR43-1 to DR43-6 1. Rock Type: 11 basalt clast 2. Size: diameter: 8-15cm 3. Shape/Angularity: rounded 4. Encrustation: sometimes with Mn-crust						Y				archive sample
DR43-12x	1. Rock Type: 5 pieces of lapilli tuff 2. Size: diameter: 5-15cm						Y				archive sample
DR43-13x	1. Rock Type: piece of white Cc? material with boreholes. Not clear what material is made of. 2. Size: diameter 20cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust 5. Colour: white 6. Internal Structure: boreholes 7. Texture: - 8. Overall Degree of Alteration: -						Y				archive sample

SO193 - DR44

North Plateau, 5nm SE of DR43, at deeper water depth beneath small plateau within slope

Dredge on bottom UTC 11/06/07 1011hrs, lat 5°14.76'S, long 163°31.18'W, depth 3342m

Dredge off bottom UTC 11/06/07 1106hrs, lat 5°14.60'S, long 163°30.82'W, depth 2960m

total volume: empty

Comments: -

Appendix II (Rock Description)

SO193 - DR45											
North Plateau, southern end of North Plateau at beginning of NNW-SSE trending valley											
Dredge on bottom UTC 11/06/07 2010hrs, lat 5°37.20'S, long 164°31.88'W, depth 2846m											
Dredge off bottom UTC 11/06/07 2109hrs, lat 5°36.73'S, long 164°31.66'W, depth 2405m											
total volume: almost full; all sedimentary											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR45-1	1. Rock Type: sediment rock 2. Size: 20x15cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, 0.5cm thick 5. Colour: red 6. Internal Structure: - 7. Texture: a) Clasts: 2% clasts of different colours and materials (rock fragments, mineral grains?); one layer, ca. 4cm thick, contains 5-7% clasts b) Matrix: fine-grained, matrix-supported 8. Overall Degree of Alteration: -				Y						
DR45-2	1. Rock Type: sandstone 2. Size: 8x10cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust, 10mm thick 5. Colour: ocre 6. Internal Structure: gradation of clasts 7. Texture: a) Clasts: coarse-grained and of different origins (minerals? rock fragments?) and colours; clast-size: range from <1mm up to 2mm b) Matrix: - 8. Overall Degree of Alteration: -				Y						
DR45-3	1. Rock Type: sediment rock 2. Size: 15x20cm 3. Shape/Angularity: - 4. Encrustation: 5mm thick Mn-crust 5. Colour: greenish 6. Internal Structure: some layers with coarser black grains between 0.5-1mm in size 7. Texture: a) clasts: fine-grained b) matrix: - 8. Overall Degree of Alteration: -				Y						
DR45-4	1. Rock Type: compacted (carbonate?) ooze, partly chert-like 2. Size: 15x15cm 3. Shape/Angularity: subangular 4. Encrustation: 10mm thick Mn-crust 5. Colour: white to brownish 6. Internal Structure: lots of veins, filled with Mn 7. Texture: - 8. Overall Degree of Alteration: -				Y						
DR45-5	1. Rock Type: sediment breccia with sedimentary clasts 2. Size: 25x15cm; size of clasts: 1-60mm 3. Shape/Angularity: subangular; clasts: subangular 4. Encrustation: - 5. Colour: clasts: brown to ocre 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: amount: 30%, size: 1-60mm b) Matrix: white to yellowish (clay or calcareous material?) 8. Overall Degree of Alteration: -				Y						
DR45-6	1. Rock Type: Mn-crust									Y	

Appendix II (Rock Description)

SO193 - DR46											
North Plateau, NW-SE elongated structure south of the North Plateau											
Dredge on bottom UTC 12/06/07 0412hrs, lat 6°1.87'S, long 164°43.27'W, depth 2862m											
Dredge off bottom UTC 12/06/07 0517hrs, lat 6°1.31'S, long 164°43.14'W, depth 2369m											
total volume: 1/4 full, 2 pieces of volcanic rock and lots of Mn-crust + some volcanoclastic material											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR46-1	1. Rock Type: dense basalt, quite heavy, not clear whether this rock is hydrothermally overprinted 2. Size: 10x10x5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust 2-3mm 5. Vesicularity: dense, no vesicles visible 6. Vesicle Fillings: - 7. Matrix Colour: on one side 1cm thick dark grey matrix; very fine-grained, no primary minerals; the remainder of the sample is quite porphyritic with abundant red dots, which are probably altered olivine; matrix between olivine very fine grained 8. Primary Minerals: ex-olivine (amount: 10-15%, diameter: 1-2mm) 9. Secondary Minerals: highly reflective like metal, silver to yellowish colour --> pyrite? (diameter: <0.5mm, amount: 1-2%, disseminated throughout Ol-rich part of sample) 10. Overall Degree of Alteration: appears moderately altered, however this basalt could also be severely overprinted by hydrothermalism	Y	Y								
DR46-2	very similar to sample DR46-1, but sample is dissected by several greyish veins, diameter 1-3mm; the veins are dense and look similar to the small greyish side of sample DR46 -1. 4. Encrustation: Mn-encrustation is thicker than in DR46-1 (~1cm)	Y	Y								
DR46-3	1. Rock Type: fine-grained breccia or brittle deformed silicate material 2. Size: 8x5cm 3. Shape/Angularity: not visible 4. Encrustation: 1-2cm thick Mn-crust 5. Vesicularity: vesicles are only visible in one spot, otherwise dense 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: not visible in uncut rock 9. Secondary Minerals: yellow staining along cracks could reflect secondary hydrothermal mineralization 10. Overall Degree of Alteration: very strongly altered				Y						sample taken for reference
DR46-4	very similar to to samples DR46-1 and DR46-2. Rock Type: basalt clast 2. Size: 7x5cm; clast: diameter 3cm; Mn-clast up to 3cm 3. Shape/Angularity: rounded 4. Encrustation: Mn-crust 10. Overall Degree of Alteration: more severely altered than DR46-1 and DR46-2				Y						sample taken for reference
DR46-5	1. Rock Type: carbonate sediment with lithic fragments 4. Encrustation: Mn-crust	Y			Y						
DR46-6	Mn-crust, 6cm thick										
DR46-7x	Breccia somewhat similar to sample DR46-3 --> hydrothermal? 10. Overall Degree of Alteration: more severely altered than DR46-3						Y				archive sample

Appendix II (Rock Description)

SO193 - DR47											
Ridge between DITs and North Plateau at the NE edge of the Western Plateau; SW slope of cone-like structure at top of NW-SE-trending ridge											
Dredge on bottom UTC 12/06/07 1409hrs, lat 6°42.51'S, long 164°10.27'W, depth 4064m											
Dredge off bottom UTC 12/06/07 1517hrs, lat 6°42.16'S, long 164°09.92'W, depth 3491m											
total volume: very few rocks; volcanoclastics and Mn-crusts											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	T/S	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR47-1	1. Rock Type: Ol-basalt 2. Size: 5x4x3cm 3. Shape/Angularity: subangular to rounded 4. Encrustation: Mn-crust, 1mm 5. Vesicularity: amount: 2%, diameter: 1mm 6. Vesicle fillings: white material of unknown origin 7. Matrix Colour: brown to slightly grey 8. Primary Minerals: ex-olivine (amount: 5-7%, diameter: 0.5-2mm) 9. Secondary Minerals: Fe-oxides and Fe-hydroxides 10. Overall Degree of Alteration: strongly altered	Y	Y								
DR47-2	see sample DR47-1 2. Size: 4x1.5cm 5. Vesicularity: 0.5%, less vesicles than DR47-1 6. Vesicle Fillings: filled with celadonite 7. Matrix Colour: greyish to brown 10. Overall Degree of Alteration: appears slightly less altered than sample DR47-1	Y			Y						
DR47-3	see sample DR47-2	Y			Y						
DR47-4	1. Rock Type: possibly basalt 2. Size: 5x5cm 3. Shape/Angularity: angular 4. Encrustation: 1mm Mn-crust 5. Vesicularity: 1%, diameter 1mm 6. Vesicle Fillings: green material 7. Matrix Colour: greyish to brown 8. Primary Minerals: ex-olivine (amount: 2%); pyroxene (amount: 1%) 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR47-5	1. Rock Type: basalt 2. Size: - 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: amount: 1-2%, diameter: 1mm 6. Vesicle Fillings: - 7. Matrix Colour: yellowish brown 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: totally altered	Y			Y						
DR47-6	see sample DR47-5 5. Vesicularity: amount: 5-10%	Y			Y						
DR47-7	1. Rock Type: serpentinite?grease on cut surface 2. Size: 5x4cm 3. Shape/Angularity: - 4. Encrustation: - 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light green 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: totally altered	Y			Y						
DR47-7x	see similar to sample DR47-7						Y				archive sample
DR47-8	1. Rock Type: Mn-crust 4. Encrustation: 5cm thick									Y	

Appendix II (Rock Description)

SO193 - DR48											
NE edge of Western Plateau between DITs & North Plateau; SW slope of NW-SE-trending ridge 2nm S of DR47 at deeper water depth											
Dredge on bottom UTC 12/06/07 1825hrs, lat 6°43.53'S, long 164°11.03'W, depth 4910m											
Dredge off bottom UTC 12/06/07 2005hrs, lat 6°43.02'S, long 164°10.88'W, depth 4325m											
total volume: 1/10; mostly filled with volcanic rocks and some volcanoclastic breccias and Mn-crusts											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR48-1A	1. Rock Type: (Ol)-basalt fragment out of breccia 2. Size: 18x18x8cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-crust <6mm 5. Vesicularity: amount: ~5%, diameter: <1mm 6. Vesicle Fillings: zeolithe ? 7. Matrix Colour: greyish brown 8. Primary Minerals: olivine (amount: ~15%, diameter: <5mm); feldspar (amount: 3-5%, diameter: <4mm) 9. Secondary Minerals: zeolithe?, Mn?; Mn as vein-filling 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR48-1B	similar to DR48-1A 4. Encrustation: no Mn-coating 5. Vesicularity: diameter: up to 5mm	Y	Y		Y						
DR48-1x	3 (Ol)- basalt fragments						Y				archive sample
DR48-2A	1. Rock Type: basalt fragment 2. Size: 11x5x4cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: ~1%, diameter: <1mm 6. Vesicle Fillings: zeolithe ? 7. Matrix Colour: brownish grey 8. Primary Minerals: olivine (amount: ~2%, diameter: 0.5-4 mm, strongly altered); feldspar? (amount: 5-7%, diameter: 1-4mm) 9. Secondary Minerals: zeolithe; veins filled with Mn and white mineral (Cc?) 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR48-2B	similar to DR48-2A 8. Primary Minerals: less feldspar than DR48-2A (amount: <1%) and more olivine (amount: 3-4%) 9. Secondary Minerals: more and thicker veins, which are filled with a white mineral (Cc?)	Y	Y		Y						
DR48-2C	similar to DR48-2A 9. Secondary Minerals: additionally there are Mn-dendrites	Y	Y		Y						
DR48-3A	1. Rock Type: basalt fragment 2. Size: orig. size: 7x4.5x3cm 3. Shape/Angularity: subangular 4. Encrustation: very thin Mn-coating 5. Vesicularity: none 6. Vesicle Fillings: none 7. Matrix Colour: greenish grey 8. Primary Minerals: feldspar (amount: 1-3%, diameter: 1-3mm); olivine? (altered); red-brown mineral --> pyroxene? 9. Secondary Minerals: dendrites, Mn (?) in veins 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR48-3B	similar to DR48-3A	Y	Y		Y						
DR48-3C	similar to DR48-3A 7. Matrix Colour: more brownish than DR48-3A 8. Primary Minerals: plus green mineral --> pyroxene? (amount: ~2%, diameter: 1-3mm) --> primary?	Y	Y		Y						
DR48-3x	1 basalt fragment + GC + TC						Y				archive sample
DR48-4A	1. Rock Type: basalt fragment 2. Size: 4x6x4cm 3. Shape/Angularity: subrounded 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: ~30%, diameter: 1-5mm 6. Vesicle Fillings: most vesicles unfilled, some vesicles may be filled with zeolithe? 7. Matrix Colour: dark grey to brown 8. Primary Minerals: - 9. Secondary Minerals: zeolithe ? 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR48-4B	similar to DR48-4A 5. Vesicularity: vesicles have a greenish thin rim (<<1mm), vesicles are smaller: diameter <3mm 7. Matrix Colour: more greenish	Y	Y		Y						
DR48-4x	1 basalt fragment similar to DR48-4A and DR48-4B						Y				archive sample
DR48-5	1. Rock Type: basalt fragment 2. Size: orig. size: 13x5x4cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 7-10%, diameter: <3mm 6. Vesicle fillings: Mn, zeolithe? 7. Matrix Colour: light grey 8. Primary Minerals: greenish mineral (pyroxene?, amount: <1%, diameter: 1-3mm); olivine (altered, amount: <1%, diameter: 1-4mm) 9. Secondary Minerals: Mn, zeolithe? 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR48-6	1. Rock Type: (Ol)-basalt 2. Size: 24x15x10cm 3. Shape/Angularity: subrounded 4. Encrustation: 3cm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light greenish grey 8. Primary Minerals: olivine (altered, amount: 10-15%, diameter: <5mm) 9. Secondary Minerals: veins filled with Mn 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR48-7	1. Rock Type: breccia 2. Size: 14x10x6cm 3. Shape/Angularity: subangular; clasts vary in shape from rounded to angular 4. Encrustation: thin Mn-coating 5. Vesicularity: varies in clasts; amount: <10% 6. Vesicle Fillings: zeolithe? 7. Matrix Colour: clasts vary in colour from greenish over brownish to ocre 8. Primary Minerals: olivine (amount: ~5%, diameter: <3mm) 9. Secondary Minerals: Mn, zeolithe 10. Overall Degree of Alteration: moderately to strongly altered				Y						
DR48-8	same as DR48-6; taken as Mn-crust-sample for BGR				Y					Y	
DR48-9x	9 basalt fragments						Y				archive sample

SO193 - DR49

Danger Islands Troughs; northern part of DIT, eastern flank

Dredge on bottom UTC 13/06/07 0239hrs, lat 6°55.06'S, long 163°44.83'W, depth 4715m

Dredge off bottom UTC 13/06/07 0339hrs, lat 6°54.92'S, long 163°44.42'W, depth 4063m

total volume: few rocks; probably sediments

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR49-1	1. Rock Type: sediment 2. Size: 40x20x10cm 3. Shape/Angularity: subangular 4. Encrustation: 2mm thick Mn-crust 5. Colour: greyish matrix with yellowish grains 6. Internal Structure: 2 veins (4cm and 9cm long), filled with a white mineral 7. Texture a) Clasts: ~30% of yellowish grains <1mm in diameter; <1% black Mn-clasts (?), diameter: 0.5-4mm; <1% white minerals, diameter: <3mm b) Matrix: fine-grained 8. Overall Degree of Alteration: -	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR49-2	<ol style="list-style-type: none"> 1. Rock Type: sediment 2. Size: 40x30x20cm 3. Shape/Angularity: angular 4. Encrustation: thin Mn-coating 5. Colour: greenish grey, yellowish 6. Internal Structure: gradation; more compacted than DR49-1; sharp contact between coarse-grained layer with matrix and fine-grained layer with matrix 7. Texture: <ol style="list-style-type: none"> a) Clasts: <1% Mn-dots, diameter: <1mm b) Matrix: fine- to coarse-grained 8. Overall Degree of Alteration: - 	Y			Y						
DR49-3	<ol style="list-style-type: none"> see sample DR49-2 2. Size: 13x8x3cm 3. Shape/Angularity: subangular 5. Colour: greenish grey) 6. Internal Structure: again with sharp contact between the 2 layers, but no visible gradation in layer 1 				Y						
DR49-4	<ol style="list-style-type: none"> 1. Rock Type: sediment 2. Size: 7x6x3cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-crust, <2mm 5. Colour: light grey to grey 6. Internal Structure: short (1-2mm) veins, filled with a yellowish mineral? 7. Texture <ol style="list-style-type: none"> a) Clasts: - b) Matrix: fine-grained 8. Overall Degree of Alteration: - 				Y						

SO193 - DR50

Danger Islands Troughs; seamount at the end of the DITs towards the E; upper SW flank

Dredge on bottom UTC 13/06/07 0720hrs, lat 6°49.64'S, long 163°44.23'W, depth 2978m

Dredge off bottom UTC 13/06/07 0818hrs, lat 6°49.22'S, long 163°44.07'W, depth 2473m

total volume: 1/4 full; Mn-crust and solidified sediments

Comments: 3200m wire length, 2487m water depth

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR50-1	<ol style="list-style-type: none"> 1. Rock Type: several pieces of sediment 2. Size: 13x8x8cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating, partly Mn-crust up to 6mm 5. Colour: brown 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: clasts in fine-grained matrix; diameter of clasts: up to 5mm; one piece shows a zonation in colour (brown and red): clasts: 1. minerals, some of them have black coatings --> Mn; 2. black dots --> Mn? b) Matrix: clasts in fine-grained matrix, matrix-supported 8. Overall Degree of Alteration: - 	Y			Y						
DR50-2	<ol style="list-style-type: none"> 1. Rock Type: several pieces of sediment 2. Size: up to 13x10x6cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-crust up to 1.5cm 5. Colour: greenish 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: 1. dark mineral, diameter: <2mm; 2. light mineral --> Cc? diameter: <1cm b) Matrix: fine-grained 8. Overall Degree of Alteration: - 	Y			y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR50-3	<ol style="list-style-type: none"> 1. Rock Type: several pieces of sediment 2. Size: up to 10x10x7cm 3. Shape/Angularity: subangular 4. Encrustation: - 5. Colour: red-brownish, grey colour along the rim; one piece also shows grey parts in the middle 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: no clasts b) Matrix: fine-grained; dark reflecting minerals and red minerals (altered?) 8. Overall Degree of Alteration: - 	Y			Y						
DR50-4A	<ol style="list-style-type: none"> 1. Rock Type: several pieces of sediment 2. Size: one piece ~35x30x30cm, the others: up to 14x7cm 3. Shape/Angularity: angular-subangular 4. Encrustation: Mn-crust up to 8mm 5. Colour: ocre to light brown 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: no clasts b) Matrix: fine-grained; dark minerals, red-brownish minerals --> altered?, reflecting mineral 8. Overall Degree of Alteration: - 	Y			Y						
DR50-4B	<p>similar to DR50-4A</p> <ol style="list-style-type: none"> 1. Rock Type: one piece of sediment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: Mn-crust up to 1.7cm, partly Mn-coating 5. Colour: ocre to light brown 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: - b) Matrix: finer grained than DR50-4A 8. Overall Degree of Alteration: - 	Y			Y						
DR50-5	<ol style="list-style-type: none"> 1. Rock Type: several pieces of sediment 2. Size: - 3. Shape/Angularity: - 4. Encrustation: Mn-coating, partly Mn-crust up to 8mm 5. Colour: grey to greenish 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: no clasts b) Matrix: fine-grained 8. Overall Degree of Alteration: - 	Y			Y						
DR50-6	<ol style="list-style-type: none"> 1. Rock Type: 1 piece of sediment 2. Size: 14x7x3.5cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust up to 1mm 5. Colour: grey 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: no clasts b) Matrix: fine-grained 8. Overall Degree of Alteration: - 	Y			Y						
DR50-7	<ol style="list-style-type: none"> 1. Rock Type: 2 pieces of sediment 2. Size: up to 9x6x2.5cm 3. Shape/Angularity: - 4. Encrustation: 1 piece has Mn-crust up to 3.5cm 5. Colour: grey to yellowish; clasts: yellow 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: yellow clasts, diameter: <2mm b) Matrix: fine-grained 8. Overall Degree of Alteration: - 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR50-8	1. Rock Type: 1 piece of sediment 2. Size: 20x15x20cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-crust up to 1.5cm 5. Colour: greenish to brown/ocre; greenish to brown clasts 6. Internal Structure: - 7. Texture a) Clasts: diameter: <5mm, almost round; black dots, partly light rounded clasts --> Cc? zonation of clasts: partly greenish/brown clasts and partly the light clasts b) Matrix: fine-grained 8. Overall Degree of Alteration: -	Y			Y						

SO193 - DR51

Danger Islands Troughs; northern margin of High Plateau; base of EW-striking seamount structure at north-facing slope

Dredge on bottom UTC 13/06/07 1253hrs, lat 6°48.51'S, long 163°29.79'W, depth 4554m

Dredge off bottom UTC 13/06/07 1418hrs, lat 6°49.07'S, long 163°29.51'W, depth 3934m

total volume: empty

Comments: -

SO193 - DR52

Danger Island Troughs at N margin of High Plateau; plateau edge at 5400m water depth; lowest position possible approx. 8nm E of DR51

Dredge on bottom UTC 13/06/07 1833hrs, lat 6°46.39'S, long 163°23.72'W, depth 5368m

Dredge off bottom UTC 13/06/07 1959hrs, lat 6°46.88'S, long 163°23.57'W, depth 4824m

total volume: few rocks + big block sitting on top of the dredge; all rocks volcanic + glass

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR52-1A	1. Rock Type: magmatic rock 2. Size: 13x12x5cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-crust <5mm 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey, matrix is very fine-grained 8. Primary Minerals: white mineral (? , amount: ~1%, diameter: <1mm); olivine (? , amount: <<1%, diameter: <2mm, strongly altered) 9. Secondary Minerals: Mn; partly long (7cm) veins, filled with ocre mineral (?) 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR52-1B	see sample DR52-1A, cut surface is partly shining/reflecting 2. Size: 7x6x4cm 8. Primary Minerals: more white minerals (amount: ~2%, diameter: 0.5mm)	Y	Y		Y						
DR52-1x	13 rocks similar to DR52-1A and DR52-1B						Y				archive sample
DR52-2	1. Rock Type: partly breccious magmatic rock; "clasts" are separated by thin veins; dark greyish "clasts" contain glass fragments <1mm; another part of this rock is layered: Mn-crust/black layer with glass/brownish layer/alteration rim / Mn-crust; one of the pieces in DR52-2 (and also TS) has palagonite in it, plus one part (3x3mm) which looks like FRESH glass, see thin sections 2. Size: 10x10x5cm 3. Shape/Angularity: subangular 4. Encrustation: with Mn-crust <5mm 5. Vesicularity: - 6. Vesicle Fillings: veins are filled with Mn and a whitish mineral 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration:-	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR52-3A	1. Rock Type: magmatic rock 2. Size: 8x3x3cm 3. Shape/Angularity: subangular 4. Encrustation: very thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light grey 8. Primary Minerals: feldspar (amount: ~1%, diameter: <1-2mm) 9. Secondary Minerals: Mn (?) in veins 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR52-3B	very similar to DR52-3A 8. Primary Minerals: slightly more feldspar than DR52-3A	Y	Y		Y						
DR52-3x	6 rocks similar to DR52-3						Y				archive sample
DR52-4	1. Rock Type: basalt fragment (out of a bigger block); this block included a top breccia and a Mn-crust which has a thickness of ~4cm 2. Size: 30x30x20cm; original block: ~50x50x30cm 3. Shape/Angularity: angular 4. Encrustation: see above 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown to ocre 8. Primary Minerals: feldspar (amount: 2-3%, diameter: 0.5-2mm) 9. Secondary Minerals: Mn in veins 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR52-4x	2 rock fragments out of the big block						Y				archive sample
DR52-5x	rock fragments similar to DR52-1 to DR52-3 10. Overall Degree of Alteration: more altered than DR52-1 to DR52-3; 15 pieces						Y				archive sample
DR52-6x	strongly altered fragments; 9 pieces						Y				archive sample
DR52-7x	several not yet sawed smaller blocks; 20 pieces						Y				archive sample

SO193 - DR53

Danger Islands Troughs; southern wall of NE end of DIT

Dredge on bottom UTC 14/06/07 0209hrs, lat 6°45.28'S, long 163°08.56'W, depth 5485m

Dredge off bottom UTC 14/06/07 0326hrs, lat 6°45.80'S, long 163°08.54'W, depth 4877m

total volume: 3 pieces; altered magmatic rocks

Comments: 9.5t, 03:00; 9.0t; 03:03, 2x8.0t, 03:05 and 03:07

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR53-1	1. Rock Type: basalt fragment 2. Size: 11x8x8cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light brown to ocre 8. Primary Minerals: pyroxene (? , amount: 3%, diameter: 0.5-2mm); red mineral; feldspar (? , amount: <1%, diameter: <1mm) 9. Secondary Minerals: Mn in veins 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR53-2	very similar to DR53-1 2. Size: 6x5x10cm 7. Matrix Colour: light grey (fresh area) 10. Overall Degree of Alteration: one area of the matrix seems fresh and NOT ALTERED	Y	Y		Y						
DR53-3	1. Rock Type: basalt fragment 2. Size: 9x3x4cm 3. Shape/Angularity: subrounded 4. Encrustation: thin Mn-coating, and compacted foraminiferal ooze (<0.5cm thick) 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light brown to ocre 8. Primary Minerals: pyroxene (? , altered, amount: 3-5%, diameter: 0.5-3mm) 9. Secondary Minerals: Mn in thin veins, Cc (?) in veins 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						

Appendix II (Rock Description)

SO193 - DR54											
Danger Islands Troughs (at northern margin of the Plateau); eastern end of E-W-striking Plateau margin at 5300m water depth, slightly NE of Coffin's 2003 dredge											
Dredge on bottom UTC 14/06/07 0952hrs, lat 6°40.51'S, long 162°44.39'W, depth 5350m											
Dredge off bottom UTC 14/06/07 1109hrs, lat 6°40.95'S, long 162°44.02'W, depth 4760m											
total volume: few rocks; mostly crusts and a few angular fist-sized rocks of basaltic(?) composition											
Comments: max. rope length: 4600m at 4780m water depth											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR54-1	1. Rock Type: basalt fragment 2. Size: 8x5x2cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 0.5mm 5. Vesicularity: ? 6. Vesicle Fillings: white material (-> feldspar); yellowish material (amount: 1-2%, diameter: <1mm); olivine; black material 7. Matrix Colour: brown to grey; for the most part grey matrix on one side of the GC sample, oxidation-halo still visible 8. Primary Minerals: feldspar, (olivine), pyroxene? 9. Secondary Minerals: iron-staining of matrix in places 10. Overall Degree of Alteration: relatively fresh basalt	Y	Y		Y						
DR54-2	1. Rock Type: basalt fragment 2. Size: 5x4x2cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust 0.5mm 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light brown to dark brown 8. Primary Minerals: feldspar (amount: 2%, diameter: 2mm) 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR54-3	see sample DR54- 2. Size: 5x4x4cm 3. Shape/Angularity: subangular 7. Matrix Colour: brown 8. Primary Minerals: one fresh olivine and feldspar (amount: 1-2%, diameter: 2mm)	Y			Y						
DR54-4	1. Rock Type: basalt fragment with Mn-veins 2. Size: 4x4x2.5cm 3. Shape/Angularity: angular 4. Encrustation: 1-2mm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: ocre; strongly oxidized 8. Primary Minerals: feldspar (amount: 1%, diameter: <1mm) 9. Secondary Minerals: Cc? 10. Overall Degree of Alteration: moderately altered	Y			Y						
DR54-5	1. Rock Type: basalt fragment 2. Size: 5.5x4x4cm 3. Shape/Angularity: subangular 4. Encrustation: 1mm Mn-crust 5. Vesicularity: amount: 1%, diameter: 0.5mm 6. Vesicle Fillings: calcite, green material -> celadonite 7. Matrix Colour: dark brown 8. Primary Minerals: Ex-olivine (amount: 10%, diameter: 2mm) 9. Secondary Minerals: Cc, celadonite 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR54-6	1. Rock Type: basalt fragment 2. Size: 8x6.5x1.5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 1mm 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greyish with ocre spots 8. Primary Minerals: microlite, olivine? (fresh) 9. Secondary Minerals: - 10. Overall Degree of Alteration: moderately altered	Y			Y						
DR54-7	see sample DR54-3 2. Size: 8x6x2.5cm 8. Primary Minerals: may contain pyroxene	Y			Y						
DR54-8x	1. Rock Type: 2 pieces of basalt fragments 2. Size: both 7x5x1.5cm 3. Shape/Angularity: angular						Y				archive sample

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR54-9x	1. Rock Type: basalt fragment 2. Size: 7x5x6cm 3. Shape/Angularity: subangular to rounded 4. Encrustation: 2.5cm Mn-crust 5. Vesicularity: amount: 10%, diameter: 1mm 6. Vesicle Fillings: mostly open, partly filled with Cc 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -						Y				archive sample

SO193 - DR55

NE rift; seamount in basin between High Plateau and North Plateau; flat topped seamount with small cones on top; dredged NE slope beneath Plateau edge

Dredge on bottom UTC 14/06/07 1755hrs, lat 5°58.03'S, long 162°46.03'W, depth 2403m

Dredge off bottom UTC 14/06/07 1910hrs, lat 5°58.42'S, long 162°45.82'W, depth 1949m

total volume: few magmatic rocks

Comments: max. rope length: 2650m at 1940m

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR55-1A	1. Rock Type: basalt fragment --> very dense 2. Size: 30x20x20cm 3. Shape/Angularity: subangular 4. Encrustation: very thin Mn-coating 5. Vesicularity: amount: <1% 6. Vesicle Fillings: Cc 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 3-5%, diameter: 2-5 mm); feldspar (amount: 1%, diameter: <1mm); pyroxene (amount: <1%, diameter: 5-8mm, relatively fresh) 9. Secondary Minerals: sparse Cc (2.5cm) 10. Overall Degree of Alteration: slightly altered	Y	Y		Y						
DR55-1Ax							Y				archive sample
DR55-1B	see sample DR55-1A; 3 pieces 5. Vesicularity: more vesicles than DR55-1A --> 1%, diameter: 0.5-1mm	Y	Y		Y						
DR55-1Bx	2 pieces						Y				archive sample
DR55-2	see sample DR55-1A 2. Size: 8x5cm 4. Encrustation: no Mn-coating 5. Vesicularity: more vesicles than DR55-1A, 10-15%, diameter: 0.5-20mm 8. Primary Minerals: less olivine, pyroxene and feldspar	Y	Y		Y						
DR55-3	1. Rock Type: basalt fragment 2. Size: 10x10x5cm 3. Shape/Angularity: subangular 4. Encrustation: 2mm thick Mn-crust 5. Vesicularity: amount: <0.5% 6. Vesicle Fillings: Cc 7. Matrix Colour: grey to brown 8. Primary Minerals: feldspar (amount: <1%, diameter: 1mm) 9. Secondary Minerals: Cc, along fractures Mn 10. Overall Degree of Alteration: in areas with fractures alteration is strong	Y	Y		Y						
DR55-3x	2 pieces						Y				archive sample
DR55-4	1. Rock Type: breccia with 50% clasts, diameter: 1-60mm --> clasts: see sample DR55-3 2. Size: 12x15x8cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: white to yellowish --> unknown material (maybe Cc?) 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: clasts are very strongly altered --> zoned alteration	Y (4A and 4B)			Y						
DR55-4x	5 pieces						Y				archive sample

Appendix II (Rock Description)

SO193 - DR56 Seamount north of Danger Islands Troughs at NE rift; small cone on guyot-plateau of the seamount N of the eastern end of the DITS Dredge on bottom UTC 14/06/07 2146hrs, lat 5°58.81'S, long 162°43.85'W, depth 1698m Dredge off bottom UTC 14/06/07 2251hrs, lat 5°58.66'S, long 162°43.60'W, depth 1433m total volume: 2 big blocks + 3 smaller ones; look like of volcanic origin Comments: tension of 6.2t at 1803m rope length											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR56-1	1. Rock Type: basalt fragment out of huge block 2. Size: 60x50x30cm 3. Shape/Angularity: subangular 4. Encrustation: around huge block was a Mn-crust up to ~8cm in thickness 5. Vesicularity: amount: 30%, diameter: 1-6mm 6. Vesicle Fillings: partly vesicles are filled with Cc (?), zeolithe (?) 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 1-2%, diameter: 1-7 mm) 9. Secondary Minerals: Cc (?), zeolithe (?) 10. Overall Degree of Alteration: slightly altered	Y	Y		Y						
DR56-1x	3 pieces of basalt						Y				archive sample
DR56-2	1. Rock Type: breccia out of block with about 50% clasts, basalt? 2. Size: 50x50x15cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust up to 10cm in thickness 5. Colour: matrix: light grey; clasts: brownish 6. Internal Structure: - 7. Texture: clast-supported a) Clasts: 50% clasts, size ranges from 1-5mm b) Matrix: - 8. Overall Degree of Alteration: strongly altered; basalt clasts: strongly altered	Y			Y			Y			
DR56-3	1. Rock Type: lapillituff 2. Size: ~30x20x15cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust: ca. 5mm thick 5. Colour: - 6. Internal Structure: - 7. Texture a) Clasts: brownish clasts (pumice?), amount: ~50%, size: 1-20mm b) Matrix: white matrix 8. Overall Degree of Alteration: -				Y			Y			
DR56-4	1. Rock Type: breccia or volcanoclastic material (lapillituff?) 2. Size: 20x10cm 3. Shape/Angularity: - 4. Encrustation: Mn-crust of ~5cm thickness 5. Colour: greenish 6. Internal Structure: some veins, filled with white mineral 7. Texture: - 8. Overall Degree of Alteration: -				Y			Y			
DR56-5	1. Rock Type: Mn-crust									Y	

SO193 - DR57 Seamount NE of Danger Islands Troughs (NE Rift); upper E flank of seamount Dredge on bottom UTC 15/06/07 0331hrs, lat 5°52.18'S, long 162°14.34'W, depth 2300m Dredge off bottom UTC 15/06/07 0520hrs, lat 5°52.12'S, long 162°14.50'W, depth 2504m total volume: 3 pieces of rock; rocks of magmatic origin Comments: dredge got stucked at starting point											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR57-1	1. Rock Type: basalt fragment 2. Size: 15x10x3cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-crust, <4mm thick; one area with some brecciated material 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey matrix, but with altered zones in the middle and the rim, which are brownish 8. Primary Minerals: feldspar (?; amount: <1%, diameter: <2mm); pyroxene (?; amount: <1%, diameter: 3mm) 9. Secondary Minerals: Mn in fractures 10. Overall Degree of Alteration: slightly to moderately altered	Y (4x)	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR57-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 5x2cm 3. Shape/Angularity: angular 4. Encrustation: - 5. Vesicularity: very few vesicles 6. Vesicle Fillings: - 7. Matrix Colour: brownish, but some areas with dark grey colour --> not altered (?) 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: moderately altered with some relatively fresh parts (?) 	Y	Y								
DR57-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 3x3cm 3. Shape/Angularity: angular 4. Encrustation: thin Mn-coating 				Y						taken as backup

SO193 - DR58

NE rift at southern part of presumed spreading ridge; SW corner of SW-NE-trending ridge which represents the SW-most termination of a series of ridges

Dredge on bottom UTC 15/06/07 1014hrs, lat 5°50.99'S, long 161°51.58'W, depth 3452m

Dredge off bottom UTC 15/06/07 1126hrs, lat 5°51.46'S, long 161°51.17'W, depth 2969m

total volume: 1/3 full; volcanoclastic sediments, basalt clasts and fragments of pillow basalt, some with chilled margins and altered glass

Comments:

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR58-1	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 20x13x7.5cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: 3%, diameter: 1-2mm 6. Vesicle Fillings: Cc, partly open 7. Matrix Colour: dark grey to dark brownish 8. Primary Minerals: Microlites; olivine (strongly weathered, diameter: 3mm, amount: 1-2%) 9. Secondary Minerals: Cc, iddingsite 10. Overall Degree of Alteration: moderately altered 	Y	Y								
DR58-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment with brown, fine-grained spots 2. Size: orig. size: 16x9.5x9 cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: 3%, diameter: 1mm 6. Vesicle Fillings: yellowish material 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: olivine (altered, amount: 1-2%, diameter: 1-2 mm) 9. Secondary Minerals: iddingsite, yellowish material; the altered parts of the sample are oxidized 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y								
DR58-3	<ol style="list-style-type: none"> 1. Rock Type: highly vesicular pillow basalt fragment 2. Size: 50x15x15cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating and partly Mn-crust up to 1mm 5. Vesicularity: amount: 40-50%, diameter: <5mm 6. Vesicle Fillings: mostly open, lined with green material at rim of the vesicles 7. Matrix Colour: dark grey, greenish at the rim of the sample 8. Primary Minerals: olivine (? , altered, amount: ~1%, diameter: <1mm) 9. Secondary Minerals: Cc, iddingsite? 10. Overall Degree of Alteration: moderately altered rim 	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR58-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment with glass (0.5-1mm; pillow lava); brown spot, which is fine-grained, reflects partially oxidized matrix 2. Size: 16x11.5x10cm 3. Shape/Angularity: subrounded to subangular 4. Encrustation: Mn-coating; glass on one side 5. Vesicularity: amount: 3-4%, diameter: 1-2mm 6. Vesicle Fillings: Cc? 7. Matrix Colour: dark grey, at the rim brownish (edge to glass encrustation) 8. Primary Minerals: olivine (altered, amount: <1%, diameter: 0.5mm) 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y; glass rim saved sepe- rately								NOTE: glass rim is heavily palagonitized with possible fresh glass for spot analyses
DR58-5	<ol style="list-style-type: none"> 1. Rock Type: volcanoclastic rock; composed of highly vesicular lapilli -> lapilli tuff, with abundant lithic fragments 2. Size: 60x20x40cm 3. Shape/Angularity: clasts: subrounded to angular 4. Encrustation: - 5. Colour: ocre, brown grey 6. Internal Structure: - 7. Texture a) Clasts: clasts: 30-40% vesicles, diameter: 1.5mm; vesicle Fillings: 30% Cc, 10% with yellowish material, 70% are open b) Matrix: - 8. Overall Degree of Alteration: strongly altered 	Y			Y			Y			
DR58-6	<ol style="list-style-type: none"> 1. Rock Type: fragment out of volcanoclastic breccia 2. Size: 10x8x7cm 3. Shape/Angularity: angular 4. Encrustation: - 5. Vesicularity: amount: 30-40%, diameter: 0.5-5mm 6. Vesicle Fillings: - 7. Matrix Colour: ocre, brown, dark grey 8. Primary Minerals: olivine (amount: <1%, diameter: up to 3mm, strongly altered) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR58-7x	for backup						Y				archive sample
DR58-8x	(glass)						Y				archive sample
DR58-9x	<ol style="list-style-type: none"> 1. Rock Type: Mn-Crust with yellow volcanoclastic sediment attached 2. Size: 5cm thick 						Y			Y	archive sample

SO193 - DR59

High Plateau; NW-SE-trending ridge structure, north of the High Plateau. Northern flank of NE-SW ridge structure

Dredge on bottom UTC 15/06/07 2318hrs, lat 6°48.52' S, long 161°15.60' W, depth 3662m

Dredge off bottom UTC 16/06/07 0025hrs, lat 6°49.00' S, long 161°15.37' W, depth 3269m

total volume: 3/4 full, looks like pillows and volcanoclastic breccias

Comments:

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR59-1	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, dense rock, highly porphyric basalt 2. Size: 13x9x6.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to grey 8. Primary Minerals: feldspar-laths (? amount: 15%, diameter: <7mm, relatively fresh) --> at the rim altered by Fe-hydroxide; olivine (altered, diameter: 3mm, amount: 5%) 9. Secondary Minerals: iddingsite (?), Fe-hydroxide 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR-59-2	<p>see sample DR59-1</p> <ol style="list-style-type: none"> 1. Rock Type: basalt fragment, dense rock, highly porphyric 2. Size: 16x15x8.5cm 	Y	Y		Y						
DR59-3	<p>see sample DR59-1 and DR59-2</p> <ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 16x18x19cm 	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR59-4	similar to sample DR59-1 2. Size: 13.5x11x9cm 8. Primary Minerals: feldspar (more rounded, not as elongated, more altered, look greenish); olivine (altered, amount: 10%, diameter: <2mm)	Y	Y		Y						
DR59-5	1. Rock Type: basalt fragment 2. Size: 18x11x4.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: no vesicles, dense rock 6. Vesicle Fillings: - 7. Matrix Colour: grey 8. Primary Minerals: feldspar (size: 7x3mm, bigger than in sample DR59-1 to DR59-4); brown mineral (amount: 3%) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR59-6	similar to DR59-5 2. Size: 10x8x6cm 8. Primary Minerals: more olivine	Y	Y		Y						
DR59-7	1. Rock Type: basalt fragment 2. Size: 12x7.5x7cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: no vesicles; dense rock 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: feldspar (amount: 10%, occurs as 5mm long elongated laths, <1mm thick, very different from other samples in this dredge); dark mineral (?) 9. Secondary Minerals: - 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR59-8	1. Rock Type: basalt fragment, matrix looks like altered glass, this could also be a hyaloclastite 2. Size: 14x11x6cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey 8. Primary Minerals: altered minerals, brownish, diameter: up to 8mm 9. Secondary Minerals: ? 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR59-9	1. Rock Type: basalt fragment, less porphyric than sample DR59-1 to DR59-6 2. Size: 9x8x5cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating, Mn-crust 2mm 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey, microcrystalline 8. Primary Minerals: olivine (diameter: <1mm, amount: 3-5%); feldspar (diameter: <2mm) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR59-10	1. Rock Type: basalt fragment 2. Size: 14x12x8cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating, partly Mn-crust 4mm 5. Vesicularity: amount: 3%, diameter: <3mm 6. Vesicle Fillings: lined with green material (celadonite), lined with brownish material (Fe-hydroxide); partly open 7. Matrix Colour: dark grey in places 8. Primary Minerals: olivine (altered, diameter: 0.5mm, amount: 1-2%) 9. Secondary Minerals: ? see 6. 10. Overall Degree of Alteration: strongly altered but in places matrix is still fresh or less altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR59-11	see sample DR59-10 2. Size: 14.5x9x5cm 5. Vesicularity: less vesicles than DR59-10, amount: 1%, diameter: 1mm 6. Vesicle Fillings: Cc?, yellowish material ? 8. Primary Minerals: more olivine (amount: 3-5%) 10. Overall Degree of Alteration: more altered than sample DR59-10	Y	Y		Y						
DR59-12	1. Rock Type: basalt fragment with Cc-veins, sample originates from pillow margin 2. Size: 14.5x11x9cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating and partly Mn-crust, 3mm thick 5. Vesicularity: amount: 1-2%, diameter: 1-2mm 6. Vesicle Fillings: filled with Cc, partly open, Fe-hydroxide fillings and total replacement of matrix 7. Matrix Colour: brown to dark brown with light brown spots to the rim, maybe oxidized material 8. Primary Minerals: olivine (altered) 9. Secondary Minerals: Cc, iddingsite 10. Overall Degree of Alteration: (very strongly altered to brown groundmass colour) _ alteration study	Y	Y		Y						alteration study
DR59-13	1. Rock Type: see sample DR59-12 2. Size: 13x11x10cm 4. Encrustation: Mn-coating, glass rim, chilled margin --> ca. 1.5cm thick	Y	Y								glass separately; check TS for spot analyses
DR59-14	1. Rock Type: see sample DR59-12/13 but less light brown spots to the rim 2. Size: 27x20x15cm 4. Encrustation: Mn-coating, glass rim, chilled margin ca. 1.5cm thick	Y			Y						a sample taken for alteration study
DR59-15	similar to DR59-1, DR59-2, DR59-3, DR59-4 1. Rock Type: feldspar porphyric basalt 2. Size: 11.5x11x8cm 7. Matrix Colour: grey to black, microcrystalline groundmass 8. Primary Minerals: feldspar is significantly smaller (amount: 10%, size: <3mm long and 1.5mm thick); some are reflecting on the surface 10. Overall Degree of Alteration: medium altered, in places the groundmass is relatively fresh	Y	Y		Y						
DR59-16x	see sample DR59-1 to DR59-4						Y				archive sample
DR59-17x	see sample DR59-5 and DR59-6						Y				archive sample
DR59-18x	see sample DR59-9						Y				archive sample
DR59-19x	see sample DR59-10 and DR59-11						Y				archive sample
DR59-20x	see sample DR59-12 to DR59-14						Y				archive sample
DR59-21	1. Rock Type: Mn-crust 2. Size: 6cm thick									Y	

SO193 - DR60

NS-trending ridge N of High Plateau; cone structure, W of Main Ridge

Dredge on bottom UTC 16/06/07 0525hrs, lat 7°2.85'S, long 161°46.25'W, depth 3142m

Dredge off bottom UTC 16/06/07 0634hrs, lat 7°2.73'S, long 161°49.71'W, depth 2565m

total volume: few; Mn-crust and fish

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR60-1	1. Rock Type: Mn-crust 2. Size: diameter 50cm _ sample fragment 20x15cm, 10cm thick									Y	

SO193 - DR61

High Plateau; small cone in top area of large N-S-trending ridge at its northern end

Dredge on bottom UTC 16/06/07 0948hrs, lat 7°14.87'S, long 161°49.72'W, depth 1939m

Dredge off bottom UTC 16/06/07 1042hrs, lat 7°14.64'S, long 161°49.36'W, depth 1737m

total volume: few Mn-crusts; 1 large Mn-crust, 20 cm thick

Comments: max. rope length 2150m, shallowest spot: 1600m, end of dredge-track 1700m; dredge got stuck at 1965m, got free at 8t; very clear bottom contact

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR61-1	1. Rock Type: 2 fragments of Mn-crust/boulder 2. Size: diameter: 70cm									Y	

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR61-2	<ol style="list-style-type: none"> 1. Rock Type: lapilli-tuff attached with Mn-crust 2. Size: - 3. Shape/Angularity: - 4. Encrustation: attached Mn-crust 5. Colour: yellowish-brown 6. Internal Structure: - 7. Texture <ol style="list-style-type: none"> a) Clasts: lapilli are highly vesicular, vesicularity: amount: 30%, diameter: 0.5mm b) Matrix: - 8. Overall Degree of Alteration: very strongly altered 	Y			Y						

SO193 - DR62

High Plateau at N-S-trending ridge; 7nm S of DR 61, W-tracing slope of ridge at 3400m water depth

Dredge on bottom UTC 16/06/07 1427hrs, lat 7°23.14'S, long 161°53.73'W, depth 3442m

Dredge off bottom UTC 16/06/07 1526hrs, lat 7°22.98'S, long 161°53.32'W, depth 3021m

tot al volume: few rocks; angular basaltic rubble

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR62-1	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 20x11.5x9.5cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: amount: 3%, up to 8mm 6. Vesicle Fillings: vesicles are open, partly lined with reddish secondary minerals (FeOOH?) 7. Matrix Colour: grey 8. Primary Minerals: olivine (altered, diameter: <0.5mm, amount: ~10%); feldspar-laths (diameter: <0.5mm, amount: ~5%) 9. Secondary Minerals: iddingsite, FeOOH? 10. Overall Degree of Alteration: slightly to moderately altered 	Y	Y		Y						
DR62-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 15.5x8x8cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating, partly Mn-crust up to 2mm thickness 5. Vesicularity: amount: ~10%, diameter: up to 4mm, but most of them are <1mm 6. Vesicle Fillings: vesicles are open 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, diameter: <2mm, amount: ~10%) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: slightly altered 	Y	Y		Y						
DR62-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 13x8.5x6cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: amount: ~3%, diameter: <3mm 6. Vesicle Fillings: all vesicles are open 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, diameter: <2mm, amount: 5-7%) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: slightly altered 	Y	Y		Y						
DR62-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 12x9x8cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: amount: ~10%, diameter: <2mm 6. Vesicle Fillings: most vesicles are open, are lined or filled with white or greyish minerals 7. Matrix Colour: zonation in matrix colour: one half of the fragment has a dark grey matrix colour and the other half has brownish colour 8. Primary Minerals: olivine (altered, amount: ~1%, diameter: <0.5mm) 9. Secondary Minerals: iddingsite, see 6. 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR62-5	1. Rock Type: probably pillow with 2.5cm thick chilled margin 2. Size: 11.5x12x6cm 3. Shape/Angularity: angular 4. Encrustation: Mn-coating 5. Vesicularity: amount: ~10%, diameter: <2mm 6. Vesicle Fillings: within the chilled margin most of the vesicles are filled with greyish minerals, within the rest of the fragment most vesicles are open or lined with greyish mineral 7. Matrix Colour: dark grey to brownish; red within the chilled margin (oxidized) 8. Primary Minerals: olivine (altered, amount: <1%) 9. Secondary Minerals: iddingsite, see 6. 10. Overall Degree of Alteration: moderately to strongly altered	Y			Y						
DR62-6	1. Rock Type: basalt fragment 2. Size: 8x7x4.5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: amount: ~5%, diameter: <9mm 6. Vesicle Fillings: all vesicles are open, some are lined with black or brown-reddish mineral 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, diameter: <0.5mm, amount: ~5%); feldspar-laths (size: up to 1mm long, amount: ~3%) 9. Secondary Minerals: iddingsite, see 6. 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y		Y						
DR62-7x	7 pieces of sample DR62-1 to DR62-4						Y				archive sample
DR62-8x	samples from DR62-5 (6 pieces)						Y				archive sample

SO193 - DR63

High Plateau; N-S-trending ridge at central part; western slope of large volcano in the central part of the ridge

Dredge on bottom UTC 16/06/07 1941hrs, lat 7°43.05'S, long 161°56.90'W, depth 2558m

Dredge off bottom UTC 16/06/07 2042hrs, lat 7°42.89'S, long 161°56.37'W, depth 2099m

total volume: 1/12 full, mixture of volcanic rocks and volcanoclastics + some carbonate aggregates, probably collected as slope debris

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR63-1A	1. Rock Type: basalt fragment 2. Size: 12x4x7cm 3. Shape/Angularity: subangular 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: 15-20%, diameter: 0.5-3mm 6. Vesicle Fillings: not filled 7. Matrix Colour: dark greyish-brown 8. Primary Minerals: olivine (altered, diameter: 0.5-2mm, amount: ~10%) 9. Secondary Minerals: - 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR63-1B	very similar to 1DR63-1A 5. Vesicularity: less vesicles than DR63-1A (~3-5%)	Y	Y		Y						
DR63-1C	very similar to DR63-1B, 5. Vesicularity: smaller vesicles, max. 0.8mm	Y	Y		Y						
DR63-1x	10 pieces similar to DR63-1A to DR53-1C						Y				archive sample
DR63-2A	1. Rock Type: basalt fragment 2. Size: 16x10x8cm 3. Shape/Angularity: subrounded 4. Encrustation: partly very thin Mn-coating, this piece has an altered dark brown glass rim up to 35mm thickness 5. Vesicularity: amount at rim: 40-50%, diameter at rim: <1mm, mostly filled with zeolithe (?) or Cc (?) 6. Vesicle Fillings: - 7. Matrix Colour: - 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR63-2B	similar to DR63-2A 1. Rock Type: piece of basalt 2. Size: originally ~8x8x4cm 4. Encrustation: glass rim up to 2cm thickness 10. Overall Degree of Alteration: strongly altered	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR63-2C	similar to DR63-2A and DR63- 2B 1. Rock Type: basalt piece, partly with glass (glass rim is ≤3cm thick)	Y			Y						
DR63-2x	4 pieces similar to DR63-2A to DR63-2C						Y				archive sample
DR63-3	1. Rock Type: volcanoclastic material 2. Size: 14x5x15cm 3. Shape/Angularity: - 4. Encrustations: - 5. Colour: - 6. Internal Structure: layered matrix 7. Texture a) Clasts: few pumice clasts, diameter: ~0.5cm b) Matrix: yellow matrix, very fine-grained, layered (flow structure? ash layers?, in the matrix there are also black minerals (Mn?), amount: ~5-7%, diameter: 1-2mm) 8. Overall Degree of Alteration: -	Y			Y						
DR63-4	1. Rock Type: volcanoclastic 2. Size: 10x8x5cm 3. Shape/Angularity: - 4. Encrustation: almost free of Mn-coatings 5. Colour: matrix: white-greyish 6. Internal Structure: - 7. Texture a) Clasts: amount: 7-10% green-red lapilli, diameter: ≤4mm b) Matrix: medium-grained matrix 8. Overall Degree of Alteration: -				Y						
DR63-5	1. Rock Type: volcanoclastic breccia 2. Size: 20x15x4cm 3. Shape/Angularity: - 4. Encrustation: thin Mn-crust, ~3mm 5. Colour: matrix: white-yellow 6. Internal Structure: - 7. Texture a) Clasts: basaltic clasts, amount: 30%, size: <1mm up to 30mm b) Matrix: fine-grained matrix 8. Overall Degree of Alteration: -				Y						

SO193 - DR65

NS-trending ridge N of the High Plateau; southernmost seamount upper western flank to plateau edge

Dredge on bottom UTC 17/06/07 0520hrs, lat 8°17.36'S, long 161°52.15'W, depth 1780m

Dredge off bottom UTC 17/06/07 0622hrs, lat 8°17.48'S, long 161°51.72'W, depth 1351m

total volume: few; Mn-encrustet basalt fragments

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR65-1	1. Rock Type: basalt fragment 2. Size: 14x11x9.5cm 3. Shape/Angularity: subrounded 4. Encrustation: partly <3cm Mn-crust 5. Vesicularity: amount: all together ~20-25%, diameter: one half <3mm, almost rounded; the other half: <1.7cm, elongated 6. Vesicle Fillings: Cc, brownish mineral, some are lined with Mn, but most vesicles are open 7. Matrix Colour: brown, completely oxidized 8. Primary Minerals: olivine (strongly altered, diameter: <5mm, amount: <1%); pyroxene (diameter: <2mm, amount: <1%, relatively fresh) 9. Secondary Minerals: iddingsite, Cc, brownish mineral --> secondary minerals, few veins filled with Cc --> up to 2mm thick 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR65-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 14x11x10cm 3. Shape/Angularity: rounded 4. Encrustation: Mn-crust, partly up to 1.3cm 5. Vesicularity: amount: altogether ~20-25%, one half higher vesicular than the other half; diameter <4mm, some vesicles are elongated and 1.2cm long 6. Vesicle Fillings: Cc, black mineral (=Mn?), lined with brownish-yellow mineral, but most vesicles are open 7. Matrix Colour: brown 8. Primary Minerals: olivine (amount: <1%, diameter: 2mm, strongly altered); pyroxene (amount: <1%, diameter: <2mm, relatively fresh) 9. Secondary Minerals: iddingsite, Cc, brownish-yellow mineral; few veins filled with Cc, up to 2mm thick 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR65-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 9x9x7cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating, partly Mn-crust up to 4mm thick 5. Vesicularity: amount: ~20%, diameter: <4mm, some vesicles are elongated and ca. <1cm 6. Vesicle Fillings: Cc, brownish mineral, some are lined with black material -->Mn? but most vesicles are open 7. Matrix Colour: brown 8. Primary Minerals: olivine (strongly altered, diameter: <4mm, amount: <1%); pyroxene (relatively fresh to slightly altered, amount: <<1%, diameter: <3mm) 9. Secondary Minerals: Cc, brownish mineral (see 6.), iddingsite 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR65-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 9x6x5cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: 1-2%, diameter: <1cm, all vesicles are elongated 6. Vesicle Fillings: some are lined or filled with Cc 7. Matrix Colour: brown 8. Primary Minerals: olivine (amount: <1%, diameter: <2mm, strongly altered); pyroxene (amount: <1%, diameter: <1.5mm, relatively fresh) 9. Secondary Minerals: Cc, iddingsite 10. Overall Degree of Alteration: moderately altered 	Y			Y						
DR65-5x	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 11x7x5cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-crust, up to 8mm 5. Vesicularity: amount: ~20%, diameter: <4mm, slightly elongated 6. Vesicle Fillings: Cc, brownish mineral, some are lined with black material (Mn?) or red-brownish mineral, but most vesicles are open 7. Matrix Colour: brown to dark brown 8. Primary Minerals: olivine (strongly altered, diameter: <1mm, amount: <1%); pyroxene (relatively fresh, amount: <1%, diameter: <1mm) 9. Secondary Minerals: Cc, iddingsite, black and red-brownish mineral (see 6.) 10. Overall Degree of Alteration: moderately altered 						Y				archive sample

SO193 - DR66

High Plateau; southernmost seamount of N-S ridge, second dredge at plateau edge, 2nm S of DR65

Dredge on bottom UTC 17/06/07 0820hrs, lat 8°19.09'S, long 161°51.23'W, depth 1720m

Dredge off bottom UTC 17/06/07 1016hrs, lat 8°19.10'S, long 161°51.08'W, depth 1672m

total volume: empty

Comments: Dredge got stucked shortly after dredge start; safety wire broken; max. wire length: 1 950m; strong vibration at 1650m rope length, water depth =1567m, 10.5t max.; dredge free at 1652m water depth

Appendix II (Rock Description)

SO193 - DR67											
High plateau, seamount chain W of N-S ridge; single seamount at SW corner beneath plateau edge											
Dredge on bottom UTC 17/06/07 1535 hrs, lat 8°33.83'S, long 162°17.83'W, depth 1964 m											
Dredge off bottom UTC 17/06/07 1705 hrs, lat 8°33.44'S, long 162°17.30'W, depth 1575 m											
total volume: few; Mn-encrusted basalt and pillow											
Comments: max. rope length: 2320m; dredge got stuck at 2116m, then free; main cable hinted at the very end _ cut											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR67-1	1. Rock Type: pillow basalt fragment 2. Size: 30x30cm 3. Shape/Angularity: subangular 4. Encrustation: 15mm thick Mn-crust 5. Vesicularity: amount: 2% 6. Vesicle Fillings: partly filled with Cc and partly unfilled 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: 7-10%, diameter: <1mm); feldspar (amount: 10%, diameter: <1mm) 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: medium altered	Y	Y		Y						
DR67-1x							Y				archive sample
DR67-2	1. Rock Type: basalt fragment 2. Size: 15x15cm 3. Shape/Angularity: subangular 4. Encrustation: 5-40mm thick Mn-crust 5. Vesicularity: amount: 3-4% 6. Vesicle Fillings: Cc (?) 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, diameter: <1mm, amount: 4%); feldspar (diameter: <1mm, amount: 2-3%) 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: medium altered	Y	Y		Y						
DR67-3	1. Rock Type: basalt fragment 2. Size: 20x20cm 3. Shape/Angularity: subangular 4. Encrustation: 15mm thick Mn-crust 5. Vesicularity: amount: ~15% 6. Vesicle Fillings: partly filled with Cc 7. Matrix Colour: dark grey to brown 8. Primary Minerals: olivine (altered, diameter: <1mm, amount: 3%); feldspar (diameter: <1mm, amount: 2%) 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR67-4	1. Rock Type: chert-like rock 2. Size: 15x20x5cm 3. Shape/Angularity: subangular 4. Encrustation: 10mm thick Mn-crust 5. Vesicularity: amount: 1%, diameter: <4mm 6. Vesicle Fillings: partly filled 7. Matrix Colour: white 8. Primary Minerals: - 9. Secondary Mineral: - 10. Overall Degree of Alteration: -				Y						
DR67-5	1. Rock Type: chert-like breccia with basalt clasts (similar to sample DR67-3) 2. Size: 20x25cm 3. Shape/Angularity: subangular 4. Encrustation: several mm 5. Vesicularity: amount: very small vesicles in the matrix, diameter: <0.1mm; vesicles in basalt clasts, diameter: 2mm 6. Vesicle Fillings: in basalt clasts vesicles partly filled with Cc 7. Matrix Colour: yellowish 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -				Y						
DR67-6	similar to sample DR67-4 with small volcanic clasts				Y						
DR67-7	Mn-crust									Y	
DR67-8x	3 pieces, one with palagonite rim						Y				archive sample

Appendix II (Rock Description)

SO193 - DR68											
High Plateau; small cone on W flank of seamount, SW of NS-trending ridge											
Dredge on bottom UTC 17/06/07 2108hrs, lat 8°56.97'S, long 162°20.62'W, depth 2455m											
Dredge off bottom UTC 17/06/07 2222hrs, lat 8°56.72'S, long 162°20.06'W, depth 1982m											
total volume. basalt, Mn-crust and volcanoclastic breccias											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR68-1A	1. Rock Type: basalt fragment 2. Size: 15x10x20cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 7-10%, diameter: 2-5mm 6. Vesicle Fillings: partly filled with Cc and chert (?) 7. Matrix Colour: dark grey 8. Primary Minerals: feldspar-microlithes 9. Secondary Minerals: Cc in vesicles, chert in thick veins (~10mm) and partly in vesicles, green unknown material 10. Overall Degree of Alteration: medium altered	Y	Y		Y						
DR68-1x	3 pieces						Y				archive sample
DR68-2	1. Rock Type: basalt fragment 2. Size: 25x25x20cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, 20mm thick 5. Vesicularity: amount: 7%, diameter: 1-3mm 6. Vesicle Fillings: white to greenish material, partly Cc 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: 2%, diameter: 0.1-2mm); pyroxene (amount: 1%, diameter: 1-7mm); feldspar (amount: 7-10%, microcrystalline, diameter: up to 2mm) 9. Secondary Minerals: greenish material, Mn, Cc 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR68-2x	3 pieces						Y				archive sample
DR68-3	1. Rock Type: volcanoclastic breccia with chert and very small volcanic clasts, also pumice 2. Size: 25x20x10cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: very few vesicles, diameter: <0.5mm 6. Vesicle Fillings: - 7. Matrix Colour: yellowish green 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -	Y			Y						
DR68-4	1. Rock Type: volcanoclastic breccia with chert and very small volcanic clasts 2. Size: 20x8x10cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, 4-20mm thick 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: greyish brown 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: -				Y						
DR68-5	Mn-crust									Y	

Appendix II (Rock Description)

SO193 - DR69 High Plateau; small cone on W flank of seamount, SW of NS-trending ridge, Western Plateau edge Dredge on bottom UTC 18/06/07 0114hrs, lat 8°58.58'S, long 162°18.09'W, depth 2149m Dredge off bottom UTC 18/06/07 0229hrs, lat 8°58.33'S, long 162°17.66'W, depth 1700m total volume: 1/2; carbonates Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR69-1	1. Rock Type: 6 samples of carbonatic rock with holes on the surface (biogene? worm tunnels?) 2. Size: between 5x6x3cm and 35x11x20cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-crust or Mn-coating 5. Colour: - 6. Internal Structure: - 7. Texture a) Clasts: - b) Matrix: fine grained 8. Overall Degree of Alteration: -										3 pieces for HU
SO193 - TVG-71 High Plateau; on 4th seamount, slightly NW of top Dredge on bottom UTC 18/06/07 0951hrs, lat 9°30.02S, long 162°4.42'W, depth 1222m Dredge off bottom UTC 18/06/07 1025hrs, lat 9°29.97'S, long 162°04.51'W, depth 1223m total volume: 1/5 full; Mn-nodules Comments: manganese nodules on sediment. 10:01 more sediment, more ripples: 10:20 : grabbed at 9°29.66'S, 162° 4.46'W, 1218m rope length, 1226m											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
TVG71-1	1. Rock Type: largest Mn-nodule in TVG with basaltic core 2. Size: nodule: 16x16x10cm; basaltic core: 8x8x3cm 3. Shape/Angularity: round nodule, basalt core = dish shape 4. Encrustation: Mn-crust up to 6cm thick with three different zones of growth; outer rim 1-2cm pitch black, middle zone 2cm brown-black with irregular rounded contact to outer rim; inner rim 1cm thick with dense network of small (<0.2mm) veins, filled with Cc 5. Vesicularity: quite dense, amount: <<0.5%, diameter: <0.3mm; a few larger cavities are 5mm in diameter 6. Vesicle Fillings: mostly open, larger cavities sometimes filled with Cc 7. Matrix Colour: greyish brown, appears quite fresh, except where spotted with FeOOH 8. Primary Minerals: phenocrysts: olivine (amount: 2%, altered, diameter: 0.5-2mm); Fsp (relatively fresh, amount: 4%, diameter: 1-2mm) 9. Secondary Minerals: FeOOH-staining of matrix and iddingsite replacement of olivine 10. Overall Degree of Alteration: moderately altered Fsp-Ol phyric basalt with fresh Fsp, suitable for age dating	Y	Y								feldspar suitable for age-dating
TVG71-2	1. Rock Type: Mn-nodule with basaltic core (olivine-phyric vesicular basalt) 2. Size: Mn-nodule: 16x15x10cm, basalt: 8x8x1.5cm 3. Shape/Angularity: basalt clast: rounded 4. Encrustation: see sample TVG71-1 5. Vesicularity: amount: 7-10%, diameter: 1-3mm 6. Vesicle Fillings: most vesicles are filled with white to reddish material 7. Matrix Colour: reddish brown 8. Primary Minerals: phenocrysts: olivine (amount: 4%, altered, diameter: <1mm) 9. Secondary Minerals: iddingsite replaces olivine, FeOOH replaces groundmass 10. Overall Degree of Alteration: strongly altered	Y			Y						
TVG71-3	1. Rock Type: basaltic core (Ol-basalt) of Mn-nodule 2. Size: 7x6x2cm 3. Shape/Angularity: rounded dish 4. Encrustation: 3-4cm thick Mn-crust 5. Vesicularity: amygdules, amount: 1% 6. Vesicle Fillings: greenish celadonite, a few larger cavities filled with Cc 7. Matrix Colour: dark grey appears quite fresh 8. Primary Minerals: olivine (amount: 3%, altered, diameter: 0.5-1mm) 9. Secondary Minerals: iddingsite replacing olivine 10. Overall Degree of Alteration: moderately altered	Y			Y						
TVG71-4x	5 Mn-nodules with small (<3cm) basaltic core for reference						Y				archive sample, reference sample
TVG71-5	cut Mn-nodule for BGR									Y	
TVG71-6	uncut Mn-nodule for BGR									Y	

Appendix II (Rock Description)

SO193 - DR72											
NE part of High Plateau, core of NW flank of the southernmost of the three solitaire interior seamounts											
Dredge on bottom UTC 18/06/07 1244 hrs, lat 9°26.85'S, long 162°7.30'W, depth 2323 m											
Dredge off bottom UTC 18/06/07 1352hrs, lat 9°26.86'S, long 162°6.84'W, depth 1898 m											
total volume: 1/3 full, Mn-crust, one piece of basalt?, carbonate rocks + octocorallia, porifera, crinoidea, bryozoa											
Comments: max. rope length: 2550m, one bite: ~ 6.1t tension, some bites of ~5t tension											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR72-1	1. Rock Type: basalt fragment (?) 2. Size: 10x8.5x6cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-crust up to 1cm 5. Vesicularity: amygdules, amount: 25-30%, diameter: ~2mm 6. Vesicle Fillings: most vesicles are filled with brownish or greenish or red brownish mineral, some vesicles are open 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (strongly altered, amount: <<1%, diameter: ~0.5mm); feldspar-laths? (white needles in the matrix, amount: <1%) 9. Secondary Minerals: iddingsite + see 6., veins filled with Cc and red-yellowish mineral 10. Overall Degree of Alteration: moderately to strongly altered	Y			Y						
DR72-2x	1. Rock Type: block of carbonate rock 2. Size: 30x19x12.5cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-crust up to 2cm 5. Vesicularity: amygdules, round cavities, diameter: 1cm 6. Vesicle Fillings: cavities are lined with Mn 7. Matrix Colour: white-yellowish 8. Primary Minerals: - 9. Secondary Minerals: - 10. Overall Degree of Alteration: ?						Y				archive sample
DR72-3	1. Rock Type: Mn-crust 2. Size: 21x16x5cm 3. Shape/Angularity: subrounded 4. Encrustation: 5cm thick 5. Vesicularity: amygdules									Y	
DR72-cc	1 piece of Cc, ~30x26x20cm						Y				archive sample

SO193 - DR75											
High Plateau, Manihiki Atoll; southern corner of Manihiki Atoll, SW-facing slope a ridge											
Dredge on bottom UTC 19/06/07 1211hrs, lat 10°30.86'S, long 160°57.82'W, depth 2431m											
Dredge off bottom UTC 19/06/07 1317hrs, lat 10°30.49'S, long 160°57.69'W, depth 1950 m											
total volume: few rocks, basalt cobbles and hyaloclastites											
Comments: max. rope length: 2600m, bites: 1bite with ~9.0 t tension! Due to the small size no GC sample were taken!											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR75-1	1. Rock Type: basalt fragment 2. Size: 13.5x9x4.5cm 3. Shape/Angularity: subrounded-rounded 4. Encrustation: none 5. Vesicularity: amygdules, amount: ~20%, in some parts almost no vesicles, in other parts vesicles up to 4mm 6. Vesicle Fillings: partly open at rim, mostly lined with green-brownish mineral (zeolithes?, clay minerals?); some in the middle are lined with brown mineral 7. Matrix Colour: dark grey to brown and reddish brown where oxidized 8. Primary Minerals: feldspar (fresh); pyroxene (amount: ~3%, diameter: ≤1.3cm); olivine (strongly altered, amount: 1-2%, diameter: ≤9mm) 9. Secondary Minerals: iddingsite, green-brownish minerals (zeolithes or clay minerals?), brown mineral 10. Overall Degree of Alteration: moderately to strongly altered	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR75-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 7x5.5x4cm 3. Shape/Angularity: rounded 4. Encrustation: partly sedimentary crust ?, ~3cm 5. Vesicularity: amygdules, amount: ~15%, less vesicles in the middle than along the rim, in the middle very few vesicles open; along the rim filled 6. Vesicle Fillings: in the middle very few vesicles open; along the rim: filled with grey mineral, some only lined with grey mineral 7. Matrix Colour: dark grey to light grey and brownish at rim, overall quite fresh 8. Primary Minerals: olivine (strongly altered, amount: ≤2%, diameter: ≤2mm); pyroxene (fresh, amount: <1%, diameter: ≤6mm) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: moderately to weakly altered, matrix might be enough for age dating 	Y			Y						
DR75-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 7x5.5x3cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-coating 5. Vesicularity: amygdules, amount: ~20%, diameter: ~5mm 6. Vesicle Fillings: some are open, some are filled and some are lined with grey material: very few are lined with Cc 7. Matrix Colour: dark grey to light grey and brown at rim 8. Primary Minerals: olivine (strongly altered, amount: 1-2%, diameter: ≤5mm); pyroxene (fresh, amount: <1%, diameter: 4mm) 9. Secondary Minerals: iddingsite, Cc, grey mineral 10. Overall Degree of Alteration: moderately altered 	Y			Y						
DR75-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 4.5x3.5x2.5cm 3. Shape/Angularity: subangular 4. Encrustation: none 5. Vesicularity: amygdules, amount: ~20%, diameter: ≤3mm 6. Vesicle Fillings: lined with grey material, some are open 7. Matrix Colour: dark grey, one part: brownish 8. Primary Minerals: olivine (strongly altered, amount: 1%, diameter: ~3mm); pyroxene (fresh, amount: 1-2%, diameter: ~9mm) 9. Secondary Minerals: iddingsite and grey material 10. Overall Degree of Alteration: moderately 	Y			Y						
DR75-5	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 7.5x6x3.5cm 3. Shape/Angularity: - 4. Encrustation: partly Mn-coating 5. Vesicularity: amygdules, amount: 1-2%, diameter: ~3mm, quite dense in comparison with other basalts from this dredge 6. Vesicle Fillings: mostly open, very few lined with white mineral (zeolithe or Cc?) 7. Matrix Colour: dark grey-brownish (oxidized?) 8. Primary Minerals: white mineral = feldspar _ otherwise aphyric feldspar (amount: <<1%, diameter: <1mm) 9. Secondary Minerals: white mineral (zeolithe or Cc?) 10. Overall Degree of Alteration: moderately to weakly altered 	Y			Y						
DR75-6	<ol style="list-style-type: none"> 1. Rock Type: volcaniclastic breccia 2. Size: 24x14.5x10cm; clasts: ≤2x1.5cm 3. Shape/Angularity: rounded; clasts: subangular-angular 4. Encrustation: none 5. Vesicularity: amygdules, amount: ~10%, diameter: ≤2mm 6. Vesicle Fillings: in clasts some open, some lined with grey mineral, some with ocre material 7. Matrix Colour: clasts: reddish-brown and dark grey 8. Primary Minerals: in clasts: olivine (strongly altered, amount: ~5%, diameter: ≤9mm!); pyroxene (fresh, amount: ~5%, diameter: ≤3mm) 9. Secondary Minerals: iddingsite, grey mineral and ocre material 10. Overall Degree of Alteration: strong, except for pyroxene; pyroxene separate can be easily obtained 	Y			Y		Y				

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR75-7	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment with affected volcanoclastics that are similar to sample 6 2. Size: 9x7x5cm 3. Shape/Angularity: rounded 4. Encrustation: partly Mn-coating; partly volcanoclastic sed. affected, ~1.8cm thick 5. Vesicularity: amygdules, amount: 15-20%, diameter: ≤9mm 6. Vesicle Fillings: partly open (50%) and partly lined with grey material (50%) _ clay mineral? 7. Matrix Colour: grey to light grey (rim) and brownish (middle) 8. Primary Minerals: olivine (strongly altered, amount: 1-2%, diameter: ≤3mm); pyroxene (fresh, amount: 3-5%, diameter: ≤12mm!) 9. Secondary Minerals: iddingsite, grey material (clay minerals?) 10. Overall Degree of Alteration: moderately altered 	Y			Y						
DR75-8x	<ol style="list-style-type: none"> 1. Rock Type: breccia (2 pieces) of volcanoclastic material 2. Size: 9x8x3cm and 7x5.5x3cm, clasts: 2.5x1cm 3. Shape/Angularity: subrounded, clasts: subangular-angular 4. Encrustation: bigger piece: partly Mn-coating; smaller piece: Mn-crust, ~2mm thick 5. Vesicularity: amygdules, clasts in bigger piece: amount: ~10%, diameter: ≤2mm; clasts in smaller piece: amount: <1%, diameter: 1-2mm 6. Vesicle Fillings: clasts in bigger piece: lined with grey material; clasts in smaller piece: mostly open, some filled with yellowish material, some with Cc 7. Matrix Colour for clasts: bigger piece: reddish to brown; smaller piece: grey to ocre 8. Primary Minerals (for clasts): bigger piece: olivine (strongly altered, amount: 3%, diameter: 9mm); pyroxene (fresh, amount: 1-2%, diameter: ~5mm); smaller piece: olivine (strongly altered, amount: ~1%, diameter: ~2mm) 9. Secondary Minerals: bigger piece: grey material; smaller piece: yellowish material, within volcanoclastic fragments: Cc 10. Overall Degree of Alteration: bigger piece: moderately to strongly altered; smaller piece: strongly altered 						Y				archive sample
DR75-9x	<ol style="list-style-type: none"> 1. Rock Type: breccia of volcanoclastic fragments/clasts 2. Size: 13x10x4.5cm 3. Shape/Angularity: subangular; clasts: angular 4. Encrustation: partly Mn-crust up to 2mm 5. Vesicularity: amygdules, clasts: amount: 15%, diameter: ~1mm 6. Vesicle Fillings: some clasts are open, other clasts lined with yellowish material, Cc 7. Matrix Colour: dark grey to ocre and reddish brown 8. Primary Minerals: olivine?; pyroxene (relatively fresh, amount: ~1%, diameter: up to ~1mm); feldspar-microlithes (sparkles) 9. Secondary Minerals: yellowish material, Cc 10. Overall Degree of Alteration: clasts: moderately to strongly; compaction of breccia: still many unfilled parts between volcanoclastic fragments 						Y				archive sample

SO193 - TVG 76

Rakahanga, SE slope of Rakahanga Atoll

TVG on bottom UTC 20/06/07 0226hrs, lat 10°2.90'S, long 161°3.78'W, depth 1474m

TVG off bottom UTC 20/06/07 0253hrs, lat 10°2.96'S, long 161°3.67'W, depth 1467m

total volume: several rock boulders

Comments: Rough slope, 4 tries to grab rocks, fourth try was finally successful

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
TVG76-1	<ol style="list-style-type: none"> 1. Rock Type: 3 large Blocks of volcanoclastic material 2. Size: up to 45x40x35cm 3. Shape/Angularity: fresh broken angular surface 4. Encrustation: few mm of Mn-crust 5. Vesicularity: amygdules, amount: high vesicularity of ~20% (=small fragments of basalt) 6. Vesicle Fillings: no vesicle fillings 7. Matrix Colour: yellow to ocre in colour; basalt (diameter: ≤5cm) has grey colour 8. Primary Minerals: pyroxene-crystals (diameter: ≤3cm, fairly fresh) 9. Secondary Minerals: volcanoclastic material seems to be compacted by carbonate 10. Overall Degree of Alteration: fairly fresh material 	Y			Y	Y few Pyroxene		Y			corals have been packed separately in box "Sonder-proben"
TVG76-1x	large boulder 35x25x24cm						Y				archive sample

Appendix II (Rock Description)

SO193 - DR77											
Rakahanga, NW slope of Rakahanga Atoll											
Dredge on bottom UTC 20/06/07 0551hrs, lat 9°57.20'S, long 161°10.55'W, depth 3372m											
Dredge off bottom UTC 20/06/07 0742hrs, lat 9°57.31'S, long 161°9.87'W, depth 2682m											
total volume: full; rounded basalt boulders and beach cobbles, volcanoclastic material, basalt breccias											
Comments: max. rope length: 3700m; 1bite ~6t tension, several bites around 6t tension											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/IN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR77-1	1. Rock Type: basalt boulder 2. Size: 50x50x30cm 3. Shape/Angularity: rounded 4. Encrustation: <1cm Mn-crust 5. Vesicularity: amount: 5-7%, diameter: 0.5-2mm; zoned distribution of vesicle size within basalt 6. Vesicle Fillings: white-grey material, in some areas open 7. Matrix Colour: when fresh -> grey, oxidized zones -> brown 8. Primary Minerals: olivine (amount: 3-5%, diameter: mostly <1mm, some up to 2mm, altered); pyroxene (amount: 1%, diameter: 2mm) 9. Secondary Minerals: iddingsite, white grey material (?) 10. Overall Degree of Alteration: moderately to strongly altered olivine pyroxene-basalt; matrix in parts relatively fresh	Y	Y		Y						
DR77-2	similar to sample DR77-1 1. Rock Type: basalt boulder, olivine-pyroxene-basalt 2. Size: 40x40x40cm 6. Vesicle Fillings: Cc-filling 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR77-3	similar to sample DR77-1 1. Rock Type: basalt boulder 2. Size: 30x30x30cm 3. Shape/Angularity: rounded 4. Encrustation: 3mm Mn-crust 5. Vesicularity: amount: 5-7%, diameter: 0.5-2mm 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR77-4	1. Rock Type: basalt boulder, olivine-phyric basalt 2. Size: 26x15x15cm 3. Shape/Angularity: rounded 4. Encrustation: thin Mn-coating 5. Vesicularity: highly vesicular, amount: 15-20%, diameter: 3mm, vesicles are all over the place 6. Vesicle Fillings: lined with grey material 7. Matrix Colour: oxidized to brown-red 8. Primary Minerals: olivine (altered, amount: 3%, diameter: 0.5-1mm) 9. Secondary Minerals: iddingsite replacing olivine 10. Overall Degree of Alteration: very strongly altered	Y			Y						
DR77-5	similar to DR77-1 to DR77-3 1. Rock Type: basalt boulder 2. Size: 20x20x15cm 3. Shape/Angularity: rounded 4. Encrustation: 1-2mm Mn-coating 5. Vesicularity: amount: 10%, diameter: 1-2mm 6. Vesicle Fillings: filled with unknown material 7. Matrix Colour: for the most part oxidized to reddish-brown 8. Primary Minerals: olivine (altered, amount: 3-4%, diameter: 0.5-1mm) 9. Secondary Minerals: groundmass replaced by FeOOH 10. Overall Degree of Alteration: very strongly altered	Y			Y						
DR77-6	similar to DR77-1 1. Rock Type: basalt boulder 2. Size: 26x30x30cm	Y			Y						
DR77-7	1. Rock Type: volcanoclastic breccia with basalt clasts 2. Size: 40x40x66cm (original size); clasts: 2x3cm, basaltic 3. Shape/Angularity: clasts: bigger ones subangular to angular, smaller ones: rounded 4. Encrustation: - 5. Vesicularity: clasts: amount: 10%, diameter: 2mm 6. Vesicle Fillings: lined with grey, black and yellowish material (clasts) 7. Matrix Colour: clasts: grey to brownish 8. Primary Minerals: olivine (clasts, amount: 2%, diameter: 1-2mm, altered) 9. Secondary Minerals: grey, yellowish and black material, iddingsite (clasts) 10. Overall Degree of Alteration: moderately to strongly	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR77-8	1. Rock Type: volcanoclastic breccia with basalt clasts 2. Size: 60x40x30cm 3. Shape/Angularity: rounded (breccia); clasts: subrounded 4. Encrustation: partly up to 4mm Mn-crust 5. Vesicularity: in clasts: amount: 5%, diameter: 2mm 6. Vesicle Fillings: yellowish and grey material (clasts) 7. Matrix Colour: clasts: grey to dark brown 8. Primary Minerals: olivine (amount: 1-2%, diameter: 1-2mm); pyroxene (amount: 2%, diameter: <2mm) 9. Secondary Minerals: yellowish and grey material (clasts) 10. Overall Degree of Alteration: moderately altered (clasts)	Y			Y						
DR77-9	similar to sample DR77-8 1. Rock Type: breccia 2. Size: 100x80x30cm; clasts are smaller (0.8x1cm) than in DR77-8 8. Primary Minerals: sample contains pyroxene (amount: 1-2%, diameter: <1mm) and less olivine (amount: <1%, diameter: 1mm, altered) 10. Overall Degree of Alteration: clasts moderately to strongly altered	Y			Y						
DR77-10	1. Rock Type: volcanoclastic breccia with basalt clasts 2. Size: 20x20x15cm (breccia); clasts: up to 4x2.5cm 3. Shape/Angularity: subangular; clasts: angular to subrounded 4. Encrustation: Mn-crust up to 1.5cm 5. Vesicularity: amount: 5-10%, diameter 3mm (clasts) 6. Vesicle Fillings: lined with grey, yellowish and black (Mn) material (clasts) 7. Matrix Colour: clasts dark grey to brown reddish (clasts) 8. Primary Minerals: olivine (clasts, amount: 2%, diameter: 1-2mm, altered) 9. Secondary Minerals: grey, yellowish and black material, iddingsite (clasts) 10. Overall Degree of Alteration: clasts: moderately to strongly altered	Y			Y						
DR77-11	similar to sample DR77-8 1. Rock Type: basalt breccia 2. Size: 25x15x20cm	Y			Y						
DR77-12x	11 basaltic beach cobbles similar to sample DR77-1 to DR77-3						Y				archive sample

SO193 - DR78

NE margin; cone structure on W side of NS-trending linear ridge at the eastern edge of the High Plateau

Dredge on bottom UTC 20/06/07 1800hrs, lat 9°50.90'S, long 160°35.04'W, depth 3499m

Dredge off bottom UTC 20/06/07 1924hrs, lat 9°51.29'S, long 160°34.75'W, depth 3150m

total volume: few rocks; two pieces of basalt encrusted with Mn-crust and several pieces of thick Mn-crust

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR78-1	1. Rock Type: basalt fragment 2. Size: 25x25x10cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-crust up to 15mm 5. Vesicularity: amount: 10-15%, diameter: <2mm 6. Vesicle Fillings: most vesicles are filled with Cc or a yellow-brownish material 7. Matrix Colour: dark grey to brown at the outer part 8. Primary Minerals: olivine (strongly altered, amount: 3%, diameter: <3mm); pyroxene (amount: 1%, diameter: <5mm) 9. Secondary Minerals: Cc, yellow-brownish material 10. Overall Degree of Alteration: moderately to strongly altered, zones of different degrees of alteration	Y			Y						
DR78-2	1. Rock Type: basalt fragment 2. Size: 5x4x2cm 3. Shape/Angularity: subrounded 4. Encrustation: - 5. Vesicularity: amount: 5-7%, diameter: 0.5-5mm 6. Vesicle Fillings: partly filled with Cc and a green material (clay mineral, montmorillonite?) 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (altered, amount: 1%, diameter: 1-2mm); pyroxene (amount: 1%, diameter: up to 4mm, fresh) 9. Secondary Minerals: Cc, green material (clay mineral?) 10. Overall Degree of Alteration: moderately altered	Y			Y						
DR78-3	Mn-crust									Y	

Appendix II (Rock Description)

SO193 - DR79											
NE from Rakahanga, NE margin; western flank of the seamount NE from Rakahanga											
Dredge on bottom UTC 21/06/07 0136hrs, lat 9°33.40'S, long 160°07.45'W, depth 2958m											
Dredge off bottom UTC 21/06/07 0305hrs, lat 9°33.87'S, long 160°07.23'W, depth 2548m											
total volume: 3/4 full; pillow basalt fragment and volcanoclastic material, some are encrusted with Mn-crust, looks like slope debris											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR79-1	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment with altered glass rim (thickness 1.5cm) of brown colour, feldspar phytic 2. Size: 20x10x8cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 5-7%, diameter: most vesicles <1-2mm, but few of them between 0.5-1cm) 6. Vesicle Fillings: partly lined with Mn (the bigger ones), the smaller ones are unfilled 7. Matrix Colour: grey 8. Primary Minerals: olivine (altered, amount: ~5%, diameter: 1-2mm); feldspar (diameter: 1-5mm, amount: 7-10%, looks fresh) 9. Secondary Minerals: Mn 10. Overall Degree of Alteration: slightly to moderately altered 	Y	Y		Y	Y					
DR79-2	<ol style="list-style-type: none"> 1. Rock Type: feldspar phytic basalt fragment with chilled margin 2. Size: 10x8x6cm 3. Shape/Angularity: subrounded 4. Encrustation: partly Mn-coating; chilled margin (~0.5cm thick, strongly altered) 5. Vesicularity: amount: ~5-10%, diameter: <<1-8mm 6. Vesicle Fillings: partly lined with yellow-white material 7. Matrix Colour: grey, brown 8. Primary Minerals: olivine (altered, amount: 7-10%, diameter: 0.5-2mm); feldspar (amount: 5%, diameter: 0.5-1mm); few pyroxene (altered, diameter: ca. 3mm) 9. Secondary Minerals: yellow-white material (?) 10. Overall Degree of Alteration: slightly to moderately altered 	Y	Y		Y						
DR79-2x	5 pieces similar to DR79-2						Y				archive sample
DR79-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, aphyric 2. Size: 13x8x8cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust 2-25mm 5. Vesicularity: amount: 15-20%, diameter: <1-10mm 6. Vesicle Fillings: mostly empty, few vesicles are filled with white material (Cc?) 7. Matrix Colour: grey to brown 8. Primary Minerals: aphyric 9. Secondary Minerals: Cc 10. Overall Degree of Alteration: slightly altered, matrix is very fresh and vesicles are open! = freshest basalt of the dredge 	Y	Y		Y						
DR79-4	<ol style="list-style-type: none"> 1. Rock Type: tufficious volcanic rock 2. Size: 10x10x8cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: ~10%, diameter: 1-10mm; round vesicles 6. Vesicle Fillings: partly lined with Mn and FeOOH 7. Matrix Colour: greenish brown, appears dissolved because in places still greyish-green 8. Primary Minerals: aphyric 9. Secondary Minerals: Mn, FeOOH (?) as vesicle lining 10. Overall Degree of Alteration: slightly altered 	Y	Y		Y						
DR79-5	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, aphyric 2. Size: 10x8x6cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: <5%, diameter: <1-20mm 6. Vesicle Fillings: mostly unfilled, partly lined with green material 7. Matrix Colour: brown 8. Primary Minerals: feldspar-microliths, otherwise quite aphyric 9. Secondary Minerals: green material 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR79-6A	<ol style="list-style-type: none"> 1. Rock Type: tufficious volcanic rock with feldspar-phenocrysts 2. Size: 20x15x10cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-crust up to 5mm 5. Vesicularity: amount: 15-20%, diameter: most vesicles <<1mm, rounded 6. Vesicle Fillings: no fillings, but partly lined with Mn 7. Matrix Colour: ocre, partly black areas (Mn?) 8. Primary Minerals: feldspar-phenocrysts (amount: <1%, diameter: up to 1mm, visible on broken surface) 9. Secondary Minerals: Mn 10. Overall Degree of Alteration: slightly altered (?) 	Y	Y		Y						
DR79-6B	<p>similar to sample DR79-6A</p> <ol style="list-style-type: none"> 1. Rock Type: tufficious volcanic rock 2. Size: 10x10x4cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-crust up to 3mm 5. Vesicularity: amount: 10%, diameter: <1-8mm, elongated to oval, resemble "ignimbrite" 6. Vesicle Fillings: - 7. Matrix Colour: ocre 8. Primary Minerals: feldspar-microliths 9. Secondary Minerals: fractures filled with Mn 10. Overall Degree of Alteration: slightly altered? 	Y	Y		Y						
DR79-7	<ol style="list-style-type: none"> 1. Rock Type: tufficious volcanic rock 2. Size: 14x16x6cm 3. Shape/Angularity: subrounded 4. Encrustation: almost no Mn-coating 5. Vesicularity: amount: 40%, diameter: <<1-4mm 6. Vesicle Fillings: the bigger vesicles are filled with Mn, all other filled with yellowish white material 7. Matrix Colour: yellowish green 8. Primary Minerals: - 9. Secondary Minerals: Mn 10. Overall Degree of Alteration: slightly altered? 	Y			Y						
DR79-8	<ol style="list-style-type: none"> 1. Rock Type: lapilli tuff 2. Size: 50x30x25cm; lapilli: 1.8x1.5cm 3. Shape/Angularity: subrounded to rounded; lapilli: angular 4. Encrustation: partly Mn-crust, <2cm 5. Vesicularity: clasts: tuff/pumice lapilli: amount: <5%, diameter: <0.5mm; others: none 6. Vesicle Fillings: some lined and some filled with grey mineral, some lined with Mn? most vesicles of the lapilli are filled and their texture is difficult to recognize 7. Matrix Colour: lapilli: brown; smaller lapilli forming matrix: yellow 8. Primary Minerals: - 9. Secondary Minerals: grey mineral (in vesicles in tuff) 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR79-9	<ol style="list-style-type: none"> 1. Rock Type: volcanoclastic (?) breccia 2. Size: 20x18x15cm; clasts: 5-15mm 3. Shape/Angularity: subrounded; clasts: angular 4. Encrustation: <1.5cm Mn-crust 5. Colour: matrix: reddish pinkclasts: reddish-brown (smaller ones), matrix-supported clasts are brown-ocre (bigger ones) 6. Internal Structure: 7. Texture: matrix-supported a) Clasts: 30%, no primary minerals visible, vesicularity: amount: <1%, diameter: <0.5mm, vesicle fillings: some open, some filled with white material b) Matrix: consists of <0.5mm broken clasts that are similar to the larger clasts 8. Overall Degree of Alteration: strongly altered 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR79-10	<ol style="list-style-type: none"> 1. Rock Type: clay sediment with clasts of clay 2. Size: 27x25x17cm; clasts: <5mm 3. Shape/Angularity: subangular to subrounded 4. Encrustation: partly Mn-crust up to 2cm; partly Mn-coating 5. Colour: greenish grey with zonation of reddish-brown colour (oxidized?) 6. Internal Structure: concretions of same material (clay), but of lighter colour; clasts not sorted 7. Texture: clay clast in mud-supported matrix (also clay) a) Clasts: contain vesicles, vesicles are lined with white material (Cc?) b) Matrix: contains black (probably Mn?) spots, diameter: <3mm, amount: <1% 8. Overall Degree of Alteration: slightly compacted (?) 	Y			Y						
DR79-11	<ol style="list-style-type: none"> 1. Rock Type: breccia 2. Size: 14x13x8.5cm, clasts: 1-3cm 3. Shape/Angularity: rounded; clasts: angular to rounded 4. Encrustation: partly Mn-crust <1mm 5. Colour: - 6. Internal Structure: veins in between clasts are made up of Cc 7) Texture: breccia is clast-supported a) Clasts: clasts do not contain any vesicle that can be identified as such; clasts are fine-grained, rounded and of unknown origin and composition b) Matrix: - 8. Overall Degree of Alteration: - 	Y			Y						
DR79-12A	<ol style="list-style-type: none"> similar to sample DR79-6 & DR79-7 2. Size: 20x15x10cm 3. Shape/Angularity: rounded 4. Encrustation: 1cm Mn-crust 5. Vesicularity: vesicles are elongated, diameter: up to 2cm; aligned parallel to each other; dissembles on ignimbrite texture --> this texture is best developed in this sample 8. Primary Minerals: no feldspar-phenocrysts visible 				Y						
DR79-12B	<ol style="list-style-type: none"> similar to sample DR79-12A 2. Size: 15x10x10cm 3. Shape/Angularity: rounded 4. Encrustation: <1mm thin Mn-coating 8. Primary Minerals: no feldspar-phenocrysts visible 				Y						
DR79-12C	<ol style="list-style-type: none"> similar to sample DR79-6 & DR79-7 2. Size: 10x8x5cm 4. Encrustation: thin Mn-coating 8. Primary Minerals: no feldspar-phenocrysts visible 				Y						
DR79-12D	<ol style="list-style-type: none"> similar to sample DR79-6 & DR79-7 Size: 20x20x15cm 				Y						
DR79-13x	<ol style="list-style-type: none"> similar to sample DR79-6 & DR79-7 1. Rock Type: piece of volcanic tuff 2. Size: 40x40cm 						Y				archive sample

SO193 - DR80

Manihiki Scarp; west-facing slope of volcanic? ridge

Dredge on bottom UTC 21/06/07 1500hrs, lat 10°51.34'S, long 160°37.45'W, depth 4186m

Dredge off bottom UTC 21/06/07 1610hrs, lat 10°51.53'S, long 160°36.96'W, depth 3791m

total volume: ?

Comments: max. rope length: 4500m

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR80-1	<ol style="list-style-type: none"> 1. Rock Type: Sediment 2. Size: 11x8x3cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: 1%, diameter: <0.5mm 6. Vesicle Fillings: partly filled with Cc? 7. Matrix Colour: brownish-grey 8. Primary Minerals: - 9. Secondary Minerals: Cc?, Mn 10. Overall Degree of Alteration: moderately altered 	Y			Y						
DR80-2	<ol style="list-style-type: none"> 1. Rock Type: Mn-crust; contains clasts? 2. Size: 26x18x11cm 3. Shape/Angularity: subrounded to rounded 4. Encrustation: 4cm 									Y	

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR80-3x	<ol style="list-style-type: none"> 1. Rock Type: sedimentary breccia? with sediment clasts? 2. Size: sample 1: 6x6x4, sample 2: 9x6x3; clasts up to 2.3x1.7cm 3. Shape/Angularity: clasts: angular to subrounded 4. Encrustation: partly Mn-crust, sample 1: up to 1.3cm, sample 2: 3cm 5. Colour: clasts: grey to ocre 6. Internal Structure: - 7. Texture a) Clasts: - b) Matrix: - 8. Overall Degree of Alteration: moderately altered 						Y				2 archive samples taken
DR80-4x	<p>similar to sample DR80-3x</p> <ol style="list-style-type: none"> 1. Rock Type: sedimentary breccia, but contains more Mn 2. Size: 17x14x7cm 3. Shape/Angularity: rounded; clasts are more rounded than in DR80-3x 4. Encrustation: 1.8cm 						Y				1 archive sample taken

SO193 - DR81

N of Manihiki Scarp; seamount on upper northern flank of Manihiki Scarp, E of High Plateau

Dredge on bottom UTC 21/06/07 2135hrs, lat 11°07.83'S, long 160°24.26'W, depth 2845m

Dredge off bottom UTC 21/06/07 2310hrs, lat 11°08.39'S, long 160°24.26'W, depth 2279m

total volume: few rocks; two small fragments of highly altered basalt and several larger pieces of yellow volcanoclastics encrusted with few cm Mn-crust

Comments: max. rope length: 3100m

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR81-1	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 5x5x4cm 3. Shape/Angularity: subrounded 4. Encrustation: partly encrusted with Cc and lapilli tuff, ~3mm thick 5. Vesicularity: amount: ~30%, diameter: 0.5-5mm 6. Vesicle Fillings: filled with Cc and partly with Mn 7. Matrix Colour: grey to brown 8. Primary Minerals: olivine (altered, amount: 0.5%, diameter: <<2mm) 9. Secondary Minerals: Cc, iddingsite, Mn 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR81-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 5x5x4cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: ~30%, diameter: 1-2mm 6. Vesicle Fillings: filled with Cc (?) or grey to yellowish material 7. Matrix Colour: grey to brown 8. Primary Minerals: olivine (altered, amount: <0.5%, diameter: <0.5mm) 9. Secondary Minerals: Cc (?), yellowish material, iddingsite 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR81-3	<ol style="list-style-type: none"> 1. Rock Type: lapilli tuff 2. Size: 20x10x8cm, 5x10x15cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-crust up to 10mm 5. Colour: yellow-ocre 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: amount: 15%, diameter: 3-25mm, altered basalt, angular, dark brownish ocre b) Matrix: fine-grained yellow matrix, porous (5%), vesicles filled with Cc (?) 8. Overall Degree of Alteration: moderately altered 	Y			Y						
DR81-4	Mn-crust for BGR									Y	

Appendix II (Rock Description)

SO193 - DR82											
Manihiki Scarp; small cone at the northern end of the Manihiki Scarp											
Dredge on bottom UTC 22/06/07 0443hrs, lat 11°14.44'S, long 160°49.04'W, depth 2592m											
Dredge off bottom UTC 22/06/07 0559hrs, lat 11°14.92'S, long 160°48.86'W, depth 2138m											
total volume: 1/4 full; Mn-encrusted pillows and pillow fragments, carbonate breccias											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR82-1	<ol style="list-style-type: none"> 1. Rock Type: pillow basalt 2. Size: 80x40x38cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust up to 2cm 5. Vesicularity: amount: 7%, diameter: 0.5-3mm 6. Vesicle Fillings: Cc, some lined with grey material, some are open 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: 1-3%, diameter: 0.5-5mm, strongly altered) 9. Secondary Minerals: iddingsite, Cc (as vesicle filling and in veins up to 2mm thick) 10. Overall Degree of Alteration: moderately to strongly, patchy replacement of groundmass by whitish-green mineral 	Y	Y		Y						
DR82-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment (possibly pillow) 2. Size: 15x7x13cm 3. Shape/Angularity: subangular to subrounded 4. Encrustation: 1cm Mn-crust 5. Vesicularity: amount: 3-5%, diameter: 0.5-1mm 6. Vesicle Fillings: most vesicles are open, some are filled with Cc, some are filled with greyish or yellowish mineral 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: ~1%, diameter: 0.5-2mm, strongly altered) 9. Secondary Minerals: Cc, iddingsite, greyish and yellowish mineral 10. Overall Degree of Alteration: slightly to moderately altered (this is the freshest sample of the dredge), patchy replacement of groundmass by whitish-green mineral 	Y	Y								
DR82-3	<ol style="list-style-type: none"> 1. Rock Type: pillow basalt 2. Size: 40x30x15cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust up to 1cm 5. Vesicularity: amount: ~15%, diameter: 0.5-5mm 6. Vesicle Fillings: some vesicles are open, most are filled with Cc or lined with Cc, some are filled with grey soft mineral 7. Matrix Colour: dark grey, in some parts brownish --> oxidized 8. Primary Minerals: olivine (amount: ~1%, diameter: 0.5-2mm, strongly altered) 9. Secondary Minerals: iddingsite, Cc, grey mineral, patchy replacement of groundmass by whitish-green mineral 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR82-4	<ol style="list-style-type: none"> 1. Rock Type: 1 piece of carbonate rock (?) 2. Size: 19x15x11cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-crust up to 8mm 5. Colour: ocre, in some parts brown 6. Internal Structure: one part is fine-grained, ocre and shows black spots; one part (layer) is dark brown, fine-grained and also shows black spots; the third part of the rock is ocre and coarser-grained 7. Texture: matrix-supported a) Clasts: the coarser-grained part has clasts up to 5mm (rock fragments? and minerals) b) Matrix: all parts are matrix-supported 8. Overall Degree of Alteration: strongly altered 	Y			Y						
DR82-5	<ol style="list-style-type: none"> 1. Rock Type: 1 piece of carbonate rock (?) 2. Size: 23x21x9cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-crust up to 1.5cm 5. Colour: ocre to yellowish 6. Internal Structure: many veins/cracks filled with black material (Mn?) 7. Texture: a) Clasts: some clasts up to 7mm in diameter (rock fragments, minerals) b) Matrix: fine-grained, ocre with black spots (Mn?) 8. Overall Degree of Alteration: strongly altered 	Y			Y						
DR82-6x	<ol style="list-style-type: none"> similar to DR82-2 6. Vesicle Fillings: more filled vesicles than in sample DR82-2 						Y				archive sample

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR82-7x	similar to DR82-3						Y				archive sample

SO193 - DR83

Eastern Manihiki Scarp; oblique to slope of large nose at 12°48' S

Dredge on bottom UTC 22/06/07 1851hrs, lat 12°48.39'S, long 161°03.72'W, depth 3268m

Dredge off bottom UTC 22/06/07 2015hrs, lat 12°47.87'S, long 161°03.57'W, depth 2925m

total volume: almost empty, solidified sediment

Comments: max. rope length: 3450m

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR83-1	<ol style="list-style-type: none"> 1. Rock Type: lithified sediment 2. Size: 20x20x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, thickness: 1-5mm 5. Colour: ocre 6. Internal Structure: some fractures, thickness: <1mm, lined with Mn 7. Texture: matrix supported a) Clasts: amount: 5%, diameter: <1mm b) Matrix: very fine grained and compacted (Cc?) 10. Overall Degree of Alteration: not recognizable 	Y			Y						
DR83-2	<ol style="list-style-type: none"> 1. Rock Type: sediment rock (??) 2. Size: 10x8x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, thickness: up to 8mm 5. Colour: yellowish brown 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: of greenish material, amount: <2%, diameter: <2mm b) Matrix: brown colour, relatively fine grained 10. Overall Degree of Alteration: not recognizable 	Y			Y						
DR83-3	<ol style="list-style-type: none"> 1. Rock Type: breccia with chert-like matrix and one larger basalt clast 2. Size: 2.5x5x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Colour: grey to brownish 6. Internal Structure: some unfilled veins in matrix 7. Texture: matrix-supported a) Clasts: 1 larger basalt clast, size: 3x2cm, rounded, contains zeolithe, calcite (?), pyroxene (?), vesicles of this clast: amount: 2%, filling: zeolithe b) Matrix: very fine-grained, chert like material 10. Overall Degree of Alteration: not known, basalt clast is strongly altered 				Y						

SO193 - DR84

Manihiki Scarp, lower eastern flank of the southern Manihiki Scarp

Dredge on bottom UTC 22/06/07 0107hrs, lat 12°57.93'S, long 161°04.98'W, depth 3663m

Dredge off bottom UTC 22/06/07 0214hrs, lat 12°57.45'S, long 161°04.89'W, depth 3455m

total volume: 1/6 full; some volcanic rocks and sedimentary fragments, encrusted with Mn

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR84-1A	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment out of breccia which consists of several volcanic clasts and sedimentary fragments 2. Size: 15x10x8cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: 7%, diameter: <2mm, fresh); feldspar (amount: ~5%, diameter: <2mm); pyroxene (?), amount: 2%, diameter: 1-5mm) 9. Secondary Minerals: - 10. Overall Degree of Alteration: slightly altered 	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR84-1B	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, out of the same breccia as DR84-1A 2. Size: 5x5x7cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: 3%, diameter: 1-4mm, fresh); pyroxene (amount: 3-4%, diameter: 0.5-2mm) 9. Secondary Minerals: - 10. Overall Degree of Alteration: slightly altered 	Y	Y		Y						
DR84-1C	<ol style="list-style-type: none"> 1. Rock Type: tectonically overprinted (?) volcanic or sedimentary rock out of the same breccia as DR84-1A and DR84-1B 2. Size: 12x10x12cm 3. Shape/Angularity: subrounded 4. Encrustation: several mm of Mn-crust 5. Vesicularity: amount: <1%, diameter: 2-4mm 6. Vesicle Fillings: zeolithes 7. Matrix Colour: brown 8. Primary Minerals: - 9. Secondary Minerals: zeolithes 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR84-1D	<ol style="list-style-type: none"> 1. Rock Type: sedimentary rock 2. Size: 10x10x5cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Colour: greenish 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: none b) Matrix: fine-grained, rounded grains 8. Overall Degree of Alteration: medium altered 	Y			Y						
DR84-1x	various rock fragments as described above under DR84-1A to DR84-1D						Y				archive sample
DR84-2	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 15x18x6cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: 1-2%, diameter: 0.5-5mm 6. Vesicle Fillings: partly filled with yellowish material (recrystallized pyroxene?) 7. Matrix Colour: dark grey with brownish parts 8. Primary Minerals: olivine (amount: 1%, diameter: <1mm, fresh); pyroxene (amount: 1-2%, diameter: <2mm) 9. Secondary Minerals: see 6. 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR84-3	<ol style="list-style-type: none"> 1. Rock Type: dense basalt clast 2. Size: 8x8x6cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: no vesicles, very dense rock 6. Vesicle Fillings: - 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 3%, diameter: 0.5-3mm, moderately altered); feldspar (amount: 2-3%, diameter: <2mm); pyroxene (augite?, amount: 1%, diameter: 1-4mm, fresh) 9. Secondary Minerals: - 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR84-4	<ol style="list-style-type: none"> 1. Rock Type: basaltic (?) fragment, slightly tectonically overprinted 2. Size: 12x11x4cm 3. Shape/Angularity: subangular 4. Encrustation: partly thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey to greenish 8. Primary Minerals: not recognizable 9. Secondary Minerals: not recognizable 10. Overall Degree of Alteration: very strongly altered 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR84-5	<ol style="list-style-type: none"> 1. Rock Type: tectonically overprinted, basalt fragment 2. Size: 12x8x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating to thin crust, thickness <1mm 5. Vesicularity: dense 6. Vesicle Fillings: - 7. Matrix Colour: grey 8. Primary Minerals: olivine (altered, amount: 1%, diameter: <1mm); pyroxene (amount: <1%, diameter: 0.5-2mm, fresh) 9. Secondary Minerals: veins, filled with yellowish mineral 10. Overall Degree of Alteration: moderately to strongly altered 	Y			Y						
DR84-6	<ol style="list-style-type: none"> see sample DR84-1C 2. Size: 10x7x9cm 3. Shape/Angularity: subangular 	Y			Y						
DR84-7A	<ol style="list-style-type: none"> 1. Rock Type: tectonically overprinted (?) basalt, part of breccia, as well as DR84-7B 2. Size: 8x10x9cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: green 8. Primary Minerals: pyroxene (amount: 1%, diameter: <3mm, relatively fresh) 9. Secondary Minerals: - 10. Overall Degree of Alteration: moderately altered 	Y			Y						
DR84-7B	<ol style="list-style-type: none"> 1. Rock Type: breccia 2. Size: 10x4x3cm 3. Shape/Angularity: angular 4. Encrustation: Mn-crust, thickness: 15mm 5. Colour: red 6. Internal Structure: partly graded 7. Texture: clast-supported a) Clasts: oxidized basalt fragments (amount: 50%, diameter: 1-10mm) b) Matrix: fine-grained 10. Overall Degree of Alteration: moderately altered? 	Y			Y						
DR84-8	<ol style="list-style-type: none"> 1. Rock Type: volcanic rock 2. Size: 5x5x4cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: elongated vesicles, amount: <1%, diameter: 1-10mm 6. Vesicle Fillings: zeolithe 7. Matrix Colour: reddish brown 8. Primary Minerals: pyroxene (amount: 0.5%, diameter: <<0.5mm) 9. Secondary Minerals: zeolithe in vesicles and veins 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR84-9	<ol style="list-style-type: none"> 1. Rock Type: (volcanic) breccia, (lapillituff?, ash?) 2. Size: 9x9x5cm 3. Shape/Angularity: rounded 4. Encrustation: thin Mn-crust, thickness: 2mm 5. Colour: matrix: light green, clasts: white 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: amount: 50%, diameter: 2-10mm, white material b) Matrix: fine-grained 10. Overall Degree of Alteration: not recognizable 	Y			Y						
DR84-10	<ol style="list-style-type: none"> 1. Rock Type: clay-stone 2. Size: 10x5x8cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Colour: brown to red 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: - b) Matrix: very fine grained red clay 10. Overall Degree of Alteration: slightly altered (?) 				Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR84-11	1. Rock Type: sedimentary rock 2. Size: 6x5x2cm 3. Shape/Angularity: angular 4. Encrustation: partly thin Mn-coating 5. Colour: beige to brown 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: - b) Matrix: very fine-grained, contains calcite(?) 10. Overall Degree of Alteration: slightly altered, compacted				Y						
DR84-12	Mn-crust									Y	

SO193 - DR86

Eastern Manihiki Scarp; NW slope of plateau (lava? sediment?) structure at top of Manihiki Scarp

Dredge on bottom UTC 23/06/07 0934hrs, lat 13°10.85'S, long 161°11.04'W, depth 2704m

Dredge off bottom UTC 23/06/07 1051hrs, lat 13°11.12'S, long 161°10.63'W, depth 2307m

total volume: 1/3 full; mostly large boulders of lapilli tuff and pillow basalt fragments

Comments: max. rope length: 3050m at 2307mbsl

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR86-1	1. Rock Type: pillow basalt fragment 2. Size: 23x21x10cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-crust up to 1.5cm, partly Mn-coating 5. Vesicularity: amount: 3-5%, diameter: <1mm; tubes: diameter up to 1.5cm, probably up to a few cm 6. Vesicle Fillings: mostly open, some are filled with calcite, some are lined with greyish material (zeolithes?), tubes are filled with calcite (partly) or with greenish lapilli tuff (partly); the tubes got filled after the basalt has formed, but it is not clear whether the tubes formed through excavating by animals or represent some sort of lava-tree effect where lava was flowing around preexisting biota 7. Matrix Colour: grey 8. Primary Minerals: olivine (amount: 2-3%, diameter: <3mm, strongly altered); feldspar-laths and -crystals (amount: 3-5%, diameter: <1mm, length ~3mm, fairly fresh) 9. Secondary Minerals: iddingsite, calcite 10. Overall Degree of Alteration: slightly altered	Y	Y		Y						
DR86-2	similar to DR86-1, but the tubes are a little smaller 1. Rock Type: pillow basalt fragment 2. Size: 11.5x10x5cm 3. Shape/Angularity: subangular 4. Encrustation: minor Mn-coating	Y	Y								
DR86-3	similar to DR86-1, but the tubes have a diameter up to 1.8cm 2. Size: 13x13x6.5cm 4. Encrustation: 1mm Mn-crust	Y	Y								
DR86-4	similar to DR86-1, but more and thinner (diameter up to 0.7cm) tubes, which are less filled 2. Size: 17.5x8x8cm 4. Encrustation: Mn-coating	Y	Y		Y						
DR86-5	similar to DR86-1, but less tubes and smaller tubes (up to 0.7cm in diameter); this sample has a chilled margin 2. Size: 16x13x9cm 4. Encrustation: Mn-coating	Y	Y		Y						
DR86-6	1. Rock Type: lapilli tuff with lithic fragments 2. Size: 12x10x6cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating 5. Colour: matrix: light green-yellowish; clasts: colour varies between ocre-brown, greenish and dark brown 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: lithic fragments (amount: 10-15%, size: 1-3cm) subangular in shape, colour see 5., some look like pumice and some like sample DR86-1 to DR86-5 but without tubes and with filled vesicles (partly) b) Matrix: grainsize: <2mm, colour see 5. 8. Overall Degree of Alteration: ?	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR86-7	<ol style="list-style-type: none"> 1. Rock Type: pillow basalt fragment 2. Size: 9x6x6cm 3. Shape/Angularity: angular 4. Encrustation: partly Mn-coating 5. Vesicularity: amount: 5-7%, diameter of most of the vesicles: <0.5mm, very few up to 5mm 6. Vesicle Fillings: vesicles are mostly open, very few are filled with calcite 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: ~2%, diameter: up to 1mm, strongly altered and some fairly fresh?); feldspar (amount: 5-7%, diameter: <0.5mm, length: <1.5mm, fairly fresh) 9. Secondary Minerals: iddingsite, calcite 10. Overall Degree of Alteration: slightly altered 	Y			Y						
DR86-8	<p>DR86-8A, -8B, and -8C = lithic fragments out of lapilli tuff</p> <ol style="list-style-type: none"> 1. Rock Type: A,B: similar to DR86-7; C: pumice 2. Size: A: 6x5x4cm; B: 6x3.5x3cm; C: 4 pieces, all about 4x2.5x3cm 3. Shape/Angularity: A: subangular-subrounded; B: angular; C: subrounded 4. Encrustation: ? 5. Vesicularity: A: amount: 25%, diameter: up to 2mm; B: ?; C: amount: 50% 6. Vesicle Fillings: A: mostly open, some are lined with brown mineral; B: ?; C: open, some are filled with calcite 7. Matrix Colour: A: brownish; B: grey; C: light grey-brownish 8. Primary Minerals: A: olivine (amount: 5-7%, diameter: <2mm, strongly altered); feldspar (amount: 1%, length: <1mm); B: ?; C: olivine? 9. Secondary Minerals: A: iddingsite, greenish mineral (celadonite?); B: ?; C: celadonite?, calcite 10. Overall Degree of Alteration: A,C: slightly to moderately altered; B: ? 	Y (A)			Y						
DR86-9x	similar to DR86-1 to DR86-5 and DR86-7						Y				archive sample
DR86-10x	similar to DR86-6						Y				archive sample

SO193 - DR87

Manihiki Scarp at 3200mbsl on east facing slope along an oblique dredge track across nose

Dredge on bottom UTC 23/06/07 1356hrs, lat 13°03.32'S, long 161°07.61'W, depth 3225m

Dredge off bottom UTC 23/06/07 1509hrs, lat 13°02.85'S, long 161°07.50'W, depth 2842m

total volume: 1/5 full; solidified sediment boulders, Mn-encrusted breccias, a few rounded boulders of possible basaltic composition

Comments: max. rope length: 3550m at 2862mbsl

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR87-1	<ol style="list-style-type: none"> 1. Rock Type: feldspar phyric basalt/trachyte 2. Size: original: 22x15x12cm 3. Shape/Angularity: subangular 4. Encrustation: minor Mn-coating 5. Vesicularity: dense, no vesicles visible 6. Vesicle Fillings: - 7. Matrix Colour: brownish-grey where fresh, reddish-brown where strongly oxidized 8. Primary Minerals: feldspar (amount: 15%, diameter: 1-2mm, appears somewhat altered); pyroxene (amount: 1-2%, diameter: 1-3mm) 9. Secondary Minerals: Fe-staining of groundmass 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR87-2	<ol style="list-style-type: none"> See sample DR87-1 2. Size: 15x15x6cm 7. Matrix Colour: grey; less Fe-stained zones 8. Primary Minerals: feldspars have shape boundaries to matrix and are a bit fresher 10. Overall Degree of Alteration: slightly to moderately altered <p>THIS IS THE FRESHEST SAMPLE</p>	Y	Y		Y						
DR87-3	<ol style="list-style-type: none"> See sample DR87-1 2. Size: 14x9x5cm 	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR87-4	<ol style="list-style-type: none"> 1. Rock Type: feldspar phyrlic highly oxidized trachyte? 2. Size: 10x6.5x3.5cm 3. Shape/Angularity: rounded 4. Encrustation: minor <<0.5mm Mn-coating 5. Vesicularity: amount: 3-4% 6. Vesicle Fillings: open vesicles 7. Matrix Colour: dark red, looks like oxidized under subaerial conditions 8. Primary Minerals: feldspar (amount: 25%, diameter: 0.5-1.5mm, rounded and appear altered) 9. Secondary Minerals: groundmass totally oxidized 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y								
DR87-5	<ol style="list-style-type: none"> 1. Rock Type: rounded clast recovered from Mn-encrusted breccia; feldspar-pyroxene phyrlic trachyte 2. Size: 7.5x7x4cm 3. Shape/Angularity: rounded 4. Encrustation: 1-2cm thick Mn-crust 5. Vesicularity: amount: 5-7%, diameter: 0.2-1mm 6. Vesicle Fillings: mostly open 7. Matrix Colour: light red throughgoing, again resembles oxidation under subaerial conditions 8. Primary Minerals: feldspar (amount: 7%, diameter: 0.3-1mm, appears somewhat pale) 9. Secondary Minerals: Fe-oxidation of groundmass 10. Overall Degree of Alteration: slightly to moderately altered, except for oxidized groundmass 	Y			Y						geochemistry sample too small to cut
DR87-6	<ol style="list-style-type: none"> 1. Rock Type: most likely igneous because it contains feldspar, pyroxene and vesicles --> feldspar-pyroxene phyrlic trachyte/basalt 2. Size: 18x15x7.5cm 3. Shape/Angularity: subangular 4. Encrustation: minor <<0.5mm Mn-coating 5. Vesicularity: amount: 3%, diameter: 1-4mm; several cracks crossing sample (tectures?) 6. Vesicle Fillings: calcite 7. Matrix Colour: brownish-red 8. Primary Minerals: feldspar (amount: 5-10%, diameter: 0.5-1mm, ~fresh); pyroxene (amount: 2%, diameter: 1-2mm, ~fresh) 9. Secondary Minerals: Fe-staining of groundmass 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR87-7	<ol style="list-style-type: none"> 1. Rock Type: volcanic rock 2. Size: 7.5x6x4cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating; calcite-crust, partly 2mm thick 5. Vesicularity: amount: 1%, diameter: 1mm 6. Vesicle Fillings: calcite 7. Matrix Colour: green 8. Primary Minerals: - 9. Secondary Minerals: calcite 10. Overall Degree of Alteration: not recognizable 	Y			Y						
DR87-8	<ol style="list-style-type: none"> 1. Rock Type: breccia 2. Size: 8x6x4cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-coating, partly Mn-crust up to 5mm thick 5. Colour: clasts: red to brown; matrix: white-greenish 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: mainly basalt clasts or pumice (amount: 50%, size: 0.5-8mm) colour is red to brown b) Matrix: fine-grained material, colour is white-greenish 10. Overall Degree of Alteration: strongly altered (?) 	Y			Y						
DR87-9	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 8.5x7.5x6cm 3. Shape/Angularity: subangular 4. Encrustation: partly up to 3mm thick Mn-crust 5. Vesicularity: amount: 10%, diameter: 0.5-2mm 6. Vesicle Fillings: calcite, dolomite (?), green material, zeolithe 7. Matrix Colour: brown 8. Primary Minerals: olivine (amount: 1%, diameter: <1mm, strongly altered) 9. Secondary Minerals: calcite, dolomite, zeolithe, green material, Mn, veins with calcite 10. Overall Degree of Alteration: strongly altered 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR87-10	1. Rock Type: sediment rock 2. Size: 23x22x14cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-crust 5. Colour: red to brownish 6. Internal Structure: layered 7. Texture: clast-supported (?) a) Clasts: - b) Matrix: ? 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR87-11	1. Rock Type: sediment rock 2. Size: 13.5x9x9cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-crust up to 5mm, partly Mn-coating 5. Colour: brown to ocreish 6. Internal Structure: graded, looks like turbidite 7. Texture: - a) Clasts: partly with clasts, partly without b) Matrix: very fine-grained 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR87-12X	taken as archive sample						Y				archive sample
DR87-13	1. Rock Type: sediment rock 2. Size: 20x20x10cm 3. Shape/Angularity: subangular 4. Encrustation: partly thin Mn-crust <4mm 5. Colour: ocre 6. Internal Structure: there are parts with clasts and parts without clasts 7. Texture: matrix-supported a) Clasts: basalt clasts (size: <1-5mm) b) Matrix: fine-grained 10. Overall Degree of Alteration: slightly altered (?)				Y						

SO193 - DR88

Manihiki Scarp (mid part); SE-trending slope of the eastern flank of the High Plateau

Dredge on bottom UTC 23/06/07 2258hrs, lat 13°40.25'S, long 160°46.14'W, depth 5477m

Dredge off bottom UTC 24/06/07 0023hrs, lat 13°39.56'S, long 160°46.22'W, depth 5127m

total volume: 3/4 full; variety of magmatic rocks and probably volcanoclastic material; reflecting most likely slope debris

Comments: max. rope length: 5700m, max. rope tension: 9.4t (1 bite)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR88-1	1. Rock Type: basalt fragment, very dense 2. Size: 7x7x2cm 3. Shape/Angularity: angular 4. Encrustation: thin Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey 8. Primary Minerals: feldspar (amount: 1%, diameter: 0.5-1mm); olivine (amount: <1%, diameter: <1mm, strongly altered) 9. Secondary Minerals: ? 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR88-2	1. Rock Type: basalt fragment, very dense 2. Size: 13x12x5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, 1-10mm thick 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: olivine (amount: <1%, diameter: 0.5-1mm, strongly altered); feldspar (amount: 1-2%, diameter: 1-2mm) 9. Secondary Minerals: one green mineral -> ?, iddingsite 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR88-3	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, fractured, very dense 2. Size: 7x6x4cm 3. Shape/Angularity: angular 4. Encrustation: thin Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: feldspar (amount: <1%, diameter: <1mm); microliths 9. Secondary Minerals: calcite in fractures 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR88-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, very dense 2. Size: 10x10x6cm 3. Shape/Angularity: subrounded 4. Encrustation: thin Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey to brownish 8. Primary Minerals: feldspar (amount: 1%, diameter: 1-2mm, altered, and as microliths) 9. Secondary Minerals: Mn, green minerals 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR88-5	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, very dense 2. Size: 10x10x6cm 3. Shape/Angularity: subangular 4. Encrustation: 2-3mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to brownish 8. Primary Minerals: olivine (amount: <1%, diameter: <1mm, altered); pyroxene (? , amount: 2%, diameter: ~2mm, altered); feldspar (amount: 2%, diameter: 0.5-2mm) 9. Secondary Minerals: calcite in veins, iddingsite 10. Overall Degree of Alteration: moderately altered 	Y	Y		Y						
DR88-6	<p>similar to sample DR88-5</p> <ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 9x8x7cm 4. Encrustation: 3mm Mn-crust 8. Primary Minerals: olivine (amount: <1%, diameter: <1mm, altered); feldspar (amount: 1-2%, diameter: <1.5mm, and as microliths); pyroxene (amount: 1%, diameter: 1-3mm, altered) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						
DR88-7	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, very dense (see DR88-5 and DR88-6) 2. Size: 7x6x6cm 3. Shape/Angularity: subrounded 4. Encrustation: 1mm up to 5mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey to brown 8. Primary Minerals: olivine (amount: 1%, diameter: <2mm, altered); feldspar (amount: 1%, diameter: up to 2mm); pyroxene (amount: <1%, diameter: <3mm, altered) 9. Secondary Minerals: iddingsite 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						
DR88-8	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment, coarser than samples DR88-5 to DR88-7 2. Size: 11x9x5cm 3. Shape/Angularity: subangular 4. Encrustation: 1-5mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey to brown 8. Primary Minerals: feldspar (amount: 1%, diameter: <3mm, altered); pyroxene (amount: 1%, diameter: up to 4mm(?), altered) 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered 	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR88-9	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 12x10x8cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust 5. Vesicularity: amount: <1%, diameter: <1mm 6. Vesicle Fillings: filled with calcite 7. Matrix Colour: grey to brown 8. Primary Minerals: feldspar microliths; green mineral (--> primary?, amount: <1%, diameter: <1mm) 9. Secondary Minerals: calcite in vesicles, Mn 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR88-10	<ol style="list-style-type: none"> 1. Rock Type: aphyric basalt fragment 2. Size: 9x6x5cm 3. Shape/Angularity: subangular 4. Encrustation: 1mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: grey to brownish 8. Primary Minerals: aphyric 9. Secondary Minerals: Mn 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR88-11	<ol style="list-style-type: none"> 1. Rock Type: fine-grained aphyric diabase 2. Size: 25x25x20cm 3. Shape/Angularity: angular 4. Encrustation: up to 5mm thick Mn-crust 5. Vesicularity: amount: 1%, diameter: <1mm 6. Vesicle Fillings: filled with yellowish material 7. Matrix Colour: brownish where altered, otherwise light-coloured due to abundant micro-crystalline feldspar 8. Primary Minerals: - 9. Secondary Minerals: yellowish material in vesicles 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR88-12	<ol style="list-style-type: none"> 1. Rock Type: fine-grained aphyric diabase 2. Size: 9x8x4cm 3. Shape/Angularity: angular 4. Encrustation: 5mm Mn-crust 5. Vesicularity: dense, no vesicles 6. Vesicle Fillings: - 7. Matrix Colour: light grey to brownish where oxidized, matrix is fairly fine-grained consisting of feldspar and pyroxene, overall relatively fresh 8. Primary Minerals: - 9. Secondary Minerals: Fe-staining of matrix 10. Overall Degree of Alteration: moderately altered 	Y	Y								
DR88-13	<ol style="list-style-type: none"> 1. Rock Type: serpentinite? 2. Size: 12x5x5cm 3. Shape/Angularity: rounded 4. Encrustation: 5mm Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: light-yellowish green, cut surface feels greasy 8. Primary Minerals: - 9. Secondary Minerals: the rock essentially consists of 3-7mm sized rounded clasts, that are green and possess an internal layered structure; not clear whether this is a mineral, since it is also quite amorphous 10. Overall Degree of Alteration: extremely strongly altered 	Y			Y						
DR88-14x	7 pieces similar to sample DR88-1 to DR88-4						Y				archive sample
DR88-15x	7 pieces similar to sample DR88-5 to DR88-7	Y (samples DR15xA and DR15xB)					Y				archive sample; sample 15xA and 15xB were cut and prepared for geochemistry and then taken into sample box; they are not in the archive box
DR88-16x	3 pieces similar to sample DR88-9 and DR88-10						Y				archive sample

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR88-17x	2 pieces similar to sample DR88-11 and DR88-12	Y (sample DR17xA)					Y				archive sample; sample 17xA was prepared for thin section and geochemistry and then taken into sample box
DR88-18x	5 pieces similar to sample DR88-13						Y				archive sample

SO193 - DR90

Manihiki Scarp; 1nm north of OFOS-track in upper part of Manihiki Scarp; dredge-track oblique to slope

Dredge on bottom UTC 24/06/07 1351hrs, lat 13°41.76'S, long 161°27.28'W, depth 4237m

Dredge off bottom UTC 24/06/07 1504hrs, lat 13°41.17'S, long 161°27.12'W, depth 3979m

total volume: ~10 pieces of rock; 1 basalt, Mn-crusts, and volcanoclastic breccias

Comments: max. rope length: 4500m at 3886mbsl

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR90-1	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 6x5.5x5cm 3. Shape/Angularity: rounded 4. Encrustation: 1-2mm Mn-crust 5. Vesicularity: amount: 1-2%, diameter: up to 7mm 6. Vesicle Fillings: mostly open, few filled with calcite (?), few lined with brown material 7. Matrix Colour: dark-grey, partly violet-reddish (looks like subaerial oxidation) 8. Primary Minerals: olivine (amount: ~2%, diameter: <1mm, fresh); feldspar (amount: 1-2%, diameter: <1mm, fresh); black mineral 9. Secondary Minerals: calcite (?), light-brown mineral at rim (iddingsite?) 10. Overall Degree of Alteration: relatively fresh 	Y	Y								
DR90-2	<ol style="list-style-type: none"> 1. Rock Type: Volcanoclastic breccia (?) 2. Size: 9.5x7x5.5cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust up to 3mm 5. Colour: matrix: white; clasts: colour varies with dark brownish, greyish, greenish, dark grey 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: probably basalt clasts, amount: 20%, size: 1-20mm, angular to rounded in shape; Mn-coating up to 0.5cm; biggest clasts contain pyroxene (amount: 3%, diameter: up to 1mm) b) Matrix: possibly calcite (?) 10. Overall Degree of Alteration: ? 				Y						
DR90-3	Mn-crust, up to 6.5cm thick									Y	
DR90-4	<ol style="list-style-type: none"> 1. Rock Type: 3 pieces of volcanoclastic breccia with Mn-crust 2. Size: all about 8x7x4cm; clasts: 1-12mm 3. Shape/Angularity: subrounded; clasts: subangular-rounded 4. Encrustation: up to 1.7cm thick Mn-crust on each piece; clasts in breccia: partly Mn-coating 5. Colour: brownish-grey; clasts: dark brown, grey, ocre 6. Internal Structure: - 7. Texture a) Clasts: primary minerals: light grey, dark grey, and dark greenish minerals in some clasts; brown minerals in other clasts b) Matrix: - 8. Overall Degree of Alteration: strongly altered 				Y						

Appendix II (Rock Description)

SO193 - DR91											
Manihiki Scarp; SE-facing slope of Manihiki Scarp near its southern termination; dredge-track oblique to slope											
Dredge on bottom UTC 24/06/07 1950hrs, lat 13°51.48'S, long 161°34.28'W, depth 4617m											
Dredge off bottom UTC 24/06/07 2130hrs, lat 13°50.90'S, long 161°34.17'W, depth 4239m											
total volume: few rocks; several small blocks and "cobbles" of brownish altered basalt, partly encrusted with few cm of Mn-crust											
Comments: -											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR91-1	1. Rock Type: basalt fragment 2. Size: 20x16x8cm 3. Shape/Angularity: subangular 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: 15%, diameter: 1-8mm 6. Vesicle Fillings: vesicles filled with calcite and dolomite (?) 7. Matrix Colour: reddish brown 8. Primary Minerals: olivine (amount: 1-2%, diameter: <<1mm, moderately altered) 9. Secondary Minerals: calcite and dolomite (?) in vesicles 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR91-2	1. Rock Type: basalt fragment 2. Size: 15x11x9cm 3. Shape/Angularity: subrounded 4. Encrustation: partly very thin Mn-coating 5. Vesicularity: amount: 5-7%, diameter: 1-7mm 6. Vesicle Fillings: vesicles filled with calcite and zeolithe 7. Matrix Colour: reddish brown 8. Primary Minerals: olivine (amount: 1%, diameter: <<1mm, moderately altered) 9. Secondary Minerals: calcite and zeolithe in vesicles 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR91-3	1. Rock Type: basalt fragment 2. Size: 9x8x5cm 3. Shape/Angularity: subrounded 4. Encrustation: - 5. Vesicularity: amount: 5%, diameter: 1-7mm 6. Vesicle Fillings: vesicles filled with calcite, zeolithe, Mn 7. Matrix Colour: reddish brown 8. Primary Minerals: olivine (amount: 1%, diameter: <1mm, moderately altered) 9. Secondary Minerals: calcite, zeolithe, and Mn in vesicles 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						
DR91-4	1. Rock Type: basalt fragment 2. Size: 20x14x9cm 3. Shape/Angularity: subangular 4. Encrustation: <1cm thick Mn-crust 5. Vesicularity: amount: 2-3%, diameter: <1mm 6. Vesicle Fillings: vesicles filled with calcite 7. Matrix Colour: brown 8. Primary Minerals: pyroxene (amount: <<1%, diameter: <1mm, altered); feldspar (amount: <<1%, diameter: ~1mm) 9. Secondary Minerals: calcite in vesicles, Fe-hydroxide (amount: ~1%, diameter: <1mm) 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR91-5	1. Rock Type: volcanic (?) rock fragment 2. Size: 20x20x15cm 3. Shape/Angularity: subangular 4. Encrustation: up to 1cm thick Mn-crust 5. Vesicularity: amount: 1%, diameter: 1-3mm, elongated 6. Vesicle Fillings: vesicles filled with calcite 7. Matrix Colour: grey 8. Primary Minerals: olivine (? , amount: ~40%, altered, not sure if these are really primary or secondary products) 9. Secondary Minerals: calcite as vesicle-filling 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR91-6	very similar to sample DR91-5 5. Vesicularity: less vesicles, amount: <<1%	Y	Y		Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR91-7	1. Rock Type: fractured basalt fragment 2. Size: 10x8x4cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: 2%, diameter: 1-2mm 6. Vesicle Fillings: filled with calcite and yellowish material 7. Matrix Colour: brown 8. Primary Minerals: not clear because its strongly altered 9. Secondary Minerals: calcite and yellowish material in vesicles 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR91-8	1. Rock Type: basalt fragment 2. Size: 10x8x6cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: 2%, diameter: 1-5mm 6. Vesicle Fillings: vesicles filled with Cc, zeolithe (and dolomite?) 7. Matrix Colour: brown 8. Primary Minerals: feldspar-microliths 9. Secondary Minerals: zeolithe, calcite (and dolomite?) in vesicles, Mn 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR91-9	1. Rock Type: fractured basalt fragment 2. Size: 10x8x5cm 3. Shape/Angularity: subangular 4. Encrustation: 1-5mm thick Mn-crust 5. Vesicularity: amount: <2%, diameter: 0.5-2mm 6. Vesicle Fillings: vesicles filled with calcite 7. Matrix Colour: brown 8. Primary Minerals: ? 9. Secondary Minerals: calcite in vesicles, Fe-hydroxides (amount: <<1%, diameter: <1mm), Mn 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR91-10x	6 pieces similar to samples DR91-1 to DR91-3 (one piece strongly altered), plus 1 piece similar to DR91-9						Y				archive sample

SO193 - DR92

Seamount south of High Plateau; ridge structure at the upper western flank of the seamount

Dredge on bottom UTC 25/06/07 0405hrs, lat 14°11.99'S, long 162°12.85'W, depth 2458m

Dredge off bottom UTC 25/06/07 0531hrs, lat 14°11.80'S, long 162°12.41'W, depth 1992m

total volume: a few pieces of Mn-crusts

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR92-1	2 Mn-crusts									Y	

SO193 - DR93

Same seamount as DR92; top area of the seamount at western flank

Dredge on bottom UTC 25/06/07 0722hrs, lat 14°13.47'S, long 162°11.81'W, depth 1823m

Dredge off bottom UTC 25/06/07 0845hrs, lat 14°13.66'S, long 162°11.29'W, depth 1323m

total volume: 1/6 full; 1x Mn-encrusted pillow, several basalt cobbles, 1x breccia, several pieces of carbonate, Mn-crusts

Comments: dredge got stuck at 2020m with 10.7t, thereafter 3 more large bites between 7-9t tension

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR93-1	1. Rock Type: highly vesicular basalt (pillow) with big feldspars 2. Size: diameter: 40cm 3. Shape/Angularity: subrounded to rounded 4. Encrustation: Mn-crust up to 2cm 5. Vesicularity: amount: 30-40%, diameter: 1-2mm 6. Vesicle Fillings: white material (calcite?), lined with greyish material, reddish-yellowish material (probably FeOOH) 7. Matrix Colour: dark grey, altered material brownish 8. Primary Minerals: feldspar (amount: 2%, diameter: up to 0.7x0.4mm, fresh) 9. Secondary Minerals: reddish, yellowish, and greyish material (calcite?), calcite veins 10. Overall Degree of Alteration: slightly to moderately altered	Y	Y								feldspars are suitable for Ar-Ar dating
DR93-2	see sample DR93-1 2. Size: 11x11x8cm 3. Shape/Angularity: angular 4. Encrustation: 2mm Mn-coating 9. Secondary Minerals: no more calcite veins visible	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR93-3	see sample DR93-1 2. Size: 16x10x9cm 3. Shape/Angularity: subangular to angular 4. Encrustation: Mn-crust, 1-2mm 5. Vesicularity: amount: 30-40%, diameter: 1mm, vesicles are smaller than in DR93-1	Y	Y								
DR93-4	see sample DR93-1 2. Size: 12x8x7cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-coating	Y	Y								
DR93-5	1. Rock Type: Volcaniclastic breccia (partly with basalt clasts) 2. Size: 18x15x9cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, 4mm 5. Colour: clasts: brownish to light grey; matrix: ocre 6. Internal Structure: gradation: one part of the sample contains angular to subangular clasts (1x1.5cm), the other part contains smaller clasts from subrounded to rounded shape (up to 1x0.7mm) 7. Texture: clast-supported at zone with larger clasts, matrix-supported at zone with smaller clasts a) Clasts: amount: 30%, angular to rounded in shape, with vesicles 5% in grey clasts (diameter: 1-2mm), with vesicles 4% in brownish clasts (diameter: 1-2mm), clast with feldspars (diameter: <0.5mm); clasts are very extremely altered b) Matrix: - 10. Overall Degree of Alteration: clasts are very extremely altered	Y									
DR93-6	1. Rock Type: sediment, carbonate 2. Size: 13x8x8cm 3. Shape/Angularity: subangular 4. Encrustation: partly Mn-crust up to 4mm 5. Colour: clasts: brownish; matrix: white to ocre 6. Internal Structure: irregular shaped areas are dense and have curved contacts to highly vesicular area; diagenetic effect? see below 7. Texture: matrix-supported a) Clasts: amount: 1%, diameter: 5x3mm, subrounded b) Matrix: fine-grained, with Mn-dots 10. Overall Degree of Alteration: -	Y									
DR93-7	Mn-crust 2. Size: 12x10x5cm									Y	
DR93-8x	8 pieces of basalt similar to sample DR93-1 to DR93-4						Y				archive sample
DR93-9x	3 pieces of carbonate similar to sample DR93-6						Y				archive sample

SO193 - DR94

Southern margin of High Plateau; SW-facing slope of High Plateau where it drops into the abyssal plain

Dredge on bottom UTC 25/06/07 1448hrs, lat 14°30.60'S, long 162°42.10'W, depth 5050m

Dredge off bottom UTC 25/06/07 1612hrs, lat 14°30.21'S, long 162°41.69'W, depth 4452m

total volume: 1/4 full; 1 large Mn-crust with sediment?, attached are several mid-sized, rounded boulders of sediment

Comments: max. rope length: 5350m at 4468mbsl

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR94-1	1. Rock Type: sediment 2. Size: 19x15x13cm 3. Shape/Angularity: subrounded 4. Encrustation: in parts very thin Mn-coating 5. Colour: dark brown 6. Internal Structure: the rock contains black minerals (amount: ~15%, size: <2mm) (Mn?) and long veins filled with Mn (?) and a yellowish material; there is a zonation in colour: ~1cm thick ocre bands cut through the dark brown matrix, the bands contain slightly more of the black minerals than the matrix 7. Texture: matrix-supported a) Clasts: - b) Matrix: very fine-grained, dark brown matrix 10. Overall Degree of Alteration: moderately altered	Y			Y						

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR94-2	1. Rock Type: clastic sediment 2. Size: 15x8x7cm 3. Shape/Angularity: subangular 4. Encrustation: Mn-crust, up to 3cm thick 5. Colour: matrix: grey; clasts: vary in colour from dark red to dark grey 6. Internal Structure: mainly small clasts in fine-grained matrix 7. Texture: matrix-supported a) Clasts: amount: ~20-30%, most clasts are subrounded to subangular in shape, diameter: <2mm, but 1 big clast (diameter: ~3cm) is visible b) Matrix: fine-grained, partly covered with a whitish material around clasts 10. Overall Degree of Alteration: slightly altered	Y			Y						
DR94-3	1. Rock Type: breccia 2. Size: 8x8x7cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-coating 5. Colour: matrix: ocre to yellowish brown; clasts: red to ocre 6. Internal Structure: unsorted clasts in fine-grained matrix 7. Texture: clast-supported a) Clasts: amount: ~50%, diameter: up to 3cm, but most clasts are around 1cm in diameter; the clasts are lithoclasts and partly have an internal structure produced by different minerals; most clasts are angular in shape b) Matrix: fine- to medium-grained 10. Overall Degree of Alteration: slightly altered	Y			Y						
DR94-4	1. Rock Type: compacted mud or ash 2. Size: 12x10x8cm 3. Shape/Angularity: subrounded 4. Encrustation: Mn-crust, up to 2cm thick 5. Colour: ocre 6. Internal Structure: - 7. Texture: matrix-supported a) Clasts: - b) Matrix: mud-supported, ocre, partly cut by very thin (<<1mm) veins filled with a brownish material 10. Overall Degree of Alteration: slightly altered	Y			Y						
DR94-5	Mn-crust, 8.5cm thick									Y	
DR94-6x	6 pieces of rock similar to samples DR94-1 to DR94-5						Y				archive sample

SO193 - DR96

Samoan Basin, seamount south of Nassau Atoll. SSW-facing flank of seamount at base

Dredge on bottom UTC 26/06/07 1556 hrs, lat 13°01.55'S, long 165°15.98'W, depth 5033 m

Dredge off bottom UTC 26/06/07 1728 hrs, lat 13°0.92'S, long 165°15.69'W, depth 4439 m

total volume: 1/3 full, volcanic rocks and volcanoclastic material partly encrusted with few cm of Mn-crust

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR96-1	1. Rock Type: basalt fragment 2. Size: 18x13x4cm 3. Shape/Angularity: subangular 4. Encrustation: 2-20mm thick Mn-crust 5. Vesicularity: amount: <1% vesicles, diameter: <1mm 6. Vesicle Fillings: vesicles filled with calcite, green mineral (?) 7. Matrix Colour: dark grey to reddish brown 8. Primary Minerals: olivine (amount: 2-3%, altered, diameter: 0.5-2mm) 9. Secondary Minerals: calcite in vesicles, green mineral in vesicles and olivines (amount: <1%, diameter: <1mm) and Mn in veins 10. Overall Degree of Alteration: moderately to strongly altered	Y	Y		Y						
DR96-2	1. Rock Type: basalt fragment (olivine-basalt) 2. Size: 8x6x4cm 3. Shape/Angularity: angular 4. Encrustation: thin Mn-coating 5. Vesicularity: amount: ~1%, diameter: 1-2mm 6. Vesicle Fillings: vesicles filled with calcite 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: ~3%, altered, diameter: 0.5-3mm); feldspar (amount: <<1%, diameter: up to 1mm) 9. Secondary Minerals: calcite as vesicle filling 10. Overall Degree of Alteration: moderately altered	Y	Y		Y						CHEM: take sample 2 as GC-sample, because it appears fresher than sample 1

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GLIMIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR96-3	<ol style="list-style-type: none"> 1. Rock Type: very dense basalt fragment 2. Size: 14x5x4cm 3. Shape/Angularity: angular 4. Encrustation: partly thin Mn-coating and partly ~ 5mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: dark grey 8. Primary Minerals: olivine (amount: 1-2%, altered, diameter: 0.5-2mm); feldspar (amount: 1%, diameter: ≤1mm) 9. Secondary Minerals: Mn 10. Overall Degree of Alteration: moderately altered 	Y	Y								
DR96-4	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 8x8x8cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: ~1% vesicles, diameter: 1-10mm 6. Vesicle Fillings: vesicles filled with green mineral and clay mineral (?) 7. Matrix Colour: grey to brown 8. Primary Minerals: olivine (amount: 2-3%, altered, diameter: 0.5-2mm); feldspar (amount: <1%, diameter: up to 1mm) 9. Secondary Minerals: in one big vesicle (1cm) white to brownish clay mineral (?), green mineral in vesicles and olivine (~1%) 10. Overall Degree of Alteration: moderately to strongly altered 	Y	Y		Y						
DR96-5	<ol style="list-style-type: none"> 1. Rock Type: very dense basalt fragment (olivine-basalt) 2. Size: 14x13.5x5cm 3. Shape/Angularity: subangular 4. Encrustation: partly thin Mn-coating and partly 5-10mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: reddish brown 8. Primary Minerals: olivine (amount: 7-10%, altered, diameter: 0.5-3mm); feldspar-microliths 9. Secondary Minerals: Mn in veins (10-40mm long and <<1mm thick) 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR96-6	<ol style="list-style-type: none"> 1. Rock Type: very dense basalt fragment (olivine-basalt) 2. Size: 14x14x6cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: reddish brown 8. Primary Minerals: olivine (amount: ~20%, altered, diameter: ~1-5mm); feldspar-microliths 9. Secondary Minerals: calcite or clay mineral (?) in 7cm long vein and Mn also in veins 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y						
DR96-7	<ol style="list-style-type: none"> 1. Rock Type: dolerite or gabbro (?) fragment 2. Size: 50x40x25cm 3. Shape/Angularity: subangular 4. Encrustation: 5mm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown to greenish 8. Primary Minerals: feldspar (amount: ~30-40%, diameter: 0.5-2mm); olivine (amount: 3-5%, diameter: ~1mm) 9. Secondary Minerals: Mn in and on veins 10. Overall Degree of Alteration: strongly altered 	Y	Y		Y		Y				
DR96-8	<ol style="list-style-type: none"> 1. Rock Type: basalt fragment 2. Size: 15x8x6cm 3. Shape/Angularity: subrounded 4. Encrustation: partly thin Mn-coating 5. Vesicularity: amount: <<1% vesicles, diameter: <<1mm 6. Vesicle Fillings: vesicles filled with greenish material 7. Matrix Colour: reddish brown to brown 8. Primary Minerals: feldspar (amount: 2-3%, diameter: up to 2mm) 9. Secondary Minerals: greenish material in vesicles, Mn on veins, green mineral (?) (amount: ~0.5%, diameter: ≤1mm) 10. Overall Degree of Alteration: strongly altered 	Y	Y								

Appendix II (Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR96-9	1. Rock Type: dolerit or gabbro (?) fragment (finer-grained than sample DR96-7) 2. Size: 30x25x20cm 3. Shape/Angularity: subangular 4. Encrustation: partly up to ~1cm thick Mn-crust 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown to greenish 8. Primary Minerals: see sample DR96-7, but finer-grained 9. Secondary Minerals: - 10. Overall Degree of Alteration: strongly altered	Y	Y		Y		Y				
DR96-10	1. Rock Type: basalt fragment 2. Size: 12x10x7cm 3. Shape/Angularity: subrounded 4. Encrustation: partly up to 4mm thick Mn-crust 5. Vesicularity: amount: 7-10%, diameter: 1-5mm 6. Vesicle Fillings: vesicles filled with greenish material (clay mineral?) 7. Matrix Colour: grey to brown 8. Primary Minerals: feldspar-microliths 9. Secondary Minerals: greenish clay mineral (?) in vesicles and Mn 10. Overall Degree of Alteration: strongly altered	Y	Y		Y						
DR96-11	1. Rock Type: dolerite or gabbro (?) fragment 2. Size: 9x8x5cm 3. Shape/Angularity: subangular 4. Encrustation: partly thin Mn-coating 5. Vesicularity: - 6. Vesicle Fillings: - 7. Matrix Colour: brown to greenish 8. Primary Minerals: see sample DR96-7, but more altered 9. Secondary Minerals: Mn and white clay mineral (?) in veins 10. Overall Degree of Alteration: strongly altered	Y			Y						
DR96-12x	30 pieces, similar to other samples DR96-1 to DR96-11						Y				

SO193 - DR97

Seamount within Samoan Basin, SW of Danger Islands; southern flank of seamount at NW-SE ridge-like structure

Dredge on bottom UTC 27/06/07 0342hrs, lat 12°29.31'S, long 166°24.36'W, depth 2199m

Dredge off bottom UTC 27/06/07 0524hrs, lat 12°28.80'S, long 166°24.27'W, depth 1672m

total volume: few carbonate rocks

Comments: -

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR97-1	1. Rock Type: carbonate (?) rock 2. Size: original size: 50x30x20cm 3. Shape/Angularity: subangular 4. Encrustation: thin Mn-crust, <1mm 5. Colour: white 6. Internal Structure: the rock is covered by multiple holes and (worm-)tubes (diameter: up to 1.5cm, possibly of biological origin) 7. Texture: matrix-supported a) Clasts: - b) Matrix: mud-supported matrix covered with black dots (amount: ~1%, diameter: <<1mm) 8. Overall Degree of Alteration: not recognizable				Y						reference sample IFM-GEOMAR
DR97-1x	see sample DR97-1 2. Size: 40x15x10cm						Y				archive sample

Appendix II (Rock Description)

SO193 - DR98											
Samoan Basin; western flank of seamount (middle seamount of three in this area) at 3100mbsl, SW of Danger Islands											
Dredge on bottom UTC 27/06/07 0810hrs, lat 12°29.89'S, long 166°31.31'W, depth 3144m											
Dredge off bottom UTC 27/06/07 1031hrs, lat 12°29.99'S, long 166°31.15'W, depth 2960m											
total volume: very few rocks; 2x small pieces of pillow basalt, Mn-encrusted, but on one side freshly broken; 1x altered basalt fragment, Mn-encrusted; 1x Mn-encrusted basalt breccia											
Comments: max. rope length 3420m at 2523 mbsl; dredge got stuck at 3150m, released in the third try; again stuck at 3040m; position of struck dredge: 2939m wire at 2921mbsl; shortly thereafter dredge got free: dredge probably pulled approx. 300m over ground											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR98-1	<ol style="list-style-type: none"> 1. Rock Type: Mn-encrusted aphyric pillow basalt margin, on one side freshly broken 2. Size: 17x10.5x5.5cm 3. Shape/Angularity: round on Mn-encrusted side, angular on broken side 4. Encrustation: ca. 1cm Mn-crust on chilled margin 5. Vesicularity: amount: 10%, diameter: 0.1-1mm, mostly <0.5mm 6. Vesicle Fillings: within 2cm of chilled margin filled with calcite, towards center of piece mostly open 7. Matrix Colour: dark grey, quite aphyric 8. Primary Minerals: possible some fresh glass at chilled margin _ check TS from this area; olivine (amount: <<1%, diameter: < 0.5mm, altered) 9. Secondary Minerals: iddingsite replacing olivine; oxidation of groundmass near chilled margin 10. Overall Degree of Alteration: slightly to moderately altered 	Y	Y								
DR98-2	<ol style="list-style-type: none"> 1. Similar to sample DR98-1, but appears overall less altered 2. Size: 7.5x6.5x2cm 3. Shape/Angularity: angular, freshly broken piece 4. Encrustation: 3mm Mn-crust on one side 5. Vesicularity: amount: 10%, diameter: 0.5-1mm 6. Vesicle Fillings: unfilled 7. Matrix Colour: dark grey, quite fresh, aphyric 8. Primary Minerals: olivine (amount: minor, <<1%, altered) 9. Secondary Minerals: see sample DR98-1 10. Overall Degree of Alteration: slightly altered pillow basalt 	Y	Y								
DR98-3	<ol style="list-style-type: none"> 1. Rock Type: vesicular basalt fragment 2. Size: 10x5.5x5cm 3. Shape/Angularity: rounded 4. Encrustation: 1cm Mn-crust 5. Vesicularity: amount: 10%, diameter: 0.5-3mm 6. Vesicle Fillings: FeOOH, calcite, 50% still open 7. Matrix Colour: reddish-brown, highly oxidized 8. Primary Minerals: possibly minor altered olivine 9. Secondary Minerals: FeOOH replacing groundmass and filling vesicles 10. Overall Degree of Alteration: strongly altered 	Y			Y						
DR98-4	<ol style="list-style-type: none"> 1. Rock Type: basalt breccia 2. Size: 16x12.5x7cm 3. Shape/Angularity: overall rounded, individual clasts are subangular 4. Encrustation: 1-2cm Mn-crust 5. Vesicularity: amount: 5%, diameter: <1mm 6. Vesicle Fillings: filled with calcite where altered, open where less altered 7. Matrix Colour: brownish-grey in freshest piece, otherwise brown 8. Primary Minerals: - 9. Secondary Minerals: FeOOH replacing groundmass 10. Overall Degree of Alteration: highly altered basalt breccia with possibly some fresher basalt clasts (check TS!) 	Y			Y						3x TS of individual basalt clasts

Appendix II (Rock Description)

SO193 - DR99											
Samoan Basin; SSW slope of westernmost seamount south of Danger Islands; dredge carried out on southern slope											
Dredge on bottom UTC 27/06/07 1741hrs, lat 12°39.65'S, long 167°16.89'W, depth 4594m											
Dredge off bottom UTC 27/06/07 1907hrs, lat 12°39.20'S, long 167°16.58'W, depth 4019m											
total volume: 4 pieces; 3x Mn-encrusted sedimentary (?) rocks, 1x Mn-crust with lithoclasts											
Comments: max. rope length: 4850m at 4003mbsl											
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar	Rest	GL/MIN	ARCH	OTAGO	SOPAC	BGR	NOTES
DR99-1	1. Rock Type: 2 pieces of rock, compacted ash (?) or other sediment 2. Size: 1: 6x6x5cm, 2: 9x7x6cm 3. Shape/Angularity: both subrounded 4. Encrustation: 1: Mn-crust, <3mm thick, 2: Mn-crust, <1.5cm thick 5. Colour: both ocre 6. Internal Structure: rock 2 has a slight zonation in colour 7. Texture: both matrix-supported a) Clasts: - b) Matrix: both have a very fine-grained (mud-supported?), ocre matrix, partly with Mn-dendrites 8. Overall Degree of Alteration: -				Y						
DR99-2	2 pieces of rock as BGR-samples 1: similar to sample DR99-1, except for 2. Size: 8x7x5cm 4. Enrustation: Mn-crust, up to 1.5cm thick 2: Mn-crust with lithoclasts (amount: ~2%, diameter: up to 7mm) Size: 9x6x4cm									Y	

Appendix III (Biological Samples)

Abbreviations: n=number of collected specimens, FIX= fixation, F=Formalin, EtOH= 100% pure Ethanol, Glu=2.5% Glutaraldehyde/PB-buffered.
 gDr=geological dredge, zDr=zoological dredge, TVG=TV grab, MUC=multicorer
 The numbers 2, 5, 50, 100, 200, 500 and 1000 give the size of the vials in ml, WP= Whirl Pack
 Fixation of meiofauna from sediment traps as 1 vol sediment : 1 vol 6% formalin

SO193 - DR1												
SW-corner of Western Plateau												
Dredge on bottom UTC 22/05/07 0855hrs, lat 10°48.52'S, long 168°44.75'W, depth 4063m												
Dredge off bottom UTC 22/05/07 1010hrs, lat 10°47.96'S, long 168°44.82'E, depth 3672m												
total volume: few. Mn encrusted sediment boulders. Yellow to brownish sediment												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	30	x								F	
	Copepoda	3	x								F	
	Acari	1	x								F	

SO193 - DR2												
SW-corner of Western Plateau												
Dredge on bottom UTC 23/05/07 1644hrs, lat 10°38.35'S, long 168°30.56'W, depth 4777m												
Dredge off bottom UTC 23/05/07 1807hrs, lat 10°37.97'S, long 168°30.80'W, depth 4380m												
total volume: few crusts. Very little manganese crusts												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	3	x								F	
	Copepoda	1	x								F	
	Plathelminthes	1	x								F	

SO193 - DR3												
SW-corner of Western Plateau												
Dredge on bottom UTC 23/05/07 2133hrs, lat 10°37.262'S, long 168°33.055'W, depth 3596m												
Dredge off bottom UTC 23/05/07 2247hrs, lat 10°37.324'S, long 168°33.204'W, depth 3310m												
total volume: 1/3 full; Mn-encrusted lava fragments from talus deposit + volcaniclastic material												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Foraminifera			x							F	many, at least 4 different species
	Cnidaria	2		x							F	2 coronate polyps
	Polychaeta	3	x								F	polychaete tubes
Meiofauna	Nematoda	1	x								F	
	Copepoda	2	x								F	
	Kinorhyncha	1	x								F	
	Tardigrada	1	x								F	
	Isopoda	1	x								F	

SO193 - DR4												
Western Plateau, Western most Seamount												
Dredge on bottom UTC 23/05/07 0740hrs, lat 9°49.50'S, long 168°43.28'W, depth 2928m												
Dredge off bottom UTC 23/05/07 1126hrs, lat 9°49.55'S, long 168°43.34'W, depth 2940m												
total volume: few rocks and crusts; basalt clast with Mn-coating but no Mn-crusts; yellow rocks of light vesicular material												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda		x								F	
	Copepoda		x								F	
	Plathelminthes		x								F	

SO193 - DR5												
Western Plateau												
Dredge on bottom UTC 24/05/07 1541hrs, lat 9°42.88'S, long 168°46.43'W, depth 2861m												
Dredge off bottom UTC 24/05/07 1655hrs, lat 9°43.120'S, long 168°46.01'W, depth 2440m												
total volume: 1/3 full; 2 large pillows, several rocks of volcaniclastic material, Mn-crusts												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	3		x							F	hexactinellid: <i>Aphrocallistes</i> ?
	Polychaeta	1		x							EtOH	tubes
Meiofauna	Copepoda	1	x								F	

SO193 - TVG6												
Western Plateau, Northern part of seamount												
TVgrab on bottom UTC 25/05/07 0049hrs, lat 9°16.38'S, long 168°1.59'W, depth 3073m												
TVgrab off bottom UTC 25/05/07 0112hrs, lat 9°16.35'S, long 168°1.45'W, depth 3076m												
total volume: 1/2 full, coarse sand exclusively consisting of foraminiferan shells												
TVG, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Sediment	Foraminifera					x				WP	F	foram shells for D. Lazarus, MfN
Meiofauna	Nematoda	7	x								F	
	Copepoda	3	x								F	
	Gastrotricha	1	x								F	

Appendix III (Biological Samples)

SO193 - MUC7

Western Plateau, Northern part of seamount

MUC on bottom UTC 25/05/07 0359hrs, lat 9°16.35'S, long 168°1.44'W, depth 3080m

MUC off bottom UTC 25/05/07 4001hrs, lat 9°16.35'S, long 168°1.44'W, depth 3080m

MUC closure mechanic did not work properly, all tubes empty

MUC, no sediment, no macrofauna

SO193 - DR8

SW-end of the Western Plateau

Dredge on bottom UTC 25/05/07 0640hrs, lat 9°16.39'S, long 168°0.49'W, depth 3012m

Dredge off bottom UTC 25/05/07 0749hrs, lat 9°16.628'S, long 168°0.149'W, depth 2747m

total volume: one very small piece of basalt; highly vesicular basalt piece

gDr, sediment, no macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	11	x								F	
	Copepoda	2	x								F	

SO193 - DR9

Western Plateau, Foram seamount

Dredge on bottom UTC 25/05/07 1025hrs, lat 9°16.96'S, long 168°2.16'W, depth 2860m

Dredge off bottom UTC 25/05/07 1134hrs, lat 9°17.28'S, long 168°1.51'W, depth 2780m

total volume: full; pillows, Mn-crusts, volcanoclastic material

gDr, no sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	>10		x							EtOH	Demospongia
	Porifera	1	x								EtOH	Calcarea?
	Porifera	>10		x							Glu	Demospongia
	Cnidaria	1		x							F	Octocorallia, Gorgonaria
	Polychaeta	1		x							EtOH	Polynoida ("seamouse")
	Polychaeta	>5		x							EtOH	Tubes
	Polychaeta	1	x								F	Tubes
	Polychaeta	1	x								F	Tubes

SO193 - TVG10

Western Plateau, deep-sea plain east of TVG6/MUC7

TVgrab on bottom UTC 25/05/07 2153hrs, lat 9°39.84'S, long 167°0.04'W, depth 3656m

TVgrab off bottom UTC 25/05/07 2211hrs, lat 9°39.99'S, long 166°59.92'W, depth 3653m

total volume: full, rather fine sediment, clay mixed with foram shells

TVG, sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Cnidaria	1	x								F	Coronate polyp
	Polychaeta	1		x							F	2 pieces
	Scaphopoda	1		x							F	
Meiofauna	Nematoda	42	x								F	
	Copepoda	11	x								F	
	Polychaeta	7	x								F	
	Crustacea	1	x								F	

SO193 - MUC11

Western Plateau, deep-sea plain east of TVG6/MUC7

MUC on bottom UTC 26/05/07 0120hrs, lat 9°39.92'S, long 166°59.97'W, depth 3652m

MUC off bottom UTC 26/05/07 0124hrs, lat 9°39.92'S, long 166°59.97'W, depth 3652m

11 tubes 2/3 full

MUC, sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Radiolaria	3	x								Glu	
	Cnidaria	1	x								Glu	coronate polyp
	Sipuncula?	1	x								Glu	very small, maybe something else
Sediment	upper 2-3 cm of 2 tubes	2								WP		dried at 50°C for nutrient analysis
Meiofauna	Nematoda	80	x								F	
	Copepoda	58	x								F	
	Polychaeta	11	x								F	
	Bryozoa	4	x								F	
	Kinorhyncha	1	x								F	
	Sipunculida	1	x								F	

SO193-DR12

Western Plateau, cone at NW base of seamount, probably formed at late stage

Dredge on bottom UTC 26/05/07 1157hrs, lat 10°10.21'S, long 165°59.68'W, depth 3330m

Dredge off bottom UTC 26/05/07 1415hrs, lat 10°10.24'S, long 165°59.63'W, depth 3200m

total volume: empty dredge, there was probably a huge rock blocking the dredge and fell of at 1000m when tension suddenly dropped from 2t --> 1t

gDr, no sediment, no macrofauna

Appendix III (Biological Samples)

SO193 - DR13												
Western Plateau												
Dredge on bottom UTC 27/05/07 0020hrs, lat 10°34.88'S, long 165°16.36'W, depth 3740m												
Dredge off bottom UTC 27/05/07 0130hrs, lat 10°35.17'S, long 165°16.14'W, depth 3471m												
total volume: 1/8 full; basalt, Mn-crusts, volcanoclastica												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Cnidaria	1	x								F	Coronate polyp
	Polychaeta	3	x								F	in tubes made from foram tests
	Tunicata	1	x								F	flat, lens-shaped
Meiofauna	Nematoda	2	x								F	
	Copepoda	1	x								F	

SO193 - DR 14												
Suvorov Trough												
Dredge on bottom UTC 30/05/07 2120hrs, lat 11°27.731'S, long 163°27.035'W, depth 3970m												
Dredge off bottom UTC 30/05/07 2220hrs, lat 11°27.72'S, long 163°27.00'W, depth 3651m												
total volume: several in situ samples, looks like sedimentary rocks, well compacted												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	>10	x								F	Demospongia, same as in #9
	Porifera	>10	x								EtOH	Demospongia, same as in #9
Meiofauna	Nematoda	4	x								F	
	Copepoda	4	x								F	
	Tardigrada	1	x								F	

SO193 - DR 15												
Suvorov Trough												
Dredge on bottom UTC 30/05/07 0010hrs, lat 11°28.866'S, long 163°26.310'W, depth 3940m												
Dredge off bottom UTC 30/05/07 0225hrs, lat 11°28.84S, long 163°26.25'W, depth 3650m												
total volume: almost empty, a few pieces of sedimentary rocks												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	1	x								F	
	Copepoda	1	x								F	

SO193 - DR 16											
Suvorov Trough											
Dredge on bottom UTC 31/05/07 0740hrs, lat 11°17.077'S, long 163°33.85'W, depth 4295m											
Dredge off bottom UTC 31/05/07 0910hrs, lat 11°16.51'S, long 163°33.34'W, depth 3617m											
total volume: few rocks; solidified Mn-encrusted sediment; no volcanics											
gDr, no sediment, no macrofauna											

SO193 - DR 17												
Suvorov Trough, Central area												
Dredge on bottom UTC 31/05/07 1659hrs, lat 10°50.49'S, long 163°51.35'W, depth 4447m												
Dredge off bottom UTC 31/05/07 1825hrs, lat 10°50.35'S, long 163°50.82'W, depth 3966m												
total volume: few crusts; sediments covered with Mn-crust												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	3	x								F	
	Copepoda	1	x								F	
	Bryozoa?	1	x								F	

SO193 - DR 18												
Suvorov Trough, Central area												
Dredge on bottom UTC 01/06/07 0203hrs, lat 10°39.281'S, long 163°52.679'W, depth 3360m												
Dredge off bottom UTC 01/06/07 0315hrs, lat 10°39.305'S, long 163°52.192'W, depth 2764m												
total volume: 1/5 full; several blocks of ultramafic (?) volcanic rocks												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	5	x								F	
	Copepoda	2	x								F	

SO193 - DR19												
Suvorov Trough, mid Suvorov Trough, upper western flank of the NW-SE trending ridge-like structure												
Dredge on bottom 01/06/07 UTC 0743 hrs, lat 10°34.417'S, long 163°55.508'W, depth 3645m												
Dredge off bottom 01/06/07 UTC 0851 hrs, lat 10°34.116'S, long 163°55.08'W, depth 3124m												
total volume: 1/2 full, lots of solidified sediment boulders, few magmatic rocks as angular boulders mixed within the sediments.												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	8	x								F	
	Copepoda	2	x								F	

Appendix III (Biological Samples)

SO193 - DR20												
Danger Island Trough, Triple Junction												
Dredge on bottom UTC 01/06/07 2328hrs, lat 10°21.30'S, long 164°47.14'W, depth 3377m												
Dredge off bottom UTC 02/06/07 0047hrs, lat 10°20.70'S, long 164°47.01'W, depth 2959m												
total volume: 1/8 full; several rocks of volcanoclastic material with fragments of basaltic rocks - looks like flow debris												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Polychaeta	1	x								F	worm tube

SO193 - DR21												
Triple Junction Area												
Dredge on bottom UTC 02/06/07 1651hrs, lat 10°15.941'S, long 165°02.831'W, depth 3835m												
Dredge off bottom UTC 02/06/07 1825hrs, lat 10°15.552'S, long 165°02.553'W, depth 3380m												
total volume: 1/3 - 1/4 full; lots of various volcanic rocks, probably slope debris												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	11	x								F	
	Copepoda	1	x								F	
	Oligochaeta	1	x								F	

SO193 - DR 22												
Triple Junction, volcanic edifice at eastern side of DITs (SW branch of DITs), west-facing slope beneath Plateau; Plateau is flat, but relatively small												
Dredge on bottom UTC 03/06/07 1007 hrs, lat 10°6.20'S, long 164°40.576'W, depth 3519 m												
Dredge off bottom UTC 03/06/07 1118 hrs, lat 10°6.085'S, long 164°40.053'W, depth 3158 m												
total volume: few rocks, Mn-crusts with greenish coarse grained sediment												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Polychaeta	1	x								F	worm tube
Meiofauna	Nematoda	19	x								F	
	Copepoda	3	x								F	
	Plathelminthes?	1	x								F	

SO193 - DR 23												
Triple Junction area, western scarp of DITs, SE-trending flank												
Dredge on bottom UTC 04/06/07 0302 hrs, lat 9°54.54'S, long 164°49.71'W, depth 4760 m												
Dredge off bottom UTC 04/06/07 0445 hrs, lat 9°54.021'S, long 164°49.863'W, depth 4283 m												
total volume: few rocks Mn-encrusted, cobbles of possible magmatic origin												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Cnidaria	1	x								F	coronate polyp
Meiofauna	Nematoda	1	x								F	
	Copepoda	2	x								F	

SO193 - DR 24												
Triple Junction, SW-facing slope of volcanic cone on the eastern scarp of the NW Suvorov Trough												
Dredge on bottom UTC 04/06/07 1344 hrs, lat 9°48.714'S, long 164°17.578'W, depth 4236 m												
Dredge off bottom UTC 04/06/07 1507 hrs, lat 9°48.377'S, long 164°17.124'W, depth 3511m												
total volume: few rocks, sediment boulders light brown and red clay rich solidified sediments.												
gDr, sediment, macrofauna (fossil)												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Bivalvia (fossil)	5								bags	wet	HU1-HU5, matrix with fossils
	Wood-like material	1	x								dry	looks like wooden fibres, in sediment boulder
Meiofauna	Nematoda	11	x								F	
	Copepoda	3	x								F	
	Ostracoda	1	x								F	

SO193 - DR25												
Danger Islands Troughs, southernmost Trough of the real DITs, western slope, lower part												
Dredge on bottom UTC 05/06/07 0243 hrs, lat 9°36.882'S, long 164°23.192'W, depth 4737 m												
Dredge off bottom UTC 05/06/07 0355 hrs, lat 9°36.245'S, long 164°23.422'W, depth 4237 m												
total volume: 2 pieces looks like volcanic rocks												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	12	x								F	
	Copepoda	12	x								F	
	Bryozoa	10	x								F	
	Eggs?	2	x								F	
	Kinorhyncha	1	x								F	

Appendix III (Biological Samples)

SO193 - DR26												
Danger Islands Troughs, SW-facing slope of volcano on the East side of DITs, beneath flat Plateau in the Middle												
Dredge on bottom UTC 05/06/07 1455hrs, lat 9°22.75'S, long 164°16.05'W, depth 4025m												
Dredge off bottom UTC 05/06/07 1635hrs, lat 9°22.41'S, long 164°15.62'W, depth 3367m												
total volume: full, basalt cobbles and two pillows												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	1	x								F	piece of a sponge
	Polychaeta	>5	x								F	worm tubes
Meiofauna	Nematoda	5	x								F	
	Copepoda	5	x								F	
	Eggs?	1	x								F	

SO193 - DR27											
Danger Islands Troughs, SW-facing slope further up section from DR26, 3000-2400m.											
Dredge on bottom UTC 05/06/07 2035hrs, lat 9°16.81'S, long 164°17.13'W, depth 3010m											
Dredge off bottom UTC 05/06/07 2220hrs, lat 9°16.82'S, long 164°17.07'W, depth 2748m											
total volume: 4 pieces, volcanoclastic material with clasts of volcanic rock, covered with Mn-crust											
gDr, no sediment, no macrofauna											

SO193 - OFOS28											
Western slope of Danger Island Trough											
OFOS on bottom UTC 06/06/07 0225 hrs, lat 9°22.62'S, long 164°27.89'W, depth 2987 m											
OFOS off bottom UTC 06/06/07 0605 hrs, lat 9°22.60'S, long 164°26.08'W, depth 4785 m											
OFOS, film and series of pictures											

SO193 - MUC29												
Danger Island Trough, south end of southern basin												
MUC on bottom UTC 06/06/07 1045 hrs, lat 9°16.748'S, long 164°23.477'W, depth 4861 m												
MUC off bottom UTC 06/06/07 1047 hrs, lat 9°16.752'S, long 164°23.499'W, depth 4854 m												
MUC, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Radiolaria	>20			x						F	together with sponge spicules in 1 vial
	Porifera	>10			x						F	snow-flake-like spicules, together with Radiolaria
	Radiolaria	>20			x						Glu	together with sponge spicules in 1 vial
	Porifera	>10			x						Glu	snow-flake-like spicules, together with Radiolaria
	Polychaeta	>10		x							F	worm tubes
Sediment	upper 2-3 cm of 2 tubes	1								WP		dried at 50°C for nutrient analysis
Meiofauna	Nematoda	250	x									dry
	Nematoda	150	x									F
	Copepoda	75	x									F
	Crustacea	3	x									F
	Kinorhyncha	2	x									F
	Ostracoda	5	x									F
	Hydrozoa	6	x									F
	Polychaeta	4	x									F
	Tardigrada	1	x									F
	Loricifera	3	x									F
?	5	x									F	

SO193 - MUC30													
Danger Island Trough, center of northern end of the southern basin													
MUC on bottom UTC 06/06/07 1924 hrs, lat 8°39.19'S, long 164°19.99'W, depth 4925 m													
MUC off bottom UTC 06/06/07 1926 hrs, lat 8°39.19'S, long 164°19.99'W, depth 4925 m													
MUC, sediment, macrofauna													
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES	
Macrofauna	Radiolaria	>10			x							F	
	Porifera	>10			x							F	spicules, together with Radiolaria
	Polychaeta?	>10			x							F	chains of sediment balls; originally worm tubes?
Sediment	upper 2-3 cm of 2 tubes	1								WP		dry	dried at 50°C for nutrient analysis
Meiofauna	Nematoda	220	x									F	
	Nematoda	235	x									F	
	Copepoda	165	x									F	
	Crustacea	5	x									F	
	Kinorhyncha	3	x									F	
	Ostracoda	3	x									F	
	Bryozoa	13	x									F	
	Polychaeta	14	x									F	
	Tardigrada	1	x									F	
	Loricifera	2	x									F	
Plathelminthes	4	x									F		

Appendix III (Biological Samples)

SO193 - TVG31											
Danger Island Trough, southern basin, north part of western slope											
TVG on bottom UTC 06/06/07 2312 hrs, lat 8°31.77'S, long 164°23.467'W, depth 2911 m											
TVG off bottom UTC 06/06/07 2328 hrs, lat 8°31.77'S, long 164°23.467'W, depth 2911 m											
total volume: half full, rocks, Mn-crusts and -nodules, sediment											
TVG, sediment (not preserved), macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	Porifera	>20	x								EtOH small sponges with radiolarian tests
	Porifera	1	x								EtOH small, roundish sponge
	Porifera	1	x								EtOH small, branched sponge
	Cnidaria	2	x								EtOH coronate polyps
	Cnidaria	1	x								EtOH coronate polyp
	Polychaeta	2	x								EtOH worm tubes
	Bryozoa	3	x								EtOH unbranched, twig-like colonies
	Tunicata	1	x								EtOH roundish, covered with foram tests
	"Pisces"	1			x						dry fossil tooth in sediment matrix
	"Pisces"	>5	x								dry pieces of teeth?

SO193-DR32											
Danger Islands Troughs, lower flank with the seamount where the two DITs are overlapping											
Dredge on bottom UTC 07/06/07 0405hrs lat 8°44.61'S, long 164°14.54'W, depth 4550 m											
Dredge off bottom UTC 07/06/07 0609hrs, lat 8°44.91'S, long 164°14.01'W, depth 3779 m											
total volume:											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	Nematoda	15	x								F
	Copepoda	4	x								F

SO193 - DR33											
Danger Islands Troughs, map see DR33; west-facing slope (mid section) of volcanic structure on east side of Middle Trough, 8nm north of DR33											
Dredge on bottom UTC 07/06/07 1359hrs, lat 8°19.415'S, long 163°47.018'W, depth 3834 m											
Dredge off bottom UTC 07/06/07 1511hrs, lat 8°19.544'S, long 163°46.570'W, depth 3429m											
total volume: 1/4 full, mainly volcanoclastics, few small angular basalt clasts											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	Nematoda	9	x								F
	Copepoda	2	x								F
	Tardigrada	1	x								F

SO193 - DR34											
Danger Island Troughs; West-facing slope (Mid section) of volcanic structure on East side of Middle Trough, 8nm North of DR33											
Dredge on bottom UTC 07/06/07 1902 hrs, lat 8°11.047'S, long 163°43.69'W, depth 3402 m											
Dredge off bottom UTC 07/06/07 2016 hrs, lat 8°11.10'S, long 163°43.25'W, depth 2853 m											
total volume: several vulcanoclastic rocks and basalt fragments; several pieces of volcanic rocks and yellow vulcanoclastic material and Mn-crusts											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	Nematoda	6	x								F
	Copepoda	5	x								F

SO193 - DR35											
Northern part of Danger Island Troughs, northern flank of the nose of the seamount at the western flank of the DIT.											
Dredge on bottom UTC 08/06/07 0214hrs, lat 7°40.387'S, long 163°54.709' W, depth 3829 m											
Dredge off bottom UTC 08/06/07 0323 hrs, lat 7°41.007'S, long 163°54.745'W, depth 3312 m											
total volume:											
gDr, sediment, macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	Porifera	1	x								F Hexactinellid sponge
	Porifera	5	x								F at least 3 different spec., all hexacs?
	Bryozoa	2	x								F branched, with single cystids forming nodes
	Bryozoa	>5	x								EtOH branched, with single cystids forming nodes
Meiofauna	Nematoda	1	x								F
	Copepoda	1	x								F
	Ostracoda	1	x								F
	Gastropoda	1	x								F

SO193 - DR36											
Danger Islands Troughs, small cone between the middle and the northern DITs, in the west of main central seamount											
Dredge on bottom UTC 08/06/07 0751hrs, lat 7°29.733'S, long 163°51.073'W, depth 4009m											
Dredge off bottom UTC 08/06/07 0905hrs, lat 7°29.23'S, long 163°50.76'W, depth 3538m											
total volume: few rocks, large block of yellowish volcanoclastic + pillow basalt fragments											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	Nematoda	15	x								F
	Copepoda	6	x								F
	Ostracoda	1	x								F

Appendix III (Biological Samples)

SO193 - DR37
Danger Islands Troughs, SW slope of volcano on eastern side of DITs. At the southernmost end of the Northern Trough
Dredge on bottom UTC 08/06/07 1345hrs, lat 7°29.335'S, long 163°35.284'W, depth 3126m
Dredge off bottom UTC 08/06/07 1550hrs, lat 7°29.313'S, long 163°35.37'W, depth 3175m
total volume: few rocks; 2 basalt clasts, huge yellow volcanoclastic bloc, another volcanoclastic bloc contained Ø 25 cm basalt fragment
gDr, sediment, macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna											
?	1	x								F	worm tubes? Net-like
?	1	x								F	worm tubes? Net-like
Porifera	4	x								F	sponges with Radiolaria
Porifera	1	x								F	long and thin sponge
Polychaeta	5	x								EtOH	pieces of worm tubes
Polychaeta	4	x								F	pieces of worm tubes
Meiofauna											
Nematoda	20	x								F	
Copepoda	6	x								F	
Kinorhyncha?	1	x								F	

SO193 - DR38
DITs, West-facing slope of Eastern scarp at the Southeastern end of the Northern Trough
Dredge on bottom UTC 08/06/07 2021hrs, lat 7°19.08'S, long 163°41.70'W, depth 4666m
Dredge off bottom UTC 08/06/07 2123hrs, lat 7°18.83'S, long 163°41.28'W, depth 4077m
total volume: 1/8 full; mostly sediment, but 1-2 small pieces of volcanic rock
gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna											
Nematoda	20	x								F	
Copepoda	1	x								F	

SO193 - DR39
North Plateau, Canyons at Western Slope of Trough cutting (?) the North Plateau
Dredge on bottom UTC 09/06/07 2220hrs, lat 5°15.97'S, long 165°26.64'W, depth 3805m
Dredge off bottom UTC 09/06/07 2336hrs, lat 5°16.20'S, long 165°26.52'W, depth 3226m
total volume: empty
gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna											
Nematoda	12	x								F	
Copepoda	5	x								F	
Plathelminthes	1	x								F	
Loricifera	1	x								F	

SO193 - DR40
North Plateau, Northern Trough, middle eastern flank --> within flank of Northern Plateau
Dredge on bottom UTC 10/06/07 0653hrs, lat 5°00.79'S, long 165°12.81'W, depth 3555m
Dredge off bottom UTC 10/06/07 0755hrs, lat 5°00.562'S, long 165°12.42'W, depth 3053m
total volume: few rocks; subrounded sediment clasts
gDr, no sediment, no macrofauna

SO193 - DR41
North Plateau; eastern side of North Plateau, in general east-facing slope with small ridge where dredging towards 160° is possible
Dredge on bottom UTC 10/06/07 1754hrs, lat 4°37.17'S, long 164°8.54'W, depth 3773m
Dredge off bottom UTC 10/06/07 1845hrs, lat 4°37.52'S, long 164°8.40'W, depth 3638m
total volume: 3 pieces; two large pieces of volcanic rock, 1 piece of sediment
gDr, no sediment, no macrofauna

SO193 - DR42
North Plateau; smaller cone of seamount structure east of North Plateau
Dredge on bottom UTC 10/06/07 2341hrs, lat 4°47.491'S, long 163°48.393'W, depth 3355m
Dredge off bottom UTC 11/06/07 0049hrs, lat 4°47.620'S, long 163°47.911'W, depth 2938m
total volume: 1 piece; basalt
gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna											
Nematoda	25	x								F	
Copepoda	5	x								F	

Appendix III (Biological Samples)

SO193 - DR43												
North Plateau; Lower Big Seamount east of North Plateau												
Dredge on bottom UTC 11/06/07 0605hrs, lat 5°10.51'S, long 163°33.62'W, depth 2270m												
Dredge off bottom UTC 11/06/07 0706hrs, lat 5°10.29'S, long 163°33.26'W, depth 1845m												
total volume: half full; Mn-encrusted volcanoclastic material with enclosed basalt clasts												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	1	x								EtOH	in 4 pieces
	Porifera	7	x								F	pieces with foram tube, from sediment trap
	Porifera	6	x								F	pieces, possibly 2 different species
	Mollusca	1	x								F	Bivalvia
	Polychaeta	3	x								EtOH	1 worm and two tube pieces
	Polychaeta	3	x								EtOH	1 large worm and unknown tubes
	Polychaeta	>5	x								EtOH	worm tubes?
	Polychaeta	1	x								F	sabellariid with tube
	Polychaeta?	>5	x								F	tubes, some of them maybe sponges
	Crustacea,	1						x				
	Natantia										F	large, bright red shrimp with "head paddles"
	Crustacea,	1			x							
	Natantia										EtOH	piece of the shrimp for DNA-analysis
	Bryozoa	1	x								EtOH	anastomosing colony
	Bryozoa	1	x								F	anastomosing colony
	Bryozoa	2	x								F	branched, opening with spiny, crown-like rim
	Echinodermata	1	x								F	brittle star, only one arm complete
	Echinodermata	1	x								F	tiny holothurian, gut filled excl. with forams
Prerobranchia?	1	x								F	tiny colony with ringed tubes, maybe a bryozoan?	
?	2	x								F	calcified, yellowish antennae?, from sediment trap	
Meiofauna	Nematoda	41	x								F	
	Copepoda	15	x								F	
	Ostracoda	2	x								F	
	Plathelminthes	1	x								F	
	Sipunculida	1	x								F	
	Acari	1	x								F	

SO193 - DR44												
Northern Plateau, 5nm SE of DR43, at deeper water depth beneath small Plateau within slope												
Dredge on bottom UTC 11/06/07 1011hrs, lat 5°14.76'S, long 163°31.18'W, depth 3342m												
Dredge off bottom UTC 11/06/07 1106hrs, lat 5°14.60'S, long 163°30.82'W, depth 2960m												
total volume: empty												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	2	x								F	with foram tubes, from sediment trap
	Polychaeta	1	x								F	from sediment trap
Meiofauna	Nematoda	18	x								F	
	Copepoda	3	x								F	
	Plathelminthes	2	x								F	
	Tardigrada	1	x								F	

SO193 - DR45												
Northern Plateau, Southern End of Northern Plateau at beginning of NNw-SSE trending valley												
Dredge on bottom UTC 11/06/07 2010hrs, lat 5°37.195'S, long 164°31.883'W, depth 2846m												
Dredge off bottom UTC 11/06/07 2109hrs, lat 5°36.73'S, long 164°31.66'W, depth 2405m												
total volume: almost full; all sedimentary?												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	5	x								EtOH	Hexactinellida
	Porifera	>10	x								EtOH	sponges with Radiolaria
	Porifera	>10	x								F	sponges with Radiolaria
	Porifera	1	x								EtOH	roundish, covered with forams
	Cnidaria	1	x								EtOH	coronate polyp
	Cnidaria	2	x								F	coronate polyps
	Cnidaria	1		x							F	hydrozoan colony
	Mollusca,	1	x									
	Bivalvia										EtOH	with byssus?
	Mollusca,	2	x									
Bivalvia										F	with byssus?	
Polychaeta	1	x								EtOH	with foram tube	
Polychaeta?	>5	x								EtOH	worm tubes?	
Polychaeta	1	x								F	sabellariid with tube	
Polychaeta	2	x								F	1 with white calcitic tube,	
Polychaeta	>5		x							Glu	several tubes	
Bryozoa	5	x								EtOH	branched (same as # 35)	
Bryozoa	1	x								EtOH	unbranched (same as # 31)	

Appendix III (Biological Samples)

SO193 - DR46												
Northern Plateau, NW-SE elongated structure south of the Northern Plateau												
Dredge on bottom UTC 12/06/07 0412hrs, lat 6°1.865'S, long 164°43.273'W, depth 2862m												
Dredge off bottom UTC 12/06/07 0517hrs, lat 6°1.314'S, long 164°43.138'W, depth 2369m												
total volume: 1/4 full, 2 pieces of volcanic rock and lots of Mn-crust + some volcanoclastic material												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Foraminifera	1	x								F	ball-like, orange
	Porifera	2	x								F	hexactinellids?
	Cnidaria	1	x								F	coronate polyp
	Polychaeta	2	x								F	
	Bryozoa	1	x								F	branched, opening with spiny, crown-like rim
Meiofauna	"Pisces"	1	x								dry	tooth
	Nematoda	28	x								F	
	Copepoda	6	x								F	
	Polychaeta	1	x								F	

SO193 - DR47												
Ridge between DITS and N Plateau at the NE edge of the W Plateau; SW-slope of cone-like structure at top of NW-SE trenching ridge												
Dredge on bottom UTC 12/06/07 1409hrs, lat 6°42.507'S, long 164°10.27'W, depth 4064m												
Dredge off bottom UTC 12/06/07 1517hrs, lat 6°42.163'S, long 164°09.917'W, depth 3491m												
total volume: very few rocks; volcanoclastics and Mn-crusts												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	44	x								F	
	Copepoda	5	x								F	
	Polychaeta	2	x								F	
	?	3	x								F	

SO193 - DR48												
NE edge of W Plateau between DITS & N Plateau, SW slope of NW-SE trenching ridge 2 m S of DR47 at deeper water depth												
Dredge on bottom UTC 12/06/07 1825hrs, lat 6°43.53'S, long 164°11.03'W, depth 4910m												
Dredge off bottom UTC 12/06/07 2005hrs, lat 6°43.02'S, long 164°10.88'W, depth 4325m												
total volume: 1/10; mostly filled with volcanic rocks and some volcanic clastic breccias and Mn-crusts												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	5	x								F	
	Copepoda	5	x								F	
	Crustacea	1	x								F	

SO193 - DR49											
Location: Danger Islands Troughs; northern part of DIT, eastern flank											
Dredge on bottom UTC 13/06/07 0239hrs, lat 6°55.06'S, long 163°44.83'W, depth 4715m											
Dredge off bottom UTC 13/06/07 0339hrs, lat 6°54.92'S, long 163°44.42'W, depth 4063m											
total volume: few rocks; probably sediments											
gDr, no sediment, no macrofauna											

SO193 - DR50												
Danger Islands Troughs; seamount at the end of the DITS towards the E; upper SW flank												
Dredge on bottom UTC 13/06/07 0720hrs, lat 6°49.64'S, long 163°44.23'W, depth 2978m												
Dredge off bottom UTC 13/06/07 0818hrs, lat 6°49.22'S, long 163°44.07'W, depth 2473m												
total volume: 1/4 full; Mn-crust and solidified sediments												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	5	x								F	
	Cnidaria	3	x								F	coronate polyps
	Nematoda	11	x								F	
Meiofauna	Copepoda	4	x								F	
	Gastrotricha?	1	x								F	

SO193 - DR51												
Danger Islands Troughs; Northern margin of High Plateau; Base of E-W striking seamount structure at North facing slope												
Dredge on bottom UTC 13/06/07 1253hrs, lat 6°48.509'S, long 163°29.785'W, depth 4554m												
Dredge off bottom UTC 13/06/07 1418hrs, lat 6°49.073'S, long 163°29.514'W, depth 3934m												
total volume: empty												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	2	x								F	
	Nematoda	9	x								F	
Meiofauna	Copepoda	5	x								F	

Appendix III (Biological Samples)

SO193 - DR52												
Danger Island Troughs at N margin of High Plateau; lower position possible approx. 8 m E of DR51												
Dredge on bottom UTC 13/06/07 1833hrs, lat 6°46.39'S, long 163°23.72'W, depth 5368m												
Dredge off bottom UTC 13/06/07 1959hrs, lat 6°46.878'S, long 163°23.574'W, depth 4824m												
total volume: few rocks + big block sitting on top of the dredge; all rocks volcanic + glass												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	5	x								F	demosponges?
	Cnidaria	1	x								F	hydrozoan?
	Polychaeta	5	x								F	worm tubes
Meiofauna	Nematoda	10	x								F	
	Copepoda	5	x								F	
	Ostracoda	1	x								F	
	Bryozoa?	1	x								F	

SO193 - DR53												
Danger Islands Troughs; southern wall of NE-end of DIT												
Dredge on bottom UTC 14/06/07 0209hrs, lat 6°45.275'S, long 163°08.559'W, depth 5485m												
Dredge off bottom UTC 14/06/07 0326hrs, lat 6°45.800'S, long 163°08.538'W, depth 4877m												
total volume: 3 pieces; altered magmatic rocks												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Polychaeta	1	x								F	with tube
	Nematoda	3	x								F	
Meiofauna	Copepoda	3	x								F	

SO193 - DR54												
Danger Islands Troughs at northern margin of the plateau; Eastern end of E-W striking Plateau margin at 5300 m												
Dredge on bottom UTC 14/06/07 0932hrs, lat 6°40.511'S, long 162°44.39'W, depth 5350m												
Dredge off bottom UTC 14/06/07 1109hrs, lat 6°40.95'S, long 162°44.02'W, depth 4760m												
total volume: few rocks; mostly crusts and a few angular fist-sized rocks of basaltic(?) composition												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	6	x								F	
	Copepoda	5	x								F	
	Ostracoda	1	x								F	

SO193 - DR55												
NE-Plateau; seamount in basin between High Plateau and N Plateau; flat topped seamount with small cones on top; dredged NE slope												
Dredge on bottom UTC 14/06/07 1755hrs, lat 5°58.03'S, long 162°46.03'W, depth 2403m												
Dredge off bottom UTC 14/06/07 1910hrs, lat 5°58.42'S, long 162°45.82'W, depth 1949m												
total volume: few magmatic rocks												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Cnidaria	1	x								EtOH	coronate polyp
	Polychaeta	5	x								EtOH	pieces of worms and tubes
	Crustacea	1					x				EtOH	completely crushed, should be ok for DNA

SO193 - DR56												
Seamount above northern Danger Islands Troughs; small cone on guyot-plateau of the seamount N of the eastern end of the DITS												
Dredge on bottom UTC 14/06/07 2146hrs, lat 5°58.81'S, long 162°43.85'W, depth 1698m												
Dredge off bottom UTC 14/06/07 2251hrs, lat 5°58.66'S, long 162°43.600'W, depth 1433m												
total volume: 2 big blocks + 3 smaller ones; look like of volcanic origin												
gDr, no sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	>10	x								EtOH	branched, tiny sponges
	Porifera	3	x								EtOH	needle-like hexactinellids
	Porifera	1	x								EtOH	hexactinellid
	Porifera	>10	x								F	hexactinellids
	Porifera	>10	x								F	pieces of burrowing sponge, <i>Cliona</i> ?
	Cnidaria	1	x								EtOH	small, branched colony
	Cnidaria	1	x								EtOH	coronate polyp
	Polychaeta	1	x								EtOH	sabellariid worm with eyespots
	Polychaeta	2	x								EtOH	sabellid worms in chitinous tubes, foram covered
	Polychaeta	5	x								F	pieces of tubes
	Crustacea	2	x								EtOH	verrucomorph Cirripedia

SO193 - DR57												
Seamount NE of Danger Islands Troughs (NE Rift); Upper E flank of seamount												
Dredge on bottom UTC 15/06/07 0249hrs, lat 5°52.176'S, long 162°14.335'W, depth 2300m												
Dredge off bottom UTC 15/06/07 0520hrs, lat 5°52.12'S, long 162°14.50'W, depth 2504m												
total volume: 3 pieces of rock; rocks of magmatic origin												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	2	x								EtOH	two different species, one branched, tiny

Appendix III (Biological Samples)

SO193 - DR58
NE-Rift at southern part of presumed spreading ridge; SW corner of SW-NE trenching ridge, SW-most termination of a series of ridges
Dredge on bottom UTC 15/06/07 1014hrs, lat 5°50.987'S, long 161°51.579'W, depth 3452m
Dredge off bottom UTC 15/06/07 1126hrs, lat 5°51.457'S, long 161°51.166'W, depth 2969m
total volume: 1/3 full; volcanoclastic sediments, basalt clasts, and fragments of pillow basalt, some with chilled margins and altered glass
gDr, sediment, macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna											
Porifera	1	x								F	encrusted with forams
Meiofauna											
Nematoda	70	x								F	
Copepoda	17	x								F	
Crustacea	1	x								F	
Plathelminthes	1	x								F	
Acari	1	x								F	

SO193 - DR59
Location: High Plateau; NE-SW trending ridge structure, north of the High Plateau. North flank of NE-SW ridge structure
Dredge on bottom UTC 15/06/07 2213 hrs, lat 6° 48.52' S, long 161° 15.598' W, depth 3662 m
Dredge off bottom UTC 16/06/07 0025 hrs, lat 6°48.996' S, long 161° 15.371' W, depth 3269 m
total volume: 3/4; DESCRIPTION: looks like pillows and volcanoclastic breccias
gDr, no sediment, macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna											
Porifera	>10	x								F	hexactinellids?
Porifera	1	x								EtOH	branched, net-like, with forams
Porifera	>10	x								EtOH	hexactinellids?
Porifera	2			x						EtOH	lithistid sponge, encrusting on Mn crust
Cnidaria	1	x								EtOH	coronate polyp

SO193 - DR60
Location: NS trending ridge N of High Plateau; Dredged structure: Cone structure, W of Main Ridge
Dredge on bottom UTC 16/06/07 0525 hrs, lat 7° 2.85'S, long 161°46.249'W, depth 3142m
Dredge off bottom UTC 16/06/07 0634hrs, lat 7°2.72'S, long 161°49.69'W, depth 2537m
total volume: few; DESCRIPTION: 1x Mn crust and fish
gDr, no sediment, macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna											
"Pisces"	1						x			EtOH	rat tail

SO193 - DR61
Location: High Plateau; Dredged structure: small cone in top area of large N-S trending ridge at ist northern end
Dredge on bottom UTC 16/06/07 0948hrs, lat 7°14.87'S, long 161°49.72'W, depth 1939m
Dredge off bottom UTC 16/06/07 1042hrs, lat 7°14.64'S, long 161°49.36'W, depth 1737m
total volume: few Mn-crusts; DESCRIPTION 1 large Mn-crust, 20 cm thick
gDr, no sediment, macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna											
Porifera	1	x								F	demosponge?
Cnidaria	1	x								F	sea anemone
Cnidaria	1								2000	F	Gorgonaria
Polychaeta	1	x								F	worm tube
Crustacea	1	x								F	Isopoda
Echinodermata	1								2000	F	Ophiuroida, same jar as the gorgonian coral
Echinodermata	1	x								F	Ophiuroida

SO193 - DR62
Location: High Plateau at N-S trending ridge; Dredged structure: 7 nm S of DR 61, W tracing slope of ridge at 3400 m water depth
Dredge on bottom UTC 16/06/07 1427hrs, lat 7°23.14'S, long 161°53.73'W, depth 3442m
Dredge off bottom UTC 16/06/07 1526hrs, lat 7°22.98'S, long 161°53.32'W, depth 3021m
total volume: few rocks; angular basaltic rubble
gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna											
Nematoda	16	x								F	
Copepoda	7	x								F	
Ostracoda	1	x								F	
Polychaeta	1	x								F	
Tardigrada	1	x								F	
Acari	1	x								F	
?	2	x								F	

SO193 - DR63
Location: High Plateau; N-S trending ridge at central part. Western slope of large volcano in the central part of the ridge.
Dredge on bottom UTC 16/06/07 19:41hrs, lat 7°43.048'S, long 161°56.90'W, depth 2558m
Dredge off bottom UTC 16/06/07 20:42hrs, lat 7°42.89'S, long 161°56.37'W, depth 2099m
total volume: 1/5; mixture of volcanic rocks and volcanoclastica + some carbonate aggregate
gDr, sediment, macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna											
Porifera	5	x								EtOH	hexactinellids?
Polychaeta	5	x								EtOH	
Meiofauna											
Nematoda	40	x								F	
Copepoda	27	x								F	
Ostracoda	2	x								F	
Plathelminthes	1	x								F	

Appendix III (Biological Samples)

SO193 - TVG64
South of trending ridge structure, NE of High Plateau
 TVG on bottom UTC 17/06/07 0252hrs, lat 8°18.054'S, long 161°46.173'W, depth 975m
 TVG off bottom UTC 17/06/07 0253hrs, lat 8°18.057'S, long 161°46.163'W, depth 976m
sediment exclusively consisting of foram tests
gDr, sediment, macrofauna, TVG almost empty, most sediment washed out

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES	
Macrofauna	Mollusca	6	x								F	Scaphopoda, shells, pieces	
	Mollusca	7		x							dry	Scaphopoda, shells, pieces	
	Mollusca	1	x								F	Gastropoda, tiny shell	
	Mollusca	>10		x							dry	snails, <i>Gibbula</i> -like	
	Mollusca	>10		x							dry	snails, neogastropods, pieces	
	Mollusca	4		x							dry	pteropods	
	Polychaeta	1	x									F	
	Crustacea	5		x								dry	verrucomorph Cirripedia
	Brachiopoda	3		x								dry	dorsal valves (pieces) of <i>Macandrevia?</i> sp.
	"Pisces"	6		x								dry	5 otoliths, 1 tooth
	"Pisces"	1									WP	dry	large subfossil shark tooth
	miscellaneous	>10		x								dry	pieces of shells, echinoid spines etc.
	Meiofauna	Nematoda	120	x									F
Copepoda		31	x									F	
Kinorhyncha		5	x									F	
Plathelminthes		2	x									F	
Loricifera		1	x									F	
Polychaeta		9	x									F	
Crustacea		1	x									F	
Caudofoveata		1	x									F	
?		9	x									F	

SO193 - DR65
Location: NS-trending ridge N of the High Plateau; Dredged structure: Southernmost seamount upper western flank to plateau edge
 Dredge on bottom UTC 17/06/07 0520hrs, lat 8°17.36'S, long 161°52.15'W, depth 1780m
 Dredge off bottom UTC 17/06/07 0622hrs, lat 8°17.48'S, long 161°51.72'W, depth 1351m
total volume: few; DESCRIPTION: Mn encrusted basalt fragments
gDr, sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Polychaeta	1		x							F	from sediment trap, complete with tube
Meiofauna	Nematoda	21	x									F
	Copepoda	4	x									F
	Plathelminthes	2	x									F
	Bivalvia	1	x									F

SO193 - DR66
Location: High Plateau ; Dredged structure: southern most seamount of N-s ridge. Second dredge at plateau edge, 2 nm S of DR65
 Dredge on bottom UTC 17/06/07 0820hrs, lat 8°19.09'S, long 161°51.23'W, depth 1720m
 Dredge off bottom UTC 17/06/07 hrs, lat °.S, long °.W, depth m
total volume: empty; DESCRIPTION dredge got stuck shortly after dredge start safety cable broken
gDr, no sediment, no macrofauna

SO193 - DR67
Location: High plateau, seamount chain W of N-S ridge; Dredged structure: single seamount at SW corner beneath plateau edge
 Dredge on bottom UTC 17/06/07 1535 hrs, lat 8°33.83'S, long 162°17.83'W, depth 1964 m
 Dredge off bottom UTC 17/06/07 1705 hrs, lat 8°33.44'S, long 162°17.30'W, depth 1575 m
total volume: few; DESCRIPTION Mn encrusted basalt and pillow, main cable hinted at the very end _ cut
gDr, no sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	3	x								EtOH	hexactinellids?
	Tunicata	1	x								EtOH	

SO193 - DR68
Location: High Plateau; Dredged structure: Small cone on W-flank of seamount, SW of NS-trending ridge
 Dredge on bottom UTC 17/06/07 2108hrs, lat 8°56.97'S, long 162°20.62'W, depth 2455m
 Dredge off bottom UTC 17/06/07 2222hrs, lat 8°56.72'S, long 162°20.06'W, depth 1982m

gDr, sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	2	x								EtOH	hexactinellids?
	Polychaeta	1	x								F	from sediment trap, 2 pieces, hind end
	Polychaeta	5	x								EtOH	tubes
Meiofauna	Nematoda	79	x									F
	Copepoda	31	x									F
	Tardigrada	1	x									F
	Kinorhyncha	1	x									F
	Loricifera	3	x									F
	Plathelminthes?	7	x									F
	Polychaeta	2	x									F
	Bivalvia	1	x									F

Appendix III (Biological Samples)

SO193 - DR69												
High Plateau; small cone on west flank of seamount, SW of NS-trending ridge												
Dredge on bottom UTC 18/06/07 0114hrs, lat 8°58.58'S, long 162°18.09'W, depth 2149m												
Dredge off bottom UTC 18/06/07 0228hrs, lat 8°58.33'S, long 162°17.66'W, depth 1700m												
total volume: 1/2; Carbonates												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Foraminifera	>10	x								EtOH	at least 4 different species, benthic
	Foraminifera	1	x								F	1 cm long, twig-like
	Radiolaria	1	x								F	
	Porifera	>5	x								EtOH	thread-like, with forams, attached to worm tube
	Porifera	2	x								F	
	Mollusca?	1	x								EtOH	worm like, aplacophoran? maldanid polychaete?
	Polychaeta	2	x								F	2 pieces, greenish, with nodules on their back
	"Pisces"	1	x								dry	tooth
Meiofauna	Nematoda	56	x								F	
	Copepoda	14	x								F	
	Plathelminthes	2	x								F	
	Crustacea	1	x								F	

SO193 - MUC 70												
NE of high Plateau; "Plain" between third and fourth seamount												
Dredge on bottom UTC 18/06/07 0602hrs, lat 9°12.67'S, long 162°12.53'W, depth 3153m												
Dredge off bottom UTC 18/06/07 0605hrs, lat 9°12.67'S, long 162°12.53'W, depth 3153m												
total volume: 11 of 12 tubes full												
gDr, sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	3	x								F	hexactinellids?
	Porifera	>5	x								F	several pieces, <i>Cliona</i> sp.?
	Mollusca	1	x								F	pteropod
Meiofauna	Nematoda	147	x								F	
	Copepoda	65	x								F	
	Plathelminthes	4	x								F	
	Polychaeta	4	x								F	
	Sipunculida	2	x								F	
Ostracoda	1	x								F		

SO193 - TVG-71												
High Plateau; on 4th Seamount, slightly NW of top												
Dredge on bottom UTC 18/06/07 0951hrs, lat 9°30.18'S, long 162°4.41'W, depth 1222m												
Dredge off bottom UTC 18/06/07 1025hrs, lat 9°29.97'S, long 162°04.51'W, depth 1223m												
total volume: 1/5 full; Mn-nodules												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Foraminifera	1	x								EtOH	sessile, cone-shaped
	Porifera	1	x								F	hexactinellid
	Porifera	1	x								EtOH	hexactinellid
	Porifera	1	x								EtOH	demosponge
	Porifera	1	x								EtOH	net-like, flexible, many adhering forams
	Porifera	1	x								EtOH	net-like, flexible, many adhering forams
	Porifera	>5	x								EtOH	hexacs? with some forams
	Porifera	2	x								EtOH	2 different hexacs, 1 ball-like
	Porifera	>10	x								EtOH	hexacs?
	Porifera	1	x								EtOH	net-like, flexible, many adhering forams
	Porifera	1	x								F	demosponge?
	Porifera	2	x					x			F	lithistid sponges
	Cnidaria	1	x								F	coronate polyp
	Cnidaria	4	x								EtOH	coronate polyps
	Cnidaria	1	x								EtOH	coronate polyp
	Cnidaria	>10	x								EtOH	hydrozoans?
	Cnidaria	4	x								EtOH	hydrozoans, crinoid-like
	Cnidaria	2	x								EtOH	hydrozoans, crinoid-like
	Sipuncula?	1	x								EtOH	
	Mollusca	1	x								F	Scaphopoda
	Polychaeta	1	x								F	with tube
	Polychaeta	3	x								EtOH	with tubes
	Polychaeta	2	x								EtOH	with two bristle-armed tentacles, very unusual
	Polychaeta	1	x								Falc.	pieces of worm tubes, from unusual specimen
	Polychaeta	1	x								EtOH	very tiny, from white, calcitic tube
	Polychaeta	3	x								Falc.	EtOH long, chitinous tubes, top end with forams/spines
	Polychaeta	1	x								F	long, chitinous tubes, top end with forams/spines
Polychaeta	1	x								F	maldanid polychaete in tube	
Polychaeta	1	x								F	sabellid? with tube	
Pterobranchia?	>5	x								EtOH	tiny, calcified? tubes; tube ends articulated	
Tunicata	1	x								F		
Tunicata	2	x								EtOH		
Tunicata	1	x								EtOH		
?	1	x								EtOH	limpet-like shell, gastropod?	

Appendix III (Biological Samples)

SO193 - DR72												
NE part of High Plateau, core of NW-flank of the southernmost of the three solitaire seamounts												
Dredge on bottom UTC 18/06/07 1244 hrs, lat 9°26.85'S, long 162°7.30'W, depth 2323 m												
Dredge off bottom UTC 18/06/07 1352hrs, lat 9°26.86'S, long 162°6.84'W, depth 1898 m												
total volume: 1/3 full, mn-crust, one piece of basalt?, carbonate rocks, Octokorallen, Schwämme, Bryozoen												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	1		x							EtOH	hexactinellid sponge
	Porifera	2	x								EtOH	hexactinellid sponges
	Porifera	1	x								EtOH	
	Porifera	2								2000	EtOH	hexactinellid sponge
	Cnidaria	3									dry	stems of isidid corals
	Cnidaria	>10								2000	F	pieces of large isidid corals
	Cnidaria	>10							x		EtOH	pieces of large isidid corals
	Cnidaria	3							x		F	pieces of large isidid corals
	Cnidaria	1		x							EtOH	red gorgonian, piece of large specimen in formalin
	Cnidaria	2							x		F	red gorgonian, large spec.; thin gorgonian
	Echinodermata	>5	x								EtOH	crinoid cirri
	Echinodermata	1				x					EtOH	crinoid cirri, on isidid coral stem
	Echinodermata	5				x					EtOH	ophiuroid arms
	Echinodermata	1		x							F	ophiuroid arm
	Meiofauna	Nematoda	79	x								F
Copepoda		12	x								F	
Plathelminthes		8	x								F	
Kinorhyncha?		1	x								F	
Tardigrada		2	x								F	
Polychaeta		2	x								F	

SO193 - MUC73												
High Plateau, half between southernmost solitary seamount and mount Eddie												
MUC on bottom UTC 18/06/07 1939hrs, lat 9°58.21'S, long 161°49.15'W, depth 3280 m												
MUC off bottom UTC 18/06/07 1942hrs, lat 9°58.21'S, long 161°49.15'W, depth 3280 m												
total volume: 11 of 12 tubes full												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	not sorted yet!											

SO193 - TVG74											
Manihiki Atoll, NE-slope, small cone/mount											
TVG on bottom UTC 19/06/07 0549hrs, lat 10°20.48'S, long 160°59.531'W, depth 1174 m											
TVG off bottom UTC 19/06/07 0702hrs, lat 10°20.467'S, long 160°59.259'W, depth 1389 m											
total volume: empty TVG											
gDr, no sediment, no macrofauna											

SO193 - DR75												
High Plateau, Manihiki Atoll; southern corner of Manihiki Atoll, SW-facing slope a ridge												
Dredge on bottom UTC 19/06/07 1211hrs, lat 10°30.86'S, long 160°57.82'W, depth 2431m												
Dredge off bottom UTC 19/06/07 1317hrs, lat 10°30.49'S, long 160°57.69'W, depth 1950 m												
total volume: few rocks, basalt cobbles and hyaloclastites												
gDr, sediment, no macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nemataoda	14	x								F	
	Copepoda	2	x								F	

Appendix III (Biological Samples)

SO193 - TVG 76												
Rakahanga, SE slope of Rakahanga Atoll												
TVG on bottom UTC 20/06/07 0226 hrs, lat 10°2.901'S, long 161°3.775'W, depth 1474 m												
TVG off bottom UTC 20/06/07 0253 hrs, lat 10°2.96'S, long 161°3.67'W, depth m												
total volume: several boulders, large fossil isidid corals												
gDr, no sediment, macrofauna												
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES	
Macrofauna	Porifera	>10	x								EtOH branched, hexactinellids?	
	Porifera	>10	x								EtOH thread-like, with adhering forams	
	Porifera	>10	x								F hexactinellids?	
	Porifera	>10	x								EtOH branched, thin	
	Porifera	1	x								EtOH hexactinellid	
	Porifera	1	x								F hexactinellid	
	Porifera	>10		x							F branched hexactinellids	
	Cnidaria	5	x									EtOH hydrozoans
	Cnidaria	1	x									EtOH 1 branched hydrozoan colony
	Cnidaria	1	x									EtOH 1 branched hydrozoan colony
	Cnidaria	1	x									EtOH 1 branched hydrozoan colony
	Cnidaria	>5									WP dry	isidid coral stems, pieces
	Cnidaria	1									WP dry	piece of <i>Oculina</i> sp.
	Cnidaria	1	x									EtOH coronate polyp
	Cnidaria	1		x								F sea anemone
	Cnidaria	3		x								F hydrozoans, with two heart-shaped ascidians?
	Mollusca	1		x								F solenogastres on hydrozoan colony
	Polychaeta	3	x									EtOH with tubes
	Crustacea	1	x									EtOH part of verruciform Cirripedia
	Crustacea	2	x									EtOH verruciform Cirripedia
	Crustacea	1	x									EtOH part of verruciform Cirripedia
	Crustacea	1	x									dry part of verruciform Cirripedia
	Bryozoa	1	x									EtOH colony on thin stem
	Bryozoa	2	x									EtOH colony on thin stem, branched
	Bryozoa	4	x									EtOH branched colonies
	Bryozoa?	5		x								EtOH branched, on substrate (fossil isidid coral)
	Echinodermata	8			x							EtOH ophiuroids
Pterobranchia?	2	x									EtOH still on Mn-matrix	
Tunicata	1	x									EtOH	
Tunicata	1		x								F	

SO193 - DR77											
Rakahanga, NW slope of Rakahanga Atoll											
Dredge on bottom UTC 20/06/07 0551hrs, lat 9°57.20'S, long 161°10.55'W, depth 3372 m											
Dredge off bottom UTC 20/06/07 0742 hrs, lat 9°57.31'S, long 161°9.87'W, depth 2682 m											
total volume: full, rounded basalt boulders and each cobbles, volcanoclastic material, basalt breccias											
gDr, sediment, macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	Porifera	1	x								EtOH branched, hexactinellid?
	Porifera	>5	x								F hexactinellids
	Polychaeta	1	x								F 2 pieces of tube
Meiofauna	Nematoda	45	x								F
	Copepoda	18	x								F
	Tardigrada	1	x								F
	Polychaeta	1	x								F
	Ostracoda	2	x								F
	?	9	x								F

SO193 - DR78											
NE-Margin; cone structure on westside of N-S-trending linear ridge at the eastern edge of the High Plateau											
Dredge on bottom UTC 20/06/07 1800hrs, lat 9°50.90'S, long 160°35.04'W, depth 3499m											
Dredge off bottom UTC 20/06/07 1924hrs, lat 9°51.29'S, long 160°34.75'W, depth 3150m											
total volume: few rocks; two pieces of basalt encrusted with Mn-crust and several pieces of thick Mn-crust											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	Nematoda	34	x								F
	Copepoda	27	x								F
	Polychaeta	1	x								F

SO193 - DR79											
Location: NE from Rakahanga, NE-Margin; Dredged Structure: Western flank of the seamount NE from Rakahanga											
Dredge on bottom UTC 21/06/07 0136hrs, lat 9°33.40'S, long 160°07.45'W, depth 2958m											
Dredge off bottom UTC 21/06/07 0305hrs, lat 9°33.87'S, long 160°07.23'W, depth 2548m											
total volume: 3/4 full; pillow basalt fragment and volcanoclastic material, some are encrusted with Mn-crust, looks like slope debris											
gDr, no sediment, macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	Porifera	1	x								EtOH with forams

Appendix III (Biological Samples)

SO193 - DR80
Location: Manihiki Scarp; Dredged Structure: west facing slope of volcanic? Ridge
 Dredge on bottom UTC 21/06/07 1500hrs, lat 10°51.34'S, long 160°37.45'W, depth 4186m
 Dredge off bottom UTC 21/06/07 1610hrs, lat 10°51.53'S, long 160°36.96'W, depth 3791m
 total volume: ?
gDr, sediment, no macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	5	x								F	
	Copepoda	1	x								F	

SO193 - DR81
Location: N of Manihiki Scarp; Dredged Structure: seamount on upper northern flank of Manihiki Scarp, E of High Plateau
 Dredge on bottom UTC 21/06/07 2135hrs, lat 11°07.83'S, long 160°24.26'W, depth 2845m
 Dredge off bottom UTC 21/06/07 2310hrs, lat 11°08.39'S, long 160°24.26'W, depth 2279m
 total volume: few rocks; two small fragments of highly altered basalt and several larger pieces of yellow volcanoclastics encrusted with few cm Mn-crust
gDr, no sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	Porifera	2	x								F	hexactinellids

SO193 - DR82
Manihiki Scarp; small cone at the northern end of the Manihiki Scarp
 Dredge on bottom UTC 22/06/07 0443hrs, lat 11°14.44'S, long 160°49.04'W, depth 2592m
 Dredge off bottom UTC 22/06/07 0559hrs, lat 11°14.92'S, long 160°48.86'W, depth 2138m
 total volume: 1/4 full; Mn-encrusted pillows and pillow fragmetns, carbonate breccias
gDr, sediment, macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna	?	1	x								F	pteropod shell?
Meiofauna	Nematoda	27	x								F	
	Copepoda	12	x								F	
	Loricifera	1	x								GF	
	Kinorhyncha	1	x								F	
	Polychaeta	1	x								F	
	Acari	1	x								F	
	?	2	x								F	

SO193 - DR83
Eastern Manihiki Scarp; oblique to slope of large nose at 12° 48' S
 Dredge on bottom UTC 22/06/07 1851hrs, lat 12°48.39'S, long 161°03.72'W, depth 3268m
 Dredge off bottom UTC 22/06/07 2015hrs, lat 12°47.87'S, long 161°03.57'W, depth 2925m
 total volume: almost empty
gDr, no sediment, no macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	7	x								F	
	Copepoda	3	x								F	
	Acari	1	x								F	

SO193 - DR84
Manihiki Scarp, lower eastern flank of the southern Manihiki scarp
 Dredge on bottom UTC 22/06/07 0107hrs, lat 12°57.93'S, long 161°04.98'W, depth 3663m
 Dredge off bottom UTC 22/06/07 0214hrs, lat 12°57.45'S, long 161°04.89'W, depth 3455m
 total volume: 1/6 full; some volcanic rocks and sedimentary fragments, encrusted with Mn
gDr, sediment, no macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Nematoda	30	x								F	
	Copepoda	5	x								F	
	Polychaeta	3	x								F	
	Ostracoda	1	x								F	

SO193 - MUC85
SE of High Plateau, directly W of Manihiki
 MUC on bottom UTC 23/06/07 0531hrs, lat 12°59.61'S, long 161°11.61'W, depth 2870m
 MUC off bottom UTC 23/06/07 0533hrs, lat 12°59.61'S, long 161°11.61'W, depth 2870m
 total volume: empty
MUC, no sediment, no macrofauna

SO193 - DR86
Eastern Manihiki Scarp; NW slope of plateau (lava? sediment?) structure at top of Manihiki Scarp
 Dredge on bottom UTC 23/06/07 0934hrs, lat 13°10.85'S, long 161°11.04'W, depth 2704m
 Dredge off bottom UTC 23/06/07 1051hrs, lat 13°11.12'S, long 161°10.63'W, depth 2307m
 total volume: 1/3 full; mostly large boulders of lapilli tuff and pillow basalt fragments
gDr, sediment, no macrofauna

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	not sorted yet!											

Appendix III (Biological Samples)

SO193 - DR87											
Manihiki Scarp at 3200mbsl on east facing slope along an oblique dredge track across nose											
Dredge on bottom UTC 23/06/07 1356hrs, lat 13°03.32'S, long 161°07.61'W, depth 3225m											
Dredge off bottom UTC 23/06/07 1509hrs, lat 13°02.85'S, long 161°07.50'W, depth 2842m											
total volume: 1/5 full; solidified sediment boulders, Mn-encrusted breccias, a few rounded boulders of possible basaltic composition											
gDr, sediment, macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	?	2		x							dry fish scales? shells of a mollusc?
Meiofauna	not sorted yet!										

SO193 - DR88											
Manihiki Scarp (mid part); SE-trending slope of the eastern flank of the High Plateau											
Dredge on bottom UTC 23/06/07 2258hrs, lat 13°40.25'S, long 160°46.14'W, depth 5477m											
Dredge off bottom UTC 24/06/07 0023hrs, lat 13°39.56'S, long 160°46.22'W, depth 5127m											
total volume: 3/4 full; variety of magmatic rocks and probably volcanoclastic material; reflecting most likely slope debris											
gDr, no sediment, macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	Cnidaria	1	x								EtOH coronate polyp

SO193 - OFOS89											
Manihiki Scarp											
OFOS on bottom UTC 24/06/07 0727hrs, lat 13°41.75'S, long 161°28.05'W, depth 3521m											
OFOS off bottom UTC 24/06/07 1029hrs, lat 13°42.58'S, long 161°26.96'W, depth 4877m											
gDr, sediment, no macrofauna											

SO193 - DR90											
Manihiki Scarp; 1nm north of OFOS-track in upper part of Manihiki Scarp; Dredge-track oblique to slope											
Dredge on bottom UTC 24/06/07 1351hrs, lat 13°41.76'S, long 161°27.28'W, depth 4237m											
Dredge off bottom UTC 24/06/07 1504hrs, lat 13°41.17'S, long 161°27.12'W, depth 3979m											
total volume: ~10 pieces of rock; 1 basalt, Mn-crusts, and volcanoclastic breccias											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	not sorted yet!										

SO193 - DR91											
Manihiki Scarp; SE-facing slope of Manihiki Scarp near its southern termination; dredge-track oblique to slope											
Dredge on bottom UTC 24/06/07 1950hrs, lat 13°51.48'S, long 161°34.28'W, depth 4617m											
Dredge off bottom UTC 24/06/07 2130hrs, lat 13°50.90'S, long 161°34.17'W, depth 4239m											
total volume: few rocks; several small blocks and "cobbles" of brownish altered basalt, partly encrusted with few cm of Mn-crust											
gDr, no sediment, no macrofauna											

SO193 - DR92											
Seamount south of High Plateau; cone ridge structure at the upper western flank of the seamount											
Dredge on bottom UTC 25/06/07 0405hrs, lat 14°11.99'S, long 162°12.85'W, depth 2458m											
Dredge off bottom UTC 25/06/07 0531hrs, lat 14°11.80'S, long 162°12.41'W, depth 1992m											
total volume: 1 piece; Mn-crust											
gDr, sediment, no macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Meiofauna	not sorted yet!										

SO193 - DR93											
Same seamount as DR92; top area of the seamount at western flank											
Dredge on bottom UTC 25/06/07 0722hrs, lat 14°13.47'S, long 162°11.81'W, depth 1823m											
Dredge off bottom UTC 25/06/07 0845hrs, lat 14°13.66'S, long 162°11.29'W, depth 1323m											
total volume: 1/6 full; 1x Mn-encrusted pillow, several basalt cobbles, 1x breccia, several pieces of carbonate, Mn-crusts											
gDr, no sediment, macrofauna											
	TAXA	n	2	5	50	100	200	500	1000	other	FIX NOTES
Macrofauna	Cnidaria	1	x								dry solitary hexacorallia
	Cnidaria	>10			x						dry pieces of octocorallia
	Mollusca	>10		x							dry pteropod shells
	Mollusca	>10	x								dry pteropod shells?
	Mollusca	>5	x								dry pteropod shells
	Mollusca	>5	x								dry pteropod shells?
	Mollusca	>5	x								dry gastropods
	Mollusca	>5	x								dry gastropods
	Mollusca	1		x							dry bivalve shell
	Polychaeta	3	x								EtOH with tubes
	Crustacea	2		x							dry large verrucosomorph scales?
	Crustacea	>5	x								dry verrucosomorph scales
	"Pisces"	6	x								dry otoliths?

SO193 - DR94											
Southern margin of High Plateau; SW-facing slope of High Plateau where it drops into the abyssal plain											
Dredge on bottom UTC 25/06/07 1448hrs, lat 14°30.60'S, long 162°42.10'W, depth 5050m											
Dredge off bottom UTC 25/06/07 1612hrs, lat 14°30.21'S, long 162°41.69'W, depth 4452m											
total volume: 1/4 full; 1 large Mn-crust with sediment?, attached are several mid-sized, rounded boulders of sediment											
gDr, no sediment, no macrofauna											

Appendix III (Biological Samples)

SO193-MUC95

High Plateau, southern margin , W of Suvorov

MUC on bottom UTC 26/06/07 0354 hrs, lat 13°13.03'S, long 163°31.89'W, depth 3939 m

MUC off bottom UTC 26/06/07 0356 hrs, lat 13°13.03'S, long 163°31.89'W, depth 3939 m

total volume: empty

gDr, no sediment, no macrofauna

SO193 - DR96

Samoan Basin, Seamount south of Nassau Atoll. SSW facing flank of seamount at base

Dredge on bottom UTC 26/06/07 1556 hrs, lat 13°01.55'S, long 165°15.98'W, depth 5033 m

Dredge off bottom UTC 26/06/07 1728 hrs, lat 13°0.92'S, long 165°15.69'W, depth 4439 m

total volume: 1/3 full, volcanic rocks and volcanoclastic material partly encrusted with few cm of Mn crust

gDr, no sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna "Pisces"	1								WP	dry	large shark tooth, subfossil

SO193 - DR97

seamount within Samoan Basin, SW of Danger Islands; Southern flank of seamount at NW-Se ridge-like structure

Dredge on bottom UTC 27/06/07 0342hrs, lat 12°29.31'S, long 166°24.36'W, depth 2199m

Dredge off bottom UTC 27/06/07 0524hrs, lat 12°28.80'S, long 166°24.27'W, depth 1672m

total volume: few carbonate rocks

gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Macrofauna Porifera	1	x								EtOH	Cliona -like, in a globular capsule
Cnidaria	1	x								EtOH	coronate polyp
Polychaeta	1	x								EtOH	very small specimen, soft tube
Tunicata	1	x								EtOH	with foram cover
"Pisces"	1	x								EtOH	tooth
"Pisces"	1								WP	dry	shark tooth, subfossil
?	2	x								EtOH	branched, very thin, almost like an algae
Meiofauna	not sorted yet!										

SO193 - DR98

Samoan Basin; western flank of seamount (middle seamount of three in this area) at 3100mbsl, SW of Danger Islands

Dredge on bottom UTC 27/06/07 0810hrs, lat 12°29.89'S, long 166°31.31'W, depth 3144m

Dredge off bottom UTC 27/06/07 1031hrs, lat 12°29.99'S, long 166°31.15'W, depth 2960m

total volume: very few rocks; 2x small pieces of pillow basalt, Mn-encr., freshly broken; 1x altered basalt fragm., Mn-encr.; 1x Mn-encr. basalt breccia

gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	not sorted yet!										

SO193 - DR99

Samoan Basin; SSW slope of westernmost seamount south of Danger Islands; Dredge carried out along southern dip

Dredge on bottom UTC 27/06/07 1741hrs, lat 12°39.65'S, long 167°16.89'W, depth 4594m

Dredge off bottom UTC 27/06/07 1907hrs, lat 12°39.20'S, long 167°16.58'W, depth 4019m

total volume: 4 pieces; 3x Mn-encrusted sedimentary (?) rocks, 1x Mn-crust with lithoclasts

gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	not sorted yet!										

SO193-MUC100

Samoan Basin W of Iris Seamount

MUC on bottom UTC 28/06/07 1741hrs, lat 12°45.04S , long 167°39.69'W, depth 5503m

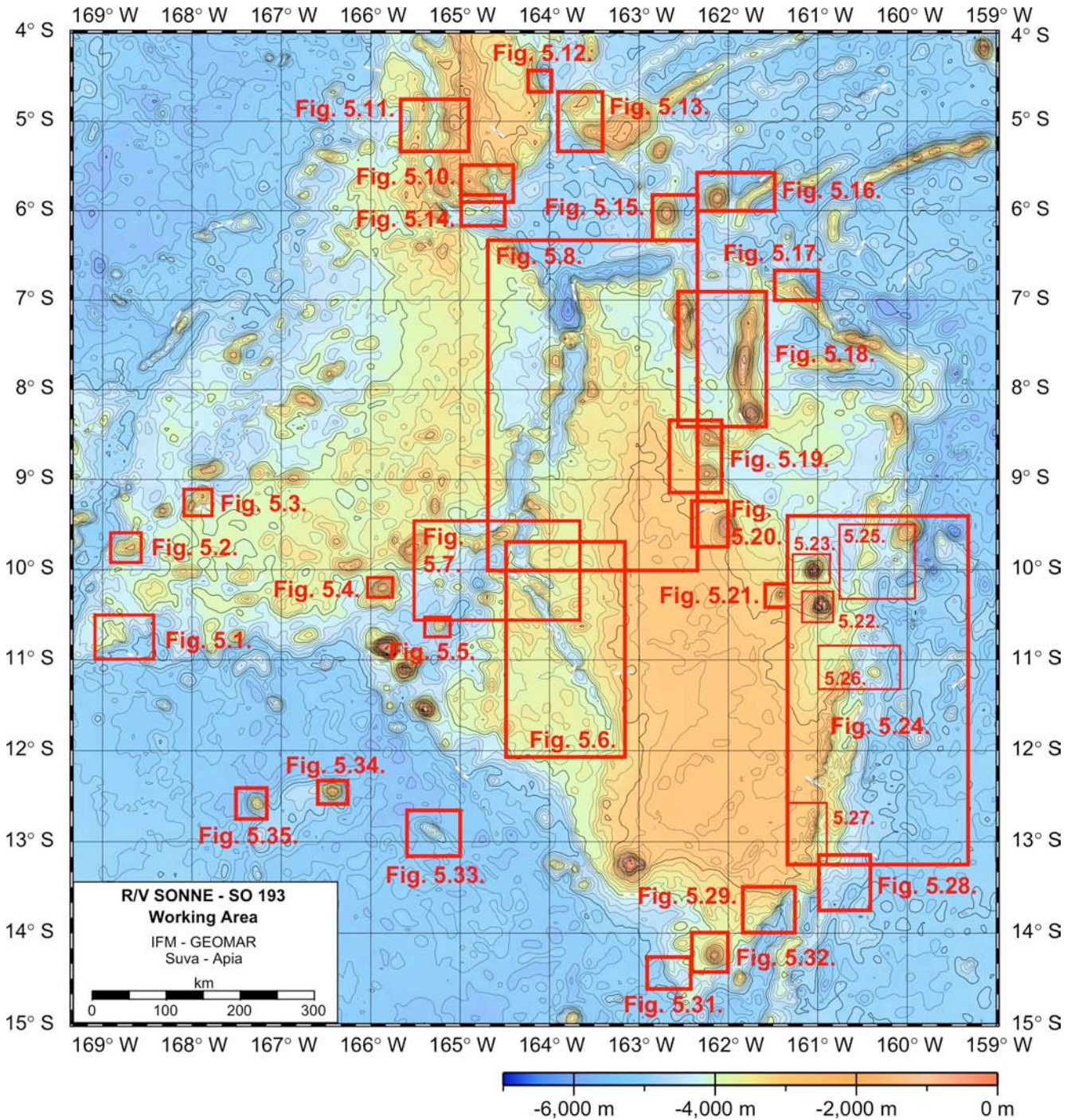
MUC off bottom UTC 28/06/07 1743hrs, lat 12°45.04S , long 167°39.69'W, depth 5503m

total volume: 6 of 12 tubes full with sediment

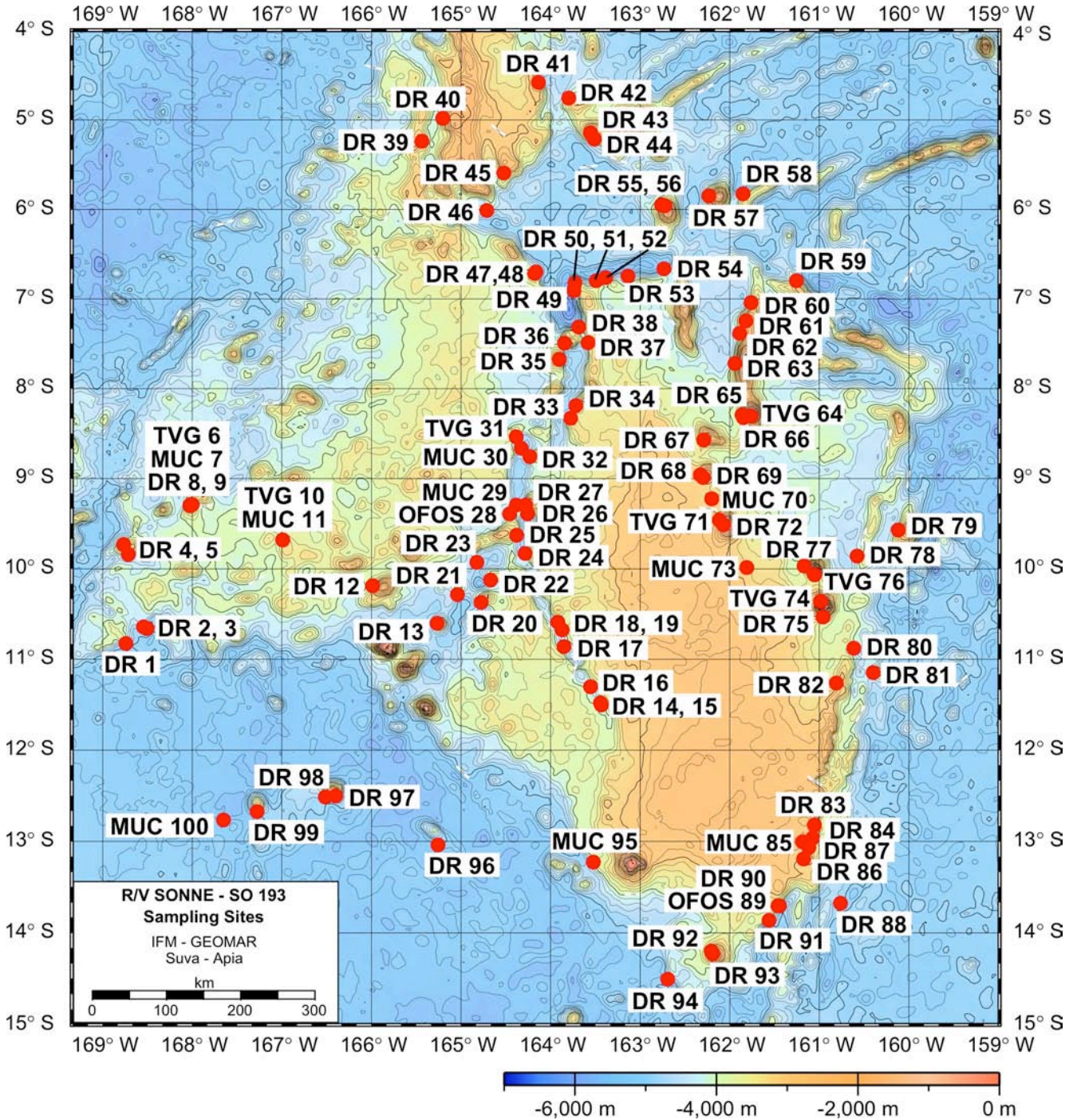
gDr, sediment, no macrofauna

TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	not sorted yet!										

Appendix IV (Map Sections)



Appendix V (SO193 Sampling Sites)



DR: Dredge
 TVG: TV Grab
 MUC: Multi Corer
 OFOS: Ocean Bottom Observation System

IFM-GEOMAR Reports

- | No. | Title |
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