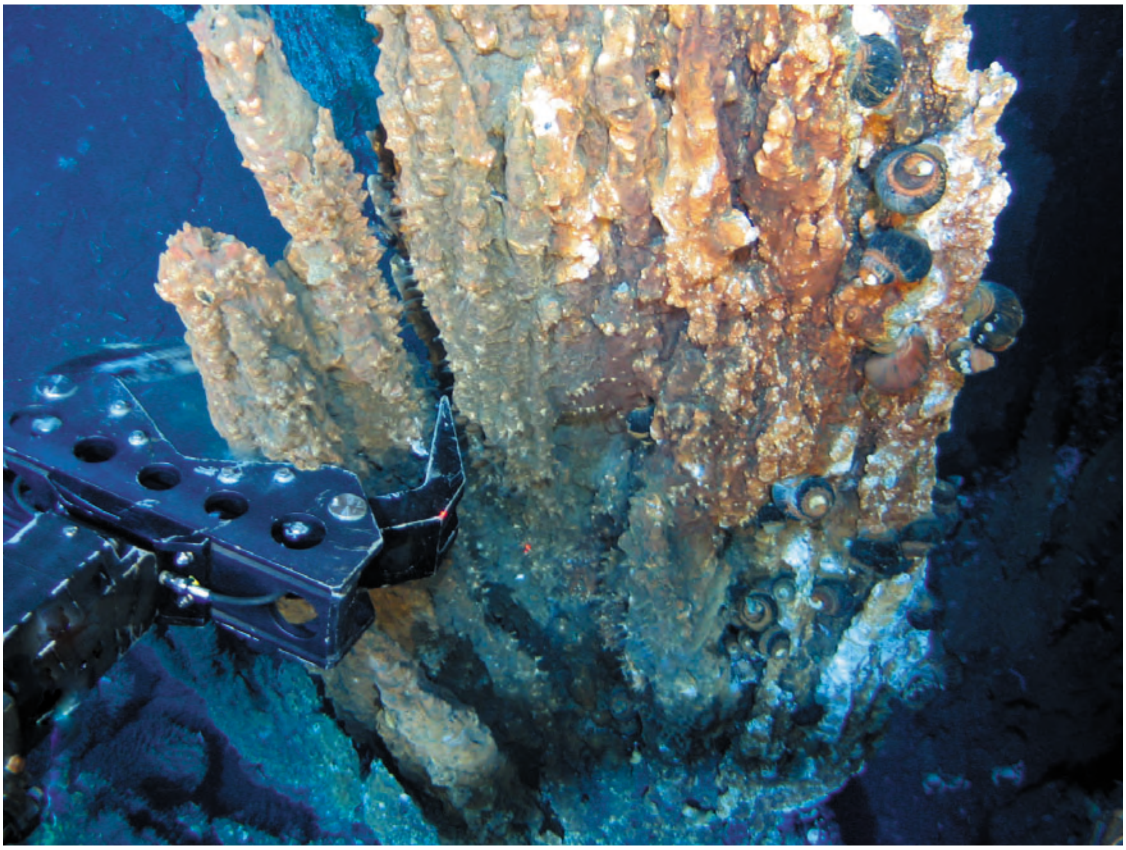

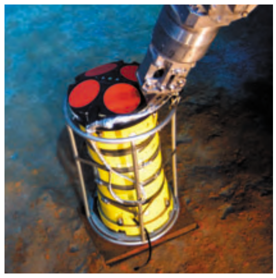


ENVIRONMENTAL IMPACT STATEMENT

Nautilus Minerals Niugini Limited

Solwara 1 Project

Volume B
Appendices 1 - 3

September 2008
CR 7008_9_v4

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SPECIALISTS IN PEOPLE AND PLACE

NAUTILUS
Minerals Niugini

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ENVIRONMENTAL IMPACT STATEMENT

Solwara 1 Project

VOLUME B

APPENDICES 1 - 3

CR 7008_09_v4
September 2008

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Appendices

Appendices 1 to 3:	1	Baseline Environmental Study Eastern Manus Basin, Papua New Guinea – Module 1 Preliminary Scoping Study
	2	Baseline Environmental Study Eastern Manus Basin, Papua New Guinea – Module 2 Detailed Scoping Study
	3	Oceanography at Solwara 1
Appendices 4 to 7:	4	Characterization and comparison of macrofauna at inactive and active sulphide mounds at Solwara 1 and South Su (Manus Basin)
	5	Macroinfauna of Active and Inactive Hydrothermal Sediments From Solwara 1 and South Su, Manus Basin, Papua New Guinea
	6	Quality Including Trace Elements of Sediments from the SuSu Knolls, Manus Basin, Bismarck Sea, Papua New Guinea
	7	Water and Sediment Characterisation and Toxicity Assessment for the Solwara 1 Project
Appendices 8 to 15:	8	Juvenile Amphipod Whole Sediment Test Report
	9	Elutriate Testing Report Solwara 1 Project, Incorporating Phase 1: Effect of Holding Time; Phase 2: Effect of Temperature
	10	Biomass, Biodiversity and Bioaccumulation Desktop Study
	11	Modelling the Dispersion and Settlement of Sediment Removal Operation Prior to Mining at the Solwara 1 Mining Lease, Papua New Guinea
	12	Modelling the Dispersion of the Returned Water Discharge Plume from the Solwara 1 Seabed Mining Project Manus Basin, Papua New Guinea
	13	Prediction of underwater noise associated with a proposed deep-sea mining operation in the Bismarck Sea
	14	The Potential for Natural Disasters being Triggered by Mineral Extraction at the Solwara 1 Seafloor Hydrothermal Vent Site
	15	Stakeholder Consultation

Appendix 1

Baseline Environmental Study
Eastern Manus Basin, Papua New Guinea
Module 1: Preliminary Scoping Study

Confidential Report P2005/221

Baseline Environmental Study
Eastern Manus Basin, Papua New Guinea

Module 1

Preliminary Scoping Study

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Date

July 2005

CSIRO Division of Exploration and Mining
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CONFIDENTIALITY

Disclaimer

This report has been commissioned by Placer Dome Oceania Limited (Papua New Guinea Company Number 1-52231) and has been prepared by officers and research associates of the CSIRO. CSIRO Exploration and Mining acknowledges that it has a separate and an independent R&D agreement with Nautilus Minerals Limited.

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1. Executive Summary

1.1 Background

CSIRO was commissioned by Placer Dome Oceania Limited to undertake an environmental baseline study in the Manus Basin, Papua New Guinea. This report fulfils the first phase, Module 1, a preliminary scoping study to determine the breadth of currently available information and makes recommendations for more detailed follow-on work in Modules 2 and 3.

1.2 Results

1.2.1 Rocks, Sediments and Sulfide

Sixteen international research expeditions have investigated the Manus Basin in Papua New Guinea over the past 20 years. CSIRO has either led or participated in 14 of them. Around 240 operations have recovered rock and around 230 operations have recovered sediment. Sulfide has been recovered in 90 operations, mostly dredges. Of the available sample types, sediments offer the best potential to perform further baseline environmental studies.

1.2.2 CTD Hydrocasts

Approximately 220 conductivity-temperature-depth (CTD) hydrocasts have been deployed throughout the Bismarck Sea to measure variations with depth of salinity, temperature and, in most instances, light transmission. Around 130 of these CTD hydrocasts are located in the Eastern Manus Basin. Despite this large number of operations, little attempt has been made to characterise the distribution and chemistry of hydrothermal plumes (fluids and particulates) and quantify their geochemical input to surrounding sediments and the near-bottom water column, other than a PhD study involving examination of samples collected during two of the earlier cruises; and a preliminary description by CSIRO of the methane-and particulate–rich ‘super plume’ at SuSu.

1.2.3 Dive Tapes and Camera Tows

Extensive submersible dives by the Japanese in particular and deep video and camera tows have photographed the seafloor in and around the active hydrothermal vents at the two main fields, PACMANUS and SuSu Knolls. CSIRO maintains a large database of information and samples, including extensive video logs, copies of approximately 240 video tapes and bottom tow still images. No animal density maps have been compiled using these tapes.

CSIRO posseses full video footage from 16 submersible dives at PACMANUS, 8 at DESMOS, 4 at Vienna Woods and one dive at Munkalin Seamount on the Manus Spreading Centre (3° 32'S 149° 53'E).

1.2.4 Animal diversity

No general synopsis exists of the fauna associated with hydrothermal vents in the Manus Basin. A literature search identified sixty nine scientific references that make mention of 98 vent species. However, less than one third of the references relate to the Manus Basin and nearby areas of Lihir Island and Edison seamount. Twenty three species are recorded from vents in the region, with some still undescribed. The lower number of formal descriptions of the fauna in the Manus Basin compared with other hydrothermal vent regions in the West Pacific probably reflects the fewer number of investigations in the Manus Basin, rather than a lower diversity. Accordingly, the diversity of animals indicated for the Eastern Manus Basin hydrothermal vents may be a significant underestimation.

Several species of barnacle and gastropod molluscs described from the Manus Basin hydrothermal vents have not been recorded elsewhere but it is currently unclear if they are unique to the Manus Basin.

Some animal species appear to have wide geographical distribution over a range of West Pacific hydrothermal vent systems, while others appear to have a high degree of endemism, and are only found in geographically limited areas. In extreme cases, distribution may be limited to a few venting areas in a restricted locality.

Further study of the genetic diversity of organisms across a range of West Pacific hydrothermal vents is needed to properly assess the degree of endemism in areas such as the Eastern Manus Basin and the possible gene flow between hydrothermal vents in the Western Pacific.

Approximately 190 fauna samples have been recovered in the Manus Basin during CSIRO-led *RV Franklin* cruises. These collections are housed at the Australian Museum, Sydney and CSIRO laboratories in Sydney and Hobart.

1.2.5 Microbiological Diversity

Just as there are relatively few published descriptions of animals from hydrothermal vents in the Manus Basin, only a handful of over 200 papers in the literature that describe vent field microorganisms make reference to the Manus Basin. A majority of literature has focused on microorganisms recovered from vent fields in the Pacific and Atlantic divergent plate settings.

Fifty or so papers published in the last 10 years describe a considerable variety of new species of microorganisms associated with hydrothermal vent fields. The existence of such a wide range of newly described microorganisms in vent environments suggests that similar diversity may be found in the Manus Basin.

A detailed analysis of the literature has not been undertaken in Module 1, but such a study would give an indication of the uniqueness of the microorganisms in the Manus Basin compared with similar environments.

1.2.6 Current Data

Near surface (0-200 m) current data is usually collected routinely by research vessels using an acoustic Doppler current profiler (ADCP). It is unlikely that these near surface current data have any direct bearing on the prediction of near bottom currents which will be more critical for mining of seafloor sulfides. Visual evidence from submersible dives and hydrothermal plume studies at PACMANUS indicate a north easterly near-bottom current of around 1-2 km per hour. At SuSu, however, the near bottom current is shown to be highly variable with swings of around 45°, based on mapping of the hydrothermal ‘super plume’.

1.3 Conclusions

The results of the preliminary scoping study indicate a considerably larger volume of available information and data relevant to a baseline environmental study than was initially envisaged. The information and data are in various stages of completeness, which influences the proposed work plan for Module 2, a detailed scoping study.

1.4 Recommendations

1.4.1 Rock, Sulfide and Sediments

Potential research on existing samples and sample data held at CSIRO includes:

Rocks

Volcanic rocks collected from a number of operations during later cruises have not been chemically analysed, but were adequately characterised by measurement of glass refractive indices. Mostly they effectively duplicate samples analysed from earlier operations nearby. There is little, if any, justification for additional chemical analyses for the purpose of either an environmental baseline study or to investigate petrogenesis.

Sulfides

Only a few of the chimney samples collected from PACMANUS and SuSu Knolls during the Binatang-2000 and Bismarck-2002 cruises have been chemically analysed by CSIRO. A number of these, however, were provided in 2004 to Placer Dome for chemical, mechanical and petrophysical investigations. Unless these provided unexpected results, there is probably no need for additional work on sulfide samples.

Sediments

Chemical data on the topmost few cm of sediments (the "mudline"), and assessment of geographic variations relative to hydrothermal/mining sites, constitute important baseline data.

Module 2
Recommended work in Module 2 includes:

1. Compile an updated list of available chemical analyses (see Appendix 3, later data near SuSu in particular were not included in the P+/P2+ Memoirs).
2. Re-examine sample logs, record cards, and if necessary the samples themselves to compile confidence factors that these samples represent the topmost few cm (mudline).
3. Prepare new element distribution maps for the Pual Ridge area. "Surfer" versions in the P+ and P2+ Memoirs predate recognition of the deeper North Pual plume.
4. Compile equivalent element distribution maps for the SuSu Knolls area (not done in P2+ Memoir). Initially, simply divide these into hemipelagic oozes and volcaniclastic grit ("tuffites") respectively.
5. Assess gaps in knowledge, and formulate plan to obtain new chemical analyses where appropriate.

Module 3
The next phase of the sediment study in Module 3 could involve research designed to convert these data into a set of practical baseline criteria against which future mining operations could be monitored.

1. Only limited mineralogical and sedimentological data are available. Rather than embark on an extensive survey of many samples, it is recommended that perhaps approximately 10 representative samples be selected from the information available, and these be examined in detail microscopically and via detailed XRD, SEM, grain size etc study to provide a "baseline collection" dataset. Such information would be considered important for inclusion in an environmental impact study.

2. Chemical analyses of additional sediments will be required to fill-in critical gaps

3. Assess potential source/mineralogical/ water depth/morphological factors that might influence geochemistry over and above proximity to hydrothermal centres or mining operations

4. Use this assessment to develop an improved approach to background and threshold, and thereby prepare improved element-distribution maps representing the present (i.e "baseline") situation relative to potential mining sites

5. Also, use this information (and current data?) to recommend and justify selection of a number (5-6?) of proximal and distal monitoring sites where repeated sediment collections should be conducted during mining operations.

Further considerations for sediments in Module 3:

1. Information on the "history" of natural hydrothermal impact on sediments might also be useful. This means detailed study of a selection of "good" sediment cores near and remote from sites. For example, MS53 in East Umbo Basin would be a good start (remote from

known sites but has a number of red-brown "metalliferous?" layers). A former MSc candidate started on this but never finished.

2. Presumably sulfide +/- "weathered sulfide" particulates will be the pollutants of concern. Preliminary work developing sensitive tests for this, and applying them to the recommended "monitoring" sites (and on sites where we have large enough samples) would be useful.

1.4.2 CTD Hydrocasts

1. Further investigation of the CTD hydrocast data is recommended to characterize the coverage and the extent to which hydrothermal plumes impact on surface sediments and the near bottom water column. This natural phenomenon of “hydrothermal pollution” is poorly understood in the Eastern Manus Basin.

2. An audit and gaps analysis of the CTD hydrocasts will enable recommendations, if appropriate, to be made regarding which samples are best suited to undertake further analysis such as water chemistry and grain size characterisation. These data, together with estimates of discharge could be used to model long term hydrothermal fluid and particulate flux and impact on the natural environment.

1.4.3 Dive Tapes and Camera Tows

Because of the greater stability of the submersible’s viewing platform, video footage is of a much higher quality than that recorded by any of the deep tow systems and therefore preferable for the purposes of detailed observation of geology and fauna at PACMANUS. As no submersible footage for SuSu knolls is held by CSIRO, it will therefore be necessary to observe fauna and geology using deep-tow footage.

As an initial measure, it is recommended that:

1. All submersible video footage held by CSIRO and all deep-tow footage over SuSu Knolls be duplicated to DVD. This equates to 90 x 120min NTSC Hi8, 33 x >100min and 14x<100min PAL VHS, 15 x 120min NTSC Video 8 and 1 x 120min PAL Video 8 tapes. Tapes of over 100 minutes length will require 2 DVDs. Therefore, at a quoted cost of $60/DVD conversion, this exercise will cost approximately $17, 500 and take about 2 months from receipt of tapes.

2. In order to compile the most complete faunal density maps it will also be necessary to re-examine all relevant deep tow footage from PACMANUS. It is recommended to convert the deep tow tapes to DVD prior to examination.

3. During Module 2, a supplementary list of videos and a costing for their duplication will be prepared. Furthermore, over half of the 57 camera tows have been corrected for lag and 26 Manus camera tows still require lag corrections.

1.4.4 Animal and Microbiological Diversity

1. Detailed analysis of the literature and of the genetic diversity of organisms of all sizes across a range of West Pacific hydrothermal vents is recommended to properly assess the degree of endemism in areas such as the Eastern Manus Basin.

2. In terms of microorganisms, as most of the literature refers to environments other than the Manus Basin, the focus of the recommended literature study will be the diversity and distribution of microorganisms in those other environments. Such a study would give an indication of the degree of endemism found in these vent environments which would in turn indicate the degree of diversity and uniqueness that could be expected in the Manus Basin.

3. An inspection by a biologist of available macrofouna recovered from CSIRO-led cruises and currently stored at the Australian Museum, CSIRO Marine and Atmospheric Research in Hobart and CSIRO Exploration and Mining in Sydney is recommended to ascertain species uniqueness and to recommend a course of further action.

4. The compilation of animal density maps based on the dive and camera tapes is recommended as a major activity of Module 3.

1.4.4 Currents

1. It is recommended to investigate the possibility of deployment of free-floating ocean robots known as Argo floats. The floats measure temperature and salinity throughout the water column, between the sea surface and 2000m depth, every 10 days. The information is relayed by satellite providing a continuous measure of ocean change. The drift of the floats provides information on current speed and direction. At the IOMEC Conference in Perth (February 2005), Ms Patricia Pepena of the Mines Department, Papua New Guinea, made specific mention of a JAMSTEC application for a 4 year program deploying ARGO floats in PNG waters from 2005-2009. Perhaps some deployment could be earmarked for the Manus Basin.

1.5 Proposed Budget for Module 2: Detailed Scoping Study

Based on our preliminary assessment during Module 1 of the work involved in a more detailed scoping study and further discussions with Placer Dome, a revised budget is set out below for Module 2. This revised budget takes into account the time required to undertake the recommendations outlined above; and to determine the suitability of current fauna collections for uniqueness studies. Provision is made for travel to complete this activity.

Module 2 Activity	**Approx timing**	**Cost**
1 Sediments (Binns)	mid Sept	$13,600
Compile updated list of available analyses		
Confirm "mudline" samples		
Prepare new element distribution maps for Pual Ridge		
Compile element distribution maps for SuSu		
Audit and Gaps analysis, plan for chemical analyses of critical samples		
2 CTD Hydrocasts (McConachy)	1-Sep	$15,000
Audit and gaps analysis, determination of samples for further anlaysis		
3 Dive Tapes and Camera Tows (Yeats)		$11,000
Prepare a priority list of tapes to be studied	5-Aug	
Lag corrections for 26 camera tows and plotting of corrected positions away from Su Su & PACMANUS, every 15 minutes time positions	1-Sep	
4 Animal Diversity (Rouse)		
Examination of CSIRO's collection	5-Oct	$8,500
5 Microbiological Diversity (Robertson & Nichols)		
Deferred		
Subtotal		**$48,100**
Copy tapes onto DVD ($60/DVD) -assuming all dive tapes at PACMANUS and deep tow camera tapes from SuSu (total 292 DVDs)*	6 weeks from go ahead date pending confirmation	
Travel		$4,000
Materials		$3,000
Total		**$55,100**

* Any copying to be done after consultation with Placer Dome (cost $60/DVD)

2. Introduction

Placer Dome has reached an agreement with Nautilus Minerals Limited to explore the eastern Manus Basin for deposits of gold-rich massive sulfides with a publicly stated objective of commercial production by the end of this current decade. The companies have approached CSIRO to assist with a baseline environmental study, an important and necessary component of the exploration and mining process.

CSIRO has a large proprietary database and information concerning research cruise and survey operations in the Manus Basin. Significant base line information could be gleaned from these databases and literature to provide a snapshot of the environment prior to mining and identify gaps in knowledge and data that will require addressing.

CSIRO reached an agreement with Placer Dome to undertake a base line environmental study which will be done in three stages or modules.

Module 1: Initial scoping study to determine breadth of data
Module 2: Detailed assessment of data with recommendations for future work
Module 3: Baseline Environmental study

The aim of this report is to summarise the breadth of data availability.

The report brings together a preliminary survey and compilation of available literature relevant to baseline database, including published materials and cruise reports, and unpublished data such as geochemical analyses, camera tow results, shipboard sample descriptions, dive tapes and water column information.

It also provides a preliminary list of available samples that would extend this database if analysed, and preliminary assessment of potential use of datasets to determine species identification, density, diversity and habitat types.

Unless stated otherwise, all operations and comments relate to work in the Eastern Manus Basin, largely within or near Nautilus Minerals Limited’s Exploration Licences.

3. Notes on Authors

Dr Timothy F. McConachy (Head of Seabed Ore Systems; Senior Principal Research Scientist)

BSc Hons 1 (Univ. New England) 1975; PhD (Toronto, Canada; including Woods Hole Oceanographic Institution, MA, USA) 1988. MGSA, FAusIMM (CP), FSEG, MAGU. Seabed Ore Systems team leader since 2001. Formerly Chief Geologist/General Manager Australia region for Rio Tinto Exploration Pty Limited which included 24 years experience in global mineral exploration and management, and leading roles in discoveries in Australia, Indonesia and PNG. Seagoing experience includes 13 cruises, three as chief scientist in Papua New Guinea, Solomon Islands, Vanuatu and Indonesia. Current interests include modern hydrothermal ore-forming environments and their relationships to ancient ore deposits.

Dr Christopher J Yeats (Research Scientist, Stream Leader Ore Systems)

BSc Hons 1 (Tasmania) 1990; PhD (Western Australia) 1996. MGSA MSEG, MSGA, MAGU. Seabed Ore Systems team member since 1997. Previous appointments include: Teaching-Research Fellow, Department of Geology and Geophysics, The University of Western Australia (1995 - 1997). Exploration Geologist, CRA Exploration, Karratha (1990 - 1992). Research experience includes: Application of structural geology, mineralogy, igneous and metamorphic petrology, geochemistry and geochronology of ancient and modern ore deposits and hydrothermal systems. Participated in 10 research cruises, including ODP Leg 193. Current research interests are studies of modern seafloor hydrothermal systems with main focus on mineralogy and geochemistry of hydrothermal alteration and oxide and sulfide mineralisation.

Dr Wendy J Robertson (Research Scientist)

B. Hort. Sci Hons 1 (Murdoch University) 1990; PhD (University of Western Australia). Associate Member Australian Society of Microbiology. Research Officer Western Australian Department of Agriculture (1990 – 1995) Post-Doctoral Fellow CSIRO Land and Water (2001-2004). Microbiologist/Biotechnologist CSIRO Land and Water (2004-). Expertise in environmental and industrial microbiology. Interests include: sulphate-reducing bacteria in bioremediation of gasoline-contaminated groundwater; hyperthermophilic microorganisms for mineral bioleaching (using samples from hydrothermal vents in the eastern Manus basin and from terrestrial environments in PNG); and biological treatment of industrial wastes and biology of in situ remediation of contaminated

Dr Peter D Nichols (Senior Principal Research Scientist)

BSc Hons (Melb) 1978; PhD (Melb) 1984. He leads new initiatives with signature lipid technology and environmental application, and on marine oils. Research has involved detailed characterization of marine and other novel oils, process development for their utilization, and transfer of know-how to industry and community. This research has lead to better utilisation of national fisheries resources, and has contributed significantly to the development of a new Australian oils industry, with CSIRO-led research resulting in novel national and international products (wax ester, omega-3 and shark liver oils).

Other innovations are the development and use of unique chemical signatures in microbial ecology, environmental (e.g. fecal pollution) and food-chain studies, and new discoveries and applications in marine biotechnology. He has participated in 12 major research expeditions, with 6 as team/cruise leader. He has published 202 peer-reviewed papers in first class journals and authored 64 conference and other papers and 360 reports to industry and government agencies.

Consultants:

Dr Raymond A. Binns (Retired Chief Research Scientist)

BSc (Sydney) 1959; PhD (Cambridge, UK) 1962. FGS, FSEG, FAusIMM, FTSE. Led the Seabed Ore Systems team 1986 – 2001. Formerly Assistant Chief, CSIRO Division of Mineralogy and Geochemistry (1977-1985); Reader in Geology, University of Western Australia (1971-77); Lecturer to Associate Professor of Geology, University of New England (1962-70). Seagoing experience includes 16 cruises, most as Chief or Co-chief scientist, including ODP Leg 193. Current research interests include modern hydrothermal ore-forming environments; petrology and geochemistry of mineralized environments.

Dr Greg W. Rouse (Senior Research Scientist, South Australian Museum)

B.Sc. (Univ. Qld) 1982; M.Sc. (Univ. Qld) 1985; PhD. (Univ. Sydney) 1991. At the South Australian Museum since 2001. Previously postdoctoral fellow at the Smithsonian Institution (1991-1994) and University of Sydney (1994-2001). Expertise on marine invertebrate diversity, particularly polychaete annelid worms. Has research experience on deep sea fauna including hydrothermal vents on United States-NSF funded cruises to the Pacific Antarctic Ridge and the North Fiji and Lau Basins.

4. Previous Cruises

The Manus Basin has been the subject of some 16 surface and submersible expeditions by Australian, Canadian, Japanese, German, French, USA and Korean research institutions (see Table 1). These expeditions have generated a wealth of information, including cruise reports and published literature.

CSIRO Exploration and Mining has led seven and participated in another five research expeditions to PNG waters, which have included some hundreds of sediment CTD hydrocast, coring, grab and dredge operations. Some of this information has been published but the majority is contained in CSIRO propriety databases.

Table 1 Summary of Cruises to Manus Basin and Their Relevance to Current Exploration Licences.

Summary of CSIRO-led/participated and Other Cruises to PNG Waters

Cruise	Ship/Cruise Ident.	Dates	Days at Sea	Area	Relevance to EL
CSIRO-led					
PACLARK I	RV Franklin	03/04/86 - 20/04/86	18	Western Woodlark Sea	None
PACLARK II	RV Franklin: FR01/88	08/01/88 - 28/01/88	21	Western Woodlark Sea and Goodenough Bay	None
PACLARK III	HMAS Cook	01/02/88 - 12/02/88	12	Western Woodlark Sea	None
PACLARK IV/ SUPACLARK	RV Akademic Mstislav Keldysh	09/04/90 - 29/04/90	21	Western Woodlark Sea and Eastern Bismarck Sea	None
PACMANUS I/ PACKLARK V	RV Franklin: FR08/91	24/09/91 - 14/10/91	21	Eastern Bismarck Sea	
PACMANUS II	RV Franklin: FR05/93	04/06/93 - 23/06/93	20	Eastern Bismarck Sea	
PACMANUS III	RV Franklin: FR10/96	23/11/96 - 17/12/96	25	Eastern Bismarck Sea	
PACMANUS IV	RV Franklin: FR09/97	08/10/97 - 03/11/97	27	Eastern Bismarck Sea	
BINATANG	RV Franklin: FR03/00	14/04/00 - 04/05/00	21	Eastern Bismarck Sea	
SHAARC	RV Franklin: FR04/00	05/05/00 - 24/05/00	20	Tabar-Lihir-Tanga-Feni Chain	None
ODP Leg 193	Joides Resolution	07/11/00 - 03/01/01	58	Eastern Bismarck Sea	
BISMARCK-SOLAVENTS 2002	RV Franklin: FR02/2002	01/03/02 - 25/03/02	25	Western Bismarck Sea	
BISMARCK-SOLAVENTS 2002	RV Franklin: FR03/2002	26/03/02 - 21/04/02	27	Bougainville-Solomons (mainly Solomons)	None
CSIRO-participated					
Edison '94 (German)	Sonne	year 1994	26	Lihir-Feni Chain, East Manus (Binns, McInnes)	(many sediments collected in New Ireland Basin, outside Manus Basin
ManusFlux (Japan)	Shinkai 6500	year 1995		PACMANUS, submersible dives (Binns)	
Bio Access 98 (Japan)	Shinkai 2000	year 1998	18	PACMANUS, submersible dives (Yeats)	
KODOS '99 (Korea)	RV Onnuri	year 1999	9	East Manus, Planet Deep (Waters)	
DaeYang-02 (Korea)	RV Onnuri	25/08/02 - 07/09/02	14	Lihir Island, E & W Bismark Sea (McConachy)	
Other					
Moana Wave (USA)	Moana WaveMW8518 1987	year 1987		Bismark Sea, Woodlark Sea and Islands	No sediments, seismic
Bio Access '96 (Japan)	Shinkai 2000	year 1996		PACMANUS, submersible dives	
EDISON II (German)	Sonne	1999 or 2000		Lihir-Feni Chain	None
MANUATE 2000 (French)	Nautile/A'talante	year 2000		East Manus, dives and dredges,	
CONDRILL (German-UK)	Sonne	year 2004		PACMANUS, TV grabs and camera tows, drilling	
		Total days at sea	383		

4.1 Original Cruise and Sample Logs

A primary source of data and comprehensive account of ship board operations for CSIRO-led cruises is the cruise log. Logs are A4 size, often written right to edge of page, in hard cover lined laboratory books. For Cruise Logs, both sides of a page were used and ultimately need copying. Some trackplots, winch plots etc are pasted in to fold over other text - for those double copying would be needed.

Table 2 Summary of Cruise Logs from CSIRO-led Cruises to Eastern Manus Basin

Cruise	Year	No. volumes	Total pages	Notes
PACLARK-I	1986	1	182	
PACLARK-II	1988	2	289	
PACLARK-III	1988	1	87	Lots fold-outs
SUPACLARK	1990	1	205	
PACLARK-V/ PACMANUS-I	1991	2	300	
PACMANUS-II	1993	2	353	Some fold-outs
PACMANUS-III	1996	2	538	
PACMANUS-IV	1997	2	537	Foldouts. Fragile binding
BINATANG	2000	4	583	Foldouts
BISMARCK	2002	5	710	Vol 5 = east Manus, 62 pages
Total 11		21	3784	3136 pages (incl. only V5 from BISMARCK 2002)

For Sample Logs, the main lists are on one side, and supplementary notes opposite. Quite a few of the latter are blank.

(page nos. include many blanks, where no opposite notes)

Table 3 Summary of Sample Logs from CSIRO-led Cruises to Eastern Manus Basin

Cruise	Year	No. of Volumes	Total Pages	Comments
PACLARK-I	1986			No separate sample log. Notes in "Petrology" book.
PACLARK-II	1988			
PACLARK-III	1988	No sample log		
SUPACLARK	1990			
PACLARK-V/ PACMANUS-I	1991	1	103	
PACMANUS-II	1993	1	207	
PACMANUS-III	1996	2	354	+ few loose pages
PACMANUS-IV	1997	1	225	
BINATANG	2000	1	169	+ a few loose pages
BISMARCK	2002	1	130	
Total		7	1188	

Note: the main sample lists are on one side, and supplementary notes opposite. Quite a few of the latter are blank.

5. All Operations (excluding hydrocasts)

All operations, excluding hydrocasts, are listed in Tables appended to this report (Appendix 1)

1. Two listings are in the file, one of all operations except hydrocasts arranged by cruises and operation type, the other by locality (only those operations that yielded samples) starting with Pual Ridge then other sites arranged generally from west to east. Figs. 1 and 2 show the main locality names used. Most names were submitted to the PNG Marine Scientific Research Committee for approval in 2000. The list arranged by cruise includes CSIRO samples (PACMANUS-III, 1996) at the East Sherburne lava field (south of the extensional transform fault in the central Manus Basin). Other-party operations in the Vienna Woods- Central Manus area are not included in either list.

2. MANUATE-2000 dives and dredges are not included (details unknown). Only partial navigation data are available for BioAccess 98 dives, and none for BioAccess ’96 dives. CSIRO has copies of BioAccess ‘96 Cruise Report, with Dive Tracks and reports.

3. Abbreviations for operation type (locality listing):
   D = dredge
   G = Smith-McIntyre grab
   GTV = TV-guided grab
   S = sediment core
   D = submersible dive
   H = drill hole
   C = camera-video or video tow

4. Corrections have been applied as appropriate for lag of tool behind ship, and distance from GPS aerial to A-frame adjusted for ship’s heading.

5. Dredge positions and depths are for estimated commencement of haul. Most would have hauled only 10-50m. Other operations are estimated on-bottom positions and depth.

6. Navigation precision covers ship's positioning and uncertainties in lag. A+ 5-10m; A ~20m; B ~50m; C ~100m; D ~200m; X unknown.

7. Start and finish positions on bottom of camera-video tows are included only where lag-corrected positions were filed on computer. These data for many other tows at PACMANUS or SuSu Knolls are available somewhere on hand-written notes, or could be recovered from plotted maps for Module 2. Where the position of samples collected by camera sled are obvious from video, estimated lag corrections have been

applied. Otherwise the samples are assigned positions mid-way in the tow. Non-critical camera-video tow samples (mostly small chips, from areas where better samples are available) have not been included.

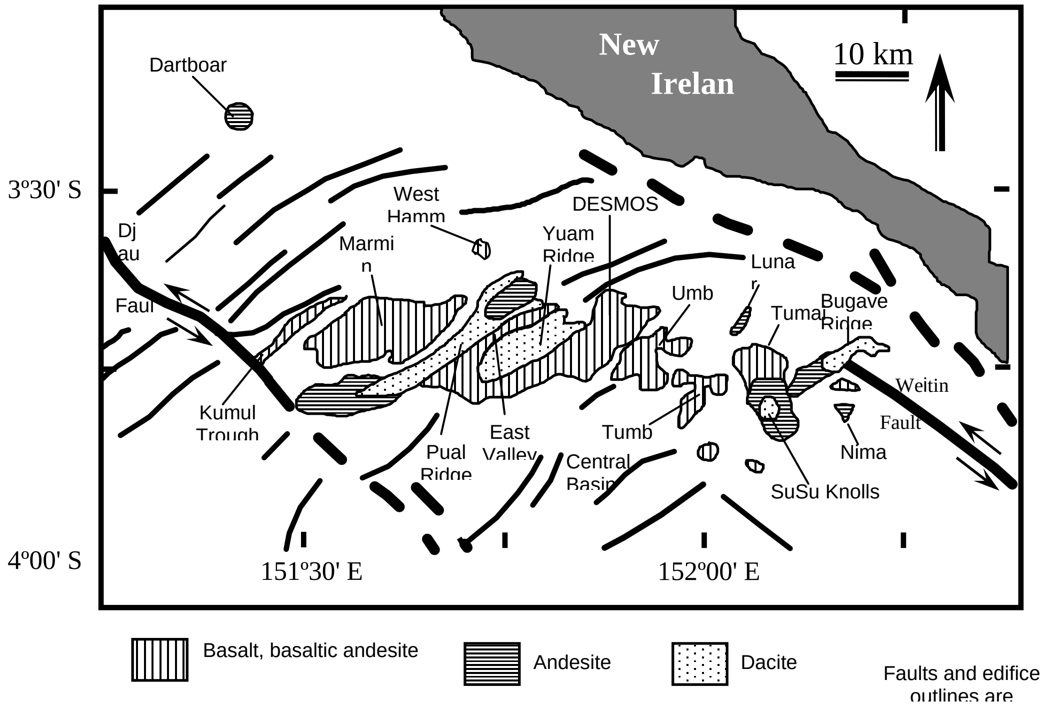

Fig. 1 Principal Names used in Eastern Manus Basin

6. Operations Yielding Rocks

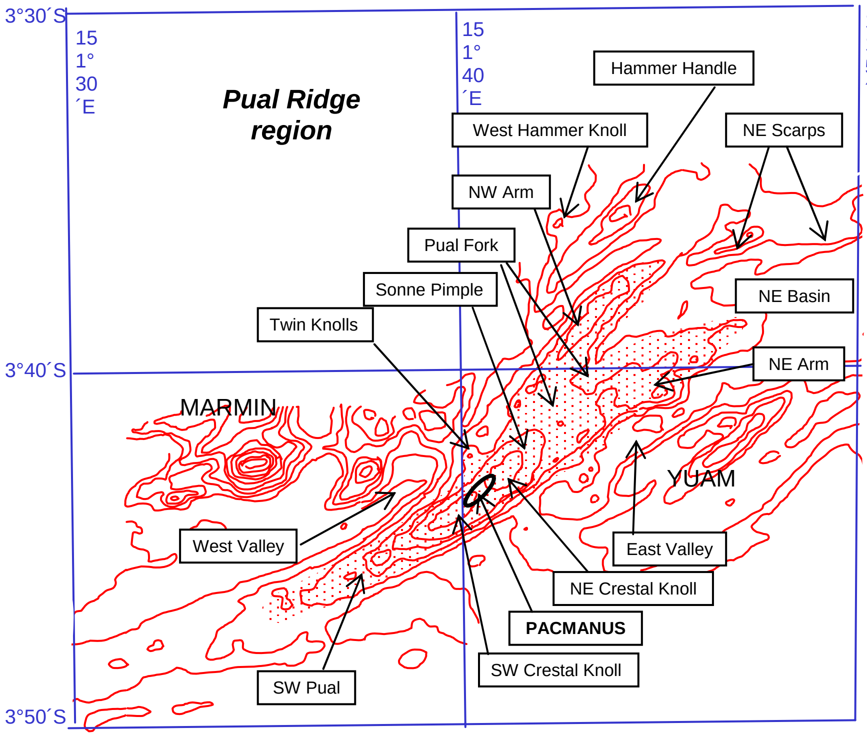

Fig. 2 Principal Names used in the Pual Ridge region

Appendix 2 includes only those operations that yielded rocks. Operations that yielded only sulfides are described in the next section.

1. MANUATE-2000 dives and dredges are not included (details unknown).

2. Rock samples from many BioAccess '96 and '98 dives are not included, although detailed descriptions of rock samples collected during Leg 1 of Bioaccess '98, and descriptions of Leg 2 rocks are in the Cruise report. The BioAccess '96 report contains very brief descriptions and locations for rock samples taken.

3. Analyses of KORDI samples at KORDI are not yet included. Presumably analyses will be conducted in Germany on CONDRILL rock samples.

4. In this table, cited lat-long positions (WGS-84) of dredges (initial position on bottom), grabs, and sediment corers have been recalculated as best possible for lag behind ship and distance from GPS aerial to A-Frame, and ship's heading. Haul directions for dredges are indicated – most would have moved <50 m on bottom. Estimated precision for positions are based on behaviour of ship (or submersible)

during deployment. A+ = 5-10m; A = ~20m; B = ~50m; C = ~100m; D = ~200m; X = unknown.

5. Abbreviations for operation type:
   D = dredge
   G = Smith-McIntyre grab
   GTV = TV-guided grab
   S = sediment core
   D = submersible dive
   H = drill hole
   C = camera-video or video tow

6. Chemical analyses of fresh and altered volcanic rocks are indicated. Refractive index measurements on glass that identify hauls without chemical analyses, or that indicate presence of contrasted rock compositions, are also provided.

7. The final column lists SiO_2 compositions of rocks, normalised to 100% volatile-free, from chemical analyses (no asterisks) or RI measurements on glass (asterisks).

7. Operations Yielding Sediments

All operations that yielded bottom sediments are shown in Appendix 3.

In this table, cited lat-long positions (WGS-84) of dredges (initial position on bottom), grabs, and sediment corers have been recalculated as best possible for lag behind ship and distance from GPS aerial to A-Frame, and ship's heading. Haul directions for dredges are indicated – most would have moved <50 m on bottom. Estimated precision for positions are based on behaviour of ship (or submersible) during deployment. A+ = 5-10m; A = ~20m; B = ~50m; C = ~100m; D = ~200m; X = unknown.

1. Bottom sediments may have been collected during some dredge operations where none are indicated in the table. Indicated coverage is nevertheless extensive, and it is not considered necessary to check this out more thoroughly.

2. In the "Recovery" column, the terms "ooze" and "mud" are as cited in sample logs and are effectively interchangeable. More specific names could be compiled in part from records, but some re-examination of samples might be necessary.

3. Compilation of CSIRO chemical analyses can be conducted in Module 2.

4. Where a single analysed sample is indicated for a sediment core or grab, this will generally be the topmost few cm of the core (i.e.mudline). Where multiple samples are cited, these generally include some from deeper in the core. Core depths can be included in Module 2 listings.

5. Analysed samples from dredges come either from the chainbag or sediment tubes attached to the dredge ring. Where possible, sloppier brown muds likely to come from close to the mudline were selected for analysis. Further information on source and nature can be extracted from records and included in Module 2.

6. Dredge chainbag samples are potentially contaminated by Zn from galvanizing of the ring and chainbag or Pb from the depressor weight, but such an effect is rarely indicated. Samples from the stainless steel sediment tubes may be contaminated by Ni etc, but no definite examples of this are identified at present.

7. For operations where there is currently no analysed sample, Module 2 can specify likely bottom or near-bottom CSIRO samples suitable for analysis. Additional regional "background" samples, and some from hydrothermal sites (including another core at Suzette) are available from the BINATANG-2000 cruise particularly. All but one sample from West Su Basin remain unanalyzed.

8. Analysed sediments (CSIRO) fall into three groups:
    - regional "background" sediments, hemipelagic oozes

- sediments (predominantly hemipelagic ooze) likely affected by fallout from plumes at Pual Ridge hydrothermal sites; in the "P2+ Memoir" these were evaluated assuming PACMANUS was the source of hydrothermal contaminants: this may need re-assessment in light of the extensive deeper plume now defined from North Pual.
- sediments in the SuSu Knolls vicinity, particularly "tuffites" considered derived by "hydrothermal eruptions" from North Su or South Su but including some hemipelagic oozes: their geochemistry has not yet been quantitatively evaluated in terms of hydrothermal plume components.

9. Most hemipelagic oozes collected from sediment basins are probably the tops of turbidite units slumped from higher edifices, mixed with in-situ settled components. Mineralogical components are probably similar to those in sandier lower sections, including volcanic glass and rock fragments, grains of plagioclase and pyroxene especially, clays (smectite, chlorite and rarer kaolinite identified), plus foram tests and other biogenic material. Oozes collected from high volcanic edifices and hydrothermal sites are presumably accumulated in situ.

10. "Tuffites" at SuSu Knolls are sands and silts dominated by fresh, devitrified, and altered porphyritic dacite fragments, and grains of plagioclase and pyroxene (= phenocrysts). Their biogenic component is low, and their geochemistry is quite distinct from that of hemipelagic oozes.

11. A few dredged sediments with very high Cu and Zn collected at hydrothermal sites (PACMANUS and SuSu Knolls) are known to be contaminated by fragments of sulfide chimneys: these can be identified in Module 2 by reference to sampling notes.

12. CSIRO analyses of sediments were by ICP-AES in all cases, plus ICP-MS in many, using open vessel dissolution which means SiO_2 is not determined. A few sediments were analysed by XRF (particularly for SiO_2) and NAA (Au).

13. Foreign sample holders:

- Shirshov = Shirshov Institute of Oceanography, Moscow (A. Lisitzyn);
- KORDI = Korean Ocean Research and Development Institute (S.-M. Lee);
- TUBAF = Technical University Freiberg (P. Herzig, but samples probably at Keil with P. Stoffers);
- HIG = Hawaii Institute of Geophysics (B. Taylor);
- GSJ = Geological Survey of Japan (T. Urabe, now moved to Univ Tokyo);
- ORI = Ocean Research Institute, University of Tokyo (H. Sakai, now retired).

Samples marked "CSIRO?" may never have been catalogued so could be difficult to find.

It is probably not necessary to seek access to any sediment geochemical data from Russia, Korea, Germany, HIG, or ORI as they do not effectively expand coverage of the database and comparative analytical accuracies and precisions are unknown.

However, filtered sediments collected by pumping at PACMANUS during the Japanese ManusFlux Cruise (1995) represent a unique sample set, uncontaminated in the way dredge samples might be by chimney fragments. It is not known where these now reside, nor whether they were ever analysed (though that was the intention of Dr Tetsuro Urabe, formerly at the Geological Survey of Japan whose unit was closed down).

8. Operations Yielding Sulfides

Operations which yielded sulfides are tabulated in Appendix 4. The table includes operations that yielded massive sulfide chimney samples, plus some key sites with strong indications such as altered volcanic rocks with sulfide veining.

All drill holes at hydrothermal sites are listed, irrespective of recovery

1. MANUATE-2000 dives and dredges are not included (details unknown). Nor are sulfide sample sites from BioAccess '96 – data may be available.

2. In this table, cited lat-long positions (WGS-84) of dredges (initial position on bottom), grabs, and sediment corers have been recalculated as best possible for lag behind ship and distance from GPS aerial to A-Frame, and ship's heading. Haul directions for dredges are indicated – most would have moved <50 m on bottom. Estimated precision for positions are based on behaviour of ship (or submersible) during deployment. A+ = 5-10m; A = ~20m; B = ~50m; C = ~100m; D = ~200m; X = unknown.

3. Abbreviations for operation type:
   D = dredge
   G = Smith-McIntyre grab
   GTV = TV-guided grab
   S = sediment core
   D = submersible dive
   H = drill hole
   C = camera-video or video tow

9. CTD Hydrocasts

Including the two CTD hydrocasts from the Papatua Expedition in 1986 which led Harmon Craig of the Scripps Institute of Oceanography to declare that the Eastern Manus Basin was a methane swamp, around 220 CTD hydrocasts have been undertaken in the Bismarck Sea. One hundred and ninety four CTD hydrocasts were deployed on RV Franklin cruises (PACMANUS-I, II, III, & IV; Binatang 2000 and Bismarck 2002). In the earlier cruises, tow-yos were preferred to map hydrothermal plumes to source, but a combination of single dip casts and tow-yos were used in subsequent cruises[1]. Twently eight CTD hydrocast operations from non-CSIRO cruises have also been captured in CSIRO's database. The majority of the 94 CTD hydrocasts completed during CSIRO's most recent cruise to the Bismarck Sea (FR02/2002) are located in the western Bismarck, well away from Placer Dome's current area interest. These CTD hydrocasts, however, have been captured in the database as they offer potentially valuable background information.

All CTD hydrocasts undertaken on RV Franklin cruises will have conductivity (salinity)-temperature-depth (=pressure in decibars) data available from CSIRO Marine Research in Hobart, archived as part of the National Facility's marine database. However, various calibrations may need to be done, for example, salinity on an unspecified number of casts to align the data with accepted formats. Other data, depending on instruments mounted on the CTD rosette, such as density, light transmission and dissolved oxygen will also be available. There has been no attempt in Module 1 to discern the availability of CTD hydrocast data from the National Facility database. To obtain some or all of the data would require around 2-3 months as a specific request to the facility to prioritise its data management. In order to test for the presence of and to characterise hydrothermal plumes, the vast majority of CSIRO's CTD hydrocasts also collected samples at various depths the water column. These details will be documented in Module 2.

A currently unspecified number of water samples were also filtered through membranes to collect particulate data from hydrothermal plumes. Particulates were also captured by several deployments of the Binatang Masins in Binatange 2000 cruise by way of a submersible pump/filter system. CSIRO has a number of ICPMS analyses of water samples which highlight anaomlous Pb and U slightly above the main particulate plume, as well as Mn, Fe and CH_4. However, these data have not been assessed in this current scoping study.

Apart from one PhD study (Scott et al., 1992; Ortega-Osario, 1996, 1997; Ortega-Osario & Scott, 2001) which focussed on hydrothermal plumes over PACMANUS during RV Franklin cruises in 1991 and 1993, and a study of the SuSu superplume by CSIRO (McDonald et al., 1997), particles from the other plume work have not been studied in detail. The SuSu 'Super Plume is arguably the most particulate- and methane-rich hydrothermal plume found

[1] A tow yo consists of see sawing the CTD unit up and down in the water column, typically between 5 and 600 metres above bottom as the ship moves, to map light transmission and hence particulate concentration in any hydrothermal plumes.

anywhere in the oceans. It contains concentrations of methane (and ethane and butane). No grain size analysis has been done which could be important for study of fines from mining operations.

Compared with other areas in the world's oceans, relatively little has been published on hydrothermal plumes in the Eastern Manus Basin.

10. Tapes of Submersible Dives and Camera Tows

CSIRO maintains a collection of 446 visual tapes from various submersible dives and camera tows that are mostly from the eastern Manus basin (Appendix 6). The tapes are in various forms**:** VHS (mostly Bioaccess98, plus some highlight tapes), NTSC Hi8 (Manusflux 95 + video from a Canadian Deep Tow system) and Mini DV**.**

Up to 1997 CSIRO also took 35 mm films. These are not continuous like video, but cover wider cross-track fields of view, and usually have better resolution.

By far the best option is to copy the tapes onto DVD. Quotes vary from ~$60 - $80 per DVD (assuming one DVD for each tape). For the dive videos and films. (Shinkai 6500, 2000). JAMSTEC rules are that copyright belongs to the photographer (i.e dive scientist). It means obtaining approval if any video/photos are used for publicity as distinct from research purposes. For CSIRO officers Binns and Yeats, who both participated in Shinkai dives, CSIRO understands that copyright has been transferred to CSIRO but has not been formalised. Should Placer Dome wish to copy tapes for public use, it would have to contact scientists at JAMSTEC; but CSIRO understands that copyright permission is not required for research use.

10.1 Camera Tows

Over half of the 57 camera tows have been corrected for lag and 26 Manus camera tows still need lag corrections.

Lag corrections are a tedious business, and to correct the remaining tows would take about 7 days to compile list of camera positions say every 10 or 15 minutes.

Most of the 26, however, are away from the main sites of hydrothermal activity (PACMANUS, Suzette, N and S Su). Perhaps for those we need only to estimate the start and end positions, and maybe one half-way. That still requires a lot of the same calculations to be performed, and would take 2-3 days.

11. Geophyics

A number of geophysical surveyes were undertaken during the Binatang 2000 cruise (FR03/2000) by CSIRO’s Drs David Dekker (deceased) and David Cousens.

The rationale was to develop techniques to find vent fields that are no longer active and detect sub-surface massive sulfide deposits though their geophysical signature. Surveys were conducted over the PACMANUS. To test deep-submergence versions of spectrometric gamma gamma and neutron loggers, and other bottom-tow geophysical sensors being developed in CSIRO to facilitate future seafloor mineral exploration. Later calculations showed the difficulty in interpreting bottom radiometric data without accurate altimetry. For that reason, the equipment focussed on two approaches: electromagnetics and high-resolution seismics, backed up by some navigational data taken from within the depressor cage.

Approximately 38 nautical miles of a deep tow magnetometer (DTM) survey were completed at PACMANUS by Dr Sang Mook Lee (then of KORDI) during the DaeYang02 cruise aboard RV Onuri.

In May 2005, CSIRO uahtorised Placer Dome and Dr David Cousens to use CSIRO’s magnetic data to merge with Placer Dome’s maganetic data collected in April 2005.

12. Animal Diversity

Hydrothermal vents tend to be small areas of extremely high biological diversity. They are characterized by chemosythentic animals with bacterial symbionts, which convert hydrogen sulfide and methane into energy and also free-living chemoautotrophic bacteria that tend to support complex communities of other organisms as well.

12.1 Results of Literature Survey

Data on animals collected from hydrothermal vents areas in the Eastern Manus Basin published in refereed literature to date were collated by Dr Greg Rouse. Sixty nine references were collected that make mention of 98 vent species (Appendix 7). However, less than one third relate to the Manus Basin and nearby areas Lihir and Edison seamount[2].

Twenty three species have been recorded from vents in the region; some still undescribed. These records have come from collections made by Russian, German and Japanese expeditions. There may be further interpretable records in cruise reports, but these were not studied.

Where animals are listed (Appendix 7) as vent organisms this means that they are likely to be obligately associated with vents and will not be found anywhere else. This is often to do with the fact that many animals (e.g., gastropod and bivalve mollusks and vestimentiferan tube worms) have obligate symbiotic associations with chemoautotrophic bacteria. These bacteria require chemicals such as sulphide found in hydrothermal vents and hence they, and their animal hosts, cannot survive anywhere else. The animals with bacterial symbionts, as well as free-living chemoautotrophic bacteria then tend to support complex communities of other organisms that will also only tend be found at vents. This means that hydrothermal vents tend to be small areas of extremely high biological diversity and may be very sensitive to disturbance.

Galkin (1997) recorded 16 species of vent animals associated with vents in the Manus Basin.

A further 12 non-vent fauna species were recorded by Galkin (1997) but no further records of non-vent animals are available.

Binns and Scott (1993) recorded that there were gastropods, alvinellids and polynoids worm, mussels, siboglinids, barnacles, patellids and turrids but gave no further details and some, such as turrids have not been formally described from the area as yet.

[2] Two references, Hashimoto et al. (1999) and Ohta & Hashimoto (1997) remain to be examined.

There has been no general synopsis of the fauna associated with hydrothermal vents in the Manus Basin to date. Descriptions of new species have tended to be by experts in a particular group e.g., molluscs or crustaceans and so are scattered widely across the literature.

There are less formal descriptions of the fauna in the Manus Basin compared with other hydrothermal vent regions in the West Pacific. However, this observation probably reflects the fewer number of investigations in the Manus Basin rather than a lower diversity. For that reason, the records for other sites were also surveyed; e.g, the Fiji and Lau Basins, Lihir/ Edison seamount, Mariana and Okinawa troughs.

This observation in the Manus Basin is of some significance owing to possible gene flow between hydrothermal vents in the Western Pacific. Also, it serves to highlight that the diversity of animals shown here for the Eastern Manus basin hydrothermal vents may be a significant underestimation.

12.2 Unique Fauna

There have been several species described from the Manus Basin hydrothermal vents that are have not been recorded elsewhere. These include the barnacle *Eochionelasmus ohtai manusensi,* the gastropod molluscs *Symmetromphalus hageni, Lepetodrilus schrolli, Olgasolaris tollmanni, Shinkailepas kaikatensis, Shinkailepas tufari.* Whether or not these forms are in fact unique to the Manus Basin requires further study.

12.3 Possible Gene Flow Among Western Pacific Hydrothermal vents.

In a study of mitochondrial gene sequences by Kojima et al. (2001), none of the specimens of the gastropod mollusc genus *Alviniconcha* collected in the Manus Basin differed genetically from the dominant group from the North Fiji Basin and so the name *Alvinoconcha hessleri* is applied across a wide geographic range. A similar result was found for a collection of vestimentiferan worms (Sibiglinidae: Annelida) referred to as *Escarpia* sp. 1. by Kojima et al. 2002 (but is probably *Paraescarpia echinospica*; Southward et al. 2002). This species has a range from seep areas in Japanese and Papua-New Guinean waters as well as hydrothermal vent fields in the Okinawa Trough and the Manus Basin.

However, it should be noted that studies by Kojima et al. (2001a, 2003) in a similar series of genetic studies on vestimentiferan tube worms revealed that there were numerous species across the Western Pacific vents in the genera *Lamellibrachia* and *Alaysia*. These include two endemic forms of *Lamellibrachia* and *Alaysia* (as yet undescribed) and in the Manus basin.

One of the *Lamellibrachia* sp. found at PACMANUS is similar to those found at cold seeps near the north coast of Papua New Guinea (Kojima et al. 2003), while the other from the DESMOS vents is unique to that site. A similar story emerges with the gastropod mollusk

Ifremeria nautilei between the Manus and North Fiji basins, though it is not clear whether there two separate species (Kojima et al. 2000).

Thus while some species appear to have wide distribution on the West Pacific hydrothermal vent systems, others appear have a high degree endemism, in that they are only found in geographically limited areas. This may potentially be limited to a few venting areas in a restricted locality. Further study of genetic diversity of organisms across a range of West Pacific hydrothermal vents is needed to properly assess the degree of endemism in areas such as the Eastern Manus Basin.

12.4 Fauna Collections From Manus Basin

Approximately 200 samples of macrofouna have been recovered from the Manus Basin in the six CSIRO-led Franklin cruises (Appendix 8). The samples are currently stored (variously in formalin, ethanol or frozen) at Australian Museum in Sydney, CSIRO Marine and Atmosphereic Research in Hobart and at CSIRO laboratories in North Ryde. No attempt was made in Module 1 to examine these collections in terms of their uniquenss or otherwise.

13. Microbiological Diversity

A literature search on microbiology associated with hydrothermal vents yielded just over 230 references. There are only a relatively small number of articles of studies in the Manus Basin or vent sites at other convergent plate boundaries.

13.1 Manus Basin

Only limited information is available on the microbiology of the Manus Basin, including 3 articles published in peer-reviewed journals, 6 conference papers, 1 CSIRO report, 2 cruise reports and 2 presentations to industry. CSIRO samples collected during FR 3/2000 were analysed for ATP content, giving an indication of active biomass and were then used to enrich for thermophilic iron and sulphur oxidisers. These attempts at enrichment were unsuccessful. Most, if not all, of these samples have been discarded. Any samples remaining from previous cruises, even if they have been stored at –80^{o}C are likely to be too old to yield meaningful information on biomass.

A range of samples from FR3/2000 were also analysed for their signature lipid profiles, including ester-linked fatty acids (derived from bacteria) and ether lipids (derived from Archaea, another important group of microorganisms genetically distinct from the Bacteria). These data have been presented at several venues as listed in the Bibliography, and are being prepared for further publication. Samples from most of these analyses remain, and are stored at -20^{o}C at the CSIRO Marine Laboratories in Hobart.

Eight samples were collected from three dredge operations at the PACMANUS hydrothermal site in the eastern Manus Basin, for use in the CSIRO “Bioprocessing Initiative”. They were scraped from rocks or chimneys into 50ml polycarbonate centrifuge tubes provided by Dr Peter Franzman (CSIRO Land and Water) immediately after dredge loads were dumped on deck and before material was otherwise handled. A sterile scalpel was used and surgical gloves sterilised with alcohol were worn. The samples were stored in a bucket in the engine room, at a temperature near 40°C for offloading in Sydney after cruise FR-03/02. Those samples were among those used to enrich for iron and sulphur oxidizing hyperthermophiles – a process that was unsuccessful. Some brief attempts were made to enrich for other types of microorganisms with limited success.These microorganisms were not maintained in culture or studied in detail.

13.2 Studies of Microbial Communities in Other Vent Fields

In the last 10 years, 23 published articles report investigations into communities of microorganisms in deep-sea hydrothermal vent environments. These are listed in the Bibliography. Many refer to chimneys, but there are also some that examine the microbiology of sediments, which are marked with an asterisk (*). Seven articles that use signature lipids (a class of compound found in cells, especially in the cell membrane) to investigate microbial communities have been published in the past 10 years

The articles listed in this part of the Bibliography generally use various microbiological techniques to investigate the range of microorganisms living in a particular environment. The information they give on particular strains is usually limited. The techniques used to investigate microbial communities include traditional ones based on growing microorganisms in the laboratory as well as molecular techniques such as DNA 'fingerprinting' or analysis of 'signature lipids', that is, lipids which are characteristic of a particular group of microorganisms.

Of the articles and conference papers listed in the Bibliography[3], approximately 50% refer to studies conducted in the Pacific Ocean, mostly around the Juan de Fuca Ridge and the East Pacific Rise, while approximately 10% refer to studies around the Mid-Atlantic Ridge and nearby areas. The remaining studies include the Indian Ocean, Japan, and Iceland, while 10% of the articles do not give a clear indication of the area where the work was carried out.

13.3 Uniqueness of Microorganisms

A considerable body of literature describes individual strains of bacteria or archaea isolated from hydrothermal vent environments, which were found to be significantly different from previously described strains. Fifty of the most relevant articles describing new species or genera of microorganisms from hydrothermal vents are listed in Section 14.2.3.

Of those articles and conference papers listed, one refers to a new bacterial species isolated from shallow sediments off Lihir Island. Approximately 45% of the references listed in the Bibliography report studies carried out in the Pacific, mostly around the Juan de Fuca Ridge and the East Pacific Rise as well as in the Guaymas Basin. Approximately 25% are based around the Mid-Atlantic Ridge and 16% in vent fields around Japan such as the Okinawa Trench and the Suiyo Seamount.

Other articles refer to work done in the Indian Ocean and the Kamchatka Peninsula while one article refers to a strain isolated from the Lau Basin.

The articles describe a considerable variety or types of microorganisms, including both aerobic (those that respire air) and anaerobic (those that do not respire air but use an alternative to O_2) microorganisms. Almost all are thermophilic (growing optimally at 45–70^{o}C) or thermotolerant (growing at 42–45^{o}C), while some articles report hyperthermophilic (growing at 80–113^{o}C) microorganisms.

Types of metabolisms found among these new species include:

- Fe(III)-reducing - anaerobic, uses Fe^{3+} instead of O_2
- Fe(II) oxidising - aerobic, uses Fe^{2+} as an energy source
- H_2-oxidising - aerobic, uses H_2 as an energy source
- Sulfate-reducing - anaerobic, uses sulfate instead of O_2
- CO-utilising - uses CO as energy and possibly also a carbon source
- Methane-producing - anaerobic, produces methane usually from CO_2 and H_2 and
- Nitrate-reducing - anaerobic, uses nitrate instead of O_2
- Numerous halophilic (salt tolerant) microorganisms and radiotolerant (tolerates radiation) and barophilic (tolerates high pressures) microorganisms are also reported.

These reports of new species and genera indicate the diversity of microbial life in hydrothermal vents and also the extent to which these environments contain forms of life not seen anywhere else. It also shows that our knowledge of the microbial life-forms in hydrothermal vents is at an early stage of development.

It is likely that a similar microbial diversity would be found in the Manus Basin were more detailed studies to be undertaken. It is not clear whether the new species listed in Section 14.2.3 are unique to the particular vent system where they were isolated or whether they are more widespread. An analysis of the literature cited in the Bibliography may give an indication of the uniqueness of the microorganisms in the Manus Basin compared with other hydrothermal vent environments. Such analysis is recommended for Module 2.

13.4 Symbiosis

An important aspect of the microbiology of hydrothermal vents is that many microorganisms live in symbiosis (a mutually beneficial relationship) with macrofauna found in vent environments, that is, they live inside or on the surface of animals and play an important role in the physiology and metabolism of these animals. It is also likely the microorganisms would require their animal hosts for their own survival.

A search of the literature produced 99 publications describing such symbioses. Those 67 articles and conference papers published in the last 10 years are listed in the Bibliography. These articles highlight the inter-relatedness of the macrofauna and the microbiology of the hydrothermal vent environment.

Almost 50% of the articles listed give no indication in the abstract of the hydrothermal vent field studied[4]. Twenty percent of the references report work related to zones in the Pacific Ocean, especially the East Pacific Rise. Approximately 10% refer to studies around Fiji and the Lau Basin, another 9% refer to studies in Japanese vent zones and 12% report studies

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[4] Overall, studies in the Pacific (East Pacific Rise, Juan de Fuca, Guaymas Basin) comprise about 34%, Atlantic 17%, Japan 11%, and Fiji/Lau 6%. Generally speaking, the relative proportion of studies of symbiosis is much the same as for other types of studies, except for the Fiji/Lau vents which have more references available on symbiotic relationships, perhaps showing that the macrobiologists have paid more attention to the Fiji/Lau vents than microbiologists.

along the Mid-Atlantic Ridge. There were two articles (3%) referring to studies in the Indian Ocean.

13.5 Biotechnology

Several biological products with biotechnological application have been isolated from vent microorganisms.

Several published articles refer to the potential for hydrothermal vent organisms to be used as sources of exopolysaccharides, a class of molecule produced and excreted by some microbial cells, which have many potential uses in the biotechnology industry; e.g. cosmetics, biomedical, environmental – metal sequestration, and food. Australian researchers at the University of Tasmania are working presently in collaboration with the IFREMER Brest Biotechnology research group lead by Dr Jean Guezennec, with IFREMER also looking to building links in the future with CSIRO on extremophiles. Some of these articles are listed in the Bibliography.

To the best of our knowledge, the Manus Basin microbiological community has yet to be examined for organisms with biotechnological application.

13.6 Conclusions

It is recommended for Module 2 to underatke a detailed examination of the literature listed in this report. As most of this literature refers to environments other than the Manus Basin, the focus of the literature study will be the diversity and distribution of microorganisms in those other environments. It may be useful to differentiate between divergent and convergent plate boundaries. Such a study would give an indication of the degree of endemism found in these vent environments which would in turn indicate the degree of diversity and uniqueness that could be expected in the Manus Basin. This study and report compilation would be expected to take 13 days.

More detailed information on the vent microbiology of the Manus Basin itself, other than the small amount of information already published, would require another cruise to collect more samples, preferably using a submarine, and would involve molecular analysis of the samples collected as well as culturing of microorganisms under a range of growth conditions. Such a project would require considerable time and resources.

14. Bottom Currents

Near surface (0-200 m) current data is usually collected routinely by research vessels using an acoustic Doppler current profiler (ADCP). It is unlikely, however, that these near surface current data have any direct bearing on the prediction of near bottom currents which will be more critical for mining of seafloor sulfides.

Visual evidence from submersible dives and hydrothermal plume studies at PACMANUS suggest a relative steady, low velocity near-bottom NE current of around 1-2 km per hour. At SuSu, however, secular changes in direction and intensity have been mapped in FR05/1993, FR10/1996, FR09/1997, FR03/2000 and FR02/2002. The near bottom current is shown to be highly variable with swings of around 45°. There is some layering in the water column down to about 400 m below sea level, plus a minor layer at 550 m depth near SuSu knolls, but below that the density profile is a very regular increase with no obvious change that could be attributed to a different water mass.

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15.2 Microbial Diversity

15.2.1 Manus Basin

Kimura, H., Asada, R., Masta, A. & Naganuma, T. (2003). Distribution of Microorganisms in the Subsurface of the Manus Basin hydrothermal Vent field in Papua New Guinea. *Applied and Environmental Microbiology* **69**(1), 644–648.

The distribution of microorganisms in the subsurfaces of hydrothermal vents was investigated by using subvent rock core samples. Microbial cells and ATP were detected from cores taken at depths of less than 99.4 and 44.8 m below the seafloor (mbsf), respectively. Cores from various depths were incubated anaerobically with a heterotrophic medium. Growth at 60 and 90°C was ascribed to a Geobacillus sp. in the 448.6- to 99.4-mbsf cores and a Deinococcus sp. in the 64.8- to 128.9-mbsf cores, respectively, based on the 16S ribosomal DNA analysis.

Takai, K., Komatsu, T., Inagaki, F., Horikoshi, K. (2001). Distribution of Archaea in a Black Smoker Chimney Structure. Applied *and Environmental Microbiology* **67**(8), 3618–3629.

Archaeal community structures in microhabitats in a deep-sea hydrothermal vent chimney structure were evaluated through the combined use of culture-independent molecular analyses and enrichment culture methods. A black smoker chimney was obtained from the PACMANUS site in the Manus Basin near Papua New Guinea, and subsamples were obtained from vertical and horizontal sections. The elemental composition of the chimney was analyzed in different subsamples by scanning electron microscopy and energy-dispersive X-ray spectroscopy, indicating that zinc and sulphur were major components while an increased amount of elemental oxygen in exterior materials represented the presence of oxidized materials on the outer surface of the chimney. Terminal restriction fragment length polymorphism analysis revealed that a shift in archaeal ribotype structure occurred in the chimney structure. Through sequencing of ribosomal DNA (rDNA) clones from archaeal rDNA clone libraries, it was demonstrated that the archaeal communities in the chimney structure consisted for the most part of hyperthermophilic members and extreme halophiles and that the distribution of such extremophiles in different microhabitats of the chimney varied. The results of the culture-dependent analysis supported in part the view that changes in archaeal community structures in these microhabitats are associated with the geochemical and physical dynamics in the black smoker chimney.

Birrien, J.-L., Roux, C. L. and Prieur, D. (1999). Isolation of thermophilic aerobic heterotrophic bacteria from deep-sea hydrothermal vents (Manus Basin, Papua New Guinea). *JAMSTEC Journal of Deep Sea Research* **14**, 621–631.

A numerical taxonomic study was carried out with thermophilic aerobic heterotrophic bacteria newly isolated from deep-sea hydrothermal vents (Manus Basin, Papua New Guinea) and several thermophilic reference strains representing Bacillus and Thermus species. The deep-sea isolates consisted of rods, single cells, pairs or filaments of variable lengths and grew aerobically above 65°C and some up to 75°C. Results from unweighted average linkage (UPGMA) clustering applied to a similarity matrix derived from the simple matching (SSM) coefficient showed the formation of a cluster defined at the 83% similarity level whereas 5 isolates remained unclustered.

Asada, R., Tazaki,K., Kimura, H., Masta, A. And Barriga, F. J. A. S. (2003). Transmission electron microscopic observation of drilling microbial core samples from a deep seafloor at hydrothermal vent field. Proceedings of an International symposium “The water, soil and environment” (ed. Kazue Tazaki, Kanazawa University), p. 294–299 (ISBN 4-924861-10-3).

Autochthonous bacteria were found in clayey rocks below a deep sea floor in an active hydrothermal vent field in the eastern Manus Basin, Papua New Guinea. Microbiological core samples were collected from Site 1188 of Leg 193 of Ocean Drilling Program (ODP). The amounts of carbon were quite low in all samples, nevertheless, the bacteria were directly observed on board without cultivation. Transmission electron microscopy revealed bacterial cooperation with clay minerals. Illite and talc were present near the bacteria, indicating that clay minerals play an important role in the bacterial habitat, e.g. as a buffer against heat from

hydrothermal fluid, and the change of water chemistry by the inflow, and as a sustainable food supply, such as H_2O and K^+. The findings of bacterial clayey community here add to the knowledge of subsurface biology in nm-order environment system of life-chain.

Nichols, P., Franzmann, P., Rayner, M., Zappia, L., Watling, H., Houchin, M., Binns, R., Dekker, D. (2000). Isolation and applications of microorganisms from hydrothermal vents in the Bismarck Sea: characterisation using signature lipids. IVth International Symposium on the Interface between Analytical Chemistry and Microbiology, Tregastel, France, June 4-7, Abstracts.

A new Australian initiative involving collaboration with PNG was commenced in 1999 to isolate, characterise and exploit novel microorganisms from collections to be conducted at hydrothermal vents in the Bismarck Sea. Materials will be collected at rich sulphide deposits surrounding hydrothermal vents in the Manus Basin. Sampling will be from *RV Franklin* using a range of sampling devices. The project aims to co-ordinate activities in microbiology, microbial signature lipid profiling, microbial mineral leaching, genetic manipulation and mineral chemistry. With respect to thermophilic and other microorganisms, activities planned as part of the initiative include:

1. Screening environmental samples for signature fatty acids and ether lipids to determine microbial biomass, community structure and nutritional status;
2. Isolation, identification and characterization of novel thermophiles;
3. Development of enrichments of mineral leaching *Bacteria* and *Archaea* for target minerals.

Signature lipid profiling will include determination of *Bacterial*-derived PLFA profiles and the use of high temperature capillary GC techniques developed to simultaneously measure the presence of both *Archaeal*-derived di- and tetra ether lipids. The scope for possible genetic manipulation of microorganisms may also be examined. These and related activities aim to initiate possible commercial exploitation of mineral leaching microorganisms.

Nichols, P. D., Gibson, J. A. E., Plumb, J. J., Stott, M. B., Watling, H. R., Franzmann, P. D. (2003). Archaeal hyperthermophilic communities in marine sediments and vents of the Manus Basin and from nearby terrestrial environments: isolation, characterisation, lipid signatures and industrial potential. Seabed hydrothermal systems of the western Pacific — Current research and new directions. Exploration and Mining Report 1112F, Abstracts p88.

Gibson, J. and Nichols, P. (2004) Archaeal Hyperthermophilic Communities: A New GC Method for Tetraether Signature Lipids. American Oils Chemists Annual Meeting, May, Cincinnati, Abstracts p8.

A multidisciplinary team was established in 2000 to isolate, characterize and develop new hyperthermophilic organisms for use in mineral processing. The team drew together skills in processing chemistry, microbiology, biochemistry and molecular biology. Initial bioprospecting for hyperthermophilic microorganisms occurred in the Manus Basin off Papua New Guinea, with further material collected from a geothermally-heated gold mine on near-by Lihir Island and from volcanic areas near Rabaul, New Britain. A new high temperature GC method was used to determine the concentrations of achaeal-derived ether lipids in the environmental samples, and subsequently in the isolated hyperthermophilic microorganisms. High concentrations of tetraether (TE) lipids, including highly cyclised TE indicative of the family Sulfolobales, indicated that hyperthermophilic Archaea were present. Use of the method allowed simultaneous profiling of diethers, TE and calditols; the latter are functionalized derivatives of TE lipids. Novel thermophilic archaeal strains and mixed archaeal cultures, with the ability to oxidise sulfide minerals at temperatures greater than 80C, were isolated from the volcanic and thermally heated samples. All strains were found to be phylogenetically related to Sulfolobus spp. and contained distinctive cyclised TE lipids. Leaching experiments showed that the isolates were capable of rapidly leaching a chalcopyrite concentrate (up to 91% Cu release in 108 hour). These unique strains have the ability to oxidise sulfides over a wide temperature range and are potentially suited to leaching applications where temperature fluctuations limit the growth of non-thermophilic bioleaching microorganisms. Based on progress to date, the GC method developed and applied allows good separation of the wide diversity of ether lipids present in various Archaeal groups. Manus Basin vents and related geothermal environments provide source material containing novel hyperthermophilic microorganisms that have applications in industrial processes, including mineral leaching.

Nichols, P.D., Gibson, J.A.E., Plumb, J.J., Stott, M.B., Watling, H.R., Franzmann, P.D. (2004) Archaeal hyperthermophilic communities in marine sediments and vents of the Manus Basin and from nearby terrestrial environments: isolation, characterisation, lipid signatures and industrial potential. American Society for Microbiology. Annual Meeting, New Orleans, May, Abstracts.

A CSIRO team from four Divisions - Minerals, Land and Water, Marine Research and Molecular Science - was established in 2000 to develop new hyperthermophilic organisms for use in mineral processing. The team drew together skills in processing chemistry, microbiology, biochemistry and molecular biology. Initial bioprospecting for hyperthermophilic microorganisms occurred in the Manus Basin, with further material collected from a geothermally-heated gold mine on Lihir Island and from volcanic areas near Rabaul. Signature lipid profiling was used to characterise the hyperthermophilic microorganims. High concentrations of Archaeal-derived tetraether (TE) lipids, including highly cyclised TE indicative of the family *Sulfolobales*, indicated that hyperthermophilic *Archaea* were present. Novel thermophilic archaeal strains and mixed archaeal cultures, with the ability to oxidise sulfide minerals at temperatures greater than 80^{o}C, were isolated from these samples. Strains were characterised using molecular methods, including signature lipid and 16S rRNA gene sequencing; all strains were phylogenetically related to *Sulfolobus* spp. and contained distinctive cyclised TE lipids. Their physiological requirements and mineral leaching capabilities have also been characterised. Isolates were able to oxidize both Fe^{2+} and sulphur, and grow on both pyrite and chalcopyrite under autotrophic conditions. Leaching experiments showed that the isolates were capable of rapidly leaching a chalcopyrite concentrate (up to 91% Cu release in 108 hour). These unique strains have the ability to oxidise sulfides over a wide temperature range and are potentially suited to leaching applications where temperature fluctuations limit the growth of non-thermophilic bioleaching microorganisms. Based on progress to date, Manus Basin vents and related geothermal environments provide source material containing novel hyperthermophilic microorganisms that have applications in industrial processes, including mineral leaching.

Nichols, P. (2004) Signature Lipids and Omega-3 Oils Down Under. Invited seminar, Procter and Gamble, Cincinnati, May.

Nichols, P. (2004) Omega-3 Oils and Signature Lipids Down Under. Invited seminar, Agilent Technologies, Wilmington, May.

Nichols, P.D., Gibson, J.A.E., Plumb, J.J., Stott, M.B., Watling, H.R., Franzmann, P.D. (2004) Archaeal hyperthermophilic communities in marine sediments and vents of the Manus Basin and from nearby terrestrial environments: isolation, characterisation, lipid signatures and industrial potential. Australian Marine Scientists Association, Annual Meeting, July, Hobart, Abstracts p89.

A CSIRO team from four Divisions - Minerals, Land and Water, Marine Research and Molecular Science - was established in 2000 to develop new hyperthermophilic organisms for use in mineral processing. The team drew together skills in processing chemistry, microbiology, biochemistry and molecular biology. Initial bioprospecting for hyperthermophilic microorganisms occurred in the Manus Basin, with further material collected from a geothermally-heated gold mine on Lihir Island and from volcanic areas near Rabaul. Signature lipid profiling was used to characterise the hyperthermophilic microorganisms. High concentrations of Archaeal-derived tetraether (TE) lipids, including highly cyclised TE indicative of the family *Sulfolobales*, indicated that hyperthermophilic *Archaea* were present. Novel thermophilic archaeal strains and mixed archaeal cultures, with the ability to oxidise sulfide minerals at temperatures greater than 80^{o}C, were isolated from these samples. Strains were characterised using molecular methods, including signature lipid and 16S rRNA gene sequencing; all strains were phylogenetically related to *Sulfolobus* spp. and contained distinctive cyclised TE lipids. Their physiological requirements and mineral leaching capabilities have also been characterised. Isolates were able to oxidize both Fe^{2+} and sulphur, and grow on both pyrite and chalcopyrite under autotrophic conditions. Leaching experiments showed that the isolates were capable of rapidly leaching a chalcopyrite concentrate (up to 91% Cu release in 108 hour). These unique strains have the ability to oxidise sulfides over a wide temperature range and are potentially suited to leaching applications where temperature fluctuations limit the growth of non-thermophilic bioleaching microorganisms. Based on progress to date, Manus Basin vents and related geothermal environments provide source material containing novel hyperthermophilic microorganisms that have applications in industrial processes, including mineral leaching.

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Franzmann, P.D., Zappia, L., Gibson, J., Nichols, P., Rayner, M, Watling, H., Houchin, M., Binns, R. and Dekker, D. (2002) Isolation and applications of microoraganisms from hydrothermal vents in Bismarck Sea. Australian Organic Geochemistry Conference, Hobart, February, Abstracts, p119.

A new Australian initiative was commenced in 1999 to isolate, characterise and exploit novel microorganisms from collections to be conducted at hydrothermal vents in the Bismarck Sea. Materials were collected at rich sulphide deposits surrounding hydrothermal vents in the Manus Basin and at thermally heated sites at Rabaul and Lihir in May 2000. Vent sampling was from *RV Franklin* using a range of sampling devices. The project aims to co-ordinate activities in microbiology, microbial signature lipid profiling, microbial mineral leaching, genetic manipulation and mineral chemistry. With respect to thermophilic and other microorganisms, activities planned as part of the initiative include:

1. Screening environmental samples for signature fatty acids and ether lipids to determine microbial biomass, community structure and nutritional status;
2. Isolation, identification and characterization of novel thermophiles;
3. Development of enrichments of mineral leaching *Bacteria* and *Archaea* for target minerals.

The scope for possible genetic manipulation of microorganisms may also be examined. These and related activities aim to initiate possible commercial exploitation of mineral leaching microorganisms.

Binns, R. A., Barriga, F. J. A. S., Miller, D. J. et al. (2002). *Proceedings of the Ocean Drilling Program, Initial Reports* Volume **193**. Chapter 3. Site 1188.

No abstract.

Binns, RA, Dekker,D, Franzman, P, and on board participants (2000). Microbes from Hydrothermal Vents: Applications in Mining and Mineral Processing. *RV Franklin Cruise 03/2000 Summary Report "Binatang 2000"*, CSIRO Exploration and Mining 37 pages. (Chapter 8 – Microbiology)

P. D. Franzmann
No abstract.

15.2.2 Other Ventfields

1. Nakagawa, T., Nakagawa, S., Inagaki, F., Takai, K., Horikoshi, K. (2004). Phylogenetic diversity of sulfate-reducing prokaryotes in active deep-sea hydrothermal vent chimney structures. *FEMS Microbiology Letters* **232**(2), 145–152.

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Seven articles that use signature lipids to investigate microbial communities have been published in the past 10 years These are listed below. Those that include information on sediment microbiology are marked with an asterisk (*).

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Halomonas hydrothermalis sp. nov.: halophilic bacteria isolated from deep-sea hydrothermal vent environments. *International Journal of Systematic and Evolutionary Microbiology* **54**(2), 499–511.

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Appendix 1

List of All Operations in the Eastern Manus Basin (excluding hydrocasts)

POSITIONS OF SAMPLING OPERATIONS IN EASTERN MANUS BASIN (AND EAST SHERBURNE, CENTRAL MANUS)

Arranged in order of cruises and operation type (see explanatory notes)

Operation	Detailed Location	Latitude deg	Latitude min	Longitude deg	Longitude min	Decimal Long	Decimal Lat	Depth (m)	Haul Dirn	Nav Precn	Recovery
DREDGES											
Franklin: PACMANUS-I 1991											
MD-1	Marmin Knolls, central	3	42.549	151	34.106	151.56844	3.70914	1625	130	C	Basalt, hyaloclastite, pumice
MD-2	Marmin Knolls, west	3	40.940	151	32.742	151.54570	3.68233	1915	90	B	Basalt, scarce mud, pumice
MD-3	Marmin Knolls, east	3	42.854	151	36.773	151.61289	3.71423	2200	110	D	Basalt, hyaloclastite, ooze
MD-4	Pual Ridge, west flank north of PACMANUS	3	42.451	151	40.335	151.67224	3.70752	1900	120	C	Felsic dacite
MD-5	Yuam Ridge, SW	3	42.371	151	43.945	151.73241	3.70619	2170	120	D	Felsic dacite, andesite, ooze, minor pumice
MD-6	Yuam Ridge, central	3	42.181	151	46.145	151.76908	3.70302	1900	120	D	Rhyodacite, andesite, basaltic andesite, ooze, minor pumice
MD-7	Pual Fork, east of North Pual	3	40.384	151	44.133	151.73555	3.67307	1880	110	C	Andesite, scarce ooze
MD-8	Pual Fork, NE of Sonne on extension of main ridge	3	41.962	151	42.232	151.70387	3.69937	1830	100	C	Andesite, ooze
MD-9	DESMOS	3	41.517	151	51.959	151.86598	3.69196	1950	70	C	Altered and fresh basaltic andesite, sulfur
MD-10	Basin at W foot of NW arm Pual Ridge	3	38.644	151	42.333	151.70555	3.64407	2120	125	C	Ooze
MD-11	Pual Fork, near foot of NW Pual	3	38.925	151	44.023	151.73371	3.64876	2050	105	D	Mafic dacite, ooze
MD-12	Pual Fork	3	40.715	151	42.083	151.70138	3.67859	1872	105	C	Ooze, pumice
MD-13	Pual Fork, 1 km N of North Pual	3	39.727	151	43.647	151.72746	3.66212	1950	120	C	Andesite, minor ooze
MD-14	NW arm Pual Ridge, east foot	3	39.102	151	43.918	151.73196	3.65169	2020	300	D	Mafic dacite, Mn crust and wad, red-brown sediment (veined), ooze
MD-15	PACMANUS, west flank Pual	3	43.292	151	39.960	151.66600	3.72154	1740	135	C	Dacite (mafic and felsic)
MD-16	PACMANUS, west flank Pual	3	43.317	151	39.950	151.66583	3.72195	1720	140	C	Felsic dacite, ooze
MD-17	PACMANUS, NE of Satanic Mills, SE Roman	3	43.427	151	40.536	151.67560	3.72379	1700	235	C	Felsic dacite
MD-18	PACMANUS, NE of Satanic Mills, SE Roman	3	43.412	151	40.551	151.67585	3.72354	1695	230	B	Felsic dacite
MD-19	PACMANUS, NE of Satanic Mills	3	43.497	151	40.471	151.67452	3.72496	1695	235	C	Felsic dacite (Fe-Si crust, stains)
MD-20	PACMANUS, just NE of Snowcap	3	43.602	151	40.281	151.67135	3.72671	1695	240	C	Felsic dacite (some Fe-Mn coats), rare tiny altered dacite, fauna, scarce mud
MD-21	PACMANUS, 200m NE of Rogers Ruins	3	43.076	151	40.531	151.67552	3.71794	1720	220	C	Mafic dacite
MD-22	SW end Pual Ridge	3	45.235	151	38.635	151.64391	3.75391	1965	270	D	Felsic dacite, ooze, rare pumice
MD-23	NE arm Pual Ridge, E flank of small S knoll	3	41.991	151	43.490	151.72484	3.69985	1925	300	D	Rhyodacite, scarce ooze
Franklin: PACMANUS-II 1993											
MD-24	PACMANUS, Snowcap, SE flank	3	43.698	151	40.223	151.67038	3.72830	1653	235	B	Fresh felsic dacite & hyaloclastite (early), altered dacite (some Fe stained) and "Talenga" chimney (late), fauna, ooze
MD-25	PACMANUS, just E of Satanic Mills	3	43.590	151	40.415	151.67358	3.72650	1680	235	C	Rhyodacite; some Fe-coating, bloom, mollusc
MD-26	Twin Knolls, N of PACMANUS	3	42.470	151	39.882	151.66470	3.70783	1880	90	C	Andesite, mud
MD-27	PACMANUS, Snowcap, E side	3	43.675	151	40.214	151.67024	3.72791	1660	45	B	Felsic dacite, dark mud
MD-28	PACMANUS, NE side of Satanic Mills	3	43.540	151	40.415	151.67358	3.72566	1688	235	C	Felsic dacite, sulfide chimney, fauna, ooze
MD-29	NE arm Pual, W side north knoll	3	41.447	151	42.282	151.70471	3.69078	1820	100	C	Andesite, mud
MD-30	PACMANUS, Satanic Mills, NE side	3	43.537	151	40.413	151.67354	3.72562	1690	225	C	Rhyodacite
MD-31	Basement scarp, S of Yuam Ridge	3	46.518	151	45.450	151.75750	3.77530	2150	0	D	Ooze, pumice
MD-32	Basement scarp, S of Yuam Ridge	3	45.013	151	46.643	151.77738	3.75021	2000	315	D	Ooze, pumice
MD-33	Basement ridge, W foot (5th W), far NW EMVZ	3	30.887	151	21.837	151.36396	3.51479	2560	137	D	Ooze, pumice
MD-34	Basement ridge (5th W of Kumul), far NW EMVZ	3	31.085	151	22.290	151.37150	3.51809	2150	145	D	Basalt; mud, semilithified mudstone, pumice
MD-35	PACMANUS, Satanic Mills	3	43.557	151	40.353	151.67254	3.72596	1689	225	C	Rhyodacite (early, Fe stains), late sulfides (including "Fred"; fauna
MD-36	NW base of cone nr E foot of Pual Ridge, E of Sonne	3	42.882	151	42.900	151.71500	3.71470	2000	180	D	Andesite (no ooze)
MD-37	W base of Hammer Handle, scarp N of Pual	3	35.335	151	43.591	151.72652	3.58891	1950	150	D	Ooze
MD-38	Knoll W of Hammer Handle scarp N of Pual Ridge	3	35.887	151	40.887	151.68146	3.59812	2150	135	D	Basalt, indurated mudstone, ooze
MD-39	Knoll, far NE arm Pual Ridge	3	40.537	151	44.737	151.74562	3.67562	1840	135	D	Rhyodacite, ooze, pumice
MD-40	Basement ridge near Djaul Flt, 10nm S of Pual Ridge	3	51.783	151	36.094	151.60157	3.86305	1950	160	C	Basaltic andesite, mud, pumice
MD-41	PACMANUS, Satanic Mills (near 297/1 juvenile vent?	3	43.611	151	40.395	151.67326	3.72685	1680	240	B	Felsic dacite (Fe stain), sulfides, fauna
MD-42	Far SW end of Pual Ridge	3	45.693	151	35.184	151.58640	3.76155	2250	160	C	Mafic dacite, andesite
MD-43	Umbo Knolls, E flank of East Knoll	3	43.240	151	55.808	151.93013	3.72067	1850	270	D	Porphyritic basaltic andesite, basalt hyaloclastite, ooze, pumice
MD-44	NW end, Tumai Ridge	3	43.571	152	2.125	152.03541	3.72619	2050	120	D	Porphyritic basaltic andesite, ooze, pumice
MD-45	Tumai Ridge, centre	3	46.280	152	4.302	152.07170	3.77133	1650	90	D	Ooze, pumice
Franklin: PACMANUS-III 1996											
MD-46	Caldera, East Sherburne	3	44.934	148	52.739	148.87898	3.74890	1819	45	C	Ooze, basalt, pumice
MD-47	Large seamount, East Sherburne	3	42.136	148	55.681	148.92802	3.70227	1777	320	B	Basalt, minor ooze
MD-48	Flat floor, central East Sherburne	3	43.602	149	4.533	149.07555	3.72671	2000	160	C	Ooze, basalt, pumice
MD-49	Small volcanic cone, East Sherburne	3	46.323	149	15.730	149.26217	3.77205	2192	0	B	Basalt, pumice
MD-50	Scarp, far NW of East Manus Basin	3	22.727	151	12.825	151.21374	3.37879	2113	320	C	Pumice, felsic dacite, sedimentary rock, trace mud
MD-51	Dartboard Seamount	3	24.459	151	21.249	151.35414	3.40765	1950	130	C	Basaltic andesite, ooze, pumice
MD-52	Eastern wall, Kumul Trough (Marmin)	3	44.350	151	29.537	151.49229	3.73917	2380	90	B	Olivine basalt, hyaloclastite, brown mud

MD-53	Sonne Pimple, Pual Ridge	3	42.560	151	41.359		151.68932	3.70933	1674	90	A	Andesite, mafic dacite, dk brown mud, fauna. Andesite on top of dredge
MD-54	SuSu Knolls, W slope North Su	3	48.062	152	5.794		152.09657	3.80103	1322	90	A	Fresh porphyritic andesite
MD-55	SuSu Knolls, SW slope South Su	3	49.016	152	5.545		152.09242	3.81693	1660	90	B	Mud, andesite, pumice
MD-56	PACMANUS (Roman Ruins)	3	43.212	151	40.516		151.67526	3.72019	1689	135	A	Mafic dacite (Fe stain), sulfides, ooze
MD-57	PACMANUS (W side Snowcap)	3	43.704	151	40.138		151.66896	3.72840	1655	90	A	Felsic dacite, sulfides, FeOx
MD-58	PACMANUS (Roman Ruins)	3	43.243	151	40.494		151.67490	3.72072	1688	120	A	Sulfides (incl Big Bertha), fauna, trace dacite
MD-59	PACMANUS (Rogers Ruins)	3	43.137	151	40.430		151.67384	3.71895	1701	135	A	Sulfides, FeOMnOx, mafic dacite, ?sulfidic mud
MD-60	PACMANUS (Rogers Ruins)	3	43.132	151	40.442		151.67404	3.71887	1699	135	B	Mafic dacite (early), Fe-MnOx, sulfides (later), ooze
MD-61	PACMANUS (Roman Ruins)	3	43.237	151	40.497		151.67496	3.72062	1694	135	A	Sulfides, fauna, oooze
MD-62	PACMANUS (Satanic Mills)	3	43.615	151	40.320		151.67200	3.72692	1678	130	A	Sulfides, minor fresh and altered rhyodacite, fauna, ooze
MD-63	Basement knoll/scarp, N end Kumul Trough	3	36.496	151	39.903		151.66505	3.60827	2462	135	A	Mud, mudstone
MD-64	NW Marmin Knolls	3	39.183	151	36.190		151.60316	3.65306	2254	135	A	Basalt, pumice, mud, ash layers, sulfides (contamination?
MD-65	PACMANUS (West Snowcap)	3	43.718	151	40.112		151.66854	3.72863	1655	45	A	Felsic dacite (early); pyritic breccia, fauna (late), ooze
MD-66	Knoll on eastern flank of Pual Ridge, E of Roman	3	43.217	151	41.376		151.68960	3.72028	1716	135	A	Mafic dacite, minor mud
MD-67	Basement scarp, W side of Kumul Trough	3	41.113	151	26.093		151.43488	3.68521	2240	310	C	Basalt, sandstone, mudstone, mud, pumice
MD-68	PACMANUS, Satanic Mills	3	43.587	151	40.324		151.67207	3.72646	1681	135	A	Felsic dacite (some Fe-stain)
MD-69	Basement scarp SE of Yuam Ridge	3	46.192	151	45.758		151.76263	3.76986	2090	315	C	Mud, mafic dacite, ash layers, rare pumice
MD-70	Cone in East Valley, S of PACMANUS	3	45.248	151	40.220		151.67034	3.75413	2036	130	B	Basalt, hyaloclastite, scarce mud
MD-71	PACMANUS, Snowcap	3	43.688	151	40.206		151.67010	3.72814	1648	45	B	Felsic dacite (glassy, minor alteration, Fe stain), limpets
MD-72	SuSu Knolls, Cleavage Col	3	48.320	152	6.132		152.10220	3.80533	1412	45	B	Fresh and weakly altered porphyritic dacite, mud
MD-73	Nimab, SW foot	3	49.297	152	10.832		152.18054	3.82162	1320	90	B	Porphyritic basaltic andesite, brown mud, pumice
MD-74	Basement scarp near Weitin Fault/Bugave Ridge	3	44.675	152	10.471		152.17451	3.74459	1756	225	B	Mud, basalt, mudstone?
MD-75	SuSu Knolls, Suzette W flank	3	47.348	152	5.385		152.08975	3.78914	1568	90	A	Andesite, mud, ash layers
MD-76	SuSu Knolls, Suzette	3	47.418	152	5.653		152.09422	3.79030	1516	310	A	Suilfides, sulfidic mud
MD-77	South Su	3	48.515	152	6.238		152.10397	3.80858	1324	225	B	Fresh and altered porphyrtic dacite; sulfide breccias; layered mud
MD-78	SuSu Knolls, col b/n North Su and Suzette	3	47.666	152	5.878		152.09797	3.79443	1460	300	B	Porphyritic dacite, mud
MD-79	Lunar Cone	3	39.710	152	2.534		152.04224	3.66183	1890	90	A	Porph andesite, mud
MD-80	SW Bugave Ridge	3	46.286	152	7.362		152.12270	3.77143	1700	300	B	Andesite, mud
MD-81	SuSu Knolls, Suzette	3	47.277	152	5.587		152.09312	3.78796	1511	145	A	Sulfides; stratified grey and black sulfidic silt
MD-82	SuSu Knolls, S flank of South Su	3	48.640	152	6.319		152.10531	3.81067	1340	310	B	Fresh and altered porph dacite; mud; leyered silty sandstone(?); fauna
MD-83	SuSu Knolls, North Su crest	3	47.972	152	6.068		152.10113	3.79953	1167	135	A	Fresh and slightly altered porph andesite; silt
MD-84	Tavui Caldera (Rabaul)	4	6.502	152	10.720		152.17867	4.10837	918	315	B	Chips dacite and andesite, ooze
Franklin: PACMANUS-IV 1997												
MD-85	Crest of Nimab	3	49.204	152	11.143		152.18572	3.82006	1045	130	B	Fresh and altered porph andesite, minor ooze
MD-86	NW of Suzette	3	47.032	152	5.447		152.09079	3.78387	1584	130	B	Sulfidic silty ooze, fauna, pumice
MD-87	Small volcano S of Nimab	3	53.054	152	11.432		152.19054	3.88423	1520	150	C	Basalt, ooze
MD-88	Crest of Nimab	3	49.185	152	1.222		152.02037	3.81975	1040	125	B	Mud with red and ash layers, pumice
MD-89	Small knoll, NW of SuSu Knolls	3	46.075	152	4.277		152.07128	3.76792	1715	130	C	Ooze, ash layers
MD-90	East Tumbo Knoll	3	45.989	152	0.491		152.00818	3.76649	1733	140	C	Basalt, ooze, pumice
MD-91	SuSu Knolls, crest of South Su	3	48.557	152	6.251		152.10418	3.80929	1326	140	B	Black sulfidic and brown mud
MD-92	SuSu Knolls, crest of South Su	3	48.450	152	6.195		152.10325	3.80751	1335	135	A	Fresh and altered porph dacite, grit, abundant fauna
MD-93	SuSu Knolls, crest of South Su	3	48.417	152	6.622		152.11037	3.80694	1472	140	B	Fresh and altered porph dacite, black sedoment, fauna
MD-94	SuSu Knolls, Suzette	3	47.341	152	5.600		152.09333	3.78901	1524	125	B	Sulfides, sulfidic grit, porphyritic dacite
MD-95	SuSu Knolls, crest of South Su	3	48.550	152	6.269		152.10449	3.80917	1329	140	A	Sulfides, grey mud
MD-96	SuSu Knolls, crest of North Su	3	47.927	152	6.019		152.10032	3.79878	1176	130	A	Fresh and altered porph andesite; sulfides, sulfidic grit
MD-97	SuSu Knolls, crest of North Su	3	47.962	152	6.029		152.10049	3.79936	1168	135	A	Fresh and altered porph andesite, sulfides
MD-98	PACMANUS, 150m NE of Roman Ruins	3	43.183	151	40.558		151.67596	3.71972	1689	140	A	Felsic dacite, trace brown ooze
MD-99	Sonne Pimple, Pual Ridge	3	42.556	151	41.429		151.69048	3.70927	1668	145	A	Andesite (some FeOx coat), brown ooze
MD-100	PACMANUS, S side of Roman Ruins	3	43.261	151	40.496		151.67494	3.72101	1695	125	A	FeOxides, mafic dacite, brown mud
MD-101	Western Marmin Knollls, ridge	3	40.983	151	33.263		151.55438	3.68306	1639	135	A	Basalt, mud, barite chimneylet
MD-102	PACMANUS, Roman Ruins	3	43.239	151	40.474		151.67456	3.72066	1694	140	B	Sulfides
MD-103	PACMANUS, Tsukushi	3	43.781	151	40.002		151.66669	3.72969	1670	130	B	Felsic dacite, FeOxides
MD-104	Ridge near NW end of Weitin Fault	3	33.785	151	55.690		151.92816	3.56309	1897	145	B	Ooze
MD-105	Ridge near NW end of Weitin Fault	3	33.778	151	55.733		151.92888	3.56297	1892	135	A	Basaltic andesite, ooze, ash layer
MD-106	Young lava field NW end of Tumai Ridge	3	43.785	152	5.591		152.09319	3.72974	1946	135	C	Ooze, ash layer (but anchored)
MD-107	Small volcano S of SuSu Knolls	3	52.511	152	3.842		152.06404	3.87518	1680	140	C	Porphyritic basalt, pumice, ooze
MD-108	Small volcano on scarp SW of SuSu Knolls	3	51.334	152	0.332		152.00554	3.85556	1874	135	C	Basalt, sandstone, ooze, pumice
MD-109	Scarp at SW margin Eastern Manus Basin	3	53.645	151	46.372		151.77287	3.89408	2090	140	C	Ooze, pumice, ash layer
MD-110	PACMANUS, 400m W of Tsukushi	3	43.741	151	39.827		151.66379	3.72902	1660	130	A	Fe-MnOx, glassy felsic dacite
MD-111	PACMANUS, 100m N of Tsukushi	3	43.703	151	39.987		151.66644	3.72839	1643	130	B	Glassy felsic dacite
MD-112	PACMANUS, Roman Ruins	3	43.254	151	40.471		151.67452	3.72090	1690	130	A	Sulfides (late), felsic dacite (early in haul), anchored
MD-113	PACMANUS, Rogers Ruins	3	43.154	151	40.440		151.67401	3.71923	1687	145	A	Mafic dacite, sulfides, Fe-MnOx

MD-114	PACMANUS, just W of Tsukushi	3	43.768	151	39.987	151.66646	3.72946	1665	130	A	Felsic dacite
MD-115	Umbo Knolls, west peak	3	43.206	151	53.746	151.89577	3.72009	1562	140	B	Olivine basalt, hyaloclastite, brown mud
MD-116	SuSu Knolls, Crest of North Su	3	47.994	152	6.067	152.10111	3.79991	1173	130	A	Fresh and altered porph andesite-dacite, sulfidic mud
MD-117	SuSu Knolls, Crest of North Su	3	47.963	152	6.029	152.10048	3.79939	1175	135	B	Altered porph andesite-dacite, sulfur
Franklin: BINATANG 2000											
MD-120	SuSu Knolls, Crest of North Su	3	47.956	152	6.030	152.10050	3.79927	1161	160	A	Fresh and altered porph andesite-dacite
MD-121	SuSu Knolls, Suzette	3	43.363	152	5.600	152.09333	3.72272	1514	135	A	Sulfides, gritty sediment, snails
MD-122	SuSu Knolls, crest of North Su	3	48.565	152	6.248	152.10413	3.80942	1319	140	B	Sulfidic grit, altered andesite-dacite, ash layer, bivalve
MD-123	SuSu Knolls, Suzette	3	47.330	152	5.587	152.09312	3.78883	1513	130	A	Sulfides, sulfidic silt
MD-124	PACMANUS, Snowcap (NW side)	3	43.670	151	40.151	151.66918	3.72784	1645	140	A	Py-enargite breccias and altered dacite (early); fresh felsic dacite (late)
MD-125	PACMANUS, Snowcap (NW side)	3	43.682	151	40.144	151.66906	3.72804	1642	130	A	Glassy felsic dacite, sulfur flow
MD-126	PACMANUS, Roman Ruins	3	43.251	151	40.515	151.67526	3.72085	1690	220	B	Mafic dacite, sulfides, FeOx
MD-127	PACMANUS. Roman Ruins	3	43.215	151	40.492	151.67486	3.72025	1688	135	A	Sulfides, fauna
MD-128	PACMANUS, Rogers Ruins	3	43.147	151	40.427	151.67379	3.71912	1698	90	B	Glassy mafic dacite with Fe-stains
MD-129	PACMANUS, NE side of Rogers Ruins	3	43.107	151	40.480	151.67467	3.71845	1695	140	B	Mafic and felsic dacite
MD-130	PACMANUS, 100m E of Roman Ruins	3	43.255	151	40.570	151.67617	3.72092	1695	130	C	Glassy mafic dacite, tube pumice
MD-131	PACMANUS, Roman Ruins	3	43.222	151	40.510	151.67517	3.72037	1695	140	B	Sulfides, FeOx, minor fresh and altered mafic dacite
MD-132	PACMANUS, SE side of Rogers Ruins	3	43.152	151	40.483	151.67472	3.71921	1690	135	C	Mafic dacite, Fe stain
MD-133	PACMANUS, Roman Ruins	3	43.239	151	40.488	151.67479	3.72064	1691	135	A	Bikpela chimney, minor mafic dacite, fauna
MD-134	SuSu Knolls, Suzette	3	47.374	152	5.661	152.09434	3.78957	1514	270	A	Sulfidic grit, pieces chimney, fauna
MD-135	PACMANUS, Roman Ruins	3	43.242	151	40.521	151.67535	3.72071	1684	220	B	Sulfides
MD-136	PACMANUS, N side of Rogers Ruins	3	43.114	151	40.472	151.67453	3.71857	1705	270	B	Felsic dacite (bloom)
MD-137	PACMANUS, W side of Satanic Mills	3	43.586	151	40.316	151.67194	3.72644	1670	225	B	Rhyodacite, tubeworms
MD-138	PACMANUS, Satanic Mills	3	43.599	151	40.349	151.67248	3.72665	1683	240	A	Felsic dacite, sulfides, fauna
MD-139	PACMANUS, Satanic Mills	3	43.592	151	40.348	151.67246	3.72654	1680	220	A	Sulfides, rhyodacite, H2S
MD-140	PACMANUS, Rogers Ruins	3	43.141	151	40.465	151.67441	3.71901	1701	225	A	Fe-MnOx, minor mafic dacite
MD-141	NE Arm, Pual Ridge, col S of northern crest	3	41.048	151	44.602	151.74337	3.68413	1870	10	B	Rhyodacite, hyaloclastite, ooze, bivalve
MD-142	NE Arm, Pual Ridge, far north knoll	3	40.018	151	45.157	151.75261	3.66696	1803	5	A	Andesite, ooze
MD-143	PACMANUS, Tsukushi	3	43.778	151	40.026	151.66709	3.72963	1662	225	B	Dacites (Fe stain), sulfides, Fe-crusted snails
MD-144	PACMANUS,Tsukushi	3	43.765	151	40.023	151.66705	3.72941	1668	225	A	Mafic and felsic dacites (Fe stain), sulfides
MD-145	SuSu Knolls, Suzette	3	47.347	152	5.658	152.09429	3.78912	1516			Aborted
MD-146	NW Pual Ridge, knoll at SW end of crest	3	40.397	151	41.923	151.69872	3.67329	1726	225	A	Fresh and silicified, flowbanded rhyodacite, ooze
MD-147	Kumul Trough (central ridge)	3	41.499	151	27.877	151.46461	3.69164	2600	225	B	Pillow basaltic andesite, minor ooze
Franklin: BISMARCK 2002											
BD-20	PACMANUS, Satanic Mills	3	43.600	151	40.371	151.67284	3.72666	1683	135	C	Dacite (Fe stain)
BD-21	PACMANUS, Satanic Mills	3	43.593	151	40.347	151.67245	3.72656	1679	230	A	Rhyodacite, fauna
BD-22	PACMANUS, Satanic Mills	3	43.610	151	40.343	151.67238	3.72683	1678	225	A	Felsic dacites, sulfides
BD-23	PACMANUS, Roman Ruins	3	43.252	151	40.499	151.67499	3.72087	1690	220	A	Rhyodacite (Fe stain), sulfides
BD-24	PACMANUS, Roman Ruins	3	43.255	151	40.502	151.67504	3.72092	1692	220	A	Mafic dacites (Fe stain), sulfides
BD-25	Knoll in Middle Valley	3	44.379	151	41.652	151.69419	3.73966	1995	225	B	No recovery
Sonne: EDISON 1994											
86/DR	Lower scarp to NE of Pual Ridge	3	36.778	151	49.605	151.82675	3.61297	2130	310	B	Andesite, ooze
87DR	Upper scarp to NE of Pual Ridge	3	36.702	151	47.312	151.78854	3.61169	1970	330	B	Rhyodacite, ooze
88/DR	Far N of NE Pual Ridge, east flank	3	39.936	151	46.520	151.77534	3.66560	2120	300	C	Rhyodacite, ooze
98/DR	PACMANUS, 300m NE of Satanic towards Roman	3	43.512	151	40.473	151.67455	3.72520	1690	0	B	Felsic dacite
100/DR	DESMOS	3	41.509	151	52.008	151.86680	3.69182	1900	45	D	Basaltic andesite
Onnuri: KODOS 1999											
HDg-1	PACMANUS, Roman Ruins, NW side	3	43.220	151	40.467	151.67445	3.72033	1678	225	X	Mafic dacite, Fe crusts, small sp fragment
HDg-1-2	PACMANUS, Roman Ruins, NW side	3	43.214	151	40.467	151.67445	3.72023	1690	160	X	Rhyodacite, sulfide fragments
HDg-1-3	PACMANUS, Roman Ruins, ESE side	3	43.258	151	40.548	151.67580	3.72097	1681	100	X	Rhyodacite, large chimney
HDg-2	PACMANUS, 250m S of Satanic Mills	3	43.725	151	40.371	151.67285	3.72875	1698	160	X	Rhyodacite
HDg-3	PACMANUS, 150 m N of Tsukushi	3	43.713	151	39.990	151.66650	3.72855	1633	45	X	Felsic dacite
HDg-4	East foot Pual Ridge, abeam Roman	3	44.150	151	41.149	151.68582	3.73583	1994	330	X	Basaltic andesite
HDg-5	PACMANUS, Roman Ruins	3	43.232	151	40.504	151.67507	3.72053	1684	70	X	Dacite (Mn coat), rare sulfides
HDg-6	DESMOS	3	42.013	151	52.017	151.86695	3.70022	2038	0	X	Basaltic andesite
HDg-7	NE Arm, Pual Ridge, col S of northern crest	3	40.656	151	44.501	151.74168	3.67760	1813	40	X	Rhyodacite
HDg-8	SuSu Knolls; Suzette	3	47.202	152	5.626	152.09377	3.78670	1506	135	X	Porphyritic mafic dacite, sulfide chimney
Hakuho Maru: AQUARIUS 1990											
AQ-31	Bugave Ridge, west flank	3	44.710	152	8.210	152.13683	3.74517	1841	35	X	Basaltic andesite pillows, brown mud, pumice
AQ-32	Bugave Ridge, crest	3	44.790	152	8.800	152.14667	3.74650	1763	30	X	Mafic dacite (plag phx), brown mud
AQ-35A	North Su, west flank	3	48.280	152	5.530	152.09217	3.80467	1655	80	X	Porphyritic mafic dacite, mud
AQ-39B	DESMOS, N end caldera	3	41.430	151	51.920	151.86533	3.69050	1899	5	X	Altered basaltic andesite with pyrite & sulfur

AQ-39C	DESMOS, N end, inner caldera	3	41.540	151	51.990	151.86650	3.69233	1961	350	X	Altered basaltic andesite with pyrite & sulfur
AQ-42	Eastern Yuam Ridge	3	40.590	151	49.090	151.81817	3.67650	2021	115	X	Felsic dacite (ropy and compact), mud
AQ-43	Elongate trough NE of DESMOS	3	40.220	151	56.100	151.93500	3.67033	2165	265	X	Basaltic andesite (Fe coat), mud
AQ-48A	DESMOS, N end caldera	3	41.540	151	52.010	151.86683	3.69233	1963	305	X	Basaltic andesite, fauna
AQ-48B	Cresent ridge on N side of DESMOS	3	41.120	151	52.020	151.86700	3.68533	1859	350	X	Basaltic andesite
AQ-48C	DESMOS, N end, inner caldera	3	41.610	151	52.090	151.86817	3.69350	1980	330	X	Fresh and altered basaltic andesite
AQ-51	Kumul Ridge	3	41.990	151	27.900	151.46500	3.69983	2598	35	X	Pillow basaltic andesite, mud
Moana Wave: MW8518 1987											
RD-14	Bugave Ridge, crest?	3	42.880	152	10.405	152.17342	3.71467	1850	120	X	Basaltic andesite and mafic dacite; pumice, mud
RD-15	Tumbo, west slope	3	46.710	151	58.600	151.97667	3.77850	1850	90	X	Basaltic andesite (porphyritic), mud
RD-16	DESMOS, east wall	3	42.105	151	52.440	151.87400	3.70175	2025	90	X	Fresh and part-altered basaltic andesite
RD-17	Southern Pual Ridge, west flank	3	44.435	151	38.800	151.64667	3.74058	1775	100	X	Mafic and felsic dacites
RD-18	Kumul Ridge, east flank	3	42.310	151	27.840	151.46400	3.70517	2660	270	X	Plag-phyric pillow basalt and basaltic andesite

GRABS

Franklin: PACMANUS-II 1993											
MG-1	PACMANUS, 200m N of Snowcap	3	43.590	151	40.196	151.66993	3.72650	1688		B	No recovery
MG-2	PACMANUS, NE side of Snowcap	3	43.640	151	40.215	151.67025	3.72733	1668		C	Mn encrusted rhyodacite tube pumice, mud
MG-3	PACMANUS, Roman Ruins	3	43.246	151	40.508	151.67513	3.72077	1685		D	Glassy (frothy) felsic dacite (pumice surfaces?) chips
MG-4	PACMANUS, 400m WSW of Roman, towards Satanic	3	43.298	151	40.300	151.67167	3.72163	1679		C	Microlitic and frothy glassy felsic dacite chips (pumice surfaces?), trace mud
MG-5	PACMANUS, 300 m N of Tsukushi	3	43.597	151	40.007	151.66678	3.72662	1653		C	Glassy felsic dacite, rhyodacite tube pumice
MG-6	PACMANUS, 200m SE of Tsukushi	3	43.860	151	40.117	151.66862	3.73100	1665		D	Mafic dacite tube pumice, mollusc, mud
MG-7	PACMANUS, 150m SSW of Snowcap	3	43.774	151	40.161	151.66935	3.72957	1660		D	Felsic dacite glass and tube pumice chips, mud
MG-8	Saddle 3km ENE of Sonne Pimple	3	42.115	151	42.482	151.70803	3.70192	1865		C	Andesite
MG-9	Saddle 3 km ENE of Sonne Pimple	3	42.186	151	42.479	151.70798	3.70310	1863		C	No recovery
MG-10	Enclosed basin near Twin Knolls	3	42.048	151	40.452	151.67420	3.70080	1939		C	Dark brown ooze with andesite (1 cm), some pumice
MG-11	Crest of main knoll NE of PACMANUS	3	42.898	151	41.190	151.68650	3.71497	1674		C	No recovery
MG-11R	Crest of main knoll NE of PACMANUS	3	42.906	151	41.112	151.68520	3.71510	1669		B	Mafic dacite, some pumice, minor oze
MG-12	S end of Pual fork	3	41.228	151	41.815	151.69692	3.68713	1868		B	Variable brown ooze, andesite chips
MG-13	Head of West Valley, SW of Twin Knolls	3	42.788	151	39.180	151.65300	3.71313	2215		C	Colour-banded mud, glass chips
Franklin: PACMANUS-III 1996											
MG-14	PACMANUS, 200m SE of Snowcap	3	43.749	151	40.289	151.67148	3.72915	1688		C	Rhyodacite in jaws, Mn coating
MG-15	PACMANUS, east side of Snowcap	3	43.666	151	40.256	151.67093	3.72777	1653		B	Brown mud, Fe-MnOx and dacite pumice chips, fauna
MG-16	PACMANUS. Snowcap	3	43.695	151	40.205	151.67008	3.72825	1652		C	Fresh and altered rhyodacite in surficial brown mud, mostly rocks deeper.; fauna and bacterial mat
MG-17	PACMANUS, Roman Ruins	3	43.243	151	40.510	151.67517	3.72072	1694		A	Sulfide chimney fragments, sulfidic mud
MG-18	PACMANUS. 200 m E of Snowcap, 150m S of Satani	3	43.699	151	40.310	151.67183	3.72832	1660		C	Dacite tube pumice fragments in brown mud
MG-19	South Su crest	3	48.520	152	6.260	152.10433	3.80867	1319		A	Altered sulfidic and some fresh porphyritic dacite
MG-20	Suzette	3	47.400	152	5.662	152.09437	3.79000	1523		A	Dark green silty sediment
MG-21	North Su crest	3	48.018	152	5.970	152.09950	3.80030	1183		A	No recovery
MG-21R	North Su crest	3	48.014	152	5.970	152.09950	3.80023	1183		A	Dark green sand
MG-22	S foot of South Su, - under eye of plume	3	49.300	152	6.150	152.10250	3.82167	1647		A	1 cm black sulfidic mud over 4 cm grey mud over 5cm brown mud
Franklin: PACMANUS-IV 1997											
MG-23	Base of SE face of Nimab Knoll	3	48.744	152	12.617	152.21028	3.81240	1778		D	8cm brown mud overlying 15cm olive mud.
MG-24	Suzette	3	47.365	152	5.643	152.09405	3.78942	1521		A	Grey sand overlying brown mud
MG-25	Suzette	3	47.260	152	5.680	152.09467	3.78767	1514		C	No recovery
MG-25R	Suzette	3	47.119	152	5.658	152.09430	3.78532	1520		B	Sulfide chimney fragments
MG-26	Suzette	3	47.372	152	5.848	152.09747	3.78953	1530		A	2 cm black mud overlying 6 cm pale grey mud, with porphyritic mafic dacite fragments at base
MG-27	East of Suzette	3	47.386	152	6.050	152.10083	3.78977	1599		B	Massive dark grey to black sand
MG-28	Ridge ENE of Suzette	3	46.885	152	6.483	152.10805	3.78142	1683		C	Grey mud with dark streaks and some sand
MG-29	Enclosed basin E of SuSu Knolls	3	49.013	152	8.236	152.13727	3.81688	1737		A	Massive black gritty silt, H2S, pumice resting on top
MG-30	East foot of North Su, under plume	3	47.836	152	6.523	152.10872	3.79727	1535		D	Graded black volcanic sand and gravel
MG-31	East of SuSu Knolls	3	48.450	152	7.130	152.11883	3.80750	1661		C	Stratified sand and granule gravel, porph dacite fragments
MG-32	PACMANUS, 300m W of Tsukushi, near 297/4	3	43.757	151	39.878	151.66463	3.72928	1664		C	FeMn oxide, some spire-like
MG-33	PACMANUS, between Snowcap & Tsukushi	3	43.750	151	40.100	151.66833	3.72917	1657		C	No recovery
MG-33R	PACMANUS, between Snowcap & Tsukushi	3	43.720	151	40.090	151.66817	3.72867	1664		C	No recovery
MG-33RR	PACMANUS, between Snowcap & Tsukushi	3	43.750	151	40.110	151.66850	3.72917	1657		C	No recovery
MG-34	PACMANUS, between Snowcap & Tsukushi	3	43.740	151	40.095	151.66825	3.72900	1667		B	5 cm red-brown ooze overlying ropy lava top (dacite?)
MG-34R	PACMANUS, between Snowcap & Tsukushi	3	43.719	151	40.108	151.66847	3.72865	1658		B	Mn oxide crusts
MG-35	PACMANUS, 250m W of Tsukushi, near 297/4	3	43.780	151	39.880	151.66467	3.72967	1667		C	No recovery
Franklin: BINATANG 2000											
MG-36	North Su crest	3	48.057	152	6.093	152.10155	3.80095	1200		B	Sulfidic grit, sulfur, H2S? Smell
MG-37	East of Suzette 800m	3	47.100	152	6.062	152.10103	3.78500	1649		C	Layered sediment, 1.5cm khaki ooze over 2.5cm laminated black silt over 5 cm massive grey silt

MG-38	North Su crest	3	47.991	152	6.062	152.10103	3.79985	1166	C	Sulfidic grit with cm fragments altered dacite/pyrite breccia, white sulfur surface
MG-39	West Su Basin	3	47.995	152	2.982	152.04970	3.79992	2080	C	Layered sediment; 15mm khaki over 3 cm layered grey/black silt over 7cm layered khaki
MG-40	West Su Basin	3	47.501	152	2.500	152.04167	3.79168	2092	B	Layered sediment; 22 mm khaki over laminayed gre/black silt
MG-41	West Su Basin	3	46.997	152	3.001	152.05002	3.78328	2070	B	Layered sediment; 4.5cm graded khaki over 2.5cm gre/black sulfidic silt
MG-42	West Su Basin	3	46.975	152	1.993	152.03322	3.78292	2087	B	Layered sediment; 20mm khaki over 5mm black over 65mm layered brown/khaki
MG-43	West Su Basin	3	48.247	152	2.266	152.03777	3.80412	2092	C	Layered sediment; 2cm brown over 5 cm layered black/grey
MG-44	West Su Basin	3	47.501	152	1.489	152.02482	3.79168	2079	B	Layered khaki sediment with thin black layer at 16-18mm
MG-45	West Su Basin	3	46.998	152	1.979	152.03298	3.78330	2050	B	Layered khaki sediment with grey/black layer at 15-35mm
MG-46	West Su Basin	3	48.007	152	0.996	152.01660	3.80012	2068	B	Layered khaki/grey ooze with black layers at 10 and 75 mm
MG-47	West Su Basin	3	48.503	152	1.508	152.02513	3.80838	2088	B	Layered khaki mud with numerous thin black layers
MG-48	North Su crest	3	48.018	152	6.100	152.10167	3.80030	1199	A	Fresh and altered porph andesite-dacite, sulfur
MG-49	PACMANUS, Snowcap	3	43.680	151	40.176	151.66960	3.72800	1643	A	Gravel; altered and sulfidic dacite; tubeworms; H2S
MG-50	PACMANUS, Snowcap, west side	3	43.688	151	40.159	151.66932	3.72813	1644	A	Glassy felsic dacite, brown ooze
MG-51	PACMANUS, S sideTsukushi	3	43.806	151	40.026	151.66710	3.73010	1666	A	Brown ooze, tiny black and white rock chips including felsic dacite
MG-52	PACMANUS, Tsukushi	3	43.775	151	40.034	151.66723	3.72958	1665	A	MnOx encrusted snails; brown ooze
MG-53	PACMANUS, Snowcap, E side	3	43.680	151	40.220	151.67033	3.72800	1645	B	Glassy rhyodacite, brown ooze; tubeworm
MG-54	PACMANUS, Tsukushi	3	43.758	151	40.036	151.66727	3.72930	1662	B	No recovery
MG-55	PACMANUS, Tsukushi	3	43.785	151	40.030	151.66717	3.72975	1657	A	Sulfides, MnOx
MG-56	West Su Basin	3	47.501	152	3.545	152.05908	3.79168	2059	B	Layered sediment: 2 cm black volcaniclastic sand over 9 cm khaki ooze
MG-57	West Su Basin	3	48.010	152	2.000	152.03333	3.80017	2089	B	Laminated khaki ooze, black layer and volcaniclastic layer
MG-58	West Su Basin	3	48.523	152	0.505	152.00842	3.80872	2059	B	Laminated khaki ooze with volcaniclastic layer at 15mm
MG-59	West Su Basin	3	47.512	152	0.501	152.00835	3.79187	2034	B	Laminated khaki ooze, thin black and volcaniclastic layers
MG-60	West Su Basin	3	47.900	151	58.854	151.98090	3.79833	1877	A	Khaki ooze, no dark layers
MG-61	West Su Basin	3	49.702	152	0.503	152.00838	3.82837	2036	A	Laminated khaki ooze, no black layers

Franklin: BISMARCK 2002

BG-31	Knoll on flank of Pual, E of Roman	3	43.205	151	41.444	151.69073	3.72008	1739	A	Andesite, ooze
BG-32	Knoll on flank of Pual, NE of Sonne	3	42.525	151	42.360	151.70600	3.70875	1772	A	Andesite
BG-33	NE Arm Pual, southern crestal knoll	3	41.923	151	43.000	151.71667	3.69872	1770	B	No recovery
BG-34	East Valley knoll	3	44.433	151	41.577	151.69295	3.74055	1980	C	No recovery
BG-35	Knoll near head of Pual Fork, 4 km NE of Sonne	3	41.602	151	42.799	151.71332	3.69337	1848	B	Andesite

Sonne: EDISON 1994

83-GTV	PACMANUS, N side of Snowcap	3	43.655	151	40.183	151.66972	3.72758	1670	B	Altered dacite hyaloclastite (rhyodacite kernels), some Fe-Mn stained; fauna
84-GTV	PACMANUS, SE side of Satanic Mills (juvenile vent?)	3	43.636	151	40.376	151.67293	3.72727	1710	B	Felsic dacite (bloom), fauna, minor ooze
85-GTV	PACMANUS, 200m SE of Satanic Mills, near Marker	3	43.664	151	40.410	151.67350	3.72773	1718	C	No sample (attempted chimney with fauna)
89-GTV	PACMANUS, S side of Satanic Mills	3	43.628	151	40.344	151.67240	3.72713	1700	B	Rhyodacite (Mn crusts), abundant fauna at site
90-GTV	PACMANUS, NE side ofTsukushi	3	43.739	151	40.050	151.66750	3.72898	1663	B	Mn-Fe oxides (cauliflower mound), felsic dacite, minor ooze
91-GTV	PACMANUS, Roman Ruins (100m S?)	3	43.315	151	40.517	151.67528	3.72192	1700	C	No sample (FeOx spire disintegrated)
95-GTV	PACMANUS, Roman Ruins	3	43.263	151	40.494	151.67489	3.72104	1698	C	FeOxides, consolidated brown ooze, mafic dacite, brown ooze (from next to chimney with fauna)

Sonne: CONDRILL, 2004

54-GTV	PACMANUS, Satanic Mills	3	43.634	151	40.294	151.67157	3.72723	1694	A	Sulfide chimney fragment
58-GTV	PACMANUS, Satanic Mills	3	43.618	151	40.311	151.67185	3.72697	1682	B	Sulfides
59-GTV	PACMANUS, Satanic Mills	3	43.618	151	40.303	151.67172	3.72697	1681	B	1m sulfide chimney
70 GTV	PACMANUS, Roman Ruins	3	43.210	151	40.470	151.67450	3.72017	1678	B	Sulfide-coated fresh dacite over altered dacite-sulfide breccia

SEDIMENT CORES

Franklin: PACMANUS-I 1991

MS-1	Marmin Knolls, enclosed basin	3	41.170	151	36.045	151.60075	3.68617	2265	D	22 cm; banded brown-green clays
MS-2	Kumul Trough	3	42.893	151	26.097	151.43496	3.71489	2724	C	44 cm; Banded green-brown clay
MS-3	Graben NW of Kumul	3	31.137	151	36.812	151.61354	3.51895	2450	C	73 cm; Banded brown to olive clay
MS-4	East Valley, enclosed basin	3	41.619	151	44.731	151.74552	3.69365	2206	D	46 cm; Banded clay
MS-5	Enclosed basin between W Pual and Hammer Ridges	3	38.571	151	42.317	151.70529	3.64285	2110	D	112 cm; banded brown and olive clays
MS-6	Shallow enclosed basin S of Pual Ridge	3	46.475	151	38.654	151.64424	3.77459	2205	D	98 cm; turbidites
MS-7	Sth of DESMOS	3	51.002	151	49.901	151.83169	3.85003	2098	C	No recovery
MS-8	Sth of DESMOS	3	50.951	151	49.366	151.82276	3.84919	2109	C	15.5 cm; banded clay and fine sand

Franklin: PACMANUS-II 1993

MS-9	East Valley, E of PACMANUS	3	43.713	151	42.584	151.70974	3.72854	2127	C	55 cm; silty mud with dark brown bands and several hyaloclastite (andesite) layers
MS-10	East Valley, S of PACMANUS	3	44.994	151	40.981	151.68302	3.74990	2120	C	Disturbed mud with some hyaloclasts (original penetration 39cm?)
MS-11	Shallow enclosed basin S of Marmin Knolls	3	43.750	151	35.972	151.59954	3.72917	2389	C	No recovery, possibly hit rock
MS-12	Shallow enclosed basin S of Marmin Knolls	3	43.818	151	35.982	151.59970	3.73031	2388	C	Trace of silt and basalt hyaloclastite
MS-13	Saddle in Pual Fork, 400m S of North Pual	3	40.780	151	43.642	151.72737	3.67967	1905	B	8 cm; andesite hyaloclastite, minor mud
MS-14	East Valley	3	40.587	151	45.944	151.76574	3.67644	2150	C	27 cm; banded silty mud
MS-15	Basin NE of Pual fork	3	38.030	151	45.243	151.75405	3.63383	2087	C	53 cm; colour banded mud, hyaloclastite layers at 33 and 48 cm

MS-16	East Valley	3	41.381	151	45.369	151.75615	3.68969	2193	C	123 cm; colour banded mud, thick dacite hyaloclastite at 71-112cm
MS-17	Sth of Yuam Ridge	3	46.244	151	46.949	151.78249	3.77073	2170	C	83 cm; ash layer at 64 cm
MS-18	NE end Kumul Trough	3	37.962	151	33.472	151.55787	3.63270	2612	B	86 cm; banded mud; dacite ash layers at 39.5 and 55.5 cm
MS-19	NE of Marmin Knolls	3	38.736	151	39.078	151.65130	3.64560	2405	C	83.5 cm; banded silty mud, ash layers at 38cm and 56 cm (latter with pumice pebble)
MS-20	East Valley	3	42.701	151	43.818	151.73030	3.71168	2150	D	32 cm; colour banded mud
MS-21	Valley W of Pual Ridge - WSW of PACMANUS	3	44.210	151	37.512	151.62520	3.73683	2349	D	Corer lost
Franklin: PACMANUS-III 1996										
MS-22	N Kumul Trough	3	36.050	151	28.949	151.48249	3.60083	2449	C	101 cm; turbidites (pumice gravel at bases)
MS-23	PACMANUS, Snowcap	3	43.676	151	40.189	151.66981	3.72794	1647	C	Mussel, chips rhyodacite and felsic dacite
MS-24	PACMANUS, Snowcap	3	43.700	151	40.208	151.67013	3.72833	1650	B	Chips glassy felsic dacite
MS-25	Proposed EMB-5A site (ODP), Central basin	3	47.820	151	46.169	151.76948	3.79700	2169	C	84 cm; turbidites, ash layer at 62 cm
MS-26	Enclosed basin NE N Su, in SE Bugave trough	3	46.877	152	7.135	152.11892	3.78128	1780	C	Dark green-grey sed; chips (sand?) porpyritic dacite
MS-27	Proposed EMB-5C site (ODP), Central basin	3	49.140	151	44.076	151.73460	3.81900	2158	C	57 cm; turbidites; ash layer at 49 cm
MS-28	PACMANUS, Snowcap	3	43.680	151	40.191	151.66985	3.72801	1648	A	No recovery
MS-29	PACMANUS, Snowcap	3	43.681	151	40.193	151.66989	3.72802	1649	A	Chips rhyodacite
MS-30	Basin NE of PACMANUS	3	37.698	151	46.975	151.78292	3.62830	2113	A	85 cm; turbidites, ash layers at 66 cm (pumice), 79 cm (rhyodacite)
MS-31	Basin NE of PACMANUS	3	38.998	151	48.976	151.81627	3.64997	2182	A	140 cm; thick turbidite, no ash layers
MS-32	Basin NE of PACMANUS	3	37.473	151	49.988	151.83314	3.62454	2175	A	113 cm; thick turbidite
MS-33	Enclosed basin in SE Bugave trough	3	45.793	152	8.212	152.13686	3.76322	1904	A	~13 cm grey sand, SuSu derived?
MS-34	Basin north of Tumai Ridge	3	40.495	152	5.958	152.09930	3.67492	2118	C	25 cm; sloppy dk brown mud over stiff clay
MS-35	Under South Su plume	3	48.773	152	4.373	152.07288	3.81288	1905	B	Minor olive-grey sandy mud
MS-36	Suzette	3	47.274	152	5.574	152.09290	3.78789	1515	A	75 cm; bedded sulfidic sand; possible chimney fragments, possible ash blebs
MS-37	East Bugave nodal basin	3	43.696	152	10.968	152.18279	3.72827	2098	A	42 cm; two turbidite units, no ash layers
MS-38	Under SE fringe of SuSu plume	3	51.296	152	8.182	152.13637	3.85493	1709	A	3 cm; mud
MS-39	Tavui Caldera	4	7.506	152	11.981	152.19969	4.12509	1089	A	152cm (24 cm gap and 20cm redeposited top, so 110 cm); sandy muds and muddy sand; no ash layers
Franklin: PACMANUS-IV 1997										
MS-40	Suzette, SuSu Knolls	3	47.346	152	5.679	152.09464	3.78911	1518	C	Trace dark grey to black grit in cone
MS-41	Under Nimab Plume	3	49.563	152	12.405	152.20675	3.82605	1775	C	47.5 cm; turbidites with ash layers at 32 and 45 cm (latter with pumice pebbles at base
MS-42	Suzette, SuSu Knolls	3	47.396	152	5.722	152.09536	3.78994	1528	C	27 cm; disturbed sulfidic sand
MS-43	West Su Basin	3	48.135	152	1.941	152.03235	3.80224	2093	C	31.5 cm; laminated sediment with black streaks; ash layer at 20.5-27 cm
MS-44	Enclosed basin E of SuSu Knolls	3	48.976	152	8.227	152.13712	3.81626	1738	B	Trace dark grey sulfidic sand (possible 35 cm penetration)
MS-45	Enclosed basin E of SuSu Knolls	3	48.971	152	8.283	152.13805	3.81619	1735	C	Trace dark grey sand (possibly deep penetration)
MS-46	Enclosed basin, SW Marmin Knolls	3	43.585	151	30.191	151.50319	3.72641	2523	C	84 cm; colour-banded mud; ash layers (basalt, dacite, rhyodacite)
MS-47	Shallow enclosed basin, NE along stike from NW Pua	3	36.287	151	46.391	151.77319	3.60478	2005	B	106 cm; turbidite with dacite and rhyodacite ash layers
MS-48	Large basin NE of Pual	3	33.974	151	48.974	151.81624	3.56623	2008	B	35 cm; turbidite with ash layers
MS-49	Basin N of Tumai Ridge	3	39.954	152	5.462	152.09103	3.66591	2121	C	45.5 cm; turbidite with ash layer at 45 cm
Franklin: BINATANG 2000										
MS-50	St Georges Channel	5	15.015	152	23.489	152.39149	5.25026	3496	C	31 cm; khaki over grey, with thin organic layers
MS-51	North Su crest	3	47.996	152	6.066	152.10110	3.79994	1172	A	Fragments fresh and altered andesite-dacite, sulfur
MS-52	Central basin, S of Umbo	3	51.970	151	50.539	151.84231	3.86616	2075	C	19cm;Layered ooze, ash layer at 31 cm
MS-53	East Umbo Basin	3	43.709	151	56.997	151.94996	3.72848	2158	B	48.5 cm; layered ooze, dark red-bn and hyaloclastic layers; ash layer at 30 cm
MS-54	West Su Basin	3	48.422	152	3.981	152.06636	3.80703	2077	B	67 cm; Layered sediment; 1.7 cm volcaniclastic sediment over layered khaki ooze; ash layer at 57-62 cm
MS-55	West Su Basin	3	47.998	151	57.723	151.96205	3.79997	2073	A	80.5 cm; Laminated khaki ooze, some red & black layers; ash layers at 45cm (pumice pebbles) and 71cm
MS-56	Far west of eastern Manus Basin	3	26.411	151	9.906	151.16509	3.44019	2450	B	89 cm; turbidites, no ash layers
MS-57	Far west of eastern Manus Basin	3	28.016	151	16.706	151.27844	3.46693	2527	B	17 cm; turbidites
Sonne: EDISON 1994										
94-GKG	East Valley (box core)	3	41.500	151	44.660	151.74433	3.69167	2201	B	71 cm; Brown mud with several dark layers; ash layers at 23-24 and 73 cm
96-SLS	East Valley	3	41.490	151	44.650	151.74417	3.69150	2200	B	Bottomed on rocks (andesite, dacite) at 3.5m; sediment section lost
97SL	East Valley	3	41.530	151	44.550	151.74250	3.69217	2205	B	Bottomed (shallow?) on andesite, sediment section lost
Onnuri: KODOS 1999										
HMC-1	Just east of Yuam Ridge	3	43.3	151	49.2	151.82000	3.72167	2190	X	Multicorer: four cores to 30 cm of sloppy brown ooze
HMC-2	East Valley	3	43.6	151	42.3	151.70500	3.72667	2120	X	Multicorer: seven cores to 10-25 cm of brown ooze
HPC-1	East Valley	3	43.7	151	42.2	151.70333	3.72833	2150	X	Piston core. 3m of brown ooze with hyaloclastite layers
HPC-2	DESMOS cldera floor	3	41.7	151	52.3	151.87167	3.69500	2080	X	Piston core. 20 cm basalt gravel
HPC-3	East Valley	3	40.5	151	46.2	151.77000	3.67500	2155	X	Piston core. 1 m disturbed ooze over rocks in nosecone
Akad. Keldysh: 21st Cruise 1990										
K2241	Marmin Knolls, enclosed basin	3	41.5	151	36.2	151.60333	3.69167		X	Core and grab
K2244	NE Crestal Knoll, Pual Ridge	3	41.2	151	42.8	151.71333	3.68667		X	Core and grab
K2246	Djual Fault scarp	3	46.4	151	28.7	151.47833	3.77333		X	Core and grab
K2248	West Kumul fault scarp	3	39.4	151	28.4	151.47333	3.65667		X	Core and grab

K2249	Marmin Knolls	3	39.7	151	34.3		151.57167	3.66167			X	Core and grab
Onnuri: DaeYang-02 2002												
MC-03	PACMANUS, Snowcap	3	43.674	151	40.186		151.66977	3.72790	1690		X	Multicorer. Cobble of fresh dacite, trace foram sand. Ship drifted off station
MC-04	PACMANUS, Snowcap	3	43.720	151	40.192		151.66987	3.72867	1636		X	Multicorer. Foram sand. Ship drifted off ststion.
MC-05	PACMANUS, Snowcap	3	43.682	151	40.209		151.67015	3.72803	1642		B?	Multicorer. 4 cores, 10-15 cm gravel, fresh and altered dacite, native S

SUBMERSIBLE DIVES (observation or sample positions)

Shinkai-6500: MANUSFLUX 1995												
297-R-01	PACMANUS, E of Satanic Mills (juvenile vent)	3	43.605	151	40.408		151.67347	3.72675	1715		A+	Felsic dacite (Mn crust)
297-S-02A	PACMANUS, Satanic Mills	3	43.603	151	40.333		151.67222	3.72672	1708		A+	Sulfides
297-S-02B	PACMANUS, Satanic Mills	3	43.603	151	40.333		151.67222	3.72672	1708		A+	Sulfides
297-R-03	PACMANUS, Snowcap	3	43.689	151	40.189		151.66982	3.72815	1656		A+	Altered rhyodacite, rhyodacite kernels
297-R-04	PACMANUS, 250m W of Tsukushi	3	43.757	151	39.881		151.66468	3.72928	1678		A+	Felsic dacite
Dive 298	DESMOS											
299-R-01	PACMANUS, E foot of Pual Ridge	3	44.474	151	40.757		151.67928	3.74123	2137		A+	Basaltic andesite
299-R-02	PACMANUS, E flank of Pual Ridge	3	44.287	151	40.663		151.67772	3.73812	2023		A+	Felsic dacite
299-R-03	PACMANUS, E flank of Pual Ridge	3	44.083	151	40.535		151.67558	3.73472	1805		A+	Felsic dacite
299-R-04	PACMANUS, E flank of Pual Ridge	3	43.969	151	40.465		151.67442	3.73282	1776		A+	Felsic dacite
299-R-05	PACMANUS, 300m SE of Snowcap, Pual flank	3	43.823	151	40.316		151.67193	3.73038	1758		A+	Felsic dacite
299-R-06	PACMANUS, between Snowcap and Tsukushi	3	43.725	151	40.095		151.66825	3.72875	1667		A+	Felsic dacite
299-Sed-01	PACMANUS, E foot of Pual Ridge	3	44.498	151	40.765		151.67942	3.74163	2140		A+	Filtered sediment
299-Sed-02	PACMANUS, E foot of Pual Ridge	3	44.498	151	40.765		151.67942	3.74163	2140		A+	Filtered sediment
299-Sed-03	PACMANUS, Snowcap	3	43.692	151	40.219		151.67032	3.72820	1656		A+	Filtered sediment
299-Sed-04	PACMANUS, Snowcap	3	43.692	151	40.219		151.67032	3.72820	1656		A+	Filtered sediment
299-Sed	PACMANUS - E flank Pual, Sed in basket from crash	3	43.979	151	40.470		151.67450	3.73298	1782		B	Ooze
Dive 300	DESMOS											
301-Sed-01	PACMANUS, Satanic Mills	3	43.609	151	40.338		151.67230	3.72682	1708		A+	Filtered sediment
301-S-01	PACMANUS, Satanic Mills	3	43.609	151	40.338		151.67230	3.72682	1708		A+	Sulfides
301-S-02	PACMANUS, Satanic Mills	3	43.609	151	40.338		151.67230	3.72682	1709		A+	Sulfides
301-S-03	PACMANUS, Roman Ruins	3	43.244	151	40.520		151.67533	3.72073	1693		A+	Sulfides
Dive 302	DESMOS											
304-S-01	PACMANUS, Roman Ruins	3	43.244	151	40.506		151.67510	3.72073	1692		A+	Sulfides
304-Sed-01	PACMANUS, Roman Ruins	3	43.244	151	40.506		151.67510	3.72073	1692		A+	Filtered sediment
304-Sed-02	PACMANUS, Roman Ruins	3	43.244	151	40.506		151.67510	3.72073	1692		A+	Filtered sediment
304-S-02	PACMANUS, Rogers Ruins	3	43.135	151	40.446		151.67410	3.71892	1735		A+	Fe oxyhydroxide
305-S-01	PACMANUS, west side of Snowcap	3	43.689	151	40.158		151.66930	3.72815	1653		A+	Sulfides
305-Sed-01	PACMANUS, west side of Snowcap	3	43.689	151	40.158		151.66930	3.72815	1656		A+	Filtered sediment
305-R-02	PACMANUS, SW crest of main Pual Ridge	3	44.042	151	39.743		151.66238	3.73403	1665		A+	Felsic dacite
305-R-03	PACMANUS, SW crest of main Pual Ridge	3	44.049	151	39.609		151.66015	3.73415	1668		A+	Felsic dacite
305-R-04	PACMANUS, SW crest of main Pual Ridge	3	44.160	151	39.566		151.65943	3.73600	1661		A+	Felsic dacite
305-R	PACMANUS, basket tube pumice, location uncertain	3	44.156	151	39.563		151.65938	3.73593	1658		X	Felsic dacite pumice
Dive 306	DESMOS											
Shinkai 2000: BioAccess '96 1996												
Dive 909	DESMOS											
Dive 910	DESMOS											
Dive 911	PACMANUS											
Dive 912	PACMANUS											
Dive 913	PACMANUS											
Dive 914	PACMANUS											
Dive 916	DESMOS											
Dive 917	DESMOS											
Dive 918	DESMOS											
Dive 919	DESMOS											
Dive 920	PACMANUS											
Dive 922	PACMANUS											
Dive 923	PACMANUS											
Dive 924	DESMOS											
Shinkai 2000: BioAccess '98 1998												
Dive 1062	PACMANUS											
Dive 1063	PACMANUS											
1063-1	PACMANUS, Roman Ruins	3	43.210	151	40.506		151.67510	3.72017	1666		A+	Sulfide chimney
1063-2	PACMANUS, Roman Ruins	3	43.241	151	40.517		151.67528	3.72068	1668		A+	Dacite (chimneys in vicinity)

1063-3	PACMANUS, SE of Roman Ruins	3	43.443	151	40.708		151.67847	3.72405	1688		A+	Dacite
1063-4,5	PACMANUS, SE of Roman Ruins	3	43.410	151	40.864		151.68107	3.72350	1689		A+	Dacite with orange oxide coating
1063-6	PACMANUS, ESE of Roman Ruins	3	43.361	151	40.959		151.68265	3.72268	1677		A+	Dacite
Dive 1064	DESMOS											
Dive 1065	PACMANUS											
Dive 1066	PACMANUS											
1066-1	PACMANUS, Tsukushi	3	43.785	151	40.019		151.66698	3.72975	1652		A+	Sulfide chimney
1066-2	PACMANUS, W side Snowcap	3	43.677	151	40.176		151.66960	3.72795	1628		A+	Sulfide chimney
1066-3	PACMANUS, Satanic Mills	3	43.618	151	40.337		151.67228	3.72697	1677		A+	Sulfide chimney
1066-4	PACMANUS, Satanic Mills	3	43.597	151	40.333		151.67222	3.72662	1676		A+	Sulfide chimney
Dive 1067	PACMANUS											
Dive 1068	DESMOS											
Dive 1069	PACMANUS											
Dive 1070	PACMANUS											
Dive 1071	PACMANUS											
Dive 1072	DESMOS											
Dive 1073	DESMOS											
Dive 1074	PACMANUS											
Dive 1075	PACMANUS											
Dive 1076	PACMANUS											

DRILL HOLES

JOIDES Resolution: ODP Leg 193 2001

1188A	PACMANUS, Snowcap	3	43.696	151	40.196		151.66993	3.72827	1640		A+	212m penetration, cored, 30m fresh rhyodacite then altered dacite. Spud in Mn crusts. Severed pipe just below seafloor
1188B	PACMANUS, Snowcap	3	43.696	151	40.198		151.66997	3.72827	1642		A+	72m penetration. uncored. Spud in sediment. Free-fall funnel remains at site
1188C	PACMANUS, Snowcap	3	43.694	151	40.174		151.66957	3.72823	1643		A+	44m penetration, uncored. Spud in sediment.
1188D	PACMANUS, Snowcap	3	43.667	151	40.178		151.66963	3.72778	1634		A+	15m penetration, uncored. Spud in sediment
1188E	PACMANUS, Snowcap	3	43.684	151	40.190		151.66983	3.72807	1641		A+	16m penetration, uncored. Spud in sediment
1188F	PACMANUS, Snowcap	3	43.685	151	40.190		151.66983	3.72808	1642		A+	387m penetration, cored 218-387m. Spud in sediment/mat. 60m of casing, and two nested funnels (large re-entry + free-fall) remain at site
1189A	PACMANUS, Roman Ruins	3	43.243	151	40.492		151.67487	3.72072	1690		A+	126m penetration, cored, <9m fresh mafic dacite then altered dacite. Spud in dacite beside chimney. 120m pipe severed just below sea floor
1189B	PACMANUS, Roman Ruins	3	43.236	151	40.508		151.67513	3.72060	1684		A+	206 m penetration, cored from 30m, stockwork then altered dacites. Spud beside chimney. 30m casing and a large re-entry funnel remain at site
1189C	PACMANUS, Roman Ruins	3	43.241	151	40.524		151.67540	3.72068	1689		A+	166m penetration, uncored. Free-fall funnel remains at site
1190A	PACMANUS, SW of Roman Ruins	3	43.292	151	40.582		151.67637	3.72153	1703		A+	9m penetration, cored, rhyodacite. Spud in rhyodacite
1190B	PACMANUS, SW of Roman Ruins	3	43.314	151	40.616		151.67693	3.72190	1701		A+	10m penetration, cored, rhyodacite. Spud in rhyodacite
1190C	PACMANUS, SW of Roman Ruins	3	43.303	151	40.610		151.67683	3.72172	1696		A+	17m penetration, cored, rhyodacite. Spud in rhyodacite
1191A	PACMANUS, Satanic Mills	3	43.608	151	40.337		151.67228	3.72680	1694		A+	20m penetration, cored, fresh felsic dacite, minor sulfide Spud beside chimney.

Sonne: CONDRILL 2002

57-RD	PACMANUS, Snowcap	3	43.722	151	40.155		151.66925	3.72870	~1650		A	1.68m penetration, 10 cm core, fresh dacite rubble
60-RD	PACMANUS, Roman Ruins	3	43.240	151	40.500		151.67500	3.72067	"1659"		A	4.42m penetration, 442 cm core, 10 cm weakly altered dacite over sulfides
61-RD	PACMANUS, Roman Ruins	3	43.230	151	40.497		151.67495	3.72050	1690		A	2.77m penetration, 140 cm core, 137m sulfides over 10cm fresh dacite
62-RD	PACMANUS, Roman Ruins	3	43.230	151	40.497		151.67495	3.72050	1687		A	2.20m penetration, 35 cm core, fresh dacite
63-RD	PACMANUS, Roman Ruins	3	43.240	151	40.500		151.67500	3.72067	1689		A	2.71m penetration, 50 cm core, sulfides
64-RD	PACMANUS, Roman Ruins	3	43.230	151	40.502		151.67503	3.72049	1692		A	3.37m penetration, 220 cm core, 190 cm fresh dacite over 30 cm altered dacite, minor silfides
65-RD	PACMANUS, Roman Ruins	3	43.238	151	40.511		151.67518	3.72064	1692		A	4.41m penetration, 45cm core, 45 cm core, sulfides
66-RD	PACMANUS, Roman Ruins	3	43.230	151	40.497		151.67495	3.72050	1689		A	3.71m penetration, 80 cm core, sulfides
67-RD	PACMANUS, Roman Ruins	3	43.240	151	40.500		151.67500	3.72067	1689		A	5.00m penetration, 190 cm core, sulfides
68-RD	PACMANUS, Roman Ruins	3	43.240	151	40.510		151.67517	3.72067	1692		A	2.06m penetration, 42 cm core, sulfides
69-RD	PACMANUS, Roman Ruins	3	43.232	151	40.503		151.67505	3.72053	1691		A	4.90m penetration, 220 cm core, 180 cm sulfides over 40 cm altered dacite (stockwork veining)
71-RD	DESMOS	3	41.469	151	52.048		151.86747	3.69115	1924		A	1.54m penetration, 26 cm core, slightly to moderately altered andesite
72-RD	DESMOS	3	41.500	151	52.000		151.86667	3.69167	1925		A	1.15m penetration, 17 cm core, fresh andesite
73-RD	DESMOS	3	41.510	151	52.001		151.86668	3.69183	1919		A	4.62m penetration, 80 cm core, altered andesite
74-RD	Suzette	3	47.354	152	5.631		152.09385	3.78923	1517		A	3.20m penetration, 25 cm core, vesicular "dacite" (no phenocrysts?)

CAMERA TOWS - Positions corrected for lag

Franklin: PACMANUS-I 1991

MCV-1	Marmin Knolls Sample plotted half-way along track	3	40.9	151	35.2		151.58667	3.68167	~1900		X	No photography. Chips of basalt glass
MCV-2	Kumul Ridge											

MCV-3	PACMANUS											Corrected navigation exists somewhere
MCV-4	East Valley: START (corr 3/9/04)	3	44.59	151	40.38		151.67300	3.74317	2075		C	
	END	3	42.46	151	43.41		151.72350	3.70767	2100		C	
	crash sample, E Valley floor	3	44.05	151	41.85		151.69750	3.73417	~2100		C	Chips of basalt glass
MCV-5	PACMANUS											
MCV-6	Crest of NE arm Pual Ridge START	3	42.120	151	42.410		151.70683	3.70200				
	END	3	40.650	151	44.340		151.73900	3.67750				
MCV-7	Northern Pual fork, START	3	40.970	151	42.020		151.70033	3.68283				
	END	3	39.570	151	44.510		151.74183	3.65950				
MCV-8	NW arm Pual Ridge											
	Ooze on cage, crash near start?	3	40.2	151	43.1		151.71833	3.67000	~1890		X	
MCV-9	PACMANUS, looped track											Corrected navigation exists somewhere
MCV-10	PACMANUS											Corrected navigation exists somewhere
MCV-11	PACMANUS											Corrected navigation exists somewhere
	Sample crash, Roman Ruins	3	43.27	151	40.47		151.67447	3.72115	1695		C	Chips sulfide chimney
Franklin: PACMANUS-II 1993												
MCV-12	PACMANUS											Corrected navigation exists somewhere
MCV-13	PACMANUS											Corrected navigation exists somewhere
MCV-14	Between PACMANUS and NE Pual Ridge											
MCV-15	Pual Fork to knoll on NE Arm											Corrected navigation exists somewhere?
	Sample from crash near end of tow?	3	42.100	151	42.900		151.71500	3.70167	~1800		X	Rhyodacite chips
MCV-16	Crest northwest arm Pual Ridge											
	Sample from crashes at ~1540h?	3	39.300	151	42.700		151.71167	3.65500	~1800		X	600m lag, chips mafic dacite
MCV-17	PACMANUS											Corrected navigation exists somewhere
MCV-18	PACMANUS											Corrected navigation exists somewhere
MCV-19	Southern finger, Yuam Ridge											
MCV-20	Small knoll, Pual Fork											
	Sample from crashes near end?	3	41.200	151	43.320		151.72200	3.68667			X	400m lag? Andesite glass chips from tail
MCV-21	Extension of MCV-19, Yuam Ridge											
MCV-22	Traverse beneath PACMANUS plume, Pual Fork											Corrected navigation exists somewhere?
	Estimated sample position, hornito crashes	3	40.320	151	43.140		151.71900	3.67200			X	600m lag? Andesite glass chips from tail
MCV-23	Knoll, Tumai Ridge											
Franklin: PACMANUS-III 1996												
MCV-24	Hover/tow knoll NE of Roman Ruins START	3	43.115	151	41.084		151.68473	3.71858	1652		A	
	END	3	43.054	151	41.132		151.68553	3.71757	1662		A	
	Sample plotted half-way along track	3	43.135	151	41.108		151.68513	3.71892			X	Glass chips of felsic dacite in tail, ooze on cage
MCV-25	Hover/tow SuSu Knolls											
MCV-26A	Roman/Rogers Ruins START	3	43.296	151	40.588		151.67647	3.72160	1725		A	
	END	3	42.860	151	40.436		151.67393	3.71433	1845		A	
MCV-27	SE finger of Yuam Ridge											
MCV-28	Roman/Rogers Ruins START	3	43.257	151	40.422		151.67370	3.72095	1710		A	
	END	3	43.013	151	40.423		151.67372	3.71688	1797		A	
MCV-29	NE arm Pual Ridge START	3	40.71	151	45.08		151.75127	3.67847	1760		B	
	END	3	41.03	151	44.37		151.73947	3.68377	1873		B	
	Sample at shoal anchor site 16:55	3	40.76	151	45.01		151.75017	3.67933	1732		X	Rhyodacite chips from tail
MCV-30	Hover/tow Sonne Pimple START	3	42.734	151	41.298		151.68830	3.71223	1691		A	
	END	3	42.510	151	41.499		151.69165	3.70850	1702		A	
MCV-31	Exploration S face South Su											
MCV-32	Exploration of crest North Su											
MCV-33	South flank South Su											
MCV-34	Col between North Su and Suzette START	3	47.599	152	5.851		152.09752	3.79332	1562		A	
	END	3	47.321	152	5.568		152.09280	3.78868	1554		A	
MCV-35	Crest of South Su											
MCV-36	Crest of North Su											
MCV-37	Crest of South Su											
MCV-38	Suzette and crest to NW START	3	47.332	152	5.651		152.09418	3.78887	1535		A	
	END	3	46.846	152	5.280		152.08800	3.78077	1665		A	
	Sample crash, Suzette	3	47.318	152	5.635		152.09392	3.78863	1523		A	Flange of a chimney
MCV-39	South flank South Su											
Franklin: PACMANUS-IV 1997												
MCV-40	Traverse across Suzette field START	3	47.135	152	5.684		152.09473	3.78558	1571		A	
	END	3	47.165	152	5.753		152.09588	3.78608	1581		A	

MCV-41	Traverse across the crest of Nimab Knoll											chips altered rock
MCV-42	Traverse across the crest of South Su START	3	48.437	152	6.166		152.10277	3.80728	1393		A	
	END	3	48.652	152	6.389		152.10648	3.81087	1412		A	
MCV-43	Traverse across Suzette field START	3	47.308	152	5.685		152.09475	3.78847			A	
	END	3	47.368	152	5.615		152.09358	3.78947			B	
	Sample crash, Suzette	3	47.351	152	5.635		152.09392	3.78918	1525		A	Sulfide chimney fragments
MCV-44	Traverse across Suzette field START	3	47.144	152	5.650		152.09417	3.78573			A	
	END	3	47.599	152	6.014		152.10023	3.79332			B	
MCV-45	Traverse across the crest of North Su											Corrected navigation exists somewhere
MCV-46	Traverse across S extension of Suzette field START	3	47.375	152	5.748		152.09580	3.78958	1531		A	
	END	3	47.474	152	5.621		152.09368	3.79123	1572		A	
MCV-47	Traverse across the crest of Sonne Pimple START	3	42.520	151	41.430		151.69050	3.70867	1684		B	
	END	3	42.624	151	41.515		151.69192	3.71040	1715		B	
MCV-48	Flank volcano, Pual Ridge E of PACMANUS: START	3	43.340	151	41.330		151.68883	3.72233	1778		A	
	END	3	42.954	151	41.932		151.69887	3.71590	1817		A	
	Sample from crash at crest of knoll? Revise if dacite	3	43.205	151	41.439		151.69065	3.72008	1769		X	
MCV-49	Traverse across Roman Ruins START	3	43.272	151	40.467		151.67445	3.72120	1712		B	
	END	3	43.078	151	40.609		151.67682	3.71797	1697		B	
MCV-50	Tsukushi traverse START	3	43.802	151	39.944		151.66573	3.73003	1681		A	
	END	3	43.439	151	40.334		151.67223	3.72398	1694		A	
MCV-51	Traverse across the crest of North Su											
MCV-52	Tsukushi traverse START	3	43.787	151	39.918		151.66530	3.72978	1682		A	
	END	3	43.428	151	40.331		151.67218	3.72380	1688		A	
MCV-53	Traverse across S end of Roman Ruins START	3	43.195	151	40.440		151.67400	3.71992	1725		A	
	END	3	43.325	151	40.563		151.67605	3.72208	1721		A	
MCV-54	Traverse across the crest of North Su											Corrected navigation exists somewhere
Franklin: BINATANG 2000												
MCV-55	Traverse on crest of North Su START	3	47.745	152	5.825		152.09708	3.79575			D	Camera,CTD, Geochirp, Orientation equipment, Corrected navigation exists somewhere for MP1-11
	END	3	48.040	152	6.095		152.10158	3.80067			D	
MP-01	Trial in West Su Basin START	3	47.980	152	0.965		152.01608	3.79967			D	Camera, CTD, Geochirp, Orientation equipment, electrode array in on standard configuration
	END	3	48.175	152	2.930		152.04883	3.80292			D	
MP-02	Link: Snowcap START	3	43.825	151	40.05		151.66750	3.73042			D	CTD, Orientation, electrode array in on standard configuration
	END	3	44.475	151	39.075		151.65125	3.74125			D	
MP-03	Traverse across Pual Ridge and Dekker Field START	3	44.165	151	39.23		151.65383	3.73608			D	Camera, CTD, Orientation, electrode array in on standard configuration
	END	3	44.200	151	39.910		151.66517	3.73667			D	
MP-04	Traverse across southern Pual Ridge START	3	43.775	151	39.515		151.65858	3.72958			D	Camera, CTD, Geochirp, Orientation equipment, electrode array in non standard configuration
	END	3	43.957	151	40.137		151.66895	3.73262			D	
MP-05	Traverse across Roman Ruins START	3	43.370	151	41.595		151.69325	3.72283			D	Camera, CTD, Geochirp (suspect data), Orientation equipment, electrode array in non standard configuration, other experiment
	END	3	43.197	151	40.325		151.67208	3.71995			D	
MP-06	Traverse across Roman Ruins START	3	43.350	151	41.27		151.68783	3.72250			D	CTD, Geochirp (suspect data), Orientation equipment, electrode array in non standard configuration; magnetometers
	END	3	43.107	151	39.738		151.66230	3.71845			D	
MP-07	Link:Roman Ruins START	3	42.651	151	41.138		151.68563	3.71085			D	CTD, Geochirp (suspect data), Orientation equipment, electrode array in non standard configuration; magnetometers
	END	3	44.477	151	39.260		151.65433	3.74128			D	
MP-08	Traverse across Snowcap START	3	43.750	151	40.6		151.67667	3.72917			D	CTD, Geochirp (suspect data), Orientation equipment, electrode array in non standard configuration; magnetometers
	END	3	43.775	151	40.850		151.68083	3.72958			D	
MP-09	Traverse across Area 'C' START	3	44.020	151	39.247		151.65412	3.73367			D	CTD, Orientation equipment, electrode array, magnetometers
	END	3	44.173	151	39.950		151.66583	3.73622			D	
MP-10	Traverse across Snowcap START	3	43.620	151	39.845		151.66408	3.72700			D	CTD, Orientation equipment, electrode array, magnetometers
	END	3	43.702	151	40.340		151.67233	3.72837			D	
MP-11	Traverse along Pual Ridge, Dekker to Snowcap STAR	3	*44.250*	*151*	39.68		151.66133	3.73750			D	Camera, CTD, Orientation equipment, electrode array, magnetometers
	END		42.960	151	41.000		151.68333	0.71600			D	
Franklin: BISMARCK 2002												
BV-7	Pual fork to Knoll on NE Pual											Note fauna increased at end, when on the knoll
	Sample from crash near start	3	41.200	151	43.150		151.71917	3.68667	~1870			Small andesite rock from battery
BV-8	North Pual site, Pual Fork											
	Near North Pual site, samples??	3	40.5	151	43.7		151.72833	3.67500	1800		X	Large chips to 1.2 cm of andesite glass, smaller (5mm) chips mafic dacite, on batteries
Sonne: EDISON 1994 (see above for samples)												
83-GTV	PACMANUS, Snowcap											

84-GTV	PACMANUS, Satanic Mills											
85-GTV	PACMANUS, Satanic Mills											
89-GTV	PACMANUS, Satanic Mills											
90-GTV	PACMANUS, just N ofTsukushi											
91-GTV	PACMANUS, just S of Roman Ruins											
95-GTV	PACMANUS, E fringe of Roman Runs											
Sonne: CONDRILL 2004 (see above for GTV samples)												
53-OFOS	PACMANUS, Roman Ruins to Tsukushi START	3	43.133	151	40.514		151.67523	3.71888	1677			
	END	3	43.774	151	40.077		151.66795	3.72956	1659			
54-GTV	PACMANUS, Satanic Mills											
58-GTV	PACMANUS, Satanic Mills											
59-GTV	PACMANUS, Satanic Mills											
70 GTV	PACMANUS, Roman Ruins											

BINATANG MASINS; Binatang 2000

MBM-01	North Su	3	48.046	152	6.094		152.10156	3.80077	1182		A	
MBM-02	Snowcap	3	43.669	151	40.191		151.66985	3.72782	1646		A	
MBM-03	DESMOS	3	41.469	151	51.905		151.86508	3.69115	1838		A	
MBM-04	Roman Ruins	3	43.254	151	40.494		151.67490	3.72090	1688		A	

Appendix 2

Eastern Manus Basin Operations Yielding Rocks

SAMPLING OPERATIONS WITH ROCKS
See explanatory notes

Operation	Type	Detailed Location	Latitude deg	Latitude min	Longitude deg	Longitude min	Decimal Long	Decimal Lat	Depth (m)	Haul Dirn	Nav Precn	Recovery	Chemical Analyses (fresh)	Chemical Analyses (altered)	Extra RI identificns (fresh)	Rock SiO2 (fresh) * = RI
PUAL RIDGE AND VICINITY																
SW Pual Ridge																
MD-22	D	SW end Pual Ridge	3	45.235	151	38.635	151.64391	3.75391	1965	270	D	Felsic dacite, ooze, rare pumice	1			68.8
MD-42	D	Far SW end of Pual Ridge	3	45.693	151	35.184	151.58640	3.76155	2250	160	C	Mafic dacite, andesite	1		1	64.7, 61.3*
SW Crestal Knoll, Pual Ridge																
305-R-02	X	PACMANUS, SW crest of main Pual Ridge	3	44.042	151	39.743	151.66238	3.73403	1665		A+	Felsic dacite	1			68.3
305-R-03	X	PACMANUS, SW crest of main Pual Ridge	3	44.049	151	39.609	151.66015	3.73415	1668		A+	Felsic dacite	1			68.2
305-R-04	X	PACMANUS, SW crest of main Pual Ridge	3	44.160	151	39.566	151.65943	3.73600	1661		A+	Felsic dacite	1			67.5
West of and Around Tsukushi																
MD-110	D	PACMANUS, 400m W of Tsukushi	3	43.741	151	39.827	151.66379	3.72902	1660	130	A	Fe-MnOx, glassy felsic dacite	1			67.4
MG-5	G	PACMANUS, 300 m N of Tsukushi	3	43.597	151	40.007	151.66678	3.72662	1653		C	Glassy felsic dacite, rhyodacite tube pumice	1		1	67.5, 70.0*
MG-6	G	PACMANUS, 200m SE of Tsukushi	3	43.860	151	40.117	151.66862	3.73100	1665		D	Mafic dacite tube pumice, mollusc, mud	1		2	64.7, 67.2*, 64.3*
MD-111	D	PACMANUS, 100m N of Tsukushi	3	43.703	151	39.987	151.66644	3.72839	1643	130	B	Glassy felsic dacite	1			69.4
HDg-3	D	PACMANUS, 150 m N of Tsukushi	3	43.713	151	39.990	151.66650	3.72855	1633	45	X	Felsic dacite	KORDI?		1	67.2*
297-R-04	X	PACMANUS, 250m W of Tsukushi	3	43.757	151	39.881	151.66468	3.72928	1678		A+	Felsic dacite	1			67.5
Tsukushi																
MD-103	D	PACMANUS, Tsukushi	3	43.781	151	40.002	151.66669	3.72969	1670	130	B	Felsic dacite, FeOxides	1			67.4
MD-114	D	PACMANUS, just W of Tsukushi	3	43.768	151	39.987	151.66646	3.72946	1665	130	A	Felsic dacite	1			67.1
MD-143	D	PACMANUS, Tsukushi	3	43.778	151	40.026	151.66709	3.72963	1662	225	B	Dacites (Fe stain), sulfides, Fe-crusted snails				
MD-144	D	PACMANUS,Tsukushi	3	43.765	151	40.023	151.66705	3.72941	1668	225	A	Mafic and felsic dacites (Fe stain), sulfides			2	65.1*, 68.3*
MG-51	G	PACMANUS, S sideTsukushi	3	43.806	151	40.026	151.66710	3.73010	1666		A	Brown ooze, tiny black and white rock chips including felsic dacite	1			69.4
90-GTV	GTV	PACMANUS, NE side ofTsukushi	3	43.739	151	40.050	151.66750	3.72898	1663		B	Mn-Fe oxides (cauliflower mound), felsic dacite, minor ooze			2	67.5*, 67.2*
Between Tsukushi and Snowcap																
MG-7	G	PACMANUS, 150m SSW of Snowcap	3	43.774	151	40.161	151.66935	3.72957	1660		D	Felsic dacite glass and tube pumice chips, mud			1	67.8*
MG-34	G	PACMANUS, between Snowcap & Tsukushi	3	43.740	151	40.095	151.66825	3.72900	1667		B	5 cm red-brown ooze overlying ropy lava top (dacite?)				
299-R-06	X	PACMANUS, between Snowcap and Tsukushi	3	43.725	151	40.095	151.66825	3.72875	1667		A+	Felsic dacite	1			67.6
Snowcap																
MD-24	D	PACMANUS, Snowcap, SE flank	3	43.698	151	40.223	151.67038	3.72830	1653	235	B	Fresh felsic dacite & hyaloclastite (early), altered dacite (some Fe stained) and "Talenga" chimney (late), fauna, ooze	2	14		69.8, 67.8
MD-27	D	PACMANUS, Snowcap, E side	3	43.675	151	40.214	151.67024	3.72791	1660	45	B	Felsic dacite, dark mud	2	1		67.9, 70.0
MD-57	D	PACMANUS (W side Snowcap)	3	43.704	151	40.138	151.66896	3.72840	1655	90	A	Felsic dacite, sulfides, FeOx	1			67.6
MD-65	D	PACMANUS (West Snowcap)	3	43.718	151	40.112	151.66854	3.72863	1655	45	A	Felsic dacite (early); pyritic breccia, fauna (late), ooze	1	2		67.5
MD-71	D	PACMANUS, Snowcap	3	43.688	151	40.206	151.67010	3.72814	1648	45	B	Felsic dacite (glassy, minor alteration, Fe stain), limpets	1			67.6
MD-124	D	PACMANUS, Snowcap (NW side)	3	43.670	151	40.151	151.66918	3.72784	1645	140	A	Py-enargite breccias and altered dacite (early); fresh felsic dacite (late)	1	5	1	67.5, 65.1*
MD-125	D	PACMANUS, Snowcap (NW side)	3	43.682	151	40.144	151.66906	3.72804	1642	130	A	Glassy felsic dacite, sulfur flow	1	3		67.4, 66.4*
MG-2	G	PACMANUS, NE side of Snowcap	3	43.640	151	40.215	151.67025	3.72733	1668		C	Mn encrusted rhyodacite tube pumice, mud			1	70.6* see>>
MG-14	G	PACMANUS, 200m SE of Snowcap	3	43.749	151	40.289	151.67148	3.72915	1688		C	Rhyodacite in jaws, Mn coating			1	71.7*
MG-15	G	PACMANUS, east side of Snowcap	3	43.666	151	40.256	151.67093	3.72777	1653		B	Brown mud, Fe-MnOx and dacite pumice chips, fauna			varied	
MG-16	G	PACMANUS. Snowcap	3	43.695	151	40.205	151.67008	3.72825	1652		C	Fresh and altered rhyodacite in surficial brown mud, mostly rocks deeper.; fauna and bacterial mat			1	70.6*
MG-49	G	PACMANUS, Snowcap	3	43.680	151	40.176	151.66960	3.72800	1643		A	Gravel; altered and sulfidic dacite; tubeworms; H2S		1		
MG-50	G	PACMANUS, Snowcap, west side	3	43.688	151	40.159	151.66932	3.72813	1644		A	Glassy felsic dacite, brown ooze			1	67.2*
MG-53	G	PACMANUS, Snowcap, E side	3	43.680	151	40.220	151.67033	3.72800	1645		B	Glassy rhyodacite, brown ooze; tubeworm			2	69.7*, 70.0*
83-GTV	GTV	PACMANUS, N side of Snowcap	3	43.655	151	40.183	151.66972	3.72758	1670		B	Altered dacite hyaloclastite (rhyodacite kernels), some Fe-Mn stained; fauna	1	5		69.9
MS-23	S	PACMANUS, Snowcap	3	43.676	151	40.189	151.66981	3.72794	1647		C	Mussel, chips rhyodacite and felsic dacite	1		1	67.5*, 71.7
MS-24	S	PACMANUS, Snowcap	3	43.700	151	40.208	151.67013	3.72833	1650		B	Chips glassy felsic dacite			1	68.9*
MS-29	S	PACMANUS, Snowcap	3	43.681	151	40.193	151.66989	3.72802	1649		A	Chips rhyodacite			1	71.1*
297-R-03	X	PACMANUS, Snowcap	3	43.689	151	40.189	151.66982	3.72815	1656		A+	Altered rhyodacite, rhyodacite kernels		1		
305-R	X	PACMANUS, basket tube pumice, location uncertain (Snowcap?)	3	44.156	151	39.563	151.65938	3.73593	1658		X	Felsic dacite pumice	1			69.6
1188A	H	PACMANUS, Snowcap	3	43.696	151	40.196	151.66993	3.72827	1640		A+	212m penetration, cored, 30m fresh rhyodacite then altered dacite. Spud in Mn crusts. Severed pipe just below seafloor	several			70.2
1188F	H	PACMANUS, Snowcap	3	43.685	151	40.190	151.66983	3.72808	1642		A+	387m penetration, cored 218-387m. Spud in sediment/mat. 60m of casing, and two nested funnels (large re-entry + free-fall) remain at site				
57-RD	H	PACMANUS, Snowcap	3	43.722	151	40.155	151.66925	3.72870	~1650		A	1.68m penetration, 10 cm core, fresh dacite rubble				
MC-03	S	PACMANUS, Snowcap	3	43.674	151	40.186	151.66977	3.72790	1690		X	Multicorer. Cobble of fresh dacite, trace foram sand. Ship drifted off station				
MC-05	S	PACMANUS, Snowcap	3	43.682	151	40.209	151.67015	3.72803	1642		B?	Multicorer. $ cores, 10-15 cm gravel, fresh and altered dacite, native S				
Between Snowcap and Satanic																
MD-20	D	PACMANUS, just NE of Snowcap	3	43.602	151	40.281	151.67135	3.72671	1695	240	C	Felsic dacite (some Fe-Mn coats), rare tiny altered dacite, fauna, scarce mud	2			67.2, 68.2

MG-18	G	PACMANUS. 200 m E of Snowcap, 150m S of Satanic	3	43.699	151	40.310	151.67183	3.72832	1660		C	Dacite tube pumice fragments in brown mud				
Satanic																
MD-25	D	PACMANUS, just E of Satanic Mills	3	43.590	151	40.415	151.67358	3.72650	1680	235	C	Rhyodacite; some Fe-coating, bloom, mollusc	1			69.7
MD-28	D	PACMANUS, NE side of Satanic Mills	3	43.540	151	40.415	151.67358	3.72566	1688	235	C	Felsic dacite, sulfide chimney, fauna, ooze	2		1	67.8, 67.8, 70.0*
MD-30	D	PACMANUS, Satanic Mills, NE side	3	43.537	151	40.413	151.67354	3.72562	1690	225	C	Rhyodacite	3			69.6, 69.5, 69.5
MD-35	D	PACMANUS, Satanic Mills	3	43.557	151	40.353	151.67254	3.72596	1689	225	C	Rhyodacite (early, Fe stains), late sulfides (including "Fred"; fauna	1		1	69.6; 67.2*
MD-62	D	PACMANUS (Satanic Mills)	3	43.615	151	40.320	151.67200	3.72692	1678	130	A	Sulfides, minor fresh and altered rhyodacite, fauna, ooze	1			69.5
MD-68	D	PACMANUS, Satanic Mills	3	43.587	151	40.324	151.67207	3.72646	1681	135	A	Felsic dacite (some Fe-stain)	1			69.4
MD-137	D	PACMANUS, W side of Satanic Mills	3	43.586	151	40.316	151.67194	3.72644	1670	225	B	Rhyodacite, tubeworms			1	70.6*
MD-138	D	PACMANUS, Satanic Mills	3	43.599	151	40.349	151.67248	3.72665	1683	240	A	Felsic dacite, sulfides, fauna	1		1	67.7, 70.3*
MD-139	D	PACMANUS, Satanic Mills	3	43.592	151	40.348	151.67246	3.72654	1680	220	A	Sulfides, rhyodacite, H2S			1	70.9*
BD-20	D	PACMANUS, Satanic Mills	3	43.600	151	40.371	151.67284	3.72666	1683	135	C	Dacite (Fe stain)				
BD-21	D	PACMANUS, Satanic Mills	3	43.593	151	40.347	151.67245	3.72656	1679	230	A	Rhyodacite, fauna			1	70.0*
BD-22	D	PACMANUS, Satanic Mills	3	43.610	151	40.343	151.67238	3.72683	1678	225	A	Felsic dacites, sulfides			2	68.6*,70.0*
84-GTV	GTV	PACMANUS, SE side of Satanic Mills (juvenile vent?)	3	43.636	151	40.376	151.67293	3.72727	1710		B	Felsic dacite (bloom,), fauna, minor ooze			1	68.3*
89-GTV	GTV	PACMANUS, S side of Satanic Mills	3	43.628	151	40.344	151.67240	3.72713	1700		B	Rhyodacite (Mn crusts), abundant fauna at site			1	70.0*
1191A	H	PACMANUS, Satanic Mills	3	43.608	151	40.337	151.67228	3.72680	1694		A+	20m penetration, cored, fresh felsic dacite, minor sulfide Spud beside chimney.	many			69.6
Satanic vicinity																
MD-41	D	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	3	43.611	151	40.395	151.67326	3.72685	1680	240	B	Felsic dacite (Fe stain), sulfides, fauna	1		1	69.6; 67.8*
HDg-2	D	PACMANUS, 250m S of Satanic Mills	3	43.725	151	40.371	151.67285	3.72875	1698	160	X	Rhyodacite			1	71.1*
297-R-01	X	PACMANUS, E of Satanic Mills (juvenile vent)	3	43.605	151	40.408	151.67347	3.72675	1715		A+	Felsic dacite (Mn crust)	1			69.6
Between Satanic and Roman																
MD-17	D	PACMANUS, NE of Satanic Mills, SE Roman	3	43.427	151	40.536	151.67560	3.72379	1700	235	C	Felsic dacite	1			69.4
MD-18	D	PACMANUS, NE of Satanic Mills, SE Roman	3	43.412	151	40.551	151.67585	3.72354	1695	230	B	Felsic dacite	1			69.2
MD-19	D	PACMANUS, NE of Satanic Mills	3	43.497	151	40.471	151.67452	3.72496	1695	235	C	Felsic dacite (Fe-Si crust, stains)	1			69.4
98/DR	D	PACMANUS, 300m NE of Satanic towards Roman	3	43.512	151	40.473	151.67455	3.72520	1690	0	B	Felsic dacite			1	69.1*
MG-4	G	PACMANUS, 400m WSW of Roman, towards Satanic	3	43.298	151	40.300	151.67167	3.72163	1679		C	Microlitic and frothy glassy felsic dacite chips (pumice surfaces?), trace mud			1	69.1*
Roman																
MD-56	D	PACMANUS (Roman Ruins)	3	43.212	151	40.516	151.67526	3.72019	1689	135	A	Mafic dacite (Fe stain), sulfides, ooze	2			64.6, 64.6
MD-58	D	PACMANUS (Roman Ruins)	3	43.243	151	40.494	151.67490	3.72072	1688	120	A	Sulfides (incl Big Bertha), fauna, trace dacite				
MD-100	D	PACMANUS, S side of Roman Ruins	3	43.261	151	40.496	151.67494	3.72101	1695	125	A	FeOxides, mafic dacite, brown mud				64.8*
MD-112	D	PACMANUS, Roman Ruins	3	43.254	151	40.471	151.67452	3.72090	1690	130	A	Sulfides (late), felsic dacite (early in haul), anchored	1			69.3
MD-126	D	PACMANUS, Roman Ruins	3	43.251	151	40.515	151.67526	3.72085	1690	220	B	Mafic dacite, sulfides, FeOx			1	65.1*
MD-131	D	PACMANUS, Roman Ruins	3	43.222	151	40.510	151.67517	3.72037	1695	140	B	Sulfides, FeOx, minor fresh and altered mafic dacite			1	64.6*
MD-133	D	PACMANUS, Roman Ruins	3	43.239	151	40.488	151.67479	3.72064	1691	135	A	Bikpela chimney, minor mafic dacite, fauna	1			64.8
BD-23	D	PACMANUS, Roman Ruins	3	43.252	151	40.499	151.67499	3.72087	1690	220	A	Rhyodacite (Fe stain), sulfides			1	71.1*
BD-24	D	PACMANUS, Roman Ruins	3	43.255	151	40.502	151.67504	3.72092	1692	220	A	Mafic dacites (Fe stain), sulfides			1	65.3*
HDg-1	D	PACMANUS, Roman Ruins, NW side	3	43.220	151	40.467	151.67445	3.72033	1678	225	X	Mafic dacite, Fe crusts, small sp fragment	KORDI?		1	65.1*
HDg-1-2	D	PACMANUS, Roman Ruins, NW side	3	43.214	151	40.467	151.67445	3.72023	1690	160	X	Rhyodacite, sulfide fragments	KORDI?		1	71.7*
HDg-1-3	D	PACMANUS, Roman Ruins, ESE side	3	43.258	151	40.548	151.67580	3.72097	1681	100	X	Rhyodacite, large chimney	KORDI?		1	71.1*
HDg-5	D	PACMANUS, Roman Ruins	3	43.232	151	40.504	151.67507	3.72053	1684	70	X	Dacite (Mn coat), rare sulfides	KORDI?			
MG-3	G	PACMANUS, Roman Ruins	3	43.246	151	40.508	151.67513	3.72077	1685		D	Glassy (frothy) felsic dacite (pumice surfaces?) chips			1	69.4*
95-GTV	GTV	PACMANUS, Roman Ruins	3	43.263	151	40.494	151.67489	3.72104	1698		C	FeOx, consolidated brown ooze, mafic dacite, brown ooze (from next to chimney with fauna)			1	64.8*
70 GTV	GTV	PACMANUS, Roman Ruins	3	43.210	151	40.470	151.67450	3.72017	1678		B	Sulfide-coated fresh dacite over altered dacite-sulfide breccia				
1189A	H	PACMANUS, Roman Ruins	3	43.243	151	40.492	151.67487	3.72072	1690		A+	126m penetration, cored, <9m fresh (mafic) then altered dacite. Spud in dacite beside chimney. 120m pipe severed just below sea floor	several			64.5
1189B	H	PACMANUS, Roman Ruins	3	43.236	151	40.508	151.67513	3.72060	1684		A+	206 m penetration, cored from 30m, stockwork then altered dacites. Spud beside chimney. 30m casing and a large re-entry funnel remain at site				
60-RD	H	PACMANUS, Roman Ruins	3	43.240	151	40.500	151.67500	3.72067	"1659"		A	4.42m penetration, 442 cm core, 10 cm weakly altered dacite over sulfides				
61-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.497	151.67495	3.72050	1690		A	2.77m penetration, 140 cm core, 137m sulfides over 10cm fresh dacite				
62-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.497	151.67495	3.72050	1687		A	2.20m penetration, 35 cm core, fresh dacite				
64-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.502	151.67503	3.72049	1692		A	3.37m penetration, 220 cm core, 190 cm fresh dacite over 30 cm altered dacite, minor silfides				
69-RD	H	PACMANUS, Roman Ruins	3	43.232	151	40.503	151.67505	3.72053	1691		A	4.90m penetration, 220 cm core, 180 cm sulfides over 40 cm altered dacite (stockwork veining)				
Roman vicinity																
MD-98	D	PACMANUS, 150m NE of Roman Ruins	3	43.183	151	40.558	151.67596	3.71972	1689	140	A	Felsic dacite, trace brown ooze	1			69.4
MD-130	D	PACMANUS, 100m E of Roman Ruins	3	43.255	151	40.570	151.67617	3.72092	1695	130	C	Glassy mafic dacite, tube pumice			2	65.1*, 65.3*
1190A	H	PACMANUS, SW of Roman Ruins	3	43.292	151	40.582	151.67637	3.72153	1703		A+	9m penetration, cored, rhyodacite. Spud in rhyodacite				
1190B	H	PACMANUS, SW of Roman Ruins	3	43.314	151	40.616	151.67693	3.72190	1701		A+	10m penetration, cored, rhyodacite. Spud in rhyodacite	many			70.0
1190C	H	PACMANUS, SW of Roman Ruins	3	43.303	151	40.610	151.67683	3.72172	1696		A+	17m penetration, cored, rhyodacite. Spud in rhyodacite	many			70.1
Rogers																
MD-59	D	PACMANUS (Rogers Ruins)	3	43.137	151	40.430	151.67384	3.71895	1701	135	A	Sulfides, FeOMnOx, mafic dacite, ?sulfidic mud	1			64.6
MD-60	D	PACMANUS (Rogers Ruins)	3	43.132	151	40.442	151.67404	3.71887	1699	135	B	Mafic dacite (early), Fe-MnOx, sulfides (later), ooze			1	65.3*
MD-113	D	PACMANUS, Rogers Ruins	3	43.154	151	40.440	151.67401	3.71923	1687	145	A	Mafic dacite, sulfides, Fe-MnOx	1			64.6

MD-128	D	PACMANUS, Rogers Ruins	3	43.147	151	40.427	151.67379	3.71912	1698	90	B	Glassy mafic dacite with Fe-stains			1	64.8*
MD-129	D	PACMANUS, NE side of Rogers Ruins	3	43.107	151	40.480	151.67467	3.71845	1695	140	B	Mafic and felsic dacite			2	64.8*, 69.1*
MD-132	D	PACMANUS, SE side of Rogers Ruins	3	43.152	151	40.483	151.67472	3.71921	1690	135	C	Mafic dacite, Fe stain			1	64.6*
MD-136	D	PACMANUS, N side of Rogers Ruins	3	43.114	151	40.472	151.67453	3.71857	1705	270	B	Felsic dacite (bloom)	1			68.3
MD-140	D	PACMANUS, Rogers Ruins	3	43.141	151	40.465	151.67441	3.71901	1701	225	A	Fe-MnOx, minor mafic dacite			1	64.6*
Rogers vicinity																
MD-21	D	PACMANUS, 200m NE of Rogers Ruins	3	43.076	151	40.531	151.67552	3.71794	1720	220	C	Mafic dacite	1			64.7
NE Crestal Knoll, Pual																
MG-11R	G	Crest of main knoll NE of PACMANUS	3	42.906	151	41.112	151.68520	3.71510	1669		B	Mafic dacite, some pumice, minor oze			1	65.9*
MCV-24	C	Sample plotted half-way along track	3	43.135	151	41.108	151.68513	3.71892			X	Glass chips of felsic dacite in tail, ooze on cage			1	67.5*
Twin Knolls																
MD-26	D	Twin Knolls, N of PACMANUS	3	42.470	151	39.882	151.66470	3.70783	1880	90	C	Andesite, mud	1			62.3
MG-10	G	Enclosed basin near Twin Knolls	3	42.048	151	40.452	151.67420	3.70080	1939		C	Dark brown ooze with andesite (1 cm), some pumice			1	62.0*
MG-13	G	Head of West Valley, SW of Twin Knolls	3	42.788	151	39.180	151.65300	3.71313	2215		C	Colour-banded mud, glass chips			several	(63.5*-67.8*)
Flanks of Pual Ridge																
MD-4	D	Pual Ridge, west flank north of PACMANUS	3	42.451	151	40.335	151.67224	3.70752	1900	120	C	Felsic dacite	1			68.0
MD-15	D	PACMANUS, west flank Pual	3	43.292	151	39.960	151.66600	3.72154	1740	135	C	Dacite (mafic and felsic)	2			69.5, 64.6
MD-16	D	PACMANUS, west flank Pual	3	43.317	151	39.950	151.66583	3.72195	1720	140	C	Felsic dacite, ooze	1			69.5
MD-66	D	Knoll on eastern flank of Pual Ridge, E of Roman	3	43.217	151	41.376	151.68960	3.72028	1716	135	A	Mafic dacite, minor mud	1			66.5
RD-17	D	Southern Pual Ridge, west flank	3	44.435	151	38.800	151.64667	3.74058	1775	100	X	Mafic and felsic dacites	2			65.0, 68.3
BG-31	G	Knoll on flank of Pual, E of Roman	3	43.205	151	41.444	151.69073	3.72008	1739		A	Andesite, ooze	2			63.4, 61.8
BG-32	G	Knoll on flank of Pual, NE of Sonne	3	42.525	151	42.360	151.70600	3.70875	1772		A	Andesite	1			62.4
299-R-02	X	PACMANUS, E flank of Pual Ridge	3	44.287	151	40.663	151.67772	3.73812	2023		A+	Felsic dacite	1			68.6
299-R-03	X	PACMANUS, E flank of Pual Ridge	3	44.083	151	40.535	151.67558	3.73472	1805		A+	Felsic dacite	1			68.8
299-R-04	X	PACMANUS, E flank of Pual Ridge	3	43.969	151	40.465	151.67442	3.73282	1776		A+	Felsic dacite	1			68.7
299-R-05	X	PACMANUS, 300m SE of Snowcap, Pual flank	3	43.823	151	40.316	151.67193	3.73038	1758		A+	Felsic dacite	1			68.8
MCV-48	C	Sample from crash at crest of knoll? Revise if dacite	3	43.205	151	41.439	151.69065	3.72008	1769		X					
Sonne Pimple																
MD-53	D	Sonne Pimple, Pual Ridge	3	42.560	151	41.359	151.68932	3.70933	1674	90	A	Andesite, mafic dacite, dk brown mud, fauna. Andesite on top of dredge	2			64.5, 60.4
MD-99	D	Sonne Pimple, Pual Ridge	3	42.556	151	41.429	151.69048	3.70927	1668	145	A	Andesite (some FeOx coat), brown ooze	1			60.3
Pual Fork																
MD-7	D	Pual Fork, east of North Pual	3	40.384	151	44.133	151.73555	3.67307	1880	110	C	Andesite, scarce ooze	1		1	57.4, 60.8*
MD-8	D	Pual Fork, NE of Sonne on extension of main ridge	3	41.962	151	42.232	151.70387	3.69937	1830	100	C	Andesite, ooze	1			61.2
MD-13	D	Pual Fork, 1 km N of North Pual	3	39.727	151	43.647	151.72746	3.66212	1950	120	C	Andesite, minor ooze	1			62.3
MD-29	D	NE arm Pual, W side north knoll	3	41.447	151	42.282	151.70471	3.69078	1820	100	C	Andesite, mud	1			59.9
MD-142	D	NE Arm, Pual Ridge, far north knoll	3	40.018	151	45.157	151.75261	3.66696	1803	5	A	Andesite, ooze	1			60.9
MG-8	G	Saddle 3km ENE of Sonne Pimple	3	42.115	151	42.482	151.70803	3.70192	1865		C	Andesite			1	61.5*
MG-12	G	S end of Pual fork	3	41.228	151	41.815	151.69692	3.68713	1868		B	Variable brown ooze, andesite chips			1	61.0*
BG-35	G	Knoll near head of Pual Fork, 4 km NE of Sonne	3	41.602	151	42.799	151.71332	3.69337	1848		B	Andesite	1			60.0
MCV-20	C	Sample from crashes near end?	3	41.200	151	43.320	151.72200	3.68667			X	400m lag? Andesite glass chips from tail			1	60.3*
MCV-22	C	Estimated sample position, hornito crashes	3	40.320	151	43.140	151.71900	3.67200			X	600m lag? Andesite glass chips from tail			1	59.1*
BV-07	C	Sample from crash near start	3	41.200	151	43.150	151.71917	3.68667	~1870		X	Small andesite rock from battery			1	62.0*
BV-08	C	Near North Pual site	3	40.5	151	43.7	151.72833	3.67500	1800		X	Large chips to 1.2 cm of andesite glass, smaller (5mm) chips mafic dacite, on batteries			2	60.1*, 63.8*
MS-13	S	Saddle in Pual Fork, 400m S of North Pual	3	40.780	151	43.642	151.72737	3.67967	1905		B	8 cm; andesite hyaloclastite, minor mud			1	62.6*
NE Arm Pual																
MD-23	D	NE arm Pual Ridge, E flank of small S knoll	3	41.991	151	43.490	151.72484	3.69985	1925	300	D	Rhyodacite, scarce ooze	1			70.5
MD-39	D	Knoll, far NE arm Pual Ridge	3	40.537	151	44.737	151.74562	3.67562	1840	135	D	Rhyodacite, ooze, pumice	1			72.5
MD-141	D	NE Arm, Pual Ridge, col S of northern crest	3	41.048	151	44.602	151.74337	3.68413	1870	10	B	Rhyodacite, hyaloclastite, ooze, bivalve	1			72.8
88-DR	D	Far N of NE Pual Ridge, east flank	3	39.936	151	46.520	151.77534	3.66560	2120	300	C	Rhyodacite, ooze	1			72.0
HDg-7	D	NE Arm, Pual Ridge, col S of northern crest	3	40.656	151	44.501	151.74168	3.67760	1813	40	X	Rhyodacite	1			69.9
MCV-15	C	Sample from crash near end of tow?	3	42.100	151	42.900	151.71500	3.70167	~1800		X	Rhyodacite chips			1	72.0*
MCV-29	C	Sample at shoal anchor site 16:55	3	40.76	151	45.01	151.75017	3.67933	1732		X	Rhyodacite chips from tail			1	72.0*
East Valley																
MD-36	D	NW base of cone nr E foot of Pual Ridge, E of Sonne	3	42.882	151	42.900	151.71500	3.71470	2000	180	D	Andesite (no ooze)	1		1	64.4, 61.0*
MD-70	D	Cone in East Valley, S of PACMANUS	3	45.248	151	40.220	151.67034	3.75413	2036	130	B	Basalt, hyaloclastite, scarce mud	1			52.1
HDg-4	D	East foot Pual Ridge, abeam Roman	3	44.150	151	41.149	151.68582	3.73583	1994	330	X	Basaltic andesite	1			55.8
299-R-01	X	PACMANUS, E foot of Pual Ridge, abeam Snowcap	3	44.474	151	40.757	151.67928	3.74123	2137		A+	Basaltic andesite	1			55.7
MCV-4	C	crash sample, E Valley floor	3	44.05	151	41.85	151.69750	3.73417	~2100		C	Chips of basalt glass			1	48.7*
96-SLS	S	East Valley	3	41.490	151	44.650	151.74417	3.69150	2200		B	Bottomed on rocks (andesite, dacite) at 3.5m; sediment section lost			3	69.4*, 62.0*,70.6*
97-SL	S	East Valley	3	41.530	151	44.550	151.74250	3.69217	2205		B	Bottomed (shallow?) on andesite, sediment section lost			1	62.5*
HPC-3	S	East Valley	3	40.5	151	46.2	151.77000	3.67500	2155		X	Piston core. 1 m disturbed ooze over rocks in nosecone				
Scarps NE of Pual																
86-DR	D	Lower scarp to NE of Pual Ridge	3	36.778	151	49.605	151.82675	3.61297	2130	310	B	Andesite, ooze	1			56.0
87-DR	D	Upper scarp to NE of Pual Ridge	3	36.702	151	47.312	151.78854	3.61169	1970	330	B	Rhyodacite, ooze	1			73.5
NW Arm Pual																
MD-11	D	Pual Fork, near foot of NW Pual	3	38.925	151	44.023	151.73371	3.64876	2050	105	D	Mafic dacite, ooze	1			64.3

MD-14	D	NW arm Pual Ridge, east foot	3	39.102	151	43.918	151.73196	3.65169	2020	300	D	Mafic dacite, Mn crust and wad, red-brown sediment (veined), ooze	1			65.4
MD-146	D	NW Pual Ridge, knoll at SW end of crest	3	40.397	151	41.923	151.69872	3.67329	1726	225	A	Fresh and silicified, flowbanded rhyodacite, ooze	1			74.1
MCV-16	C	Sample from crashes at ~1540h?	3	39.300	151	42.700	151.71167	3.65500	~1800		X	600m lag, Chips mafic dacite			1	64.8*

OTHER EDIFICES (West to East)

Dartboard

MD-51	D	Dartboard Seamount	3	24.459	151	21.249	151.35414	3.40765	1950	130	C	Basaltic andesite, ooze, pumice	1			56.5

Kumul

MD-147	D	Kumul Trough (central ridge)	3	41.499	151	27.877	151.46461	3.69164	2600	225	B	Pillow basaltic andesite, minor ooze	1			53.2
AQ-51	D	Kumul Ridge	3	41.990	151	27.900	151.46500	3.69983	2598	35	X	Pillow basaltic andesite, mud	1			54.7
RD-18	D	Kumul Ridge, east flank	3	42.310	151	27.840	151.46400	3.70517	2660	270	X	Plag-phyric pillow basalt and basaltic andesite	1			52.5

Marmin Knolls

MD-1	D	Marmin Knolls, central	3	42.549	151	34.106	151.56844	3.70914	1625	130	C	Basalt, hyaloclastite, pumice	1			52.3
MD-2	D	Marmin Knolls, west	3	40.940	151	32.742	151.54570	3.68233	1915	90	B	Basalt, scarce mud, pumice	1			52.8
MD-3	D	Marmin Knolls, east	3	42.854	151	36.773	151.61289	3.71423	2200	110	D	Basalt, hyaloclastite, ooze	1			52.1
MD-52	D	Eastern wall, Kumul Trough (Marmin)	3	44.350	151	29.537	151.49229	3.73917	2380	90	B	Olivine basalt, hyaloclastite, brown mud			1	52.8*
MD-64	D	NW Marmin Knolls	3	39.183	151	36.190	151.60316	3.65306	2254	135	A	Basalt, pumice, mud, ash layers, sulfides (contamination?	1			51.5
MD-101	D	Western Marmin Knollls, ridge	3	40.983	151	33.263	151.55438	3.68306	1639	135	A	Basalt, mud, barite chimneylet	1			52.5
MCV-1	C	Sample plotted half-way along track	3	40.9	151	35.2	151.58667	3.68167	~1900		X	Chips of basalt glass			1	52.2*
MS-12	S	Shallow enclosed basin S of Marmin Knolls	3	43.818	151	35.982	151.59970	3.73031	2388		C	Trace of silt and basalt hyaloclastite			1	52.2*

West Hammer Knoll

MD-38	D	Knoll W of Hammer Handle scarp N of Pual Ridge	3	35.887	151	40.887	151.68146	3.59812	2150	135	D	Basalt, indurated mudstone, ooze	1			50.4

Yuam

MD-5	D	Yuam Ridge, SW	3	42.371	151	43.945	151.73241	3.70619	2170	120	D	Felsic dacite, andesite, ooze, minor pumice	1		1	67.1, 60.8*
MD-6	D	Yuam Ridge, central	3	42.181	151	46.145	151.76908	3.70302	1900	120	D	Rhyodacite, andesite, basaltic andesite, ooze, minor pumice	1		2	73.7, 61.0*, 53.4*
AQ-42	D	Eastern Yuam Ridge	3	40.590	151	49.090	151.81817	3.67650	2021	115	X	Felsic dacite (ropy and compact), mud				67.3

DESMOS and Vicinity

MD-9	D	DESMOS	3	41.517	151	51.959	151.86598	3.69196	1950	70	C	Altered and fresh basaltic andesite, sulfur	1	7	1	55.7*
100/DR	D	DESMOS	3	41.509	151	52.008	151.86680	3.69182	1900	45	D	Basaltic andesite	1			55.3
HDg-6	D	DESMOS	3	42.013	151	52.017	151.86695	3.70022	2038	0	X	Basaltic andesite				
AQ-39B	D	DESMOS, N end caldera	3	41.430	151	51.920	151.86533	3.69050	1899	5	X	Altered basaltic andesite with pyrite & sulfur				
AQ-39C	D	DESMOS, N end, inner caldera	3	41.540	151	51.990	151.86650	3.69233	1961	350	X	Altered basaltic andesite with pyrite & sulfur				
AQ-43	D	Elongate trough NE of DESMOS	3	40.220	151	56.100	151.93500	3.67033	2165	265	X	Basaltic andesite (Fe coat), mud	1			55.3
AQ-48A	D	DESMOS, N end caldera	3	41.540	151	52.010	151.86683	3.69233	1963	305	X	Basaltic andesite, fauna				
AQ-48B	D	Cresent ridge on N side of DESMOS	3	41.120	151	52.020	151.86700	3.68533	1859	350	X	Basaltic andesite	1			55.7
AQ-48C	D	DESMOS, N end, inner caldera	3	41.610	151	52.090	151.86817	3.69350	1980	330	X	Fresh and altered basaltic andesite	1			55.8
RD-16	D	DESMOS, east wall	3	42.105	151	52.440	151.87400	3.70175	2025	90	X	Fresh and part-altered basaltic andesite	1			55.3
HPC-2	S	DESMOS cldera floor	3	41.7	151	52.3	151.87167	3.69500	2080		X	Piston core. 20 cm basalt gravel				
71-RD	H	DESMOS	3	41.469	151	52.048	151.86747	3.69115	1924		A	1.54m penetration, 26 cm core, altered andesite				
72-RD	H	DESMOS	3	41.500	151	52.000	151.86667	3.69167	1925		A	1.15m penetration, 17 cm core, fresh andesite				
73-RD	H	DESMOS	3	41.510	151	52.001	151.86668	3.69183	1919		A	4.62m penetration, 80 cm core, altered andesite				

Umbo

MD-43	D	Umbo Knolls, E flank of East Knoll	3	43.240	151	55.808	151.93013	3.72067	1850	270	D	Porphyritic basaltic andesite, basalt hyaloclastite, ooze, pumice	2			53.5, 52.0
MD-115	D	Umbo Knolls, west peak	3	43.206	151	53.746	151.89577	3.72009	1562	140	B	Olivine basalt, hyaloclastite, brown mud	1			51.4

Tumbo-Lunar-Tumai

MD-90	D	East Tumbo Knoll	3	45.989	152	0.491	152.00818	3.76649	1733	140	C	Basalt, ooze, pumice	1			52.8
RD-15	D	Tumbo, west slope	3	46.710	151	58.600	151.97667	3.77850	1850	90	X	Basaltic andesite (porphyritic), mud	1			54.0
MD-44	D	NW end, Tumai Ridge	3	43.571	152	2.125	152.03541	3.72619	2050	120	D	Porphyritic basaltic andesite, ooze, pumice	1			55.2
MD-79	D	Lunar Cone	3	39.710	152	2.534	152.04224	3.66183	1890	90	A	Porph. andesite, mud	2			61.8, 61.2

Bugave Ridge & vicinity

MD-74	D	Basement scarp near Weitin Fault/Bugave Ridge	3	44.675	152	10.471	152.17451	3.74459	1756	225	B	Mud, basalt, mudstone?	1			51.3
MD-80	D	SW Bugave Ridge	3	46.286	152	7.362	152.12270	3.77143	1700	300	B	Andesite, mud	1			60.1
AQ-31	D	Bugave Ridge, west flank	3	44.710	152	8.210	152.13683	3.74517	1841	35	X	Basaltic andesite pillows, brown mud, pumice	1			57.9
AQ-32	D	Bugave Ridge, crest	3	44.790	152	8.800	152.14667	3.74650	1763	30	X	Mafic dacite (plag phx), brown mud	1			64.6
RD-14	D	Bugave Ridge, crest?	3	42.880	152	10.405	152.17342	3.71467	1850	120	X	Basaltic andesite and mafic dacite; pumice, mud	2			53.2, 63.3

Suzette

MD-94	D	SuSu Knolls, Suzette	3	47.341	152	5.600	152.09333	3.78901	1524	125	B	Sulfides, sulfidic grit, porphyritic mafic dacite	1			64.3
HDg-8	D	SuSu Knolls; Suzette	3	47.202	152	5.626	152.09377	3.78670	1506	135	X	Porphyritic mafic dacite, sulfide chimney	1			64.7

MG-26	G	Suzette	3	47.372	152	5.848	152.09747	3.78953	1530		A	2 cm black mud overlying 6 cm pale grey mud, with porphyritic mafic dacite fragments at base	1			63.4
74-RD	H	Suzette	3	47.354	152	5.631	152.09385	3.78923	1517		A	3.20m penetration, 25 cm core, vesicular "dacite" (no phenocrysts?)				

Suzette vicinity

MD-75	D	SuSu Knolls, Suzette W flank	3	47.348	152	5.385	152.08975	3.78914	1568	90	A	Andesite, mud, ash layers	1			60.2

North Su

MD-54	D	SuSu Knolls, W slope North Su	3	48.062	152	5.794	152.09657	3.80103	1322	90	A	Fresh porphyritic andesite	1			62.6
MD-83	D	SuSu Knolls, North Su crest	3	47.972	152	6.068	152.10113	3.79953	1167	135	A	Fresh and slightly altered porph andesite; silt	1			62.8
MD-96	D	SuSu Knolls, crest of North Su	3	47.927	152	6.019	152.10032	3.79878	1176	130	A	Fresh and altered porph andesite; sulfides, sulfidic grit	1	4		62.5
MD-97	D	SuSu Knolls, crest of North Su	3	47.962	152	6.029	152.10049	3.79936	1168	135	A	Fresh and altered porph andesite, sulfides	1	2		62.6
MD-116	D	SuSu Knolls, Crest of North Su	3	47.994	152	6.067	152.10111	3.79991	1173	130	A	Fresh and altered porph andesite-dacite, sulfidic mud				
MD-117	D	SuSu Knolls, Crest of North Su	3	47.963	152	6.029	152.10048	3.79939	1175	135	B	Altered porph andesite-dacite, sulfur		4		
MD-120	D	SuSu Knolls, Crest of North Su	3	47.956	152	6.030	152.10050	3.79927	1161	160	A	Fresh and altered porph andesite-dacite				
MD-122	D	SuSu Knolls, crest of North Su	3	48.565	152	6.248	152.10413	3.80942	1319	140	B	Sulfidic grit, altered andesite-dacite, ash layer, bivalve				
AQ-35A	D	North Su, west flank	3	48.280	152	5.530	152.09217	3.80467	1655	80	X	Porphyritic mafic dacite, mud	1			64.5
MG-38	G	North Su crest	3	47.991	152	6.062	152.10103	3.79985	1166		C	Sulfidic grit with cm fragments altered dacite/pyrite breccia, white sulfur surface		1		67.2
MG-48	G	North Su crest	3	48.018	152	6.100	152.10167	3.80030	1199		A	Fresh and altered porph andesite-dacite, sulfur				
MS-51	S	North Su crest	3	47.996	152	6.066	152.10110	3.79994	1172		A	Fragments fresh and altered andesite-dacite, sulfur				
MCV-32	C	Exploration of crest North Su										Porphyritic andesite	1			61.2

South Su

MD-55	D	SuSu Knolls, SW slope South Su	3	49.016	152	5.545	152.09242	3.81693	1660	90	B	Mud, andesite, pumice	1			60.7
MD-77	D	South Su	3	48.515	152	6.238	152.10397	3.80858	1324	225	B	Fresh and altered porphyrtic dacite; sulfide breccias; layered mud	1	4		66.9
MD-82	D	SuSu Knolls, S flank of South Su	3	48.640	152	6.319	152.10531	3.81067	1340	310	B	Fresh and altered porph dacite; mud; leyered silty sandstone(?); fauna	1			64.0
MD-92	D	SuSu Knolls, crest of South Su	3	48.450	152	6.195	152.10325	3.80751	1335	135	A	Fresh and altered porph dacite, grit, abundant fauna	1	9		63.8
MD-93	D	SuSu Knolls, crest of South Su	3	48.417	152	6.622	152.11037	3.80694	1472	140	B	Fresh and altered porph dacite, black sedoment, fauna	1			64.5
MG-19	G	South Su crest	3	48.520	152	6.260	152.10433	3.80867	1319		A	Altered sulfidic and some fresh porphyritic dacite				

SuSu Vicinity

MD-72	D	SuSu Knolls, Cleavage Col	3	48.320	152	6.132	152.10220	3.80533	1412	45	B	Fresh and weakly altered porphyritic dacite, mud	1			63.3
MD-78	D	SuSu Knolls, col b/n North Su and Suzette	3	47.666	152	5.878	152.09797	3.79443	1460	300	B	Porphyritic dacite, mud	1			63.3
MG-30	G	East foot of North Su, under plume	3	47.836	152	6.523	152.10872	3.79727	1535		D	Graded black volcanic sand and gravel			1	64.6*
MG-31	G	East of SuSu Knolls	3	48.450	152	7.130	152.11883	3.80750	1661		C	Stratified sand and granule gravel, porph dacite fragments	1			63.9

Nimab

MD-73	D	Nimab, SW foot	3	49.297	152	10.832	152.18054	3.82162	1320	90	B	Porphyritic basaltic andesite, brown mud, pumice	1			59.1
MD-85	D	Crest of Nimab	3	49.204	152	11.143	152.18572	3.82006	1045	130	B	Fresh and altered porph andesite, minor ooze	1			59.2

Small volcanoes south of SuSu

MD-87	D	Small volcano S of Nimab	3	53.054	152	11.432	152.19054	3.88423	1520	150	C	Basalt, ooze	1			51.3
MD-107	D	Small volcano S of SuSu Knolls	3	52.511	152	3.842	152.06404	3.87518	1680	140	C	Porphyritic basalt, pumice, ooze	1			51.0
MD-108	D	Small volcano on scarp SW of SuSu Knolls	3	51.334	152	0.332	152.00554	3.85556	1874	135	C	Basalt, sandstone, ooze, pumice	1			52.6

Basement Scarps

MD-34	D	Basement ridge (5th W of Kumul), far NW EMVZ	3	31.085	151	22.290	151.37150	3.51809	2150	145	D	Basalt; mud, semilithified mudstone, pumice	1			52.4
MD-40	D	Basement ridge near Djaul Flt, 10nm S of Pual Ridge	3	51.783	151	36.094	151.60157	3.86305	1950	160	C	Basaltic andesite, mud, pumice	1			53.7
MD-50	D	Scarp, far NW of East Manus Basin	3	22.727	151	12.825	151.21374	3.37879	2113	320	C	Pumice, felsic dacite, sedimentary rocks (basalt clasts), trace mud	1		1	68.9, 53.0*
MD-67	D	Basement scarp, W side of Kumul Trough	3	41.113	151	26.093	151.43488	3.68521	2240	310	C	Basalt, sandstone, mudstone, mud, pumice	2			52.7, 51.6
MD-69	D	Basement scarp SE of Yuam Ridge	3	46.192	151	45.758	151.76263	3.76986	2090	315	C	Mud, mafic dacite, ash layers, rare pumice	2			65.1, 64.9
MD-105	D	Ridge near NW end of Weitin Fault	3	33.778	151	55.733	151.92888	3.56297	1892	135	A	Basaltic andesite, ooze, ash layer	2			54.1, 54.1

Appendix 3

Eastern Manus Basin Operations Yielding Sediments

SAMPLING OPERATIONS WITH SEDIMENT

See explanatory notes

Operation	Type	Location	Latitude deg	Latitude min	Longitude deg	Longitude min	Decimal Long	Decimal Lat	Depth (m)	Haul Dirn	Nav Precn	Recovery (The terms mud and ooze are used interchageably in this column)	Chemical Analyses	Holder of samples
PUAL RIDGE AND VICINITY														
SW Pual Ridge														
MD-22	D	SW end Pual Ridge	3	45.235	151	38.635	151.64391	3.75391	1965	270	D	Felsic dacite, ooze, rare pumice	1	CSIRO
Tsukushi and vicinity														
MG-6	G	PACMANUS, 200m SE of Tsukushi	3	43.860	151	40.117	151.66862	3.73100	1665		D	Mafic dacite tube pumice, mollusc, mud	1	CSIRO
MG-52	G	PACMANUS, Tsukushi	3	43.775	151	40.034	151.66723	3.72958	1665		A	MnOx encrusted snails; brown ooze		CSIRO
90-GTV	GTV	PACMANUS, NE side ofTsukushi	3	43.739	151	40.050	151.66750	3.72898	1663		B	Mn-Fe oxides (cauliflower mound), felsic dacite, minor ooze		CSIRO, TUBAF
Between Tsukushi and Snowcap														
MG-7	G	PACMANUS, 150m SSW of Snowcap	3	43.774	151	40.161	151.66935	3.72957	1660		D	Felsic dacite glass and tube pumice chips, mud		CSIRO
MG-34	G	PACMANUS, between Snowcap & Tsukushi	3	43.740	151	40.095	151.66825	3.72900	1667		B	5 cm red-brown ooze overlying ropy lava top (dacite?)	1	CSIRO
Snowcap														
MD-24	D	PACMANUS, Snowcap, SE flank	3	43.698	151	40.223	151.67038	3.72830	1653	235	B	Fresh felsic dacite & hyaloclastite (early), altered dacite (some Fe stained) and "Talenga" chimney (late), fauna, ooze	1	CSIRO
MD-27	D	PACMANUS, Snowcap, E side	3	43.675	151	40.214	151.67024	3.72791	1660	45	B	Felsic dacite, dark mud	1	CSIRO
MD-65	D	PACMANUS (West Snowcap)	3	43.718	151	40.112	151.66854	3.72863	1655	45	A	Felsic dacite (early); pyritic breccia, fauna (late), ooze	1	CSIRO
MG-2	G	PACMANUS, NE side of Snowcap	3	43.640	151	40.215	151.67025	3.72733	1668		C	Mn encrusted rhyodacite tube pumice, mud	1	CSIRO
MG-15	G	PACMANUS, east side of Snowcap	3	43.666	151	40.256	151.67093	3.72777	1653		B	Brown mud, Fe-MnOx and dacite pumice chips, fauna	2	CSIRO
MG-16	G	PACMANUS. Snowcap	3	43.695	151	40.205	151.67008	3.72825	1652		C	Fresh and altered rhyodacite in surficial brown mud, mostly rocks deeper. fauna and bacterial mat	1	CSIRO
MG-49	G	PACMANUS, Snowcap	3	43.680	151	40.176	151.66960	3.72800	1643		A	Gravel; altered and sulfidic dacite; tubeworms; H2S		CSIRO
MG-50	G	PACMANUS, Snowcap, west side	3	43.688	151	40.159	151.66932	3.72813	1644		A	Glassy felsic dacite, brown ooze		CSIRO
MG-53	G	PACMANUS, Snowcap, E side	3	43.680	151	40.220	151.67033	3.72800	1645		B	Glassy rhyodacite, brown ooze; tubeworm		CSIRO
299-Sed-03	X	PACMANUS, Snowcap	3	43.692	151	40.219	151.67032	3.72820	1656		A+	Filtered sediment	?	GSJ
299-Sed-04	X	PACMANUS, Snowcap	3	43.692	151	40.219	151.67032	3.72820	1656		A+	Filtered sediment	?	GSJ
299-Sed	X	PACMANUS - Snowcap, Sed in basket from crash	3	43.979	151	40.470	151.67450	3.73298	1782		A+	Ooze	?	GSJ
305-Sed-01	X	PACMANUS, west side of Snowcap	3	43.689	151	40.158	151.66930	3.72815	1656		A+	Filtered sediment	?	GSJ
MC-03	S	PACMANUS, Snowcap	3	43.674	151	40.186	151.66977	3.72790	1690		X	Multicorer. Cobble of fresh dacite, trace foram sand. Ship drifted off		KORDI
MC-04	S	PACMANUS, Snowcap	3	43.720	151	40.192	151.66987	3.72867	1636		X	Multicorer. Foram sand. Ship drifted off ststion.		KORDI
MC-05	S	PACMANUS, Snowcap	3	43.682	151	40.209	151.67015	3.72803	1642		B?	Multicorer. 4 cores, 10-15 cm gravel, fresh and altered dacite, native S		KORDI, CSIRO
Between Snowcap and Satanic														
MD-20	D	PACMANUS, just NE of Snowcap	3	43.602	151	40.281	151.67135	3.72671	1695	240	C	Felsic dacite (some Fe-Mn coats), rare tiny altered dacite, fauna, scarce mud	1	CSIRO
MG-18	G	PACMANUS. 200 m E of Snowcap, 150m S of Satanic	3	43.699	151	40.310	151.67183	3.72832	1660		C	Dacite tube pumice fragments in brown mud	1	CSIRO
Satanic														
MD-28	D	PACMANUS, NE side of Satanic Mills	3	43.540	151	40.415	151.67358	3.72566	1688	235	C	Felsic dacite, sulfide chimney, fauna, ooze	1	CSIRO
MD-62	D	PACMANUS (Satanic Mills)	3	43.615	151	40.320	151.67200	3.72692	1678	130	A	Sulfides, minor fresh and altered rhyodacite, fauna, ooze	1	CSIRO
84-GTV	GTV	PACMANUS, SE side of Satanic Mills (juvenile vent?)	3	43.636	151	40.376	151.67293	3.72727	1710		B	Felsic dacite (bloom), fauna, minor ooze	1	TUBAF, CSIRO
301-Sed-01	X	PACMANUS, Satanic Mills	3	43.609	151	40.338	151.67230	3.72682	1708		A+	Filtered sediment	?	GSJ
Between Satanic and Roman														
MG-4	G	PACMANUS, 400m WSW of Roman, towards Satanic	3	43.298	151	40.300	151.67167	3.72163	1679		C	Microlitic and frothy glassy felsic dacite chips (pumice surfaces?), trace mud		CSIRO
Roman														
MD-56	D	PACMANUS (Roman Ruins)	3	43.212	151	40.516	151.67526	3.72019	1689	135	A	Mafic dacite (Fe stain), sulfides, ooze	1	CSIRO
MD-61	D	PACMANUS (Roman Ruins)	3	43.237	151	40.497	151.67496	3.72062	1694	135	A	Sulfides, fauna, ooze	1	CSIRO
MD-100	D	PACMANUS, S side of Roman Ruins	3	43.261	151	40.496	151.67494	3.72101	1695	125	A	FeOxides, mafic dacite, brown mud		CSIRO
MG-17	G	PACMANUS, Roman Ruins	3	43.243	151	40.510	151.67517	3.72072	1694		A	Sulfide chimney fragments, sulfidic mud	1	CSIRO
304-Sed-01	X	PACMANUS, Roman Ruins	3	43.244	151	40.506	151.67510	3.72073	1692		A+	Filtered sediment	?	GSJ
304-Sed-02	X	PACMANUS, Roman Ruins	3	43.244	151	40.506	151.67510	3.72073	1692		A+	Filtered sediment	?	GSJ
Roman vicinity														

MD-98	D	PACMANUS, 150m NE of Roman Ruins	3	43.183	151	40.558	151.67596	3.71972	1689	140	A	Felsic dacite, trace brown ooze	1	CSIRO
95-GTV	GTV	PACMANUS, Roman Ruins	3	43.263	151	40.494	151.67489	3.72104	1698		C	FeOx, consolidated brown ooze, mafic dacite, brown ooze (from next to chimney with fauna)	1	TUBAF, CSIRO
Rogers														
MD-59	D	PACMANUS (Rogers Ruins)	3	43.137	151	40.430	151.67384	3.71895	1701	135	A	Sulfides, FeOMnOx, mafic dacite, mud (with sulfide chips)	1	CSIRO
MD-60	D	PACMANUS (Rogers Ruins)	3	43.132	151	40.442	151.67404	3.71887	1699	135	B	Mafic dacite(early), Fe-MnOx, sulfides (later), ooze	1	CSIRO
NE Crestal Knoll, Pual														
MG-11R	G	Crest of main knoll NE of PACMANUS	3	42.906	151	41.112	151.68520	3.71510	1669		B	Mafic dacite, some pumice, minor oze		CSIRO
MCV-24	C	Sample plotted half-way along track	3	43.135	151	41.108	151.68513	3.71892			X	Glass chips of felsic dacite in tail, ooze on cage	1	CSIRO
K2244	S, G	NE Crestal Knoll, Pual Ridge	3	41.2	151	42.8	151.71333	3.68667			X	Core and grab		Shirshov
Twin Knolls														
MD-26	D	Twin Knolls, N of PACMANUS	3	42.470	151	39.882	151.66470	3.70783	1880	90	C	Andesite, mud	1	CSIRO
MG-10	G	Enclosed basin near Twin Knolls	3	42.048	151	40.452	151.67420	3.70080	1939		C	Dark brown ooze with andesite (1 cm), some pumice	1	CSIRO
MG-13	G	Head of West Valley, SW of Twin Knolls	3	42.788	151	39.180	151.65300	3.71313	2215		C	Colour-banded mud	1	CSIRO
Flanks of Pual Ridge														
MD-16	D	PACMANUS, west flank Pual	3	43.317	151	39.950	151.66583	3.72195	1720	140	C	Felsic dacite, ooze	1	CSIRO
MD-66	D	Knoll on eastern flank of Pual Ridge, E of Roman	3	43.217	151	41.376	151.68960	3.72028	1716	135	A	Mafic dacite, minor mud	1	CSIRO
BG-31	G	Knoll on flank of Pual, E of Roman	3	43.205	151	41.444	151.69073	3.72008	1739		A	Andesite, ooze	1	CSIRO
299-Sed	X	PACMANUS - E Flank Pual, Sed in basket from crash	3	43.979	151	40.470	151.67450	3.73298	1782		B	Ooze	1	CSIRO, GSJ
Sonne Pimple														
MD-53	D	Sonne Pimple, Pual Ridge	3	42.560	151	41.359	151.68932	3.70933	1674	90	A	Andesite, dacite, dk brown mud, fauna. Andesite on top of dredge	1	CSIRO
MD-99	D	Sonne Pimple, Pual Ridge	3	42.556	151	41.429	151.69048	3.70927	1668	145	A	Andesite (some FeOx coat), brown ooze	1	CSIRO
Pual Fork														
MD-7	D	Pual Fork, east of North Pual	3	40.384	151	44.133	151.73555	3.67307	1880	110	C	Andesite, scarce ooze	2	CSIRO
MD-8	D	Pual Fork, NE of Sonne on extension of main ridge	3	41.962	151	42.232	151.70387	3.69937	1830	100	C	Andesite, ooze	1	CSIRO
MD-12	D	Pual Fork	3	40.715	151	42.083	151.70138	3.67859	1872	105	C	Ooze, pumice	2 (duplicate)	CSIRO
MD-13	D	Pual Fork, 1 km N of North Pual	3	39.727	151	43.647	151.72746	3.66212	1950	120	C	Andesite, minor ooze	1	CSIRO
MD-29	D	NE arm Pual, W side north knoll	3	41.447	151	42.282	151.70471	3.69078	1820	100	C	Andesite, mud	1	CSIRO
MD-142	D	NE Arm, Pual Ridge, far north knoll	3	40.018	151	45.157	151.75261	3.66696	1803	5	A	Andesite, ooze		CSIRO
MG-12	G	S end of Pual fork	3	41.228	151	41.815	151.69692	3.68713	1868		B	Variable brown ooze, andesite chips	1	CSIRO
NE Arm Pual														
MD-23	D	NE arm Pual Ridge, E flank of small S knoll	3	41.991	151	43.490	151.72484	3.69985	1925	300	D	Rhyodacite, scarce ooze	1	CSIRO
MD-39	D	Knoll, far NE arm Pual Ridge	3	40.537	151	44.737	151.74562	3.67562	1840	135	D	Rhyodacite, ooze, pumice	1	CSIRO
MD-141	D	NE Arm, Pual Ridge, col S of northern crest	3	41.048	151	44.602	151.74337	3.68413	1870	10	B	Rhyodacite, hyaloclastite, ooze, bivalve	1	CSIRO
88/DR	D	Far N of NE Pual Ridge, east flank	3	39.936	151	46.520	151.77534	3.66560	2120	300	C	Rhyodacite, ooze	1	TUBAF, CSIRO
East Valley														
MD-70	D	Cone in East Valley, S of PACMANUS	3	45.248	151	40.220	151.67034	3.75413	2036	130	B	Basalt, hyaloclastite, scarce mud	1	CSIRO
Scarps NE of Pual														
86/DR	D	Lower scarp to NE of Pual Ridge	3	36.778	151	49.605	151.82675	3.61297	2130	310	B	Andesite, ooze	1	TUBAF, CSIRO
87DR	D	Upper scarp to NE of Pual Ridge	3	36.702	151	47.312	151.78854	3.61169	1970	330	B	Rhyodacite, ooze	1	TUBAF, CSIRO
NW Arm Pual														
MD-10	D	Basin at W foot of NW arm Pual Ridge	3	38.644	151	42.333	151.70555	3.64407	2120	125	C	Ooze	1	CSIRO
MD-11	D	Pual Fork, near foot of NW Pual	3	38.925	151	44.023	151.73371	3.64876	2050	105	D	Mafic dacite, ooze	1	CSIRO
MD-14	D	NW arm Pual Ridge, east foot	3	39.102	151	43.918	151.73196	3.65169	2020	300	D	Mafic dacite, Mn crust and wad, red-brown sediment (veined), ooze	6	CSIRO
MD-146	D	NW Pual Ridge, knoll at SW end of crest	3	40.397	151	41.923	151.69872	3.67329	1726	225	A	Fresh and silicified, flowbanded rhyodacite, ooze		CSIRO
MCV-8	C	E foot of NW Pual Ridge	3	40.2	151	43.1	151.71833	3.67000	~1890		X	Ooze on cage, crash near start	1	CSIRO
OTHER EDIFICES (West to East)														
Dartboard														
MD-51	D	Dartboard Seamount	3	24.459	151	21.249	151.35414	3.40765	1950	130	C	Basaltic andesite, ooze, pumice		CSIRO
Kumul														
MD-147	D	Kumul Trough (central ridge)	3	41.499	151	27.877	151.46461	3.69164	2600	225	B	Pillow basaltic andesite, minor ooze		CSIRO
AQ-51	D	Kumul Ridge	3	41.990	151	27.900	151.46500	3.69983	2598	35	X	Pillow basaltic andesite, mud		ORI

MCV-8	C	E foot of NW Pual Ridge	3	40.2	151	43.1	151.71833	3.67000	~1890		X	Ooze on cage, crash near start		CSIRO
Marmin Knolls														
MD-1	D	Marmin Knolls, central	3	42.549	151	34.106	151.56844	3.70914	1625	130	C	Basalt, hyaloclastite, pumice	1	CSIRO
MD-2	D	Marmin Knolls, west	3	40.940	151	32.742	151.54570	3.68233	1915	90	B	Basalt, scarce mud, pumice	1	CSIRO
MD-3	D	Marmin Knolls, east	3	42.854	151	36.773	151.61289	3.71423	2200	110	D	Basalt, hyaloclastite, ooze	1	CSIRO
MD-52	D	Eastern wall, Kumul Trough (Marmin)	3	44.350	151	29.537	151.49229	3.73917	2380	90	B	Olivine basalt, hyaloclastite, brown mud		CSIRO
MD-64	D	NW Marmin Knolls	3	39.183	151	36.190	151.60316	3.65306	2254	135	A	Basalt, pumice, mud, ash layers, sulfides (contamination?	1	CSIRO
MD-101	D	Western Marmin Knollls, ridge	3	40.983	151	33.263	151.55438	3.68306	1639	135	A	Basalt, mud, barite chimneylet	1	CSIRO
K2249	S, G	Marmin Knolls	3	39.7	151	34.3	151.57167	3.66167			X	Core and grab		Shirshov
West Hammer Knoll														
MD-38	D	Knoll W of Hammer Handle scarp N of Pual Ridge	3	35.887	151	40.887	151.68146	3.59812	2150	135	D	Basalt, indurated mudstone, ooze	1	CSIRO
Yuam														
MD-5	D	Yuam Ridge, SW	3	42.371	151	43.945	151.73241	3.70619	2170	120	D	Felsic dacite, andesite, ooze, minor pumice	1	CSIRO
MD-6	D	Yuam Ridge, central	3	42.181	151	46.145	151.76908	3.70302	1900	120	D	Rhyodacite, andesite, basaltic andesite, ooze, minor pumice	1	CSIRO
AQ-42	D	Eastern Yuam Ridge	3	40.590	151	49.090	151.81817	3.67650	2021	115	X	Felsic dacite (ropy and compact), mud		ORI
DESMOS Vicinity														
AQ-43	D	Elongate trough NE of DESMOS	3	40.220	151	56.100	151.93500	3.67033	2165	265	X	Basaltic andesite (Fe coat), mud		ORI
Umbo														
MD-43	D	Umbo Knolls, E flank of East Knoll	3	43.240	151	55.808	151.93013	3.72067	1850	270	D	Basaltic andesite, basalt hyaloclastite, ooze, pumice	1	CSIRO
MD-115	D	Umbo Knolls, west peak	3	43.206	151	53.746	151.89577	3.72009	1562	140	B	Olivine basalt, hyaloclastite, brown mud	1	CSIRO
Tumbo-Lunar-Tumai														
MD-90	D	East Tumbo Knoll	3	45.989	152	0.491	152.00818	3.76649	1733	140	C	Basalt, ooze, pumice	1	CSIRO
RD-15	D	Tumbo, west slope	3	46.710	151	58.600	151.97667	3.77850	1850	90	X	Basaltic andesite (porphyritic), mud		HIG
MD-44	D	NW end, Tumai Ridge	3	43.571	152	2.125	152.03541	3.72619	2050	120	D	Porphyritic basaltic andesite, ooze, pumice	1	CSIRO
MD-45	D	Tumai Ridge, centre	3	46.280	152	4.302	152.07170	3.77133	1650	90	D	Ooze, pumice		CSIRO
MD-79	D	Lunar Cone	3	39.710	152	2.534	152.04224	3.66183	1890	90	A	Porph andesite, mud	1	CSIRO
Bugave Ridge & vicinity														
MD-74	D	Basement scarp near Weitin Fault/Bugave Ridge	3	44.675	152	10.471	152.17451	3.74459	1756	225	B	Mud, basalt, mudstone?	1	CSIRO
MD-80	D	SW Bugave Ridge	3	46.286	152	7.362	152.12270	3.77143	1700	300	B	Andesite, mud	1	CSIRO
MD-106	D	Young lava field NW end of Tumai Ridge	3	43.785	152	5.591	152.09319	3.72974	1946	135	C	Ooze, ash layer (but anchored)	1	CSIRO
AQ-31	D	Bugave Ridge, west flank	3	44.710	152	8.210	152.13683	3.74517	1841	35	X	Basaltic andesite pillows, brown mud, pumice		ORI
AQ-32	D	Bugave Ridge, crest	3	44.790	152	8.800	152.14667	3.74650	1763	30	X	Mafic dacite (plag phx), brown mud		ORI
RD-14	D	Bugave Ridge, crest?	3	42.880	152	10.405	152.17342	3.71467	1850	120	X	Basaltic andesite and mafic dacite; pumice, mud		HIG
Suzette														
MD-76	D	SuSu Knolls, Suzette	3	47.418	152	5.653	152.09422	3.79030	1516	310	A	Suilfides, sulfidic mud	1	CSIRO
MD-81	D	SuSu Knolls, Suzette	3	47.277	152	5.587	152.09312	3.78796	1511	145	A	Sulfides; stratified grey and black sulfidic silt	1	CSIRO
MD-94	D	SuSu Knolls, Suzette	3	47.341	152	5.600	152.09333	3.78901	1524	125	B	Sulfides, sulfidic grit, porphyritic andesite	1	CSIRO
MD-121	D	SuSu Knolls, Suzette	3	43.363	152	5.600	152.09333	3.72272	1514	135	A	Sulfides, gritty sediment, snails		CSIRO
MD-123	D	SuSu Knolls, Suzette	3	47.330	152	5.587	152.09312	3.78883	1513	130	A	Sulfides, sulfidic silt		CSIRO
MD-134	D	SuSu Knolls, Suzette	3	47.374	152	5.661	152.09434	3.78957	1514	270	A	Sulfidic grit, pieces chimney, fauna		CSIRO
MG-20	G	Suzette	3	47.400	152	5.662	152.09437	3.79000	1523		A	Dark green silty sediment	1	CSIRO
MG-24	G	Suzette	3	47.365	152	5.643	152.09405	3.78942	1521		A	Grey sand overlying brown mud	1	CSIRO
MG-26	G	Suzette	3	47.372	152	5.848	152.09747	3.78953	1530		A	2 cm black mud overlying 6 cm pale grey mud, with porphyritic mafic daci fragments at base	1	CSIRO
MS-36	S	Suzette	3	47.274	152	5.574	152.09290	3.78789	1515		A	75 cm; bedded sulfidic sand; possible chimney fragments, possible ash blebs	9	CSIRO
MS-40	S	Suzette, SuSu Knolls	3	47.346	152	5.679	152.09464	3.78911	1518		C	Trace dark grey to black grit in cone	1	CSIRO
MS-42	S	Suzette, SuSu Knolls	3	47.396	152	5.722	152.09536	3.78994	1528		C	27 cm; disturbed sulfidic sand	1	CSIRO
Suzette vicinity														
MD-75	D	SuSu Knolls, Suzette W flank	3	47.348	152	5.385	152.08975	3.78914	1568	90	A	Andesite, mud, ash layers	1	CSIRO

MD-86	D	NW of Suzette	3	47.032	152	5.447	152.09079	3.78387	1584	130	B	Sulfidic silty ooze, fauna, pumice	1	CSIRO
MG-27	G	East of Suzette	3	47.386	152	6.050	152.10083	3.78977	1599		B	Massive dark grey to black sand	1	CSIRO
MG-28	G	Ridge ENE of Suzette	3	46.885	152	6.483	152.10805	3.78142	1683		C	Grey mud with dark streaks and some sand	1	CSIRO
MG-37	G	East of Suzette 800m	3	47.100	152	6.062	152.10103	3.78500	1649		C	Layered sediment, 1.5cm khaki ooze over 2.5cm laminated black silt over 5 cm massive grey silt		CSIRO
North Su														
MD-83	D	SuSu Knolls, North Su crest	3	47.972	152	6.068	152.10113	3.79953	1167	135	A	Fresh and slightly altered porph dacite; silt	1	CSIRO
MD-96	D	SuSu Knolls, crest of North Su	3	47.927	152	6.019	152.10032	3.79878	1176	130	A	Fresh and altered porph andesite; sulfides, sulfidic grit	1	CSIRO
MD-116	D	SuSu Knolls, Crest of North Su	3	47.994	152	6.067	152.10111	3.79991	1173	130	A	Fresh and altered porph andesite-dacite, sulfidic mud	1	CSIRO
MD-122	D	SuSu Knolls, crest of North Su	3	48.565	152	6.248	152.10413	3.80942	1319	140	B	Sulfidic grit, altered andesite-dacite, ash layer, bivalve		CSIRO
AQ-35A	D	North Su, west flank	3	48.280	152	5.530	152.09217	3.80467	1655	80	X	Porphyritic mafic dacite, mud		ORI
MG-21R	G	North Su crest	3	48.014	152	5.970	152.09950	3.80023	1183		A	Dark green sand	1	CSIRO
MG-36	G	North Su crest	3	48.057	152	6.093	152.10155	3.80095	1200		B	Sulfidic grit, sulfur, H2S? Smell		CSIRO
MG-38	G	North Su crest	3	47.991	152	6.062	152.10103	3.79985	1166		C	Sulfidic grit with cm fragments altered dacite/pyrite breccia, white sulfur surface		CSIRO
South Su														
MD-55	D	SuSu Knolls, SW slope South Su	3	49.016	152	5.545	152.09242	3.81693	1660	90	B	Mud, andesite, pumice	1	CSIRO
MD-77	D	South Su	3	48.515	152	6.238	152.10397	3.80858	1324	225	B	Fresh and altered porphyrtic dacite; sulfide breccias; layered mud		CSIRO
MD-82	D	SuSu Knolls, S flank of South Su	3	48.640	152	6.319	152.10531	3.81067	1340	310	B	Fresh and altered porph dacite; mud; leyered silty sandstone(?); fauna		CSIRO
MD-91	D	SuSu Knolls, crest of South Su	3	48.557	152	6.251	152.10418	3.80929	1326	140	B	Black sulfidic and brown mud		CSIRO
MD-92	D	SuSu Knolls, crest of South Su	3	48.450	152	6.195	152.10325	3.80751	1335	135	A	Fresh and altered porph dacite, grit, abundant fauna		CSIRO
MD-93	D	SuSu Knolls, crest of South Su	3	48.417	152	6.622	152.11037	3.80694	1472	140	B	Fresh and altered porph dacite, black sedoment, fauna		CSIRO
MD-95	D	SuSu Knolls, crest of South Su	3	48.550	152	6.269	152.10449	3.80917	1329	140	A	Sulfides, grey mud		CSIRO
MG-22	G	S foot of South Su, - under eye of plume	3	49.300	152	6.150	152.10250	3.82167	1647		A	1 cm black sulfidic mud over 4 cm grey mud over 5cm brown mud	2	CSIRO
SuSu Vicinity														
MD-72	D	SuSu Knolls, Cleavage Col	3	48.320	152	6.132	152.10220	3.80533	1412	45	B	Fresh and weakly altered porphyritic dacite, mud	1	CSIRO
MD-78	D	SuSu Knolls, col b/n North Su and Suzette	3	47.666	152	5.878	152.09797	3.79443	1460	300	B	Porphyritic dacite, mud	1	CSIRO
MG-29	G	Enclosed basin E of SuSu Knolls	3	49.013	152	8.236	152.13727	3.81688	1737		A	Massive black gritty silt, H2S, pumice resting on top	2	CSIRO
MG-30	G	East foot of North Su, under plume	3	47.836	152	6.523	152.10872	3.79727	1535		D	Graded black volcanic sand and gravel	1	CSIRO
MG-31	G	East of SuSu Knolls	3	48.450	152	7.130	152.11883	3.80750	1661		C	Stratified sand and granule gravel, porph dacite fragments	1	CSIRO
Nimab														
MD-73	D	Nimab, SW foot	3	49.297	152	10.832	152.18054	3.82162	1320	90	B	Porphyritic basaltic andesite, brown mud, pumice	2	CSIRO
MD-85	D	Crest of Nimab	3	49.204	152	11.143	152.18572	3.82006	1045	130	B	Fresh and altered porph andesite, minor ooze	2	CSIRO
MD-88	D	Crest of Nimab	3	49.185	152	1.222	152.02037	3.81975	1040	125	B	Mud with red and ash layers, pumice	2	CSIRO
Small volcanoes south of SuSu														
MD-87	D	Small volcano S of Nimab	3	53.054	152	11.432	152.19054	3.88423	1520	150	C	Basalt, ooze	1	CSIRO
MD-89	D	Small knoll, NW of SuSu Knolls	3	46.075	152	4.277	152.07128	3.76792	1715	130	C	Ooze, ash layers	1	CSIRO
MD-107	D	Small volcano S of SuSu Knolls	3	52.511	152	3.842	152.06404	3.87518	1680	140	C	Porphyritic basalt, pumice, ooze		CSIRO
MD-108	D	Small volcano on scarp SW of SuSu Knolls	3	51.334	152	0.332	152.00554	3.85556	1874	135	C	Basalt, sandstone, ooze, pumice	1	CSIRO
Basement Scarps														
MD-31	D	Basement scarp, S of Yuam Ridge	3	46.518	151	45.450	151.75750	3.77530	2150	0	D	Ooze, pumice	1	CSIRO
MD-32	D	Basement scarp, S of Yuam Ridge	3	45.013	151	46.643	151.77738	3.75021	2000	315	D	Ooze, pumice	1	CSIRO
MD-33	D	Basement ridge, W foot (5th W), far NW EMVZ	3	30.887	151	21.837	151.36396	3.51479	2560	137	D	Ooze, pumice	1	CSIRO
MD-34	D	Basement ridge (5th W of Kumul), far NW EMVZ	3	31.085	151	22.290	151.37150	3.51809	2150	145	D	Basalt; mud, semilithified mudstone, pumice	1	CSIRO
MD-37	D	W base of Hammer Handle, scarp N of Pual	3	35.335	151	43.591	151.72652	3.58891	1950	150	D	Ooze	1	CSIRO
MD-40	D	Basement ridge near Djaul Flt, 10nm S of Pual Ridge	3	51.783	151	36.094	151.60157	3.86305	1950	160	C	Basaltic andesite, mud, pumice	1	CSIRO
MD-50	D	Scarp, far NW of East Manus Basin	3	22.727	151	12.825	151.21374	3.37879	2113	320	C	Pumice, felsic dacite, sedimentary rock, trace mud		CSIRO
MD-63	D	Basement knoll/scarp, N end Kumul Trough	3	36.496	151	39.903	151.66505	3.60827	2462	135	A	Mud, mudstone	1	CSIRO
MD-67	D	Basement scarp, W side of Kumul Trough	3	41.113	151	26.093	151.43488	3.68521	2240	310	C	Basalt, sandstone, mudstone, mud, pumice	1	CSIRO
MD-69	D	Basement scarp SE of Yuam Ridge	3	46.192	151	45.758	151.76263	3.76986	2090	315	C	Mud, mafic dacite, ash layers, rare pumice	1	CSIRO
MD-104	D	Ridge near NW end of Weitin Fault	3	33.785	151	55.690	151.92816	3.56309	1897	145	B	Ooze		CSIRO
MD-105	D	Ridge near NW end of Weitin Fault	3	33.778	151	55.733	151.92888	3.56297	1892	135	A	Basaltic andesite, ooze, ash layer	1	CSIRO
MD-109	D	Scarp at SW margin Eastern Manus Basin	3	53.645	151	46.372	151.77287	3.89408	2090	140	C	Ooze, pumice, ash layer	1	CSIRO

SEDIMENT BASIN SAMPLES

Sediment Basins, west of Kumul														
MS-3	S	Graben NW of Kumul	3	31.137	151	36.812	151.61354	3.51895	2450		C	73 cm; Banded brown to olive clay	1	CSIRO
MS-56	S	Far west of eastern Manus Basin	3	26.411	151	9.906	151.16509	3.44019	2450		B	89 cm; turbidites, no ash layers		CSIRO
MS-57	S	Far west of eastern Manus Basin	3	28.016	151	16.706	151.27844	3.46693	2527		B	17 cm; turbidites		CSIRO
Sediment Basins, Kumul Trough and NE														
MS-2	S	Kumul Trough	3	42.893	151	26.097	151.43496	3.71489	2724		C	44 cm; Banded green-brown clay	1	CSIRO
MS-5	S	Enclosed basin between W Pual and Hammer Ridges	3	38.571	151	42.317	151.70529	3.64285	2110		D	112 cm; banded brown and olive clays	1	CSIRO
MS-18	S	NE end Kumul Trough	3	37.962	151	33.472	151.55787	3.63270	2612		B	86 cm; banded mud; dacite ash layers at 39.5 and 55.5 cm	1	CSIRO
MS-22	S	N Kumul Trough	3	36.050	151	28.949	151.48249	3.60083	2449		C	101 cm; turbidites (pumice gravel at bases)	1	CSIRO
K2246	S, G	Djual Fault scarp	3	46.4	151	28.7	151.47833	3.77333			X			Shirshov
K2248	S, G	West Kumul fault scarp	3	39.4	151	28.4	151.47333	3.65667			X			Shirshov
Sediment Basins, Marmin & vicinity														
MS-1	S	Marmin Knolls, enclosed basin	3	41.170	151	36.045	151.60075	3.68617	2265		D	22 cm; banded brown-green clays	1	CSIRO
MS-12	S	Shallow enclosed basin S of Marmin Knolls	3	43.818	151	35.982	151.59970	3.73031	2388		C	Trace of silt and basalt hyaloclastite		CSIRO
MS-19	S	NE of Marmin Knolls	3	38.736	151	39.078	151.65130	3.64560	2405		C	83.5 cm; banded silty mud, ash layers at 38cm and 56 cm (latter with pumice pebble)	1	CSIRO
MS-46	S	Enclosed basin, SW Marmin Knolls	3	43.585	151	30.191	151.50319	3.72641	2523		C	84 cm; colour-banded mud; ash layers (basalt, dacite, rhyodacite)	1	CSIRO
K2241	S, G	Marmin Knolls, enclosed basin	3	41.5	151	36.2	151.60333	3.69167			X	Core and grab		Shirshov
Sediment Basins, NE of Pual Ridge & Pual Fork														
MS-13	S	Saddle in Pual Fork, 400m S of North Pual	3	40.780	151	43.642	151.72737	3.67967	1905		B	8 cm; andesite hyaloclastite, minor mud	1	CSIRO
MS-15	S	Basin NE of Pual fork	3	38.030	151	45.243	151.75405	3.63383	2087		C	53 cm; colour banded mud, hyaloclastite layers at 33 and 48 cm	1	CSIRO
MS-30	S	Basin NE of PACMANUS	3	37.698	151	46.975	151.78292	3.62830	2113		A	85 cm; turbidites, ash layers at 66 cm (pumice), 79 cm (rhyodacite)	1	CSIRO
MS-31	S	Basin NE of PACMANUS	3	38.998	151	48.976	151.81627	3.64997	2182		A	140 cm; thick turbidite, no ash layers	9	CSIRO
MS-32	S	Basin NE of PACMANUS	3	37.473	151	49.988	151.83314	3.62454	2175		A	113 cm; thick turbidite	1	CSIRO
MS-47	S	Shallow enclosed basin, NE along stike from NW Pual	3	36.287	151	46.391	151.77319	3.60478	2005		B	106 cm; turbidite with dacite and rhyodacite ash layers	1	CSIRO
MS-48	S	Large basin NE of Pual	3	33.974	151	48.974	151.81624	3.56623	2008		B	35 cm; turbidite with ash layers	1	CSIRO
East Valley Sediment Basin														
MS-4	S	East Valley, enclosed basin	3	41.619	151	44.731	151.74552	3.69365	2206		D	46 cm; Banded clay	1	CSIRO
MS-6	S	Shallow enclosed basin S of Pual Ridge	3	46.475	151	38.654	151.64424	3.77459	2205		D	98 cm; turbidites	1	CSIRO
MS-9	S	East Valley, E of PACMANUS	3	43.713	151	42.584	151.70974	3.72854	2127		C	55 cm; silty mud with dark brown bands and several hyaloclastite (andesite) layers	1	CSIRO
MS-10	S	East Valley, S of PACMANUS	3	44.994	151	40.981	151.68302	3.74990	2120		C	Disturbed mud with some hyaloclasts (original penetration 39cm?)	1	CSIRO
MS-14	S	East Valley	3	40.587	151	45.944	151.76574	3.67644	2150		C	27 cm; banded silty mud	1	CSIRO
MS-16	S	East Valley	3	41.381	151	45.369	151.75615	3.68969	2193		C	123 cm; colour banded mud, thick dacite hyaloclastite at 71-112cm	1	CSIRO
MS-20	S	East Valley	3	42.701	151	43.818	151.73030	3.71168	2150		D	32 cm; colour banded mud	1	CSIRO
94-GKG	S	East Valley (box core)	3	41.500	151	44.660	151.74433	3.69167	2201		B	71 cm; Brown mud with several dark layers; ash layers at 23-24 and 73 cm		TUBAF, CSIRO?
96-SLS	S	East Valley	3	41.490	151	44.650	151.74417	3.69150	2200		B	Bottomed on rocks (andesite, dacite) at 3.5m; sediment section lost		TUBAF, CSIRO?
97SL	S	East Valley	3	41.530	151	44.550	151.74250	3.69217	2205		B	Bottomed (shallow?) on andesite, sediment section lost	1	TUBAF, CSIRO
299-Sed-01	X	PACMANUS, E foot of Pual Ridge	3	44.498	151	40.765	151.67942	3.74163	2140		A+	Filtered sediment		GSJ
299-Sed-02	X	PACMANUS, E foot of Pual Ridge	3	44.498	151	40.765	151.67942	3.74163	2140		A+	Filtered sediment		GSJ
HMC-2	S	East Valley	3	43.6	151	42.3	151.70500	3.72667	2120		X	Multicorer: seven cores to 10-25 cm of brown ooze		KORDI, CSIRO?
HPC-1	S	East Valley	3	43.7	151	42.2	151.70333	3.72833	2150		X	Piston core. 3m of brown ooze with hyaloclastite layers		KORDI
HPC-3	S	East Valley	3	40.5	151	46.2	151.77000	3.67500	2155		X	Piston core. 1 m disturbed ooze over rocks in nosecone		KORDI
Sediment Basins, Yuam-DESMOS area														
MS-8	S	Sth of DESMOS	3	50.951	151	49.366	151.82276	3.84919	2109		C	15.5 cm; banded clay and fine sand	1	CSIRO
MS-17	S	Sth of Yuam Ridge	3	46.244	151	46.949	151.78249	3.77073	2170		C	83 cm; ash layer at 64 cm	1	CSIRO
HMC-1	S	Just east of Yuam Ridge	3	43.3	151	49.2	151.82000	3.72167	2190		X	Multicorer: four cores to 30 cm of sloppy brown ooze		KORDI, CSIRO?

Sediment Basins, Central area

MS-25	S	Proposed EMB-5A site (ODP), Central basin	3	47.820	151	46.169	151.76948	3.79700	2169		C	84 cm; turbidites, ash layer at 62 cm	2	CSIRO
MS-27	S	Proposed EMB-5C site (ODP), Central basin	3	49.140	151	44.076	151.73460	3.81900	2158		C	57 cm; turbidites; ash layer at 49 cm	1	CSIRO
MS-52	S	Central basin, S of Umbo	3	51.970	151	50.539	151.84231	3.86616	2075		C	19cm;Layered ooze, ash layer at 31 cm		CSIRO
Sediment Basins, Umbo-Tumai-Bugave														
MS-34	S	Basin north of Tumai Ridge	3	40.495	152	5.958	152.09930	3.67492	2118		C	25 cm; sloppy dk brown mud over stiff clay	1	CSIRO
MS-37	S	East Bugave nodal basin	3	43.696	152	10.968	152.18279	3.72827	2098		A	42 cm; two turbidite units, no ash layers	1	CSIRO
MS-49	S	Basin N of Tumai Ridge	3	39.954	152	5.462	152.09103	3.66591	2121		C	45.5 cm; turbidite with ash layer at 45 cm	1	CSIRO
MS-53	S	East Umbo Basin	3	43.709	151	56.997	151.94996	3.72848	2158		B	48.5 cm; layered ooze, dark red-bn and hyaloclastic layers; ash layer at 30 cm		CSIRO
Sediment Basins, SuSu vicinity														
MS-26	S	Enclosed basin NE N Su, in SE Bugave trough	3	46.877	152	7.135	152.11892	3.78128	1780		C	Dark green-grey sed; chips (sand?) porpyritic dacite	1	CSIRO
MS-33	S	Enclosed basin in SE Bugave trough	3	45.793	152	8.212	152.13686	3.76322	1904		A	~13 cm grey sand, SuSu derived?	1	CSIRO
MS-35	S	Under South Su plume	3	48.773	152	4.373	152.07288	3.81288	1905		B	Minor olive-grey sandy mud		CSIRO
MS-38	S	Under SE fringe of SuSu plume	3	51.296	152	8.182	152.13637	3.85493	1709		A	3 cm; mud	1	CSIRO
MS-41	S	Under Nimab Plume	3	49.563	152	12.405	152.20675	3.82605	1775		C	47.5 cm; turbidites with ash layers at 32 and 45 cm (latter with pumice pebbles at base	2 duplicate?	CSIRO
MS-44	S	Enclosed basin E of SuSu Knolls	3	48.976	152	8.227	152.13712	3.81626	1738		B	Trace dark grey sulfidic sand (possible 35 cm penetration)	1	CSIRO
MS-45	S	Enclosed basin E of SuSu Knolls	3	48.971	152	8.283	152.13805	3.81619	1735		C	Trace dark grey sand (possibly deep penetration)	1	CSIRO
MG-23	G	Base of SE face of Nimab Knoll	3	48.744	152	12.617	152.21028	3.81240	1778		D	8cm brown mud overlying 15cm olive mud.	2 duplicate?	CSIRO
West Su Basin														
MG-39	G	West Su Basin	3	47.995	152	2.982	152.04970	3.79992	2080		C	Layered sediment; 15mm khaki over 3 cm layered grey/black silt over 7cm layered khaki		CSIRO
MG-40	G	West Su Basin	3	47.501	152	2.500	152.04167	3.79168	2092		B	Layered sediment; 22 mm khaki over laminayed gre/black silt		CSIRO
MG-41	G	West Su Basin	3	46.997	152	3.001	152.05002	3.78328	2070		B	Layered sediment; 4.5cm graded khaki over 2.5cm gre/black sulfidic silt		CSIRO
MG-42	G	West Su Basin	3	46.975	152	1.993	152.03322	3.78292	2087		B	Layered sediment; 20mm khaki over 5mm black over 65mm layered brown/khaki		CSIRO
MG-43	G	West Su Basin	3	48.247	152	2.266	152.03777	3.80412	2092		C	Layered sediment; 2cm brown over 5 cm layered black/grey		CSIRO
MG-44	G	West Su Basin	3	47.501	152	1.489	152.02482	3.79168	2079		B	Layered khaki sediment with thin black layer at 16-18mm		CSIRO
MG-45	G	West Su Basin	3	46.998	152	1.979	152.03298	3.78330	2050		B	Layered khaki sediment with grey/black layer at 15-35mm		CSIRO
MG-46	G	West Su Basin	3	48.007	152	0.996	152.01660	3.80012	2068		B	Layered khaki/grey ooze with black layers at 10 and 75 mm		CSIRO
MG-47	G	West Su Basin	3	48.503	152	1.508	152.02513	3.80838	2088		B	Layered khaki mud with numerous thin black layers		CSIRO
MG-56	G	West Su Basin	3	47.501	152	3.545	152.05908	3.79168	2059		B	Layered sediment: 2 cm black volcaniclastic sand over 9 cm khaki ooze		CSIRO
MG-57	G	West Su Basin	3	48.010	152	2.000	152.03333	3.80017	2089		B	Laminated khaki ooze, black layer and volcaniclastic layer		CSIRO
MG-58	G	West Su Basin	3	48.523	152	0.505	152.00842	3.80872	2059		B	Laminated khaki ooze with volcaniclastic layer at 15mm		CSIRO
MG-59	G	West Su Basin	3	47.512	152	0.501	152.00835	3.79187	2034		B	Laminated khaki ooze, thin black and volcaniclastic layers		CSIRO
MG-60	G	West Su Basin	3	47.900	151	58.854	151.98090	3.79833	1877		A	Khaki ooze, no dark layers		CSIRO
MG-61	G	West Su Basin	3	49.702	152	0.503	152.00838	3.82837	2036		A	Laminated khaki ooze, no black layers		CSIRO
MS-43	S	West Su Basin	3	48.135	152	1.941	152.03235	3.80224	2093		C	31.5 cm; laminated sediment with black streaks; ash layer at 20.5-27 cm	2 duplicate?	CSIRO
MS-54	S	West Su Basin	3	48.422	152	3.981	152.06636	3.80703	2077		B	67 cm; Layered sediment; 1.7 cm volcaniclastic sediment over layered khaki ooze; ash layer at 57-62 cm		CSIRO
MS-55	S	West Su Basin	3	47.998	151	57.723	151.96205	3.79997	2073		A	80.5 cm; Laminated khaki ooze, some red & black layers; ash layers at 45cm (pumice pebbles) and 71cm		CSIRO

Appendix 4

Eastern Manus Basin Operations Yielding Sulfides

SAMPLING OPERATIONS WITH SULFIDE CHIMNEYS

See explanatory notes

Operation	Type	Location	Latitude deg	Latitude min	Longitude deg	Longitude min	Decimal Long	Decimal Lat	Depth (m)	Haul Dirn	Nav Precn	Recovery
PACMANUS												
Tsukushi-Snowcap												
MD-24	D	PACMANUS, Snowcap, SE flank	3	43.698	151	40.223	151.67038	3.72830	1653	235	B	Fresh felsic dacite & hyaloclastite (early), altered dacite (some Fe stained) and "Talenga" chimney (late), fauna, ooze
MD-57	D	PACMANUS (W side Snowcap)	3	43.704	151	40.138	151.66896	3.72840	1655	90	A	Felsic dacite, sulfides, FeOx
MD-65	D	PACMANUS (West Snowcap)	3	43.718	151	40.112	151.66854	3.72863	1655	45	A	Felsic dacite (early); pyritic breccia, fauna (late), ooze
MD-124	D	PACMANUS, Snowcap (NW side)	3	43.670	151	40.151	151.66918	3.72784	1645	140	A	Py-enargite breccias and altered dacite (early); fresh felsic dacite (late)
MD-143	D	PACMANUS, Tsukushi	3	43.778	151	40.026	151.66709	3.72963	1662	225	B	Dacites (Fe stain), sulfides, Fe-crusted snails
MD-144	D	PACMANUS,Tsukushi	3	43.765	151	40.023	151.66705	3.72941	1668	225	A	Mafic and felsic dacites (Fe stain), sulfides
MG-55	G	PACMANUS, Tsukushi	3	43.785	151	40.030	151.66717	3.72975	1657		A	Sulfides, MnOx
305-S-01	S	PACMANUS, SW Snowcap	3	43.689	151	40.158	151.66930	3.72815	1653		A+	Sulfides
1066-1	S	PACMANUS, Tsukushi	3	43.785	151	40.019	151.66698	3.72975	1652		A+	Sulfide chimney
1066-2	S	PACMANUS, Tsukushi	3	43.677	151	40.176	151.66960	3.72795	1628		A+	Sulfide chimney
1188A	H	PACMANUS, Snowcap	3	43.696	151	40.196	151.08975	3.72827	1640		A+	Spud in dacite, Fe-Mn crusts. 210m pipe severed just below seafloor.
1188B	H	PACMANUS, Snowcap	3	43.696	151	40.198	151.09422	3.72827	1642		A+	No core. Free-fall funnel remains at site
1188C	H	PACMANUS, Snowcap	3	43.694	151	40.174	151.10397	3.72823	1643		A+	No core
1188D	H	PACMANUS, Snowcap	3	43.667	151	40.178	151.09797	3.72778	1634		A+	No core
1188E	H	PACMANUS, Snowcap	3	43.684	151	40.190	151.04224	3.72807	1641		A+	No core
1188F	H	PACMANUS, Snowcap	3	43.685	151	40.190	151.12270	3.72808	1642		A+	Deep hole. 60m of casing, and two nested funnels (large re-entry + free-fall) remain at site
57-RD	H	PACMANUS, Snowcap	3	43.722	151	40.155	151.66925	3.72870	~1650		A-B	1.68m penetration, 10 cm core, fresh dacite rubble
Satanic Mills and Vicinity												
MD-28	D	PACMANUS, NE side of Satanic Mills	3	43.540	151	40.415	151.67358	3.72566	1688	235	C	Felsic dacite, sulfide chimney, fauna, ooze
MD-35	D	PACMANUS, Satanic Mills	3	43.557	151	40.353	151.67254	3.72596	1689	225	C	Rhyodacite (early, Fe stains), late sulfides (including "Fred"; fauna
MD-41	D	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	3	43.611	151	40.395	151.67326	3.72685	1680	240	B	Felsic dacite (Fe stain), sulfides, fauna
MD-62	D	PACMANUS (Satanic Mills)	3	43.615	151	40.320	151.67200	3.72692	1678	130	A	Sulfides, minor fresh and altered rhyodacite, fauna, ooze
MD-138	D	PACMANUS (Satanic Mills)	3	43.599	151	40.349	151.67248	3.72665	1677	240	A	Felsic dacite, sulfides, fauna
MD-139	D	PACMANUS (Satanic Mills)	3	43.592	151	40.348	151.67246	3.72654	1680	220	A	Sulfides, rhyodacite, H2S
BD-22	D	PACMANUS (Satanic Mills)	3	43.610	151	40.343	151.67238	3.72683	1678	225	A	Felsic dacites, sulfides
297-S-02A	S	PACMANUS, Satanic Mills	3	43.603	151	40.333	151.67222	3.72672	1708		A+	Sulfides
297-S-02B	S	PACMANUS, Satanic Mills	3	43.603	151	40.333	151.67222	3.72672	1708		A+	Sulfides
301-S-01	S	PACMANUS, Satanic Mills	3	43.609	151	40.338	151.67230	3.72682	1708		A+	Sulfides
301-S-02	S	PACMANUS, Satanic Mills	3	43.609	151	40.338	151.67230	3.72682	1709		A+	Sulfides
1066-3	S	PACMANUS, Satanic Mills	3	43.618	151	40.337	151.67228	3.72697	1677		A+	Sulfide chimney
1066-4	S	PACMANUS, Satanic Mills	3	43.597	151	40.333	151.67222	3.72662	1676		A+	Sulfide chimney
1191A	H	PACMANUS, Satanic Mills	3	43.608	151	40.337	151.19054	3.72680	1694		A+	Spud in dacite
54-GTV	GTV	PACMANUS, Satanic Mills	3	43.634	151	40.294	151.67157	3.72723	1694		A	Sulfide chimney fragment
58-GTV	GTV	PACMANUS, Satanic Mills	3	43.618	151	40.311	151.67185	3.72697	1682		B	Sulfides
59-GTV	GTV	PACMANUS, Satanic Mills	3	43.618	151	40.303	151.67172	3.72697	1681		B	1m sulfide chimney
Roman Ruins and Vicinity												
MD-56	D	PACMANUS (Roman Ruins)	3	43.212	151	40.516	151.67526	3.72019	1689	135	A	Mafic dacite (Fe stain), sulfides, ooze
MD-58	D	PACMANUS (Roman Ruins)	3	43.243	151	40.494	151.67490	3.72072	1688	120	A	Sulfides (incl Big Bertha), fauna, trace dacite
MD-61	D	PACMANUS (Roman Ruins)	3	43.237	151	40.497	151.67496	3.72062	1694	135	A	Sulfides, fauna, oooze
MD-102	D	PACMANUS (Roman Ruins)	3	43.239	151	40.474	151.67456	3.72066	1694	140	B	Sulfides
MD-112	D	PACMANUS (Roman Ruins)	3	43.254	151	40.471	151.67452	3.72090	1690	130	A	Sulfides (late), felsic dacite (early in haul), anchored
MD-126	D	PACMANUS (Roman Ruins)	3	43.251	151	40.515	151.67526	3.72085	1690	220	B	Mafic dacite, sulfides, FeOx
MD-127	D	PACMANUS (Roman Ruins)	3	43.215	151	40.492	151.67486	3.72025	1688	135	A	Sulfides, fauna
MD-131	D	PACMANUS (Roman Ruins)	3	43.222	151	40.510	151.67517	3.72037	1695	140	B	Sulfides, FeOx, minor fresh and altered mafic dacite
MD-133	D	PACMANUS (Roman Ruins)	3	43.239	151	40.488	151.67479	3.72064	1691	135	A	Bikpela chimney, minor mafic dacite, fauna
MD-135	D	PACMANUS (Roman Ruins)	3	43.242	151	40.521	151.67535	3.72071	1684	220	B	Sulfides
BD-23	D	PACMANUS (Roman Ruins)	3	43.252	151	40.499	151.67499	3.72087	1690	220	A	Rhyodacite (Fe stain), sulfides
BD-24	D	PACMANUS (Roman Ruins)	3	43.255	151	40.502	151.67504	3.72092	1692	220	A	Mafic dacites (Fe stain), sulfides
HDg-1	D	PACMANUS, Roman Ruins	3	43.220	151	40.467	151.87898	3.72033	1678	225	X	Mafic dacite, Fe crusts, small sp fragment
HDg-1-2	D	PACMANUS, Roman Ruins	3	43.214	151	40.467	151.92802	3.72023	1690	160	X	Rhyodacite, sulfide fragments
HDg-1-3	D	PACMANUS, Roman Ruins	3	43.258	151	40.548	151.07555	3.72097	1681	100	X	Rhyodacite, large chimney
HDg-5	D	PACMANUS, Roman Ruins	3	43.232	151	40.504	151.49229	3.72053	1684	70	X	Dacite (Mn coat), rare sulfides
HDg-8	D	SuSu Knolls; Suzette	3	47.202	152	5.626	152.09377	3.78670	1506	135	X	Porphyritic mafic dacite, sulfide chimney
MG-17	G	PACMANUS (Roman Ruins)	3	43.243	151	40.510	151.67517	3.72072	1694		A	Sulfide chimney fragments, sulfidic mud

301-S-03	S	PACMANUS, Roman Ruins	3	43.244	151	40.520	151.67533	3.72073	1693		A+	Sulfides
304-S-01	S	PACMANUS, Roman Ruins	3	43.244	151	40.506	151.67510	3.72073	1692		A+	Sulfides
1063-1	S	PACMANUS, Roman Ruins	3	43.210	151	40.506	151.67510	3.72017	1666		A+	Sulfide chimney
1063-2	S	PACMANUS, Roman Ruins	3	43.241	151	40.517	151.67528	3.72068	1668		A+	Dacite (chimneys in vicinity)
1189A	H	PACMANUS, Roman Ruins	3	43.243	151	40.492	151.09312	3.72072	1690		A+	Spud in dacite beside chimney. 120m pipe severed just below sea floor
1189B	H	PACMANUS, Roman Ruins	3	43.236	151	40.508	151.10531	3.72060	1684		A+	Spud beside chimney. 30m casing and a large re-entry funnel remain at site
1189C	H	PACMANUS, Roman Ruins	3	43.241	151	40.524	151.10113	3.72068	1689		A+	No core. Free-fall funnel remains at site
60-RD	H	PACMANUS, Roman Ruins	3	43.240	151	40.500	151.67500	3.72067	"1659"		A-B	4.42m penetration, 442 cm core, 10 cm weakly altered dacite over sulfides
61-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.497	151.67495	3.72050	1690		A-B	2.77m penetration, 140 cm core, 137m sulfides over 10cm fresh dacite
62-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.497	151.67495	3.72050	1687		A-B	2.20m penetration, 35 cm core, fresh dacite
63-RD	H	PACMANUS, Roman Ruins	3	43.240	151	40.500	151.67500	3.72067	1689		A-B	2.71m penetration, 50 cm core, sulfides
64-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.502	151.67503	3.72049	1692		A-B	3.37m penetration, 220 cm core, 190 cm fresh dacite over 30 cm altered dacite, minor silfides
65-RD	H	PACMANUS, Roman Ruins	3	43.238	151	40.511	151.67518	3.72064	1692		A-B	4.41m penetration, 45cm core, 45 cm core, sulfides
66-RD	H	PACMANUS, Roman Ruins	3	43.230	151	40.497	151.67495	3.72050	1689		A-B	3.71m penetration, 80 cm core, sulfides
67-RD	H	PACMANUS, Roman Ruins	3	43.240	151	40.500	151.67500	3.72067	1689		A-B	5.00m penetration, 190 cm core, sulfides
68-RD	H	PACMANUS, Roman Ruins	3	43.240	151	40.510	151.67517	3.72067	1692		A-B	2.06m penetration, 42 cm core, sulfides
69-RD	H	PACMANUS, Roman Ruins	3	43.232	151	40.503	151.67505	3.72053	1691		A-B	4.90m penetration, 220 cm core, 180 cm sulfides over 40 cm altered dacite (stockwork veining)
MCV-11	C	Sample crash, Roman Ruins	3	43.269	151	40.468	151.67447	3.72115	1695		B	Chips sulfide chimney (the discovery of Roman Ruins)
70 GTV	GTV	PACMANUS, Roman Ruins	3	43.210	151	40.470	151.67450	3.72017	1678		B	Sulfide-coated fresh dacite over altered dacite-sulfide breccia
Rogers Ruins												
MD-59	D	PACMANUS (Rogers Ruins)	3	43.137	151	40.430	151.67384	3.71895	1701	135	A	Sulfides, FeOMnOx, mafic dacite, ?sulfidic mud
MD-60	D	PACMANUS (Rogers Ruins)	3	43.132	151	40.442	151.67404	3.71887	1699	135	B	Mafic dacite (early), Fe-MnOx, sulfides (later), ooze
MD-113	D	PACMANUS (Rogers Ruins)	3	43.154	151	40.440	151.67401	3.71923	1687	145	A	Mafic dacite, sulfides, Fe-MnOx

SUSU KNOLLS

Suzette												
MD-76	D	SuSu Knolls, Suzette	3	47.418	152	5.653	152.09422	3.79030	1516	310	A	Suilfides, sulfidic mud
MD-81	D	SuSu Knolls, Suzette	3	47.277	152	5.587	152.09312	3.78796	1511	145	A	Sulfides; stratified grey and black sulfidic silt
MD-94	D	SuSu Knolls, Suzette	3	47.341	152	5.600	152.09333	3.78901	1524	125	B	Sulfides, sulfidic grit, porphyritic dacite
MD-121	D	SuSu Knolls, Suzette	3	43.363	152	5.600	152.09333	3.72272	1514	135	A	Sulfides, gritty sediment, snails
MD-123	D	SuSu Knolls, Suzette	3	47.330	152	5.587	152.09312	3.78883	1513	130	A	Sulfides, sulfidic silt
MD-134	D	SuSu Knolls, Suzette	3	47.374	152	5.661	152.09434	3.78957	1514	270	A	Sulfidic grit, pieces chimney, fauna
MG-25R	G	Suzette	3	47.119	152	5.658	152.09430	3.78532	1520		B	Sulfide chimney fragments
74-RD	H	Suzette	3	47.354	152	5.631	152.09385	3.78923	1517		A-B	3.20m penetration, 25 cm core, vesicular "dacite" (no phenocrysts?)
MCV-38	C	Sample crash, Suzette	3	47.318	152	5.635	152.09392	3.78863	1523		A	Flange of a chimney
MCV-43	C	Sample crash, Suzette	3	47.351	152	5.635	152.09392	3.78918	1525		A	Sulfide chimney fragments
North Su												
MD-96	D	SuSu Knolls, crest of North Su	3	47.927	152	6.019	152.10032	3.79878	1176	130	A	Fresh and altered porph andesite; sulfides, sulfidic grit
MD-97	D	SuSu Knolls, crest of North Su	3	47.962	152	6.029	152.10049	3.79936	1168	135	A	Fresh and altered porph andesite, sulfides
South Su												
MD-77	D	South Su	3	48.515	152	6.238	152.10397	3.80858	1324	225	B	Fresh and altered porphyrtic dacite; sulfide breccias; layered mud
MD-95	D	SuSu Knolls, crest of South Su	3	48.550	152	6.269	152.10449	3.80917	1329	140	A	Sulfides, grey mud
MG-19	G	South Su crest	3	48.520	152	6.260	152.10433	3.80867	1319		A	Altered sulfidic and some fresh porphyitic dacite

MARMIN KNOLLS

MD-64	D	NW Marmin Knolls	3	39.183	151	36.190	151.60316	3.65306	2254	135	A	Basalt, pumice, mud, ash layers, sulfides (contamination?)
MD-101	D	Ridge on W side Marmin Knolls	3	40.983	151	33.263	151.55438	3.68306	1639	135	A	Basalt, mud, barite chimneylet

DRILL HOLES (ALL LISTED FOR THE RECORD)

JOIDES Resolution: ODP Leg 193 2001

1188A	H	PACMANUS, Snowcap	3	43.696	151	40.196	151.66993	3.72827	1640		A+	212m penetration, cored, 30m fresh rhyodacite then altered dacite. Spud in Mn crusts. Severed pipe just below seafloor
1188B	H	PACMANUS, Snowcap	3	43.696	151	40.198	151.66997	3.72827	1642		A+	72m penetration. uncored. Spud in sediment. Free-fall funnel remains at site
1188C	H	PACMANUS, Snowcap	3	43.694	151	40.174	151.66957	3.72823	1643		A+	44m penetration, uncored. Spud in sediment.
1188D	H	PACMANUS, Snowcap	3	43.667	151	40.178	151.66963	3.72778	1634		A+	15m penetration, uncored. Spud in sediment
1188E	H	PACMANUS, Snowcap	3	43.684	151	40.190	151.66983	3.72807	1641		A+	16m penetration, uncored. Spud in sediment
1188F	H	PACMANUS, Snowcap	3	43.685	151	40.190	151.66983	3.72808	1642		A+	387m penetration, cored 218-387m. Spud in sediment/mat. 60m of casing, and two nested funnels (large re-entry + free-fall) remain at site
1189A	H	PACMANUS, Roman Ruins	3	43.243	151	40.492	151.67487	3.72072	1690		A+	126m penetration, cored, <9m fresh mafic dacite then altered dacite. Spud in dacite beside chimney. 120m pipe severed just below sea floor
1189B	H	PACMANUS, Roman Ruins	3	43.236	151	40.508	151.675133	3.7206	1684		A+	206 m penetration, cored from 30m, stockwork then altered dacites. Spud beside chimney. 30m casing and a large re-entry funnel remain at site
1189C	H	PACMANUS, Roman Ruins	3	43.241	151	40.524	151.6754	3.720683	1689		A+	166m penetration, uncored. Free-fall funnel remains at site

1190A	H	PACMANUS, SW of Roman Ruins	3	43.292	151	40.582	151.676367	3.721533	1703		A+	9m penetration, cored, rhyodacite. Spud in rhyodacite
1190B	H	PACMANUS, SW of Roman Ruins	3	43.314	151	40.616	151.676933	3.7219	1701		A+	10m penetration, cored, rhyodacite. Spud in rhyodacite
1190C	H	PACMANUS, SW of Roman Ruins	3	43.303	151	40.61	151.676833	3.721717	1696		A+	17m penetration, cored, rhyodacite. Spud in rhyodacite
1191A	H	PACMANUS, Satanic Mills	3	43.608	151	40.337	151.672283	3.7268	1694		A+	20m penetration, cored, fresh felsic dacite, minor sulfide Spud beside chimney.
Sonne: CONDRILL 2002												
57-RD	H	PACMANUS, Snowcap	3	43.722	151	40.155	151.66925	3.7287	~1650		A	1.68m penetration, 10 cm core, fresh dacite rubble
60-RD	H	PACMANUS, Roman Ruins	3	43.24	151	40.5	151.675	3.720667	"1659"		A	4.42m penetration, 442 cm core, 10 cm weakly altered dacite over sulfides
61-RD	H	PACMANUS, Roman Ruins	3	43.23	151	40.497	151.67495	3.7205	1690		A	2.77m penetration, 140 cm core, 137m sulfides over 10cm fresh dacite
62-RD	H	PACMANUS, Roman Ruins	3	43.23	151	40.497	151.67495	3.7205	1687		A	2.20m penetration, 35 cm core, fresh dacite
63-RD	H	PACMANUS, Roman Ruins	3	43.24	151	40.5	151.675	3.720667	1689		A	2.71m penetration, 50 cm core, sulfides
64-RD	H	PACMANUS, Roman Ruins	3	43.2295	151	40.502	151.675033	3.720492	1692		A	3.37m penetration, 220 cm core, 190 cm fresh dacite over 30 cm altered dacite, minor silfides
65-RD	H	PACMANUS, Roman Ruins	3	43.2383	151	40.511	151.675183	3.720638	1692		A	4.41m penetration, 45cm core, 45 cm core, sulfides
66-RD	H	PACMANUS, Roman Ruins	3	43.23	151	40.497	151.67495	3.7205	1689		A	3.71m penetration, 80 cm core, sulfides
67-RD	H	PACMANUS, Roman Ruins	3	43.24	151	40.5	151.675	3.720667	1689		A	5.00m penetration, 190 cm core, sulfides
68-RD	H	PACMANUS, Roman Ruins	3	43.24	151	40.51	151.675167	3.720667	1692		A	2.06m penetration, 42 cm core, sulfides
69-RD	H	PACMANUS, Roman Ruins	3	43.232	151	40.503	151.67505	3.720533	1691		A	4.90m penetration, 220 cm core, 180 cm sulfides over 40 cm altered dacite (stockwork veining)
71-RD	H	DESMOS	3	41.469	151	52.048	151.867467	3.69115	1924		A	1.54m penetration, 26 cm core, slightly to moderately altered andesite
72-RD	H	DESMOS	3	41.5	151	52	151.866667	3.691667	1925		A	1.15m penetration, 17 cm core, fresh andesite
73-RD	H	DESMOS	3	41.51	151	52.001	151.866683	3.691833	1919		A	4.62m penetration, 80 cm core, altered andesite
74-RD	H	Suzette	3	47.354	152	5.631	152.09385	3.789233	1517		A	3.20m penetration, 25 cm core, vesicular "dacite" (no phenocrysts?)
MCV-38		Suzette and crest to NW Sample crash, Suzette	3	47.318	152	5.635	152.09392	3.78863	1523		A	Flange of a chimney
Franklin: PACMANUS-IV 1997												
MCV-43		Traverse across Suzette field Sample crash, Suzette	3	47.351	152	5.635	152.09392	3.78918	1525		A	Sulfide chimney fragments

Appendix 5

Eastern Manus Basin CTD Hydrocasts

Cruise	Date	Type	Area	Time In	Time Out	Start depth (m)	End depth (m)	Time In Lat Deg (S)	Time In Lat Min	Time In Long Deg (E)	Time In Long Min	Time Out Lat Deg	Time Out Lat Min	Time Out Long Deg	Time Out Long Min	Time In Dec. Latitude	Time In Dec. Longitude	Time Out Dec. Latitude	Time Out Dec. Longitude	Light Transmission Anomalies	Anomaly Depth (m)	Water Analyses	Comments	Other Notes
PAPATUA 1986 (Thos. Washington)	1986		Pual Ridge, near PACMANUS					3	43.4	151	40.2					-3.72	151.67			moderate (CH4)	1650-1700	CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	No transmissometer
PAPATUA 1986 (Thos. Washington)	1986		Bugave Ridge					3	42.8	152	9.8					-3.71	152.16			moderate (CH4)	1600	CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	No transmissometer
21st Cruise 1990 (Akad. Keldysh)	1990	Dip	Marmin Knolls, Enclosed basin					3	41.6	151	36.1					-3.69	151.60			moderate*	1550-1700*	Mn CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	* nephelometer, broader signals
21st Cruise 1990 (Akad. Keldysh)	1990	Dip	NortH0east crestal knoll, near PACMANUS					3	42.8	151	41.1					-3.71	151.69			moderate*	1550-1700*	Mn CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
21st Cruise 1990 (Akad. Keldysh)	1990	Dip	Djual Fault scarp					3	47	151	29.2					-3.78	151.49			weak*	1500	Mn CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
21st Cruise 1990 (Akad. Keldysh)	1990	Dip	Graben 1, west of Kumul Trough					3	39	151	27.8					-3.65	151.46			strong*	1600-1750*	Mn CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Kumul Trough			2494		3	39.55	151	30.08					-3.66	151.50			none* (CH4, Mn)		Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	* No transmissometer
Aquarius 1990 (Hakuho Maru)	1990	Dip	Central Basin (SW of DESMOS, E of Yuam)			2143		3	43.61	151	50.07					-3.73	151.83			weak (CH4, Mn)	?	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	Anomalies read off an EW prfile - we don't have actual data
Aquarius 1990 (Hakuho Maru)	1990	Dip	Bugave Ridge			1968		3	43.03	152	9.92					-3.72	152.17			weak (CH4, Mn)	1050, 1850	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Tumbo Knolls			1926		3	46.35	151	59.69					-3.77	151.99			weak (CH4, Mn)	750, 1550	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	DESMOS			2078		3	41.99	151	52.18					-3.70	151.87			v strong (CH4, Mn)	1700	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Pual Ridge, head of fork			1739		3	42.11	151	41.62					-3.70	151.69			v strong (CH4, Mn)	1600	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Southof DESMOS			1962		3	42.77	151	52.48					-3.71	151.87			weak (CH4, Mn)	?	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Crescent rise N of DESMOS			1915		3	40.86	151	51.96					-3.68	151.87			weak (CH4, Mn)	?	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Umbo Kolls			1685		3	43.6	151	54.21					-3.73	151.90			strong (CH4, Mn)	1650	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	Yuam Ridge, NE tip			1983		3	41.03	151	48.46					-3.68	151.81			strong (CH4, Mn)	1800	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
Aquarius 1990 (Hakuho Maru)	1990	Dip	DESMOS			1964		3	41.48	151	52					-3.69	151.87			v strong (CH4, Mn)	1964	Mn, Al, CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
EDISON 1994 (Sonne)	1994	Dip	Just NE of PACMANUS			1728		3	43.4	151	40.7					-3.72	151.68			strong	1575	CH4	NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	water samples taken
KODOS 1999 (Onnuri)	1999	Dip	SuSu knolls, "eye of plume"			1572		3	47.45	152	6.07					-3.79	152.10			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	(transmissometer carried, many water samples taken
KODOS 1999 (Onnuri)	1999	Dip	SuSu knolls, "eye of plume"					3	42.8	151	58.6					-3.71	151.98			no info*			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	*Position cited is "in water",well west of SuSu! We don't have max depth position
KODOS 1999 (Onnuri)	1999	Dip	Northeast of PACMANUS			1918		3	40.54	151	45.67					-3.68	151.76			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	Northeast of PACMANUS			1758		3	41.74	151	41.66					-3.70	151.69			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	Northeast of PACMANUS			2178		3	41.2	151	45.45					-3.69	151.76			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	East of PACMANUS			1953		3	43.13	151	43.84					-3.72	151.73			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	East of PACMANUS			2122		3	43.23	151	43.87					-3.72	151.73			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	East of PACMANUS			1671		3	42.55	151	42					-3.71	151.70			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	East of PACMANUS			1873		3	42.93	151	44.17					-3.72	151.74			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	SW of DESMOS			2111		3	42.89	151	49.11					-3.71	151.82			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
KODOS 1999 (Onnuri)	1999	Dip	DESMOS			1902		3	40.63	151	51.87					-3.68	151.86			no info			NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
DaeYang02 (Onnuri)	2002	Dip	Just NW of PACMANUS					3	42.85	151	40					-3.71	151.67						NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
PACMANUS-I	29-Sep-91	Tow-yo	Marmin Knolls	4:17	9:08	2178	2615	3	43.9	151	33.05	3	39.29	151	32.75	-3.73	151.55	-3.65	151.55					
PACMANUS-I	29-Sep-91	Tow-yo	Marmin Knolls	23:00	4:07	2189	1804	3	45.85	151	38.91	3	41.19	151	38.65	-3.76	151.65	-3.69	151.64					
PACMANUS-I	30-Sep-91	Tow-yo	Kumul Ridge	12:33	17:30	2558	2473	3	43.9	151	25.98	3	40.44	151	28.81	-3.73	151.43	-3.67	151.48					
PACMANUS-I	1-Oct-91	Tow-yo	Pual Ridge	23:15	4:30	2202	2061	3	41.56	151	44.69	3	38.77	151	44.4	-3.69	151.74	-3.65	151.74					
PACMANUS-I	2-Oct-91	Tow-yo	Pual Ridge	23:14	5:06	1910	1781	3	42.01	151	43.44	3	36.58	151	43.2	-3.70	151.72	-3.61	151.72					
PACMANUS-I	3-Oct-91	Tow-yo	DESMOS	18:20	19:53	2070	1949	3	43.01	151	51.02	3	40.88	151	51.52	-3.72	151.85	-3.68	151.86					
PACMANUS-I	5-Oct-91	Tow-yo	PACMANUS	20:35	2:39	1691	1901	3	44.43	151	39.09	3	41.39	151	40.98	-3.74	151.65	-3.69	151.68					
PACMANUS-I	6-Oct-91	Tow-yo	PACMANUS	22:18	4:00	2096	2115	3	40.96	151	40.35	3	45.58	151	45.58	-3.68	151.67	-3.76	151.76					
PACMANUS-I	6-Oct-91	Tow-yo	PACMANUS	22:12	0:12	1943	1874	3	41.5	151	43.78	3	42.37	151	42.71	-3.69	151.73	-3.71	151.71					
PACMANUS-I	7-Oct-91	Tow-yo	PACMANUS	0:48	3:49	1864	1679	3	41.33	151	42.42	3	42.58	151	41.13	-3.69	151.71	-3.71	151.69					
PACMANUS-I	7-Oct-91	Tow-yo	PACMANUS	4:40	6:44	2099	1839	3	43.43	151	42.01	3	40.7	151	42.81	-3.72	151.70	-3.68	151.71					
PACMANUS II	8-Jun-93	Tow-yo	Tavui caldera, N of Rabual	2:55	5:20	1089	519	4	7.68	152	12.72	4	7.5	152	14.6	-4.13	152.21	-4.13	152.24					
PACMANUS II	9-Jun-93	Tow-yo	PACMANUS	1:30	4:15	2100	1802	3	44.17	151	42.21	3	41.3	151	39.4	-3.74	151.70	-3.69	151.66					
PACMANUS II	9-Jun-93	Tow-yo	Pual Ridge	20:25	0:00	2177	2050	3	43.01	151	35.88	3	39.58	151	35.85	-3.72	151.60	-3.66	151.60					
PACMANUS II	10-Jun-93	Tow-yo	PACMANUS	2:05	7:13	2344	2000	3	44.12	151	37.38	3	37.84	151	37.49	-3.74	151.62	-3.63	151.62					
PACMANUS II	10-Jun-93	Tow-yo	PACMANUS	19:40	0:00	1920	nd	3	42.38	151	44.94	3	39.71	151	41.92	-3.71	151.75	-3.66	151.70					
PACMANUS II	11-Jun-93	Tow-yo	PACMANUS	1:10	6:09	1856	1860	3	42.97	151	44.31	3	40.5	151	41.83	-3.72	151.74	-3.68	151.70					
PACMANUS II	12-Jun-93	Tow-yo	PACMANUS	11:40	5:34	1749	1640	3	39.17	151	42.89	3	42.34	151	46.33	-3.65	151.71	-3.71	151.77					
PACMANUS II	12-Jun-93	Tow-yo	PACMANUS	22:06	3:31	1845	1960	3	41.09	151	44.45	3	43.39	151	47.11	-3.68	151.74	-3.72	151.79					
PACMANUS II	13-Jun-93	Tow-yo	PACMANUS	15:55	16:47	1860	1900	3	40.53	151	42.83	3	40.71	151	43.16	-3.68	151.71	-3.68	151.72					
PACMANUS II	14-Jun-93	Tow-yo	PACMANUS	10:10	12:11	1869	1910	3	41.45	151	43.51	3	40.58	151	43.09	-3.69	151.73	-3.68	151.72					
PACMANUS II	14-Jun-93	Tow-yo	PACMANUS (test)	18:45	19:45	nd	nd	3	43.33	151	42.82	3	43.04	151	42.98	-3.72	151.71	-3.72	151.72					
PACMANUS II	15-Jun-93	Tow-yo	PACMANUS	3:50	9:33	2060	nd	3	44.77	151	41.87	3	42.14	151	39.88	-3.75	151.70	-3.70	151.66					
PACMANUS II	15-Jun-93	Single Dip	PACMANUS	19:38	21:42		1866	3	43.33	151	39.97	3	42.43	151	40.21	-3.72	151.67	-3.71	151.67					
PACMANUS II	16-Jun-93	Tow-yo	PACMANUS	11:10	15:19	nd	2000	3	37.81	151	43.53	3	40.06	151	45.56	-3.63	151.73	-3.67	151.76					
PACMANUS II	18-Jun-93	Single Dip	SW Pual Ridge	5:19	6:46	nd	nd	3	46.05	151	37.47	3	46.11	151	36.79	-3.77	151.62	-3.77	151.61					
PACMANUS II	18-Jun-93	Tow-yo	DESMOS	17:23	18:47	nd	nd	3	41.46	151	52.16	3	41.18	151	51.89	-3.69	151.87	-3.69	151.86					
PACMANUS II	19-Jun-93	Tow-yo	SuSu	3:20	5:35	1825	nd	3	45.71	152	3.96	3	45.46	152	5.54	-3.76	152.07	-3.76	152.09					
PACMANUS II	19-Jun-93	Tow-yo	SuSu	6:06	8:37	nd	nd	3	45.16	152	3.3	3	46.93	152	4.78	-3.75	152.06	-3.78	152.08					
PACMANUS III	1-Dec-96	Tow-yo	East Sherburne Zone	1:20	3:36	nd	nd	3	44.86	148	52.82					-3.75	148.88							
PACMANUS III	1-Dec-96	Single Dip	Giant Seamount, East Sherburne	8:25	9:35	1768	1771	3	39.04	148	56.01	3	39.03	148	56.02	-3.65	148.93	-3.65	148.93					
PACMANUS III	1-Dec-96	Single Dip	Giant Seamount, East Sherburne	11:50	12:29	931	nd	3	40.69	148	54.12	3	40.68	148	54.08	-3.68	148.90	-3.68	148.90					
PACMANUS III	1-Dec-96	Single Dip	East Sherburne Zone	14:00	15:17	nd	nd	3	43.61	149	4.57	3	43.58	149	4.44	-3.73	149.08	-3.73	149.07					
PACMANUS III	1-Dec-96	Single Dip	East Sherburne Zone	21:00	22:50	2167	2170	3	46	149	15.8	3	46.06	149	15.8	-3.77	149.26	-3.77	149.26					
PACMANUS III	2-Dec-96	Single Dip	Willaumez Extension Zone	3:14	5:14	2400	2358	3	32.53	148	36	3	30.92	149	35.72	-3.54	148.60	-3.52	149.60					
PACMANUS III	3-Dec-96	Tow-yo	PACMANUS	9:01	13:00	1686	1676	3	43	151	40.66	3	39.74	151	44.17	-3.72	151.68	-3.66	151.74					
PACMANUS III	4-Dec-96	Tow-yo	SuSu	1:49	6:53	1904	1768	3	44.99	152	2.99	3	47.27	152	6.93	-3.75	152.05	-3.79	152.12					
PACMANUS III	4-Dec-96	Tow-yo	SuSu	7:36	10:28	1689	1864	3	49.56	152	6.44	3	47.26	152	4.25	-3.83	152.11	-3.79	152.07					
PACMANUS III	4-Dec-96	Tow-yo	SuSu	11:21	15:40	1704	2039	3	51.52	152	4.52	3	48.02	152	3.81	-3.86	152.08	-3.80	152.06					
PACMANUS III	4-Dec-96	Tow-yo	SuSu	16:30	20:24	1713	1640	3	49.96	152	7.91	3	46.87	152	5.38	-3.83	152.13	-3.78	152.09					
PACMANUS III	5-Dec-96	Tow-yo	SuSu	8:45	13:50	1784	nd	3	49.95	152	4.75	3	46.2	152	8.15	-3.83	152.08	-3.77	152.14					
PACMANUS III	5-Dec-96	Single Dip	concealed intrusion	17:54	19:20	2158	2158	3	49.16	152	44.09	3	49.21	152	44.61	-3.82	152.73	-3.82	152.74					
PACMANUS III	9-Dec-96	Tow-yo	SuSu	7:55	13:59	1682	1247	3	52.41	152	9.49	3	47.36	152	5.5	-3.87	152.16	-3.79	152.09					
PACMANUS III	9-Dec-96	Tow-yo	SuSu	20:48	2:26	1786	1789	3	50.47	152	4.98	3	46.24	152	9.4	-3.84	152.08	-3.77	152.16					
PACMANUS III	10-Dec-96	Single Dip	SuSu	21:24	22:48	1616	1639	3	49.3	152	6.26	3	49.28	152	6.22	-3.82	152.10	-3.82	152.10					
PACMANUS III	11-Dec-96	Tow-yo	Tumai	6:30	9:12	1672	1765	3	46.99	152	6.38	3	44.93	152	8.61	-3.78	152.11	-3.75	152.14					
PACMANUS III	13-Dec-96		Bugave Ridge	0:50	1:56	1721	1728	3	44.18	152	9.31	3	44.21	152	9.36	-3.74	152.16	-3.74	152.16					
PACMANUS III	13-Dec-96	Single Dip	Tavui caldera, N of Rabual	10:47	11:36	1088	1087	4	7.63	152	12.72	4	7.53	152	12.79	-4.13	152.21	-4.13	152.21					
PACMANUS IV	16-Oct-97	Single Dip	Weiten Volcano	10:19	15:22	nd	5	4	1.66	152	31.06	3	59.519	152	30.216	-4.03	152.52	-3.99	152.50					
PACMANUS IV	16-Oct-97	Tow-yo	SuSu	6:28	13:12	1695.8	nd	3	51.23	152	10	3	49.25	152	12.16	-3.85	152.17	-3.82	152.20					
PACMANUS IV	16-Oct-97	Tow-yo	Nimab	11:13	16:16	1750	2042.8	3	49.794	152	12.285	3	46.43	152	16.46	-3.83	152.20	-3.77	152.27					
PACMANUS IV	17-Oct-97	Tow-yo	SuSu	0:28	4:04	1782.3	nd	3	49.94	152	8.81	3	46.09	152	12.2	-3.83	152.15	-3.77	152.20					
PACMANUS IV	18-Oct-97	Single Dip	SuSu	21:18	23:03	1646	nd	3	49.29	152	6.25	3	49.13	152	6.36	-3.82	152.10	-3.82	152.11					
PACMANUS IV	18-Oct-97	Tow-yo	Tumbo	3:21	8:09	2050	nd	3	46.95	152	0.96	3	46.44	152	1.65	-3.78	152.02	-3.77	152.03					
PACMANUS IV	19-Oct-97	Tow-yo	Bewteen SuSu and Nimab	8:09	1:40	1929.5	7	3	50.68	152	6.62	3	46.119	152	11.45	-3.84	152.11	-3.77	152.19					
PACMANUS IV	20-Oct-97	Tow-yo	SuSu	0:43	1:55	1542.3	nd	3	48.15	152	6.13	3	45	152	10.11	-3.80	152.10	-3.75	152.17					
PACMANUS IV	21-Oct-97	Tow-yo	SuSu	8:06	9:30	1540	nd	3	48.09	152	6.51					-3.80	152.11							
PACMANUS IV	22-Oct-97	Single Dip	Basin near PACMANUS	0:14	11:31	2524.8	1472	3	43.59	151	30.21	3	43.41	151	30.24	-3.73	151.50	-3.72	151.50					
PACMANUS IV	27-Oct-97	Tow-yo	Umbo Knolls	8:38	6:43	2024.8	nd	3	46.95	152	0.96	3	42.03	151	57.37	-3.78	152.02	-3.70	151.96					
PACMANUS IV	27-Oct-97	Tow-yo	Tumbo	3:39	6:30	2026	6	3	48.59	151	59.99	3	46.858	152	2.264	-3.81	152.00	-3.78	152.04					
PACMANUS IV	27-Oct-97	Single Dip	SuSu	9:41	10:57	1669	900	3	49.49	152	8.49	3	49.488	152	8.492	-3.82	152.14	-3.82	152.14					
Binatang 2000	4-Feb-00		North George Basin					4	31.1	152	29.7					-4.52	152.50							
Binatang 2000	18-Apr-00	Single Dip	South George Basin	1:04	3:23	3563	3563	5	15.084	152	24.942	5	15.002	152	25	-5.25	152.42	-5.25	152.42					
Binatang 2000	18-Apr-00	Single Dip	North Su	18:54	20:17	1543	1412	3	48.08	152	6.49	3	48.14	152	6.33	-3.80	152.11	-3.80	152.11					
Binatang 2000	19-Apr-00	Single Dip	North Su	2:50	3:08	?		3	48	152	6.5	?				-3.80	152.11							
Binatang 2000	20-Apr-00	Single Dip	North Su	22:05	22:36	1385	1289	3	48.08	152	6.15	3	48.1	152	6.2	-3.80	152.10	-3.80	152.10					
Binatang 2000	21-Apr-00	Single Dip	SnowCap	7:35	8:27	1657	1668	3	42.998	151	41.003	3	43.007	151	41.007	-3.72	151.68	-3.72	151.68					
Binatang 2000	21-Apr-00	Single Dip	SnowCap	9:38	10:24	1678	1678	3	43.644	151	40.31	3	43.657	151	40.297	-3.73	151.67	-3.73	151.67					
Binatang 2000	21-Apr-00	Single Dip	Pacmanus	21:10	21:40	1685	1684	3	42.744	151	40.743	3	42.759	151	40.757	-3.71	151.68	-3.71	151.68					
Binatang 2000	21-Apr-00	Single Dip	Pacmanus	22:39	0:30	1690	1660	3	43.237	151	41.256	3	43.262	151	41.218	-3.72	151.69	-3.72	151.69					
Binatang 2000	22-Apr-00	Tow-yo	NE Pual Ridge	0:35	5:15	1860	1751	3	41.537	151	43.016	3	42.823	151	46.482	-3.69	151.72	-3.71	151.77					

Binatang 2000	22-Apr-00	Single Dip	South East Pacmanus	21:52	23:00	1786	1727	3	43.449	151	41.513	3	43.403	151	41.419	-3.72	151.69	-3.72	151.69
Binatang 2000	23-Apr-00	Single Dip	NE Pual Ridge	3:46	6:21	1937	2063	3	42.742	151	47	3	39.996	151	40.987	-3.71	151.78	-3.67	151.68
Binatang 2000	23-Apr-00	Single Dip	NE Pual Ridge	6:21	12:43	2063	1909	3	39.996	151	40.987	3	44.33	151	40.466	-3.67	151.68	-3.74	151.67
Binatang 2000	23-Apr-00	Single Dip	NE Pual Ridge	23:52	5:32	2006	2344	3	43.509	151	44.444	3	39.308	151	39.151	-3.73	151.74	-3.66	151.65
Binatang 2000	24-Apr-00	Single Dip	Satanic Mills	15:56	17:13	1687		3	43.441	151	40.469			1687		-3.72	151.67		
Binatang 2000	25-Apr-00	Tow-yo	NE Pual Ridge	0:11	6:21	1884	1970	3	39.953	151	39.01	3	44.668	151	44.061	-3.67	151.65	-3.74	151.73
Binatang 2000	25-Apr-00	Single Dip	Roman Ruins	11:34	12:44	1690	1682	3	43.141	151	40.51	3	43.012	151	40.658	-3.72	151.68	-3.72	151.68
Binatang 2000	25-Apr-00	Single Dip	Sonne Pimple	16:11	17:23	1714	1708	3	42.399	151	41.595	3	42.199	151	41.562	-3.71	151.69	-3.70	151.69
Binatang 2000	25-Apr-00	Single Dip	Sonne Pimple	18:29	19:23	1676	1676	3	42.696	151	41.293	3	42.596	151	41.32	-3.71	151.69	-3.71	151.69
Binatang 2000	26-Apr-00	Tow-yo	NE Pual Ridge	5:19	9:53	1887	2086	3	38.523	151	44.016	3	42.726	151	49.003	-3.64	151.73	-3.71	151.82
Binatang 2000	26-Apr-00	Single Dip	North Su	15:23	16:45	1237	1240	3	48.954	151	6.442	3	48.101	151	6.213	-3.82	151.11	-3.80	151.10
Binatang 2000	27-Apr-00	Single Dip	West Su Basin	0:24	6:29	1860	2016	3	47.864	152	4.443	3	49.565	151	58.823	-3.80	152.07	-3.83	151.98
Binatang 2000	28-Apr-00	Single Dip	NE Pual Ridge	3:40	5:05	1802	1807	3	40.683	151	45.338	3	40.698	151	45.338	-3.68	151.76	-3.68	151.76
Binatang 2000	28-Apr-00	Single Dip	NE Pual Ridge	5:34	6:54	1864	1859	3	40.901	151	44.609	3	40.938	151	44.594	-3.68	151.74	-3.68	151.74
Binatang 2000	28-Apr-00	Single Dip	NE Pual Ridge	10:32	11:31	1920	1952	3	39.547	151	46.186	3	39.506	151	46.246	-3.66	151.77	-3.66	151.77
Binatang 2000	29-Apr-00	Single Dip	NE Pual Ridge	8:04	9:23	1907	1896	3	40.003	151	44.676	3	40.049	151	44.669	-3.67	151.74	-3.67	151.74
Binatang 2000	29-Apr-00	Single Dip	Tsukushi	11:14	12:21			3	43.874	151	39.938	4	43.864	151	39.89	-3.73	151.67	-4.73	151.66
Binatang 2000	30-Apr-00	Single Dip	NE Pual Ridge	1:40	3:00	1982	1976	3	39.487	151	43.992	3	39.522	151	44.008	-3.66	151.73	-3.66	151.73
Binatang 2000	30-Apr-00	Single Dip	NE Pual Ridge	5:53	6:40	1942	1939	3	39.992	151	43.512	3	39.998	151	43.505	-3.67	151.73	-3.67	151.73
Binatang 2000	30-Apr-00	Single Dip	Pacmanus	16:32	17::34	1654	1652	3	44.202	151	39.507	3	44.218	151	39.589	-3.74	151.66	-3.74	151.66
Binatang 2000	30-Apr-00	Tow-yo	Marmin Knolls	21:20	23:52	2053	1700	3	40.74	151	39.007	3	42.254	151	41.341	-3.68	151.65	-3.70	151.69
Binatang 2000	1-May-00	Single Dip	Su Su Plume	11:12	12:54	1212	1484	3	48.184	152	6.177	3	48.271	152	6.413	-3.80	152.10	-3.80	152.11
Binatang 2000	1-May-00	Single Dip	North Su	14:41	15:36	1557	1549	3	47.46	152	5.903	3	47.623	152	5.827	-3.79	152.10	-3.79	152.10
Binatang 2000	1-May-00	Single Dip	North Su	17:17	17:44	1648	1655	3	47.6	152	6.486	3	47.601	152	6.491	-3.79	152.11	-3.79	152.11
Binatang 2000	1-May-00	Single Dip	North Su	18:42	19:30	1544	1531	3	47.942	152	6.525	3	47.938	152	6.514	-3.80	152.11	-3.80	152.11
Binatang 2000	2-May-00	Tow-yo	West Su Basin	0:30	4:00	2048	2057	3	48.004	152	0.936	3	48.037	151	56.973	-3.80	152.02	-3.80	151.95
Binatang 2000	2-May-00	Tow-yo	NE Pual Ridge	23:49	3:42	20??	1659	3	39.409	151	41.652	3	42.554	151	46.045	-3.66	151.69	-3.71	151.77
Binatang 2000	3-May-00	Single Dip	Marmin Knolls	8:00	8:58	2266	2266	3	41.091	151	36.293	3	41.091	151	36.304	-3.68	151.60	-3.68	151.61
Binatang 2000	3-May-00		West EMB	20:02	20:12	2527		3	27.941	151	16.503					-3.47	151.28		
Bismarck 2002	4-Mar-02	Single Dip	Vitiaz Knoll	18:52	20:27	1297	1296	5	47.83	147	35.89	5	47.49	147	35.38	-5.80	147.60	-5.79	147.59
Bismarck 2002	4-Mar-02	Single Dip	Vitiaz Knoll	23:54	0:37	1133	1140	5	50.02	147	40.02	5	50.07	147	39.92	-5.83	147.67	-5.83	147.67
Bismarck 2002	5-Mar-02	Single Dip	SE Long Island	5:41	6:45	1488	1492	5	30.99	147	29.06	5	30.98	147	29	-5.52	147.48	-5.52	147.48
Bismarck 2002	5-Mar-02	Single Dip	Long Island	9:56	10:45	1379	1374	5	24.53	147	16.99	5	24.47	147	17.05	-5.41	147.28	-5.41	147.28
Bismarck 2002	5-Mar-02	Single Dip	Long Island	12:18	13:11	1189	1193	5	30	147	6.87	5	30.9	147	6.75	-5.50	147.11	-5.52	147.11
Bismarck 2002	5-Mar-02	Single Dip	South Long Knoll	16:40	17:34	1391	nd	5	32.72	147	3.58	5	33	147	2.91	-5.55	147.06	-5.55	147.05
Bismarck 2002	5-Mar-02	Single Dip	South Long Knoll	19:53	20:55	1351	nd	5	33.97	147	5.72	5	34.03	147	5.6	-5.57	147.10	-5.57	147.09
Bismarck 2002	6-Mar-02	Single Dip	Long Island	0:08	1:01	1247	1261	5	16.7	146	53.16	5	17.44	146	53	-5.28	146.89	-5.29	146.88
Bismarck 2002	6-Mar-02	Single Dip	Long Island	3:31	4:20	1169	1160	5	4.46	147	4.35	5	4.67	147	4.38	-5.07	147.07	-5.08	147.07
Bismarck 2002	6-Mar-02	Single Dip	North Long Knoll	6:00	6:55	1233	1233	5	5.24	147	7.7	5	5.25	147	7.72	-5.09	147.13	-5.09	147.13
Bismarck 2002	6-Mar-02	Single Dip	North Long Knoll	9:52	10:33	913	898	5	5	147	5.06	5	5	147	5.68	-5.08	147.08	-5.08	147.09
Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef	14:11	15:15	1377	1368	4	56.02	146	39.98	4	56.36	146	40.05	-4.93	146.67	-4.94	146.67
Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef	17:45	18:26	561	558	4	54.88	146	42.08	4	54.19	146	42.06	-4.91	146.70	-4.90	146.70
Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef	20:38	21:31	1073	1190	4	56.15	146	42.96	4	56.39	146	42.85	-4.94	146.72	-4.94	146.71
Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef	23:44	0:23	1047	1120	4	55.56	146	41.17	4	54.6	146	41.1	-4.93	146.69	-4.91	146.69
Bismarck 2002	7-Mar-02	Single Dip	Greig Bank	7:09	8:33	1795	1834	4	35.96	146	19.29	4	35.53	146	19.95	-4.60	146.32	-4.59	146.33
Bismarck 2002	7-Mar-02	Single Dip	Greig Bank	11:40	15:08	1816	1814	4	36.45	146	14.97	4	36.62	146	14.99	-4.61	146.25	-4.61	146.25
Bismarck 2002	7-Mar-02	Single Dip	Greig Bank	18:54	20:09	1786	1756	4	33.02	146	12.55	4	32.98	146	12.65	-4.55	146.21	-4.55	146.21
Bismarck 2002	7-Mar-02	Single Dip	Greig Bank	23:58	0:59	1845	1845	4	30.33	146	19.15	4	39.84	146	19.37	-4.51	146.32	-4.66	146.32
Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt	5:15	5:39	945	950	4	21.01	146	44.05	4	24.97	146	14.05	-4.35	146.73	-4.42	146.23
Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt	10:40	11:58	1828	1780	4	24.03	146	6.07	4	23.8	146	6.31	-4.40	146.10	-4.40	146.11
Bismarck 2002	8-Mar-02	Single Dip	"Mud Volcano"	15:12	16:30	1870	1869	4	18.99	146	15.27	4	18.99	146	15.31	-4.32	146.25	-4.32	146.26
Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt	19:29	20:15	803	793	4	24.19	146	11.47	4	24.18	146	11.43	-4.40	146.19	-4.40	146.19
Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt	22:10	23:21	1442	1437	4	21.98	146	11.51	4	22.01	146	11.5	-4.37	146.19	-4.37	146.19
Bismarck 2002	9-Mar-02	Single Dip	Karkar Island	6:12	7:22	1654	1661	4	42.67	146	7.49	4	42.17	146	7.68	-4.71	146.12	-4.70	146.13
Bismarck 2002	9-Mar-02	Single Dip	Isumrud Strait	9:16	10:09	661	796	4	51.11	145	53.88	4	51.17	145	53.77	-4.85	145.90	-4.85	145.90
Bismarck 2002	9-Mar-02	Single Dip	Isumrud Strait.	11:38	12:10	761	744	4	45.9	145	50.2	4	44.03	145	49.93	-4.77	145.84	-4.73	145.83
Bismarck 2002	9-Mar-02	Single Dip	Karkar Island	15:45	16:46	1263	1266	4	30.12	145	50.03	4	30	145	49.98	-4.50	145.83	-4.50	145.83
Bismarck 2002	9-Mar-02	Single Dip	East Manam	22:53	23:57	1918	1918	4	5.46	145	16.57	4	5.41	145	16.51	-4.09	145.28	-4.09	145.28
Bismarck 2002	10-Mar-02	Single Dip	East Manam	3:30	4:07	1643	1643	4	5.48	145	10	4	5.51	145	9.98	-4.09	145.17	-4.09	145.17
Bismarck 2002	10-Mar-02	Single Dip	East Manam	9:16	10:18	1448	1450	4	7.2	145	12.31	4	7.17	145	12.36	-4.12	145.21	-4.12	145.21
Bismarck 2002	10-Mar-02	Single Dip	East Manam	11:02	12:25	1867	1872	4	4.5	145	13.02	4	4.5	145	13.04	-4.08	145.22	-4.08	145.22
Bismarck 2002	10-Mar-02	Single Dip	East Manam	13:08	14:05	1838	1843	4	1.9	145	9.43	4	1.96	145	9.52	-4.03	145.16	-4.03	145.16
Bismarck 2002	10-Mar-02	Single Dip	East Manam	16:07	17:08	1467	1489	4	4.95	145	7	4	4.99	145	7.06	-4.08	145.12	-4.08	145.12
Bismarck 2002	10-Mar-02	Single Dip	East Manam	18:40	19:30	1660	1658	4	5.44	145	8.02	4	5.48	145	8.04	-4.09	145.13	-4.09	145.13
Bismarck 2002	10-Mar-02	Single Dip	East Manam	21:55	22:52	1420	1388	4	1.99	145	5.98	4	1.83	145	5.81	-4.03	145.10	-4.03	145.10
Bismarck 2002	10-Mar-02	Single Dip	East Manam	23:30	0:47	1825	1838	3	59.96	145	1.98	3	59.74	145	8.04	-4.00	145.03	-4.00	145.13
Bismarck 2002	11-Mar-02	Single Dip	Manam Island	1:45	2:49	1833	1632	3	59.05	145	2	3	59.21	145	3.03	-3.98	145.03	-3.99	145.05
Bismarck 2002	11-Mar-02	Single Dip	Bam Island	6:39	7:37	1381	1382	3	39.69	144	48.71	3	39.7	144	48.7	-3.66	144.81	-3.66	144.81
Bismarck 2002	11-Mar-02	Single Dip	Bam Island	8:42	9:48	1559	1590	3	34.43	144	53.03	3	34.47	144	53.14	-3.57	144.88	-3.57	144.89
Bismarck 2002	11-Mar-02	Single Dip	North Bam Seamount	12:10	13:35	1475	1492	3	30.85	144	47.86	3	30.7	144	48.15	-3.51	144.80	-3.51	144.80
Bismarck 2002	11-Mar-02	Single Dip	East Schouten Ridge	16:24	17:27	1411	1385	3	24.54	144	50.02	3	24.58	144	49.98	-3.41	144.83	-3.41	144.83
Bismarck 2002	11-Mar-02	Single Dip	East Schouten Ridge	23:03	0:05	1453	1460	3	26.09	144	6.91	3	26.14	144	37.57	-3.43	144.12	-3.44	144.63
Bismarck 2002	12-Mar-02	Single Dip	East Schouten Ridge	4:56	6:11	614	608	3	16.31	145	16.32	3	16.55	144	6.26	-3.27	145.27	-3.28	144.10
Bismarck 2002	12-Mar-02	Single Dip	East Schouten Ridge	8:57	9:56	1424	1420	3	24.89	144	56.81	3	24.89	144	56.8	-3.41	144.95	-3.41	144.95
Bismarck 2002	12-Mar-02	Single Dip	Wei Island	12:00	13:30	1726	983	3	25.19	144	35.16	3	25.4	144	29.02	-3.42	144.59	-3.42	144.48
Bismarck 2002	12-Mar-02	Single Dip	Wei Island	14:40	15:29	1669	1324	3	5.29	144	49.23	3	14.3	144	0.82	-3.09	144.82	-3.24	144.01
Bismarck 2002	12-Mar-02	Single Dip	Vokeo Island	19:31	19:59	614	608	3	16.51	144	6.31	3	16.552	144	6.263	-3.28	144.11	-3.28	144.10
Bismarck 2002	12-Mar-02	Single Dip	West Schouten Ridge	19:35	20:31	1399	1400	3	10.71	143	57.49	3	10.71	143	57.55	-3.18	143.96	-3.18	143.96
Bismarck 2002	12-Mar-02	Single Dip	West Schouten Ridge	21:39	22:36	1695	1693	3	4.98	143	49.46	3	5.07	143	49.44	-3.08	143.82	-3.08	143.82
Bismarck 2002	13-Mar-02	Single Dip	SW Vokeo	4:25	5:30	2241	2232	3	20.98	143	55.96	3	21.043	143	55.978	-3.35	143.93	-3.35	143.93
Bismarck 2002	13-Mar-02	Single Dip	W Koil	9:45	10:35	1099	1096	3	20.98	144	10	3	20.93	144	10	-3.35	144.17	-3.35	144.17
Bismarck 2002	13-Mar-02	Single Dip	SW Vokeo	13:33	14:09	1969	1963	3	18.06	144	2.48	3	18.04	144	2.5	-3.30	144.04	-3.30	144.04
Bismarck 2002	14-Mar-02	Single Dip	East Schouten Ridge	5:25	6:39	1573	1540	3	26.489	144	39.496	3	26.984	144	37.828	-3.44	144.66	-3.45	144.63
Bismarck 2002	14-Mar-02	Single Dip	East Schouten Ridge	10:29	11:18	1170	1162	3	26.02	144	46.54	3	26.03	144	46.47	-3.43	144.78	-3.43	144.77
Bismarck 2002	14-Mar-02	Tow-yo	East Schouten Ridge	12:02	14:37	1612	1484	3	25.06	144	45	3	27.18	144	45.48	-3.42	144.75	-3.45	144.76
Bismarck 2002	14-Mar-02	Tow-yo	East Schouten Ridge	15:25	18:00	1838	1165	3	23.77	144	46.89	3	26.48	144	47	-3.40	144.78	-3.44	144.78
Bismarck 2002	15-Mar-02	Tow-yo	East Schouten Ridge	0:45	5:07	1250	1524	3	25.85	144	45.27	3	26.321	144	43.182	-3.43	144.75	-3.44	144.72
Bismarck 2002	15-Mar-02	Tow-yo	East Schouten Ridge	7:15	10:29	1983	1524	3	24.43	144	40	3	27.91	144	39.99	-3.41	144.67	-3.47	144.67
Bismarck 2002	15-Mar-02	Single Dip	East Schouten Ridge	19:01	19:54	2091	1524	3	22.025	144	44.51	3	22.03	144	44.45	-3.37	144.74	-3.37	144.74
Bismarck 2002	16-Mar-02	Single Dip	Central Bismarck B	6:10	7:28	2054	1524	3	13.51	145	4.51	3	13.5	145	4.5	-3.23	145.08	-3.23	145.08
Bismarck 2002	16-Mar-02	Single Dip	Betano Seamount	13:45	15:18	1147	1524	2	56.59	145	5.4	2	56.76	145	2.52	-2.94	145.09	-2.95	145.04
Bismarck 2002	16-Mar-02	Single Dip	Betano Seamount	16:55	17:59	1638	1524	2	56.46	145	10	2	56.5	145	10	-2.94	145.17	-2.94	145.17
Bismarck 2002	16-Mar-02	Single Dip	Central Bismarck C	22:31	23:48	2129	1524	3	22.38	145	19.52	3	22.17	145	19.33	-3.37	145.33	-3.37	145.32
Bismarck 2002	17-Mar-02	Single Dip	East Manam	7:53	8:49	1938	1524	4	1.94	143	13.97	4	1.77	143	13.62	-4.03	143.23	-4.03	143.23
Bismarck 2002	17-Mar-02	Single Dip	East Manam	10:15	11:35	1976	1524	4	1.95	145	16.01	4	2.1	145	16.31	-4.03	145.27	-4.04	145.27
Bismarck 2002	17-Mar-02	Single Dip	East Manam	13:04	14:29	1888	1890	4	1.88	145	11.94	4	1.01	145	11.55	-4.03	145.20	-4.02	145.19
Bismarck 2002	17-Mar-02	Single Dip	East Manam	20:17	21:02	1866	1866	4	4.51	145	13.01	4	4.52	145	13.1	-4.08	145.22	-4.08	145.22
Bismarck 2002	17-Mar-02	Single Dip	East Manam	0:38	1:17	1941	1942	3	59.99	145	14.6	3	0.05	145	13.98	-4.00	145.24	-3.00	145.23
Bismarck 2002	18-Mar-02	Tow-yo	East Manam	3:40	7:50	1857	1941	4	3.97	145	11.43	4	1.32	145	14.14	-4.07	145.19	-4.02	145.24
Bismarck 2002	18-Mar-02	Tow-yo	East Manam	12:25	17:14	1859	1940	4	4.68	145	13.54	4	3.49	145	13.99	-4.08	145.23	-4.06	145.23
Bismarck 2002	18-Mar-02	Single Dip	East Manam	20:38	21:58	2050	2051	4	2.5	145	22.01	4	2.37	145	21.93	-4.04	145.37	-4.04	145.37
Bismarck 2002	19-Mar-02	Single Dip	East Manam	1:17	2:28	1762	1749	4	3.74	145	9.23	4	3.64	145	9.17	-4.06	145.15	-4.06	145.15
Bismarck 2002	19-Mar-02	Single Dip	Stephan Strait	8:00	8:46	1304	1299	4	10.05	145	3.43	4	9.87	145	2.43	-4.17	145.06	-4.16	145.04
Bismarck 2002	19-Mar-02	Single Dip	W Manam	9:53	10:27	900	900	4	2.69	144	56.3	4	2.71	144	56.45	-4.04	144.94	-4.05	144.94
Bismarck 2002	19-Mar-02	Single Dip	East Manam	13:01	14:18	2008	2007	3	56.06	145	16.95	3	56	145	16.97	-3.93	145.28	-3.93	145.28
Bismarck 2002	19-Mar-02	Single Dip	Northwest Karkar Smt	0:30	1:34	1400	1391	4	22.99	145	47.24	4	23.08	145	46.95	-4.38	145.79	-4.38	145.78
Bismarck 2002	19-Mar-02	Single Dip	Northwest Karkar Smt	4:15	4:57	1820	1890	4	16.95	145	52.01	4	17	145	52.04	-4.28	145.87	-4.28	145.87
Bismarck 2002	20-Mar-02	Single Dip	West Hankow Smt	21:38	22:44	1778	1778	4	53.08	146	33.98	4	53.21	146	33.79	-4.88	146.57	-4.89	146.56

Bismarck 2002	20-Mar-02	Single Dip	Ritter	12:40	13:19	871	872	5	31.32	148	4.5	5	31.39	148	4.14	-5.52	148.08	-5.52	148.07
Bismarck 2002	21-Mar-02	Single Dip	Ritter	16:06	16:46	880	887	5	32.23	148	8.08	5	32.23	148	8.1	-5.54	148.13	-5.54	148.14
Bismarck 2002	21-Mar-02	Single Dip	Ritter	17:20	17:50	903	903	5	29.9	148	7.89	5	29.9	148	7.9	-5.50	148.13	-5.50	148.13
Bismarck 2002	21-Mar-02	Single Dip	Cape Gloucester site	21:18	21:56	900	895	5	12	148	34.22	5	12.06	148	34.2	-5.20	148.57	-5.20	148.57
Bismarck 2002	22-Mar-02	Single Dip	Cape Gloucester site	5:15	5:43	803	809	5	7.88	148	34.64	5	7.89	148	34.61	-5.13	148.58	-5.13	148.58
Bismarck 2002	22-Mar-02	Single Dip	Garove	11:48	12:01	140	140	4	40.53	149	29.48	4	40.48	149	29.47	-4.68	149.49	-4.67	149.49
Bismarck 2002	22-Mar-02	Single Dip	Garove	13:49	14:17	140	140	4	41.34	149	29	4	41.33	149	29.78	-4.69	149.48	-4.69	149.50
Bismarck 2002	23-Mar-02	Single Dip	PACMANUS area	12:40	14:30	2255	2144	3	41.4	151	36.54	3	41.08	151	36.31	-3.69	151.61	-3.68	151.61
Bismarck 2002	23-Mar-02	Single Dip	Djaul Fault	20:33	22:11	2730	2730	3	42.99	151	25.79	3	42.83	151	25.82	-3.72	151.43	-3.71	151.43
Bismarck 2002	23-Mar-02	Single Dip	Djaul Fault	23:13	1:10	2707	2710	3	38.98	151	18.29	3	38.99	151	18.31	-3.65	151.30	-3.65	151.31
Bismarck 2002	24-Mar-02	Single Dip	Umbo Basin	21:23	22:46	2108	2151	3	43.02	151	57.51	3	42.94	151	57.57	-3.72	151.96	-3.72	151.96
Bismarck 2002	24-Mar-02	Single Dip	SuSu Knolls	23:49	0:49	1558	1559	3	47.95	152	6.53	3	47.98	152	6.56	-3.80	152.11	-3.80	152.11
Bismarck 2002	25-Mar-02	Single Dip	SuSu Knolls	1:12	2:10	1635	1635	3	48.52	152	7.01	3	48.54	152	7.06	-3.81	152.12	-3.81	152.12

Appendix 6

Tapes of Submersible Dives and Camera Tows

Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
1986	PACLARK	UBC/Toronto Deep Tow System	C 1A	Woodlark Basin - East Basin		NO VIDEO	Colour stills available
1986	PACLARK	UBC/Toronto Deep Tow System	C 2	Woodlark Basin - east of Franklin Seamount		NO VIDEO	Colour stills available
1986	PACLARK	UBC/Toronto Deep Tow System	C 3	Woodlark Basin - West Basin		NO VIDEO	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 4	Woodlark Basin - north wall of South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 5	Woodlark Basin - North Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 6	Woodlark Basin - Goodenough Bay graben	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 7	Woodlark Basin - Goodenough Bay	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 8	Woodlark Basin - ridge north of Craig Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 9	Woodlark Basin - Craig Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 10	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 11	Woodlark Basin - Dobu Szeamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 12	Woodlark Basin - Doby Seamount - South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 13	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 14	Woodlark Basin - north wall od South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 15	Woodlark Basin - north wall of South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 16	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 17	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 18	Woodlark Basin - North Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 19	Woodlark Basin - Northwest Basin	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 20	Woodlark Basin - South Valley	1 of 1	NTSC Video8 Colour 120min	
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 21	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 22	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 24	Woodlark Basin - Franklin Seamount		NO VIDEO	Colour stills available
1988	PACLARK II	UBC/Toronto Deep Tow System	CV 25	Woodlark Basin - Franklin Seamount	1 of 1	NTSC Video8 Colour 120min	
1990	SUPACLARK			Woodlark Basin	1 of 11	PAL Video8 Colour 90min	Deck shots
1990	SUPACLARK	MIR	MIR Dive	Franklin Seamount	2 of 11	PAL Video8 Colour 90min	MIR 2 Dive 1 at Franklin Seamount
1990	SUPACLARK			Woodlark Basin	3 of 11	PAL Video8 Colour 90min	MIR recovery and deployment deck shots
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	4 of 11	PAL Video8 Colour 90min	MIR Dive 1, Franklin Seamount
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	5 of 11	PAL Video8 Colour 90min	MIR Dive 2, Franklin Smt; Dive 3, Dobu Smt
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	6 of 11	PAL Video8 Colour 90min	MIR Dive 3, Dobu Smt
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	7 of 11	PAL Video8 Colour 90min	MIR Dive 4, Dobu Smt; Dive 5, Franklin Smt
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	8 of 11	PAL Video8 Colour 90min	MIR Dive 5, Franklin Smt
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	9 of 11	PAL Video8 Colour 90min	MIR Dive 6, East Valley; Dive 7, Fran klin Smt
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	10 of 11	PAL Video8 Colour 90min	MIR Dive 7, Franklin Smt
1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	12 of 11	PAL Video8 Colour 90min	Selections from Dives 1 and 7; Honiara arrival
1991	PACLARK V	UBC/Toronto Deep Tow System	CV 26	Graben southeast of Franklin Seamount	1 of 1	NTSC Video8 Colour 120min	
1991	PACLARK V	UBC/Toronto Deep Tow System	CV 27	Ridge north of East Basin	1 of 1	NTSC Video8 Colour 90min	
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 2	Southern Kumul Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 3	Pual Ridge, PACMANUS Site	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 4	Graben between Pual Ridge and Area D	1 of 1	NTSC Video8 Colour 90min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 5	Pual Ridge, PACMANUS Site	1 of 1	NTSC Video8 Colour 90min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 6	Northeast Arm of Pual Ridge	1 of 1	NTSC Video8 Colour 90min	
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 7	Between arms of 'Y', Northern Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 8	Eastern foot of western arm, North Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 9	PACMANUS Deposit, Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 10	PACMANUS Deposit, Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 11	PACMANUS Deposit, Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 12	PACMANUS		NO VIDEO	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 13	PACMANUS		NO VIDEO	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 14	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available

Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 15	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 16	NW Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 17	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 18	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 19	SE Yuam Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 20	NW Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 21	SE Yuam Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 22	NW Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 23	Tumai Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1994	Sonne-Edison SO-94	TV Guided Grab	Various	PACMANUS vicinity	1 of 3	PAL VHS	95 GTV (0136 – 0240); 83 GTVA (0651 – 0701); copy of 84 GTVA (0829 – 0857); start of 85 GTVA (10:19 - 10:33)
1994	Sonne-Edison SO-94	TV Guided Grab	Various	PACMANUS vicinity	2 of 3	PAL VHS	84 GTVA (08:29 - 08:5); 85 GTVA (10:17 - 12:51)
1994	Sonne-Edison SO-94	TV Guided Grab	Various	PACMANUS vicinity	3 of 3	PAL VHS	89 GTVA (0242 – 0326); 90 GTVA (1449 – 0519); 91 GTVA (0712 – 0913)
1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 295	Munkalin Seamount	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 295	Munkalin Seamount	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 295	Munkalin Seamount	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 295	Munkalin Seamount	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 295	Munkalin Seamount	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 295	Munkalin Seamount	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1041:11 - 1236:55
1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1237:37 - 1432:52
1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1433:21 - 1618:34
1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1041:13 - 1237:54
1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1238:37 - 1433:51
1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1434:21 - 1618:14
1995	Manusflux	Shinkai 6500	Dive 298	Desmos	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 298	Desmos	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 298	Desmos	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 298	Desmos	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 298	Desmos	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 298	Desmos	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	

Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
1995	Manusflux	Shinkai 6500	Dive 300	Desmos	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 300	Desmos	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 300	Desmos	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 300	Desmos	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 300	Desmos	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 300	Desmos	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1047:19 - 1250:27
1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1255:43 - 1456:26
1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1456:49 - 1611:13
1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1047:22 - 1250:33
1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1256:11 - 1455:52
1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1456:00 - 1611:10
1995	Manusflux	Shinkai 6500	Dive 302	Desmos	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 302	Desmos	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 302	Desmos	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 302	Desmos	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 302	Desmos	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 302	Desmos	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1050:42 - 1250:56
1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1251:25 - 1452:02
1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1452:36 - 1608:04
1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1050:40 - 1251:40
1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1252:09 - 1451:24
1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1451:49 - 1608:05
1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1040:14 - 1241:06
1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1241:26 - 1440:48
1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1441:30 - 1608:05
1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1045:15 - 1242:04
1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1242:24 - 1441:36
1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1442:09 - 1608:14
1995	Manusflux	Shinkai 6500	Dive 306	Desmos	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 306	Desmos	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 306	Desmos	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 306	Desmos	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 306	Desmos	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 306	Desmos	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	

Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 24	NE of Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 25	SuSu Knolls		NO VIDEO	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 26	North of Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 27	SE Yuam Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 28	Roman Ruins	1 of 1	NTSC Video8 Colour 120min	
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 29	NE Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 30	Sonne Pimple	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 31	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 32	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 33	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 34	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 36	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 37	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 38	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 39	South Su		NO VIDEO	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 40	Suzette	1 of 1	NTSC Video8 Colour 120min	
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 41	Nimab	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 42	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 43	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 44	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 45	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 46	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 47	Sonne Pimple	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 48	Flank of Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 49	Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 50	Crest of Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 51	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 52	Crest of Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 53	Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 54	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	1 of 4	PAL VHS Colour 105min	9:16 - 10:29
1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	2 of 4	PAL VHS Colour 120min	10:29 - 12:29
1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	3 of 4	PAL VHS Colour 120min	12:29 - 14:27
1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	4 of 4	PAL VHS Colour 90min	14:27 - 14:55
1998	Bioaccess 98	Shinkai 2000	Dive 1063	Roman Ruins	1 of 3	PAL VHS Colour 120min	10:29 - 12:30
1998	Bioaccess 98	Shinkai 2000	Dive 1063	Roman Ruins	2 of 3	PAL VHS Colour 150min	12:30 - 14:23
1998	Bioaccess 98	Shinkai 2000	Dive 1063	Roman Ruins	3 of 3	PAL VHS Colour 60min	14:23 - 14:51
1998	Bioaccess 98	Shinkai 2000	Dive 1064	DESMOS	1 of 2	PAL VHS Colour 120min	11:45 - 13:44
1998	Bioaccess 98	Shinkai 2000	Dive 1064	DESMOS	2 of 2	PAL VHS Colour 120min	13:44 - 15:41
1998	Bioaccess 98	Shinkai 2000	Dive 1065	PACMANUS	1 of 3	PAL VHS Colour 150min	10:25 - 12:25
1998	Bioaccess 98	Shinkai 2000	Dive 1065	PACMANUS	2 of 3	PAL VHS Colour 120min	12:25 - 14:25
1998	Bioaccess 98	Shinkai 2000	Dive 1065	PACMANUS	3 of 3	PAL VHS Colour 60min	14:25 - 15:02
1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	1 of 3	NTSC SVHS Colour 120min	10:27 - 12:27
1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	2 of 3	NTSC SVHS Colour 120min	12:27 - 14:27
1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	3 of 3	NTSC SVHS Colour 30min	14:27 - 14:58
1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	1 of 3	PAL VHS Colour 120min	10:27 - 12:27

Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	2 of 3	PAL VHS Colour 120min	12:27 - 14:27
1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	3 of 3	PAL VHS Colour 30min	14:27 - 14:58
1998	Bioaccess 98	Shinkai 2000	Dive 1067	PACMANUS	1 of 3	PAL VHS Colour 180min	10:20 - 12:14
1998	Bioaccess 98	Shinkai 2000	Dive 1067	PACMANUS	2 of 3	PAL VHS Colour 150min	12:14 - 14:10
1998	Bioaccess 98	Shinkai 2000	Dive 1067	PACMANUS	3 of 3	PAL VHS Colour 60min	14:10 - 14:55
1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	1 of 4	PAL VHS Colour 150min	9:21 - 10:39
1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	2 of 4	PAL VHS Colour 150min	10:39 - 12:44
1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	3 of 4	PAL VHS Colour 120min	12:44 - 14:44
1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	4 of 4	PAL VHS Colour 30min	14:44 - 15:05
1998	Bioaccess 98	Shinkai 2000	Dive 1069	PACMANUS	1 of 3	PAL VHS Colour 120min	10:19 - 12:18
1998	Bioaccess 98	Shinkai 2000	Dive 1069	PACMANUS	2 of 3	PAL VHS Colour 120min	12:18 - 14:18
1998	Bioaccess 98	Shinkai 2000	Dive 1069	PACMANUS	3 of 3	PAL VHS Colour 60min	14:18 - 14:48
1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	1 of 4	PAL VHS Colour 90min	9:16 - 10:19
1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	2 of 4	PAL VHS Colour 120min	10:19 - 12:23
1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	3 of 4	PAL VHS Colour 120min	12:23 - 14:24
1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	4 of 4	PAL VHS Colour 90min	14:24 - 15:16
1998	Bioaccess 98	Shinkai 2000	Dive 1071	PACMANUS	1 of 3	PAL VHS Colour 150min	10:25 - 12:25
1998	Bioaccess 98	Shinkai 2000	Dive 1071	PACMANUS	2 of 3	PAL VHS Colour 120min	12:25 - 14:21
1998	Bioaccess 98	Shinkai 2000	Dive 1071	PACMANUS	3 of 3	PAL VHS Colour 60min	14:21 - 14:41
1998	Bioaccess 98	Shinkai 2000	Dive 1072	DESMOS	1 of 3	PAL VHS Colour 120min	11:41 - 13:41
1998	Bioaccess 98	Shinkai 2000	Dive 1072	DESMOS	2 of 3	PAL VHS Colour 120min	13:41 - 15:41
1998	Bioaccess 98	Shinkai 2000	Dive 1072	DESMOS	3 of 3	PAL VHS Colour 30min	15:41 - 15:57
1998	Bioaccess 98	Shinkai 2000	Dive 1073	DESMOS	1 of 3	PAL VHS Colour 120min	10:27 - 12:27
1998	Bioaccess 98	Shinkai 2000	Dive 1073	DESMOS	2 of 3	PAL VHS Colour 120min	12:27 - 14:27
1998	Bioaccess 98	Shinkai 2000	Dive 1073	DESMOS	3 of 3	PAL VHS Colour 60min	14:27 - 14:50
1998	Bioaccess 98	Shinkai 2000	Dive 1074	PACMANUS	1 of 3	PAL VHS Colour 120min	10:14 - 12:13
1998	Bioaccess 98	Shinkai 2000	Dive 1074	PACMANUS	2 of 3	PAL VHS Colour 120min	12:13 - 14:14
1998	Bioaccess 98	Shinkai 2000	Dive 1074	PACMANUS	3 of 3	PAL VHS Colour 150min	14:14 - 14:53
1998	Bioaccess 98	Shinkai 2000	Dive 1075	PACMANUS	1 of 3	PAL VHS Colour 150min	10:58 - 12:56
1998	Bioaccess 98	Shinkai 2000	Dive 1075	PACMANUS	2 of 3	PAL VHS Colour 150min	12:56 - 14:56
1998	Bioaccess 98	Shinkai 2000	Dive 1075	PACMANUS	3 of 3	PAL VHS Colour 60min	14:56 - 15:18
1998	Bioaccess 98	Shinkai 2000	Dive 1076	PACMANUS	1 of 3	PAL VHS Colour 120min	10:34 - 12:35
1998	Bioaccess 98	Shinkai 2000	Dive 1076	PACMANUS	2 of 3	PAL VHS Colour 150min	12:35 - 14:39
1998	Bioaccess 98	Shinkai 2000	Dive 1076	PACMANUS	3 of 3	PAL VHS Colour 60min	14:39 - 14:44
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 1	SuSu	1 of 2	PAL Video8 B&W 120min	
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 1	SuSu	2 of 2	PAL Video8 B&W 120min	
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 1	SuSu	1 of 1	PAL Video8 Colour 120min	
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 2-1	Satanic Mills	1 of 1	PAL Video8 B&W 120min	
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 2-1	Satanic Mills	1 of 1	PAL Video8 Colour 120min	
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 3	Roman Ruins	1 of 1	PAL Video8 B&W 120min	
1999	KODOS 99-1	KORDI Deeptow camera	HDSC 3	Roman Ruins	1 of 1	PAL Video8 Colour 120min	
2000	Binatang	CSIRO Deep Tow Camera	MCV 55	North Su	1 of 1	PAL Mini DV Colour 120min	Focus Problems
2000	Binatang	CSIRO Deep Tow Camera	MP 3	Southern Pual Ridge	1 of 1	PAL Mini DV Colour 120min	Focus Problems; Physics tow mostly too high for good images
2000	Binatang	CSIRO Deep Tow Camera	MP 4	Southern Pual Ridge	1 of 1	PAL Mini DV Colour 120min	Physics tow mostly too high for good images
2000	Binatang	CSIRO Deep Tow Camera	MP 11	Southern Pual Ridge, PACMANUS	1 of 1	PAL Mini DV Colour 120min	Physics tow mostly too high for good images
2002	Bismarck	CSIRO Deep Tow Camera	BV01	Caldera of Northeast Karkar Seamount	1 of 1	PAL Mini DV Colour 80min	
2002	Bismarck	CSIRO Deep Tow Camera	BV02	North Bam Ridge	1 of 1	PAL Mini DV Colour 120min	
2002	Bismarck	CSIRO Deep Tow Camera	BV03	North Bam Ridge	1 of 1	PAL Mini DV Colour 80min	
2002	Bismarck	CSIRO Deep Tow Camera	BV04	East of Manam Island		NO VIDEO	Camera damaged during operation - tape unreadable
2002	Bismarck	CSIRO Deep Tow Camera	BV05	East of Manam Island	1 of 1	PAL Mini DV Colour 120min	

Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
2002	Bismarck	CSIRO Deep Tow Camera	BV06	Northwest Karkar Seamount	1 of 1	PAL Mini DV Colour 120min	
2002	Bismarck	CSIRO Deep Tow Camera	BV07	Northeast Arm of Pual Ridge	1 of 1	PAL Mini DV Colour 80min	
2002	Bismarck	CSIRO Deep Tow Camera	BV08	Pual Fork	1 of 1	PAL Mini DV Colour 80min	

Appendix 7

Animal Diversity

Phylum	Class	Order	Family	Genus species	Citation	Locality Details	Vent or Non
Arthropoda	Crustacea	Anomura	Chirostylidae	*Uroptychus bicavus*	Baba, K. & de-Saint-Laurent, M. 1992 Chirostylid and galatheid crustaceans (Decapoda: Anomura) from active thermal vent areas in the southwest Pacific. Scientia Marina 56, 321-332.	Fiji	Vent
Arthropoda	Crustacea	Anomura	Chirostylidae	*Uroptychus thermalis*	Baba, K. & de-Saint-Laurent, M. 1992 Chirostylid and galatheid crustaceans (Decapoda: Anomura) from active thermal vent areas in the southwest Pacific. Scientia Marina 56, 321-332.	Fiji	Vent
Arthropoda	Crustacea	Anomura	Chirostylidae	*Munidopsis starmer*	Baba, K. & de-Saint-Laurent, M. 1992 Chirostylid and galatheid crustaceans (Decapoda: Anomura) from active thermal vent areas in the southwest Pacific. Scientia Marina 56, 321-332.	Fiji	Vent
Arthropoda	Crustacea	Decapoda	Galatheidae	*Munidopsis starmer*	Baba, K. & de-Saint-Laurent, M. 1992 Chirostylid and galatheid crustaceans (Decapoda: Anomura) from active thermal vent areas in the southwest Pacific. Scientia Marina 56, 321-332.	Fiji	Vent
Arthropoda	Crustacea	Decapoda	Hippolytidae	*Lebbeus sp.*	Desbruyères, D., Alayes-Danet, A.-M. & Ohta, S. 1994 Deep-sea hydrothermal communities in Southwestern Pacific back-arc basins (the North Fiji and Lau Basins): Composition, microdistribution and food web. Mar. Geol. 116, 227-242.	Fiji	Vent
Arthropoda	Crustacea	Decapoda	Lithodidae	*Paralomis sp.*	Desbruyères, D., Alayes-Danet, A.-M. & Ohta, S. 1994 Deep-sea hydrothermal communities in Southwestern Pacific back-arc basins (the North Fiji and Lau Basins): Composition, microdistribution and food web. Mar. Geol. 116, 227-242.	Fiji	Vent
Arthropoda	Crustacea	Ostracoda	Cytheruridae	New genus	Desbruyères, D., Alayes-Danet, A.-M. & Ohta, S. 1994 Deep-sea hydrothermal communities in Southwestern Pacific back-arc basins (the North Fiji and Lau Basins): Composition, microdistribution and food web. Mar. Geol. 116, 227-242.	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Buccinidae	*Eosipho desbruyeresi*	Okutani & Ohta, Venus (Jap. Jour. Malac. 52, 217-221 (1993)	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Desbruyeresia cancellata*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Desbruyeresia melanioides*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Desbruyeresia spinosa*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Provanna buccinoides*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Provanna segonzaci*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Mollusca	Gastropoda	Caenogastropoda	Turridae	*Phymorhynchus hyfifluxi*	BECK, L. A. (1996): Systematic position and relationship of Phymorhynchus hyfifluxi n. sp., a further new turrid gastropod species associated with hydrothermal vent sites in the North Fiji Basin (Gastropoda: Prosobranchia: Turridae).- Arch. Molluskenkunde 126 (1/2): 109-115.	Fiji	Vent
Mollusca	Gastropoda	Heterobranchia	Hyalogyrinidae	*Hyalogyra vitrinelloides*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Mollusca	Gastropoda	Heterobranchia	Xylodisculidae	*Xylodiscula major*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Opisthotrochopodus segonzaci*	Miura, T. & Desbruyeres, D. 1995 Two new species of Opisthotrochopodus (Polychaeta: Polynoidae: Branchinotogluminae) from the Lau and the North Fiji Bac-arc Basins, southwestern Pacific Ocean. Proceedings of the Biological Society of Washington 108, 583-595.	Fiji/Lau	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Opisthotrochopodus trifurcus*	Miura, T. & Desbruyeres, D. 1995 Two new species of Opisthotrochopodus (Polychaeta: Polynoidae: Branchinotogluminae) from the Lau and the North Fiji Bac-arc Basins, southwestern Pacific Ocean. Proceedings of the Biological Society of Washington 108, 583-595.	Fiji/Lau	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Thermiphione fijiensis*	Miura, T. 1994 Two new scale-worms (Polynoidae: Polychaeta) from the Lau Back-Arc and North Fiji basins, south Pacific Ocean. Proceedings of the Biological Society of Washington 107, 532-543.	Fiji/Lau	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Thermopolynoe branchiata*	Miura, T. 1994 Two new scale-worms (Polynoidae: Polychaeta) from the Lau Back-Arc and North Fiji basins, south Pacific Ocean. Proceedings of the Biological Society of Washington 107, 532-543.	Fiji/Lau	Vent
Annelida	Polychaeta	Terebellida	Alvinellidae	*Paralvinella fijiensis*	Desbruyères, D. & Laubier, L. 1993 New species of Alvinellidae (Polychaeta) from the North Fiji back-arc Basin hydrothermal vents (southwestern Pacific). Proceedings of the Biological Society of Washington 106, 225-236.	Fiji/Lau	Vent
Annelida	Polychaeta	Terebellida	Alvinellidae	*Paralvinella unidentata*	Desbruyères, D. & Laubier, L. 1993 New species of Alvinellidae (Polychaeta) from the North Fiji back-arc Basin hydrothermal vents (southwestern Pacific). Proceedings of the Biological Society of Washington 106, 225-236.	Fiji/Lau	Vent
Arthropoda	Crustacea	Decapoda	Alvinocarididae	*Nautilocaris saintlaurentae*	Komai, T. & Segonzac, M. 2004 A new genus and species of alvinocaridid shrimp (Crustacea: Decapoda: Caridea) from hydrothermal vents on the north Fiji and Lau Basins, south-western Pacific. Journal of the Marine Biological Association of the United Kingdom 84, 1179-1188.	Fiji/Lau	Vent
Mollusca	Bivalvia	Filibranchia	Mytilidae	*Bathymodiolus brevior*	von Cosel, R., Metivier, B. & Hashimoto, J. 1994 Three new species of Bathymodiolus (Bivalvia: Mytilidae) from hydrothermal vents in the Lau Basin and the North Fiji Basin, western Pacific, and the Snake Pit area, Mid-Atlantic Ridge. Veliger 37, 374-392.	Fiji/Lau	Vent
Mollusca	Bivalvia	Filibranchia	Mytilidae	*Bathymodiolus elongatus*	von Cosel, R., Metivier, B. & Hashimoto, J. 1994 Three new species of Bathymodiolus (Bivalvia: Mytilidae) from hydrothermal vents in the Lau Basin and the North Fiji Basin, western Pacific, and the Snake Pit area, Mid-Atlantic Ridge. Veliger 37, 374-392.	Fiji/Lau	Vent
Mollusca	Gastropoda	Neomphalina	Peltospiridae	*Pachydermia sculpta*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent
Mollusca	Gastropoda	Neomphalina	Peltospiridae	*Planorbidella depressa*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent
Mollusca	Gastropoda	Vetigastropoda	Skeneidae	*Bruceiella globulus*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent
Mollusca	Gastropoda	Vetigastropoda	Skeneidae	*Leptogyra inflata*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent

Phylum	Class	Order	Family	Genus species	Citation	Locality Details	Vent or Non
Mollusca	Gastropoda	Vetigastropoda	Skeneidae	*Ventsia tricarinata*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent
Mollusca	Gastropoda	Vetigastropoda	Skeneidae	*Vetulonia phalcata*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent
Mollusca	Gastropoda	Vetigastropoda	uncertain	*Helicrenion reticulatum*	Warén, A. & Bouchet, P. 1993 New records, species, genera, and a new family of gastropods from hydrothermal vents and hydrocarbon seeps. Zool. Scr. 22, 1-90.	Fiji?	Vent
Annelida	Canalipalpata	Sabellida	Siboglinidae	*Alaysia spiralis*	Southward, E. C. 1991 Three new species of Pogonophora, including two vestimentiferans, from hydrothermal sites in the Lau Back-arc Basin (Southwest Pacific Ocean). J. nat. Hist. 25, 859-881.	Lau	Vent
Annelida	Canalipalpata	Sabellida	Siboglinidae	*Lamellibrachia columna*	Southward, E. C. 1991 Three new species of Pogonophora, including two vestimentiferans, from hydrothermal sites in the Lau Back-arc Basin (Southwest Pacific Ocean). J. nat. Hist. 25, 859-881.	Lau	Vent
Arthropoda	Crustacea	Cirripedia	Neobrachylepadidae	*Neobrachylepas relica*	Newman, W. A. & Yamaguchi, T. 1995 A new sessile barnacle (Cirripedia, Brachylepadomorpha) from the Lau Back-Arc Basin, Tonga; first record of a living representative since the Miocene. Bulletin du Museum National d'Histoire Naturelle Section A Zoologie Biologie e Ecologie Animales 17, 221-243.	Lau	Vent
Arthropoda	Crustacea	Decapoda	Galatheidae	*Munida magniantennulata*	Baba, K. & Turkay, M. 1992 Munida magniantennulata, a new deepsea decapod crustacean from active thermal vent areas of Valu-Fa-Ridge in the Lau Basin, SW-Pacific (Anomura: Galatheidae). Senckenbergiana-Maritima 22, 203-210. CHECK Machordom, A. & Macpherson, E. 2004 Rapid radiation and cryptic speciation in squat lobsters of the genus Munida (Crustacea, Decapoda) and related genera in the South West Pacific: molecular and morphological evidence. Molecular Phylogenetics and Evolution 33, 259-279.	Lau	Vent
Arthropoda	Crustacea	Decapoda	Galatheidae	*Munidopsis lauensis*	Baba, K. & de-Saint-Laurent, M. 1992 Chirostylid and galatheid crustaceans (Decapoda: Anomura) from active thermal vent areas in the southwest Pacific. Scientia Marina 56, 321-332.	Lau	Vent
Chordata	Osteichthyes	Anguilliformes	Synaphobranchidae	*Thermobiotes mytilogeiton*	Geistdoerfer, P. 1991 Ichthyofaune associee a l'hydrothermalisme oceanique et description de Thermobiotes mytilogeiton, nouveau genre et nouvelle espece de Synaphobranchidae (Pisces, Anguilliformes) de l'Ocean Pacifique. Comptes Rendus de l'Academie des Sciences Serie II Sciences de la Vie 312, 91-97.	Lau	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Ifremeria nautilei (j. syn = Olgaconcha tufari Beck 91?)*	Bouchet, P., and Warén, A. (1991) Ifremeria nautilei, a new gastropod from hydrothermal vents, probably associated with symbiotic bacteria. CR Acad Sci Paris Serie III 312: 495–501.	Lau	Vent
Annelida	Polychaeta	Sabellida	Siboglinidae	*Siphonobrachia lauensis*	Southward, E. C. 1991 Three new species of Pogonophora, including two vestimentiferans, from hydrothermal sites in the Lau Back-arc Basin (Southwest Pacific Ocean). J. nat. Hist. 25, 859-881.	Lau	Vent
Mollusca	Bivalvia	Protobranchia	Solemyidae	*Acharax alinae*	Metivier, B. & von-Cosel, R. 1993 Acharax alinae n. sp., Solemyidae (Mollusca: Bivalvia) geante du bassin de Lau. Comptes-Rendus-de-l'Academie-des-Sciences-Serie-III-Sciences-de-la-Vie 316, 229-237.	Lau	Vent
Arthropoda	Crustacea	Cirripedia	Eolepadidae	*Leucolepas-longa*	Southward, A. J. & Jones, D. S. 2003 A revision of stalked barnacles (Cirripedia: Thoracica: Scalpellomorpha: Eolepadidae: Neolepadinae) associated with hydrothermalism, including a description of a new genus and species from a volcanic seamount off Papua New Guinea. Senckenbergiana Maritima 32, 77-93.	Lihir/Edison	Vent
Mollusca	Gastropoda	Caenogastropoda	Turridae	*Phymorhynchus wareni*	Sysoev, A.V. & Kantor, Yu.I., 1995. Two new species of *Phymorynchus* (Gastropoda, Conoidea, Conidae) from hydro-thermal vents. Ruthenica, 5, 17-26.	Lihir	Vent
Mollusca	Gastropoda	Caenogastropoda	Turridae	*Pyropelta bohlei*	Beck, L. A. 1996 Morphology and anatomy of new species of neolepetopsid, acmaeid, fissurellid and pyropeltid limpets from Edison Seamount off Lihir Islands (West Pacific). (Gastropoda: Prosobranchia: Neolepetopsidae, Acmaeidae, Fissurellidae, Pyropeltidae). Archiv für Mulluskenkunde 125, 87-103.	Lihir/Edison	Vent
Mollusca	Gastropoda	Patellogastropoda	Acmaeidae	*Bathyacmaea jonassoni*	Beck, L. A. 1996 Morphology and anatomy of new species of neolepetopsid, acmaeid, fissurellid and pyropeltid limpets from Edison Seamount off Lihir Islands (West Pacific). (Gastropoda: Prosobranchia: Neolepetopsidae, Acmaeidae, Fissurellidae, Pyropeltidae). Archiv für Mulluskenkunde 125, 87-103.	Lihir/Edison	Vent
Mollusca	Bivalvia	Veneroida	Vesicomyidae	*Calyptogena edisonensis*	Okutani, T., Kojima, S. & Kim, D. 2004 A new Calyptogena clam (Bivalvia: Vesicomyidae) from the southwest Pacific. Venus (Tokyo) 63, 29-32; Stecher, J., Tunnicliffe, V. & Türkay, M. 2003 Population characteristics of abundant bivalves (Mollusca, Vesicomyidae) at a sulphide-rich seaflorr site near Lihir island, Papua New Guinea. Canadian Journal of Zoology 81, 1815-1824.	Lihir/Edison	Vent
Mollusca	Gastropoda	Patellogastropoda	Neolepetopsidae	*Paralepetopsis rosemariae*	Beck, L. A. 1996 Morphology and anatomy of new species of neolepetopsid, acmaeid, fissurellid and pyropeltid limpets from Edison Seamount off Lihir Islands (West Pacific). (Gastropoda: Prosobranchia: Neolepetopsidae, Acmaeidae, Fissurellidae, Pyropeltidae). Archiv für Mulluskenkunde 125, 87-103.	Lihir	Vent
Mollusca	Gastropoda	Vetigastropoda	Fissurellidae	*Puncturella solis*	Beck, L. A. 1996 Morphology and anatomy of new species of neolepetopsid, acmaeid, fissurellid and pyropeltid limpets from Edison Seamount off Lihir Islands (West Pacific). (Gastropoda: Prosobranchia: Neolepetopsidae, Acmaeidae, Fissurellidae, Pyropeltidae). Archiv für Mulluskenkunde 125, 87-103.	Lihir	Vent
Mollusca	Gastropoda	Vetigastropoda	Trochidae	*Fucaria mystax*	Warén, A. & Bouchet, P. 2001 Gastropoda and Monoplacophora from hydrothermal vents and seeps; new taxa and records. Veliger 44, 116-231.	Lihir	Vent
Arthropoda	Crustacea	Decapoda	Alvinocaridae	*Alvinocaris sp. 2*	Komai, T. & Segonzac, M. 2005 A revision of the genus Alvinocaris Williams and Chace (Crustacea: Decapoda: Caridea: Alvinocarididae), with descriptions of a new genus and a new species of Alvinocaris. Journal Of Natural History 39, 1111-1175.	Lihir/Edison	Vent
Arthropoda	Crustacea	Anomura	Chirostylidae	*Uroptychusedisonicus*	Baba, K. & Williams, A. B. 1998 New Galatheoidea (Crustacea, Decapoda, Anomura) from hydrothermal systems in the west Pacific Ocean: Bismarck Archipelago and Okinawa Trough. Zoosystema 20, 143-156.	Lihir/Edison	Vent

Phylum	Class	Order	Family	Genus species	Citation	Locality Details	Vent or Non
Arthropoda	Crustacea	Anomura	Chirostylidae	*Shinkaia crosnieri*	Baba, K. & Williams, A. B. 1998 New Galatheoidea (Crustacea, Decapoda, Anomura) from hydrothermal systems in the west Pacific Ocean: Bismarck Archipelago and Okinawa Trough. Zoosystema 20, 143-156.	Lihir/Edison	Vent
Annelida	Canalipalpata	Sabellida	Siboglinidae	*Arcovestia ivanovi*	Southward, E. C. & Galkin, S. V. 1997 A new vestimentiferan (Pogonophora, Obturata) from hydrothermal vent fields in the Manus back-arc basin (Bismarck sea, Papua New Guinea, southwest Pacific Ocean). J. Nat. Hist. 31, 43-55.	Manus	Vent
Arthropoda	Crustacea	Cirripedia	Chionelasmatidae	*Eochionelasmus ohtai manusensi*	Yamaguchi, T. & Newman, W. A. 1997 The hydrothermal vent barnacle Eochionelasmus (Cirripedia, Balanomorpha) from the North Fiji, Lau and Manus basins, south-west Pacific. Zoosystema 19. 623-649. Galkin, S. V. 1992 Eochionelasmus ohtai (Cirripedia, Balanomorpha) from hydrothermal vents in the Manus Back-Arc Basin. Zoologicheskii-Zhurnal. 71, 139-143. Galkin 1997	Manus	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Olgaconcha tufari (Possible sysn of I. nautilei)*	Beck, L. A. 1991 Olgaconcha tufari n. gen. et n. sp. - a new mesogastropod (Gstropoda: Prosobranchia) from hydrothermal vents in the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Annalen des Naturhistorischen Museums in Wien Serie B Botanik und Zoologie 92, 277-287.	Manus	Vent
Mollusca	Gastropoda	Neomphalina	Neomphalidae	*Symmetromphalus hageni*	Beck, L. A. 1992 Symmetromphalus hageni sp.n., a new neomphalid gastropod (Prosobranchia: Neomphalidae) from hydrothermal vents at the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Ann. Naturhist. Mus. Wien 93B, 243-257.	Manus	Vent
Mollusca	Gastropoda	Vetigastropoda	Lepetodrilidae	*Lepetodrilus schrolli*	Beck, L. A. 1993 Morphological and anatomical studies on a new lepetodrilacean limpet (Gastropoda, Prosobranchia) from hydrothermal vents at the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Ann. Naturhist. Mus. Wien 94/95 B, 167-179.	Manus	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Branchipolynoe sp.*	Galkin, S. V. 1997 Megafauna associated with hydrothermal vents in the Manus Back-Arc Basin (Bismarck Sea). Marine Geology 142, 197-206.	Manus	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Iphionella sp.*	Galkin 1997	Manus	Vent
Annelida	Polychaeta	Sabellida	Siboglinidae	*Lamellibrachia sp?*	Galkin 1997	Manus	Vent
Arthropoda	Crustacea	Decapoda	Galatheidae	*Munidopsis sp.*	Galkin 1997	Manus	Vent
Cnidaria	Anthozoa	Actinaria	unknown	*small pink anemone*	Galkin 1997	Manus	Vent
Porifera	Hexactinellida	?	?	*Hyalonema sp.*	Galkin 1997	Manus	NonVent
Cnidaria	Anthozoa	Actinaria	unknown	yellow sp.	Galkin 1997	Manus	NonVent
Cnidaria	Anthozoa	Actinaria	unknown	black sp.	Galkin 1997	Manus	NonVent
Cnidaria	Anthozoa	Gorgonaria	unknown	*Candidella n.sp.*	Galkin 1997	Manus	NonVent
Cnidaria	Hydrozoa	Siphonophora	Rhodaliidae	n.sp.	Galkin 1997	Manus	NonVent
Arthropoda	Crustacea	Amphipoda	?	?	Galkin 1997	Manus	NonVent
Arthropoda	Crustacea	Decapoda	Galatheidae	*Munidopsis sp.*	Galkin 1997	Manus	NonVent
Echinodermata	Asteroidea	Forcipulatacea	Brisingidae	*Freyella sp.*	Galkin 1997	Manus	NonVent
Echinodermata	Asteroidea	Spinulosacea	Echinasteridae	*Henricia sp.*	Galkin 1997	Manus	NonVent
Echinodermata	Ophiuroidea	?	?	?	Galkin 1997	Manus	NonVent
Echinodermata	Crinoidea	?	?	stalked crinoid	Galkin 1997	Manus	NonVent
Echinodermata	Holothuroidea	Elasipodida	Pelagothuridae	?	Galkin 1997	Manus	NonVent
Mollusca	Gastropoda	Neritopsina	Phenacolepadidae	*Olgasolaris tollmanni*	Beck, L. A. 1992 Two new neritacean limpets (Gastropoda: Prosobranchia: Neritacea: Phenacolepadidae from active hydrothermal vents at Hydrothermal Field 1 "Wiener-wald" in the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Ann. Naturhist. Mus. Wien 93 B, 259-275.	Manus Back-Arc Basin "Wiener- wald"	Vent
Mollusca	Gastropoda	Neritopsina	Phenacolepadidae	*Shinkailepas kaikatensis*	Beck, L. A. 1992 Two new neritacean limpets (Gastropoda: Prosobranchia: Neritacea: Phenacolepadidae from active hydrothermal vents at Hydrothermal Field 1 "Wiener-wald" in the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Ann. Naturhist. Mus. Wien 93 B, 259-275. Okutani, T., Saito, H. & Hashimoto, J. 1989 A new neritacean limpet from a hydrothermal vent site near Ogasawara Islands, Japan. Venus Japanese Journal of Malacology. 48, 223-230.	Manus Back-Arc Basin "Wiener- wald"	Vent
Mollusca	Gastropoda	Neritopsina	Phenacolepadidae	*Shinkailepas tufari*	Beck, L. A. 1992 Two new neritacean limpets (Gastropoda: Prosobranchia: Neritacea: Phenacolepadidae from active hydrothermal vents at Hydrothermal Field 1 "Wiener-wald" in the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Ann. Naturhist. Mus. Wien 93 B, 259-275.	Manus Back-Arc Basin; "Wiener- wald"	Vent
Mollusca	Gastropoda	Vetigastropoda	Lepetodrilidae	*Lepetodrilus 'elevatus'*	Beck, L. A. 1993 Morphological and anatomical studies on a new lepetodrilacean limpet (Gastropoda, Prosobranchia) from hydrothermal vents at the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea). Ann. Naturhist. Mus. Wien 94/95 B, 167-179.	Manus originally described from EPR	Vent
Echinodermata	Holothuroidea	Apodida	Synaptidae	*Chirodota sp.*	Desbruyeres et al., 1994; Galkin 1997	Manus, Fiji,	Vent
Annelida	Canalipalpata	Sabellida	Siboglinidae	*Lamellibrachia sp.*	Kojima S., Ohta S., Yamamoto T., Yamaguchi T., Miura T., Fujiwara Y., Fujikura K. and Hashimoto J. (2003). Molecular taxonomy of vestimentiferans of the western Pacific, and their phylogenetic relationship to species of the eastern Pacific III. Alaysia-like vestimentiferans and relationships among families. Marine Biology 142: 625-635.	Manus; DESMOS site, Manus Basin 03 42'S; 151 52'E	Vent
Annelida	Canalipalpata	Sabellida	Siboglinidae	*Alaysia sp.*	Kojima S., Ohta S., Yamamoto T., Miura T., Fujiwara Y. and Hashimoto J. (2001). Molecular taxonomy of vestimentiferans of the western Pacific and their phylogenetic relationship to species of the eastern Pacific. I. Family Lamellibrachiidae. Marine Biology 139: 211-219.	Manus; DESMOS site, Manus Basin 03 42'S; 151 52'E	Vent
Annelida	Polychaeta	Terebellida	Ampharetdiae	*Amphisamytha 'galapagensis'*	Galkin 1997	Manus; East Pacific; Mariana;	Vent
Arthropoda	Crustacea	Decapoda	Bythograeidae	*Austinograea alayseae*	Guinot, D. 1989 Austinograea alayseae sp. nov., crabe hydrothermal decouvert dans le bassin de Lau, Pacifique sud-occidental (Crustacea, Decapoda, Brachyura). Bulletin du Museum National d'Histoire Naturelle Section A Zoologie Biologie e Ecologie Animales 11, 879-903. Galkin 1997.	Manus; Lau	Vent

Phylum	Class	Order	Family	Genus species	Citation	Locality Details	Vent or Non
Annelida	Polychaeta	Terebellida	Alvinellidae	*Paralvinella hessleri*	Desbruyères, D. & L. Laubier 1989. Paralvinella hessleri, new species of Alvinellidae from the Mariana Back-Arc Basin hydrothermal vents. Proceedings of the Biological Society of Washington 102: 761-767. Galkin 1997.	Manus; Mariana	Vent
Mollusca	Gastropoda	Caenogastropoda	Provannidae	*Alviniconcha hessleri*	Okutani, T. & Ohta, S., 1988. A new gastropod Mollusk associated with hydrothermal vents in the Mariana Back-Arc Basin, Western Pacific. Venus 47(1):1-9; Galkin 1997; Kojima, S., Segawa, R., Fijiwara, Y., Fujikura, K., Ohta, S. & Hashimoto, J. 2001 Phylogeny of hydrothermal-vent-endemic gastropods Alviniconcha spp. from the western Pacific revealed by mitochondrial DNA sequences. Biological Bulletin 200, 298-304.	Manus; Mariana	Vent
Arthropoda	Crustacea	Decapoda	Alvinocarididae	*Chorocaris vandoverae*	Martin, J. W. & Hessler, R. R. 1990 Chorocaris vandoverae, a new genus and species of hydrothermal vent shrimp (Crustacea, Decapoda, Bresiliidae) from the western Pacific. Contributions in Science (Los-Angeles) 417, 1-11. Galkin 1997.	Manus; Mariana	Vent
Annelida	Canalipalpata	Sabellida	Siboglinidae	*Lamellibrachia sp.*	Kojima S., Ohta S., Yamamoto T., Miura T., Fujiwara Y. and Hashimoto J. (2001). Molecular taxonomy of vestimentiferans of the western Pacific and their phylogenetic relationship to species of the eastern Pacific. I. Family Lamellibrachiidae. Marine Biology 139: 211-219.	Manus; PACMANUS site, Manus Basin 03 44'S; 151 40'E	Vent
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Hesiocaeca hessleri*	Blake, J. A. 1991 A new species of Hesiocaeca (Polychaeta: Hesionidae) from hydrothermal vents at the Mariana back-arch basin with notes on other polychaetes. Proceedings of the Biological Society of Washington 104, 175-180.	Mariana	Vent
Arthropoda	Crustacea	Decapoda	Bythograeidae	*Austinograea willliamsi*	Hessler, R. R. & Martin, J. W. 1989 Austinograea williamsi, new genus, new species, a hydrothermal vent crab (Decapoda: Bythograeidae) from the Mariana Back-Arc Basin, western Pacific. Journal of Crustacean Biology 9, 645-661.	Mariana	Vent
Mollusca	Gastropoda	Vetigastropoda	Clypeosectidae	*Pseudorimula marianae*	McLean, J. H. 1989 New slit-limpets (Scissurellacea and Fissurellacea) from hydrothermal vents. Part 1. Systematic descriptions and comparisons based on shell and radular characters. Contributions-in-Science-(Los-Angeles) 407, 1-29.	Mariana	Vent
Arthropoda	Crustacea	Copepoda	Dirivultidae	*Dirivultus spinigulatus*	Humes, A. G. 1999 Copepoda (Siphonostomatoida) from Pacific hydrothermal vents and cold seeps, including Dirivultus spinigulatus sp. nov. in Papua New Guinea. Journal of the Marine Biological Association of the United Kingdom 79, 1053-1060.	Lihir/Edison	Vent
Arthropoda	Crustacea	Copepoda	Dirivultidae	*Chasmatopontius thescalus*	Humes, A. G. 1990 Copepods (Siphonostomatoida) from a deep-sea hydrothermal vent at the Mariana Back-Arc Basin in the Pacific, including a new genus and species. Journal of Natural History 24, 289-304. Humes, A. G. 1991 Siphonostomatoid copepods from a de	Mariana/Lau	Vent
Arthropoda	Crustacea	Copepoda	Dirivultidae	*Stygiopontius brevispina*	Humes, A. G. 1990 Copepods (Siphonostomatoida) from a deep-sea hydrothermal vent at the Mariana Back-Arc Basin in the Pacific, including a new genus and species. Journal of Natural History 24, 289-304. Humes, A. G. 1991 Siphonostomatoid copepods from a deep-water hydrothermal zone in the Lau Basin, South Pacific. Bulletin du Museum National d'Histoire Naturelle Section A Zoologie Biologie e Ecologie Animales 13.	Mariana/Lau	Vent
Arthropoda	Crustacea	Copepoda	Dirivultidae	*Stygiopontius lauensis*	Humes, A. G. 1990 Copepods (Siphonostomatoida) from a deep-sea hydrothermal vent at the Mariana Back-Arc Basin in the Pacific, including a new genus and species. Journal of Natural History 24, 289-304. Humes, A. G. 1991 Siphonostomatoid copepods from a deep-water hydrothermal zone in the Lau Basin, South Pacific. Bulletin du Museum National d'Histoire Naturelle Section A Zoologie Biologie e Ecologie Animales 13.	Mariana/Lau	Vent
Annelida	Polychaeta	Terebellida	Maldanidae	*Nicomache 'arwidssoni'*	Blake, J. A. 1991 A new species of Hesiocaeca (Polychaeta: Hesionidae) from hydrothermal vents at the Mariana back-arch basin with notes on other polychaetes. Proceedings of the Biological Society of Washington 104, 175-180.	Mariana; East Pacific	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Branchipolynoe pettiboneae*	Miura, T. & Hashimoto, J. 1991 Two new branchiate scale-worms (Polynoidae: Polychaeta) from the hydrothermal vent of the Okinawa Trough and the volcanic seamount off Chichijima Island. Proceedings of the Biological Society of Washington. 104, 166-174.	Okinawa	Vent
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Opisthotrochopodus japonicus*	Miura, T. & Hashimoto, J. 1991 Two new branchiate scale-worms (Polynoidae: Polychaeta) from the hydrothermal vent of the Okinawa Trough and the volcanic seamount off Chichijima Island. Proceedings of the Biological Society of Washington. 104, 166-174.	Okinawa	Vent
Arthropoda	Arachnidae	Acarina	Halacaridae	*Copidognathus papillatus*	Bartsch, I. 1991 Copidognathus papillatus Krantz (Acari, Halacaridae), a hydrothermal vent mite in the Pacific Ocean. Zoological-Science (Tokyo) 8, 789-792.	West Pacific; EPR; Galapagos	Vent

Appendix 8

Fauna Recovered From CSIRO-led RV Franklin Cruises

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to
MD-1	PACMANUS I	1991	Dredge	Marmin Knolls, Central	1542	3	42.74	151	34.18	-3.71	151.57		One fish 30 cm long and another 2 cm long among gravelly basaltic rocks with brown mud. The fish lay on top of the gravel in the dredge, so may have been collected during ascent.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-2	PACMANUS I	1991	Dredge	Marmin Knolls, west	1903	3	40.94	151	32.88	-3.68	151.55		Unidentified small animal with angular dacite fragments and a small amount of ooze	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-3	PACMANUS I	1991	Dredge	Marmin Knolls, east	1902	3	42.89	151	37.1	-3.71	151.62		Small starfish, worm, shell fragments and some wood mixed with sloppy brown mud and dacite fragments	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-4	PACMANUS I	1991	Dredge	Pual Ridge, west flank north of PACMANUS	1794	3	42.46	151	40.5	-3.71	151.68		A small worm connected to a basaltic andesite fragment coated with brown mud.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-5	PACMANUS I	1991	Dredge	Yuam Ridge, SW	2037	3	42.49	151	44.21	-3.71	151.74		Numerous living tube-worms and dead casings. Numerous white galatheid crabs (some in roe), white prawns, 3-4 tiny yellow gastropod shells. Two small fish 10 cm long (vent fish?)	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-8	PACMANUS I	1991	Dredge	Pual Fork, NE of Sonne on extension of main ridge	1860	3	41.91	151	42.51	-3.70	151.71		Worm casing on grey-black dacite fragment	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-9	PACMANUS I	1991	Dredge	DESMOS	1957	3	41.52	151	52.19	-3.69	151.87		Tube-worms and galatheid crabs in fish-net liner, probably remaining from MD-9. Coconut husk and small pieces of wood mixed with small pumice fragments.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-11	PACMANUS I	1991	Dredge	Pual Fork, near foot of NW Pual	2005	3	39.04	151	44.35	-3.65	151.74		One small fish 2 cm long mixed in with rock fragments	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-12	PACMANUS I	1991	Dredge	Pual Fork	1844	3	40.78	151	42.28	-3.68	151.70		One pink galatheid crab, broken mussel shells, 1 small gastropod (alive), 2 soft worms, 1 worm casing. One small jar of ooze was preserved.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-19	PACMANUS I	1991	Dredge	PACMANUS, NE of Satanic Mills	1659	3	43.72	151	40.13	-3.73	151.67		One live large, coiled, gastropod 4 cm across was caught between the strobe battery and frame of the cage. The coordinates given refer to a collision observed on video at 0757 when the camera collided with a chimney, dislodging numerous bouyant gastropods adhering to it.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-20	PACMANUS I	1991	Dredge	PACMANUS, just NE of Snowcap	1673	3	43.74	151	40.07	-3.73	151.67			Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MCV-11	PACMANUS I	1991	Camera tow	PACMANUS	1690	3	43.37	151	40.34	-3.72	151.67			Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-1	6 white galatheid crabs in 2 plastic vials.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-2	1 gastropod, olive green-greyshell, in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-3	3 mm diameter, round, light green soft "cling-ons" with central black spot, attached to dacite. 3 specimens in plastic bag.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-4	Molluscs, with light brown shells 2 specimens with intact shell 4 specimens total in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-5	Tube worms, green-brown colour. 3 specimens in plastic bag.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-6	Clam shell (broken), grey and white in colour. 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-26	PACMANUS II	1993	Dredge	Twin Knolls, N of PACMANUS	1837	3	42.47	151	39.93	-3.71	151.67	MD-26-1	Red shrimp, 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-1	Brown "sea slug" 2 mm long appendages. 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-2	Gastropod, black and brown spiral shell (9-12 mm long). 2 specimens in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-3	Oyster? shells adhering to dacite glass and hyaloclastite. Shells are white with a blue-grey tint and a pearly lustre. 9 specimens in a plastic bag.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-4	Single shells of same type as in MD-27-3. 20 specimens in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-1	Large gastropod with black-brown shell. Black colour appears to be a coating. 1 specimen in a plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-2	Broken shell pieces similar to MD-28-1. Shells have brown exterior and white interior. 7 pieces in a plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-3	Brown molluscs, same as MD-24: 4.24-30 mm long shells. 3 specimens, 2 adhering to dacite chips, 2 intact, in plastic vial	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-4	White galatheid crab, 20x9 mm carapace in plastic vial. other 2 black-brown tube worms, 2	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-29	PACMANUS II	1993	Dredge	NE arm Pual, W side north knoll	1783	3	41.46	151	42.38	-3.69	151.71	MD-29-1	Red "shrimp", 20x5mm carapace, 13 mm long tail. In plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-29	PACMANUS II	1993	Dredge	NE arm Pual, W side north knoll	1783	3	41.46	151	42.38	-3.69	151.71	MD-29-2	Red shrimp, 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-32	PACMANUS II	1993	Dredge	Basement scarp, S of Yuam Ridge	1922	3	44.82	151	46.41	-3.75	151.77	MD-32-1	Black, carbonaceous worm burrows, 35-100mm long, 7-15 mm diameter with central conduits 2-5 mm in diameter. 5 specimens in glass jar.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-35	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills	1660	3	43.67	151	40.26	-3.73	151.67	MD-35-1	1 specimen of gastropod, dark	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-35	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills	1660	3	43.67	151	40.26	-3.73	151.67	MD-35-2	1 specimen of gastropod with	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-35	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills	1660	3	43.67	151	40.26	-3.73	151.67	MD-35-3	7 small specimens of fibrous,	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-36	PACMANUS II	1993	Dredge	NW base of cone nr E foot of Pual Ridge, E of Sonne	2091	3	43.09	151	42.89	-3.72	151.71	MD-36-1	1 specimen of black vesicular	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-36	PACMANUS II	1993	Dredge	NW base of cone nr E foot of Pual Ridge, E of Sonne	2091	3	43.09	151	42.89	-3.72	151.71	MD-36-2	1 specimen of gastropod, dark	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-40	PACMANUS II	1993	Dredge	Basement ridge near Djaul Flt, 10nm S of Pual Ridge	2056	3	52.07	151	36.31	-3.87	151.61	MD-40-1	1 star-fish specimen. Yellow	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-1	smashed up gastropod, black	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-2	mollusc-brown shell with	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-3	white galatheid crab, 10x5 mm	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-4	along length of worm ~2 mm	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-5	1 specimen of brown coloured	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-6	90 mm long shell (soft)	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-7	oyster? shell attached to small	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-8	soft shelled and soft bodied	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-9	5 specimens of minute single	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-42	PACMANUS II	1993	Dredge	Far SW end of Pual Ridge	2112	3	45.99	151	35.27	-3.77	151.59	MD-42-1	~23 cm long worm? or tail of	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-42	PACMANUS II	1993	Dredge	Far SW end of Pual Ridge	2112	3	45.99	151	35.27	-3.77	151.59	MD-42-2	purplish-blue coloured, soft	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-43	PACMANUS II	1993	Dredge	Umbo Knolls, E flank of East Knoll	1600	3	43.23	151	55.45	-3.72	151.92	MD-43-1	1 specimen of red shrimp.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-43	PACMANUS II	1993	Dredge	Umbo Knolls, E flank of East Knoll	1600	3	43.23	151	55.45	-3.72	151.92	MD-43-2	1 sided piece of mollusc shell	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-44	PACMANUS II	1993	Dredge	NW end, Tumai Ridge	1837	3	43.78	152	2.6	-3.73	152.04	MD-44-1	1 specimen of bivalve shells .	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-44	PACMANUS II	1993	Dredge	NW end, Tumai Ridge	1837	3	43.78	152	2.6	-3.73	152.04	MD-44-2	1 specimen of segmented semi-	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-44	PACMANUS II	1993	Dredge	NW end, Tumai Ridge	1837	3	43.78	152	2.6	-3.73	152.04	MD-44-3	10 cm long piece of black dead	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-45	PACMANUS II	1993	Dredge	Tumai Ridge, centre	1581	3	46.34	152	4.73	-3.77	152.08	MD-45-1	1 specimen of shrimp, dull	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-45	PACMANUS II	1993	Dredge	Tumai Ridge, centre	1581	3	46.34	152	4.73	-3.77	152.08	MD-45-2	1 specimen of yellowish	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-4	PACMANUS II	1993	Grab	PACMANUS, 400m WSW of Roman, towards Satanic	1680	3	43.31	151	40.38	-3.72	151.67	MG-4-1	40 mm long khaki-light brown	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-6	PACMANUS II	1993	Grab	PACMANUS, 200m SE of Tsukushi	1731	3	43.71	151	40.16	-3.73	151.67	MG-6-1	mollusc shell pieces, echinoid	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-10	PACMANUS II	1993	Grab	Enclosed basin near Twin Knolls	1948	3	42.03	151	40.5	-3.70	151.68	MG-10-1	1 specimen , of tube worm ,	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-10	PACMANUS II	1993	Grab	Enclosed basin near Twin Knolls	1948	3	42.03	151	40.5	-3.70	151.68	MG-10-2	one bag of calcareous ooze in	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-10	PACMANUS II	1993	Grab	Enclosed basin near Twin Knolls	1948	3	42.03	151	40.5	-3.70	151.68	MG-10-2	mud oozes in 2 large plastic	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-1	a branch of black coral ?, 60	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney

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MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-2	70 mm long tube cast ? with 6	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-3	a shell fragment. 11x8 mm	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-4	2 ooze samples in 2 plastic bags for Australian Museum.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MG-13	PACMANUS II	1993	Grab	Head of West Valley, SW of Twin Knolls	2203	3	42.74	151	39.29	-3.71	151.65	MG-13-1	2 small plastic bags half-full of mud for Australian Museum, 1 with formalin and other without.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney
MD-46	PACMANUS III	1/12/1996	Dredge	Caldera, East Sherburne	1819	3	44.90	148	52.8	-3.75	148.88	MD46/1	Mashed red prawn	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-46	PACMANUS III	1/12/1996	Dredge	Caldera, East Sherburne	1819	3	44.90	148	52.8	-3.75	148.88	MD46/2	Part of small prawn	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-47	PACMANUS III	1/12/1996	Dredge	Large seamount, East Sherburne	1116	3	41.72	148	55.92	-3.70	148.93	MD47/3	Ooze +rocks + Formalin	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-47	PACMANUS III	1/12/1996	Dredge	Large seamount, East Sherburne	1116	3	41.72	148	55.92	-3.70	148.93	MD47/4	Ooze + rocks No Formalin	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-47	PACMANUS III	1/12/1996	Dredge	Large seamount, East Sherburne	1116	3	41.72	148	55.92	-3.70	148.93	MD47/5	Coral and tubeworms	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-50	PACMANUS III	2/12/1996	Dredge	Scarp, far NW of East Manus Basin	2103	3	22.78	151	12.84	-3.38	151.21	MD50/6	Orange Starfish 10cm	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-53	PACMANUS III	3/12/1996	Dredge	Sonne Pimple, Pual Ridge	1676	3	42.61	151	41.35	-3.71	151.69	MD53/8	Small starfish 2cm	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-53	PACMANUS III	3/12/1996	Dredge	Sonne Pimple, Pual Ridge	1676	3	42.61	151	41.35	-3.71	151.69	MD53/9	1 small tubeworm 2cm	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-55	PACMANUS III	4/12/1996	Dredge	SuSu Knolls, SW slope South Su	1658	3	49.00	152	5.59	-3.82	152.09	MD55/10	Small crab,	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-55	PACMANUS III	4/12/1996	Dredge	SuSu Knolls, SW slope South Su	1658	3	49.00	152	5.59	-3.82	152.09	MD55/11	small worm	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-57	PACMANUS III	6/12/1996	Dredge	PACMANUS (W side Snowcap)	1648	3	43.70	151	40.13	-3.73	151.67	MD/14	1 small rock, mussels attached + 1 small lobster 2cm + many snail shells + 1 Ophioroid	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-58	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1687	3	43.24	151	40.51	-3.72	151.68	MD58/33	2 Large snails, 2 crabs and 1 small prawn	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-61	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1689	3	43.25	151	40.51	-3.72	151.68	MD61/17	Small shells + 1 galatheid	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/19	Galatheids + crabs	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/20	Snails + shells 1 Alvinicocha 1 Ifremeria	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/21	1 fish - Vent fish	Chris Taylor, CSIRIO	formalin solution (10%)	Australian Museum Sydney

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MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/22	Unidentified	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/23	Galatheids	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/24	Tubeworms without rocks	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/25	Tubeworms with rocks	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/26	Snail shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-69	PACMANUS III	8/12/1996	Dredge	Basement scarp SE of Yuam Ridge	2087	3	46.10	151	45.65	-3.77	151.76	MD69/27	1 Small jelly fish	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-70	PACMANUS III	8/12/1996	Dredge	Cone in East Valley, S of PACMANUS	2033	3	45.23	151	40.24	-3.75	151.67	MD70/28	1 Octopus leg 10cm long	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-73	PACMANUS III	10/12/1996	Dredge	Nimab, SW foot	1356	3	49.29	152	10.85	-3.82	152.18	MD73/29	1 small tubeworm casing	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-74	PACMANUS III	10/12/1996	Dredge	Basement scarp near Weitin Fault/Bugave Ridge	1780	3	44.70	152	10.44	-3.75	152.17	MD74/30	1 small fish 10cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-76	PACMANUS III	11/12/1996	Dredge	SuSu Knolls, Suzette	1511	3	47.40	152	5.66	-3.79	152.09	MD76/34	2 snails, 1 galatheid, pieces of wood, tubeworms and snail shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-77	PACMANUS III	11/12/1996	Dredge	South Su	1321	3	48.52	152	6.26	-3.81	152.10	MD77/35	1 tubeworm 6cm long, many small lobsters 2-3cm or galatheids	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-77	PACMANUS III	11/12/1996	Dredge	South Su	1321	3	48.52	152	6.26	-3.81	152.10	MD77/36	1 piece of wood 13cm long	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-79	PACMANUS III	12/12/1996	Dredge	Lunar Cone	1867	3	39.71	152	2.56	-3.66	152.04	MD79/37	Brittle starfish, worm casings, plant material	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-81	PACMANUS III	12/12/1996	Dredge	SuSu Knolls, Suzette	1505	3	47.29	152	5.6	-3.79	152.09	MD81/38	1 medium prawn, 1 small lobster ?, mussel shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-82	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, S flank of South Su	1339	3	48.64	152	5.3	-3.81	152.09	MD82/39	Many mussels and mussel shells,	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-82	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, S flank of South Su	1339	3	48.64	152	5.3	-3.81	152.09	MD82/40	Snails, (1 hairy), small crab 4cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-83	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, North Su crest	1174	3	47.97	152	6.05	-3.80	152.10	MD83/41	1 small trevally 3.5cm, 1 small worm 4cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-84	PACMANUS III	13/12/1996	Dredge	Tavui Caldera (Rabaul)	918	4	6.49	152	10.7	-4.11	152.18	MD84/42	1 sea slug 4cm, 2 small red prawns 2cm, 2 cone shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MG-15	PACMANUS III	6/12/1996	Grab	PACMANUS, east side of Snowcap	1684	3	43.65	151	40.34	-3.73	151.67	MG/12	Mussel shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MG-16	PACMANUS III	6/12/1996	Grab	PACMANUS. Snowcap	1647	3	43.69	151	40.21	-3.73	151.67	MG/13	Mussel + Galatheids + worms	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney

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MG-17	PACMANUS III	6/12/1996	Grab	PACMANUS, Roman Ruins	1689	3	43.25	151	40.51	-3.72	151.68	MG17/15	Small tubeworm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MG-18	PACMANUS III	6/12/1996	Grab	PACMANUS. 200 m E of Snowcap, 150m S of Satanic	1642	3	43.65	151	40.17	-3.73	151.67	MG18/18	Small snail shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MG-19	PACMANUS III	10/12/1996	Grab	South Su crest	1318	3	48.52	152	6.26	-3.81	152.10	MG19/31	1 Galatheid and a tubeworm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MG-20	PACMANUS III	11/12/1996	Grab	Suzette	1516	3	47.40	152	5.66	-3.79	152.09	MG12/32	1 Tubeworm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MS-23	PACMANUS III	3/12/1996	Core	PACMANUS, Snowcap	1636	3	49.69	151	40.2	-3.83	151.67	MS23/7	Clam shell, soft body parts which blocked corer nozzle	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/1	3 tube worms 40cm, 2x15cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/2	1 large vial of gray mud + Formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/3	1 red shrimp 5cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/4	6 white shell fragments up to 2cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/5	2 worm casts	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/6	3 pieces of crab (galatheid?)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-87	PACMANUS IV	17/10/1997	Dredge	Small volcano S of Nimab	1507	3	53.10	152	0.7854	-3.89	152.01	MD87/10	Shell fragments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-88	PACMANUS IV	18/10/1997	Dredge	Crest of Nimab	1038	3	49.22	152	11.223	-3.82	152.19	MD88/11	Assorted worms and basal attachments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-88	PACMANUS IV	18/10/1997	Dredge	Crest of Nimab	1038	3	49.22	152	11.223	-3.82	152.19	MD88/12	1 large vial mud + Formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-88	PACMANUS IV	18/10/1997	Dredge	Crest of Nimab	1038	3	49.22	152	11.223	-3.82	152.19	MD88/13	1 large jelly fish (25cm) and 1 seed pod	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-90	PACMANUS IV	19/10/1997	Dredge	East Tumbo Knoll	1660	3	46.22	152	0.655	-3.77	152.01	MD90/16	1 large vial mud + Formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-90	PACMANUS IV	19/10/1997	Dredge	East Tumbo Knoll	1660	3	46.22	152	0.655	-3.77	152.01	MD90/17	1 small worm case	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-91	PACMANUS IV	19/10/1997	Dredge	SuSu Knolls, crest of South Su	1323	3	48.55	152	6.262	-3.81	152.10	MD91/22	1 small vial with mussel shell peelings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/23	1 small bucket 1/2 full of galatheid crabs (1 to 2cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/24	1 large vial with 10 shrimp (one red), 1 tropical fish (3cm), 1 black fish (1cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney

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MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/25	1 small vial of tube worms	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/26	1 large vial of mussels and their shell peelings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/27	1 small vial of tube worms and basal attachments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-95	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1350	3	48.54	152	6.268	-3.81	152.10	MD95/28	2 Large snails, 2 crabs and 1 small prawn	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-95	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1350	3	48.54	152	6.268	-3.81	152.10	MD95/29	1 large vial with tube worm casings, snail shell fragments and mussel shell pieces	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-96	PACMANUS IV	21/10/1997	Dredge	SuSu Knolls, crest of North Su	1175	3	47.94	152	6.042	-3.80	152.10	MD96/30	1 med. vial with 5 shrimp, 6 galatheids, 1 fish (2cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-94	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, Suzette	1533.5	3	47.36	152	5.616	-3.79	152.09	MD94/31	Mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-97	PACMANUS IV	21/10/1997	Dredge	SuSu Knolls, crest of North Su	1170.3	3	47.98	152	6.037	-3.80	152.10	MD97/32	1 shrimp (2cm) and piece of sea grass	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-100	PACMANUS IV	22/10/1997	Dredge	PACMANUS, S side of Roman Ruins	1697	3	43.28	151	40.533	-3.72	151.68	MD100/33	1 small vial with piece of sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-101	PACMANUS IV	23/10/1997	Dredge	Western Marmin Knollls, ridge	1635	3	41.02	151	33.266	-3.68	151.55	MD101/34	1 small vial with mussel shell coating, tube worm casing and 2 centipedes	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-102	PACMANUS IV	23/10/1997	Dredge	PACMANUS, Roman Ruins	1693	3	43.27	151	49.469	-3.72	151.82	MD102/35	8 barnacles associated with dead chimney fragments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-104	PACMANUS IV	24/10/1997	Dredge	Ridge near NW end of Weitin Fault	1899	3	33.79	151	55.699	-3.56	151.93	MD104/36	tube worm casings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-105	PACMANUS IV	24/10/1997	Dredge	Ridge near NW end of Weitin Fault	1893	3	33.80	151	55.743	-3.56	151.93	MD105/37	1 tiny bivalve (0.5cm) and mussel shell coatings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-105	PACMANUS IV	24/10/1997	Dredge	Ridge near NW end of Weitin Fault	1893	3	33.80	151	55.743	-3.56	151.93	MD105/38	1 large vial of olive/brown mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-106	PACMANUS IV	24/10/1997	Dredge	Young lava field NW end of Tumai Ridge	1936	3	43.83	152	5.626	-3.73	152.09	MD106/39	1 tube worm casing	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-107	PACMANUS IV	24/10/1997	Dredge	Small volcano S of SuSu Knolls	1668	3	52.54	152	3.891	-3.88	152.06	MD107/40	1 bivalve	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-110	PACMANUS IV	25/10/1997	Dredge	PACMANUS, 400m W of Tsukushi	1671	3	43.76	151	39.84	-3.73	151.66	MD110/41	1 red shrimp, 1 clear worm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-106	PACMANUS IV	24/10/1997	Dredge	Small volcano S of SuSu Knolls	1936	3	43.83	152	5.626	-3.73	152.09	MD106/42	1 vial of mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-112	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Roman Ruins	1690.5	3	43.26	151	40.475	-3.72	151.67	MD112/43	1 large bucket with 12 large snails, 3 crabs, 1 sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-113	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Rogers Ruins	1657	3	43.15	151	40.453	-3.72	151.67	MD113/44	1 large snail (10 cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney

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MD-113	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Rogers Ruins	1657	3	43.15	151	40.453	-3.72	151.67	MD113/45	2 large snails and 1 barnacle	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-116	PACMANUS IV	28/10/1997	Dredge	SuSu Knolls, Crest of North Su	1174.3	3	48.01	152	6.073	-3.80	152.10	MD116/47	2 shrimp and 3 pieces of sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-117	PACMANUS IV	28/10/1997	Dredge	SuSu Knolls, Crest of North Su	1176	3	47.99	152	6.038	-3.80	152.10	MD117/48	9 shrimp, assorted sizes	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-118	PACMANUS IV	29/10/1997	Dredge	Seamount between New Ireland & Bougainville	611.5	5	31.48	153	54.088	-5.52	153.90	MD118/49	1 small vial with coral and sponge pieces (limestone talus)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-119	PACMANUS IV	29/10/1997	Dredge	Seamount between New Ireland & Bougainville	1080	5	31.03	153	54.134	-5.52	153.90	MD119/50	Coral pieces, 4 shell fragments, rugose coral	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
D-46	PACMANUS IV	31/10/1997	Dredge	NE Seamount, Misima Is cluster	2050	10	34.61	153	42.327	-10.58	153.71	D46/51	1 large vial pale brown mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
D-46	PACMANUS IV	31/10/1997	Dredge	NE Seamount, Misima Is cluster	2050	10	34.61	153	42.327	-10.58	153.71	D46/52	18 cm long pink worm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-23	PACMANUS IV	17/10/1997	Grab	Base of SE face of Nimab Knoll	1806.3	3	48.58	152	12.785	-3.81	152.21	MG23/7	1 large vial of olive and brown mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-23	PACMANUS IV	17/10/1997	Grab	Base of SE face of Nimab Knoll	1806.3	3	48.58	152	12.785	-3.81	152.21	MG23/8	4 tube worms from 2 to 5cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-23	PACMANUS IV	17/10/1997	Grab	Base of SE face of Nimab Knoll	1806.3	3	48.58	152	12.785	-3.81	152.21	MG23/9	Assorted small shells, coelenterate spines, sea urchin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-24	PACMANUS IV	19/10/1997	Grab	Suzette	1516.8	3	47.36	152	5.645	-3.79	152.09	MG24/18	1 long worm (20cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-24	PACMANUS IV	19/10/1997	Grab	Suzette	1516.8	3	47.36	152	5.645	-3.79	152.09	MG24/19	Worm fragments and casings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-24	PACMANUS IV	19/10/1997	Grab	Suzette	1516.8	3	47.36	152	5.645	-3.79	152.09	MG24/20	Mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MG-26	PACMANUS IV	19/10/1997	Grab	Suzette	1528	3	47.37	152	5.861	-3.79	152.10	MG26/14	Worm casings and shell fragments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MCV-42	PACMANUS IV	18/10/1997	Camera tow	Traverse across the crest of South Su	2448	3	48.48	152	6.212	-3.81	152.10	MCV42/15	1 shell fragment (1cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MCV-43	PACMANUS IV	19/10/1997	Camera tow	Traverse across Suzette field START	1523	3	47.32	152	5.717	-3.79	152.10	MCV43/21	Barnacles from chimney piece that surfaced on camera cage	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MH-59	PACMANUS IV	27/10/1997	CTD Hydrocast TowYo	SE Umbo Knolls	1944.5	3	45.72	151	54.737	-3.76	151.91	MH59/ 46	1 small fish (2cm) caught in tiny foam cup	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney
MD-120	Binatang 2000	19/04/2000	Dredge	SuSu Knolls, Crest of North Su	1161	3	47.96	152	6.047	-3.80	152.10	MD 120/01	5 small prawns, 1 galatheid, 2 worm, 1 scale-worm	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-121	Binatang 2000	19/04/2000	Dredge	SuSu Knolls, Suzette	1514	3	43.37	152	5.617	-3.72	152.09	MD 121/02	1 barnacle, 1 prawn;	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart

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MD-121	Binatang 2000	19/04/2000	Dredge	Suzette	1514	3	43.37	152	5.617	-3.72	152.09	MD 121/03	10 giant snail frozen, Ifremaria (7) and Alviniconcha (3)	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MD-121	Binatang 2000	19/04/2000	Dredge	Suzette	1514	3	43.37	152	5.617	-3.72	152.09	MD 121/04	2 giant snail, Ifremaria	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MD-122	Binatang 2000	19/04/2000	Dredge	South Su	1405	3	48.78	152	6.404	-3.81	152.11	MD 122/05	2 tubeworm, 1 worm, 1 bivalve	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MG-44	Binatang 2000	20/04/200	Dredge	West Su Basin	2079	3	47.50	152	1.496	-3.79	152.02	MG 44/06	3 tubeworm casings	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MD-123	Binatang 2000	20/04/2000	Dredge	Suzette	1513	3	47.33	152	5.598	-3.79	152.09	MD 123/07	3 tubeworm burrowed in a piece of rock	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-123	Binatang 2000	20/04/2000	Dredge	Suzette	1513	3	47.33	152	5.598	-3.79	152.09	MD 123/08	1 empty giant snail shell Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-123	Binatang 2000	20/04/2000	Dredge	Suzette	1513	3	47.33	152	5.598	-3.79	152.09	MD 123/09	1 giant snail Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/10	1 bivalve, 5 mussel	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/11	1 jar of mussels attached to rock pieces	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/12	2 living tubeworm and 3 tubeworm casings	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/13	1 bucket full of mussels of varies sizes	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/14	8 galatheid, 1 starfish, 2 Whelk?	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MG-49	Binatang 2000	21/04/2000	Grab	Snowcap	1645	3	43.68	151	40.179	-3.73	151.67	MG 44/15	4 tubeworm	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/16	1 bucket full of tubeworm of varies sizes and species	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/17	1 mussel, 3 galatheid	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/18	2 tubeworms burrowed into a piece of rock	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/19	a gigantic tubeworm 20 mm in diameter	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MG-50	Binatang 2000	21/04/2000	Grab	Snowcap	1643	3	43.69	151	40.157	-3.73	151.67	MG 50/20	2 tubeworms	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MG-52	Binatang 2000	22/04/2000	Grab	Tsukushi	1666	3	43.77	151	40.032	-3.73	151.67	MG 50/21	1 fossilized gigantic snail covered with Fe oxy-hydroxide	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-126	Binatang 2000	22/04/2000	Dredge	Roman Ruins	1694	3	43.26	151	40.519	-3.72	151.68	MD 126/22	1 gigantic snail, Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-127	Binatang 2000	22/04/2000	Dredge	Roman Ruins	1528	3	43.23	151	40.487	-3.72	151.67	MD 127/23	1 small bright red prawn and 4 galatheids	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-131	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1698	3	43.26	151	40.508	-3.72	151.68	MD 131/24	2 pieces of gigantic snail outer shell epidermis and a piece of grab claw	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/25	1 gigantic snail, Alviniconcha	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/26 (1 of 2)	frozen gigantic snail empty shells, Ifremaria	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/26 (2 of 2)	Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/27	1 galatheid	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-134	Binatang 2000	26/04/2000	Dredge	Roman Ruins	1691	3	43.23	151	40.487	-3.72	151.67	MD 134/28	pieces of tubeworm castings, 2 crushed barnacles, 1 galatheid	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MD-135	Binatang 2000	26/04/2000	Dredge	Roger Ruins	1691	3	43.23	151	40.487	-3.72	151.67	MD 135/29	1 bright red small prawn, 2 galatheids, crushed barnacle pieces with scales (goose-bumps), small crab	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-135	Binatang 2000	26/04/2000	Dredge	Roger Ruins	1691	3	43.23	151	40.487	-3.72	151.67	MD 135/30	3 Alviniconcha	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-137	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1691	3	43.23	151	40.487	-3.72	151.67	MD 137/31	1 spaghetti tubeworm.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to
MD-138	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1678	3	43.61	151	40.337	-3.73	151.67	MD 138/32	1 small, bright reb prawn, 1 galatheid (~70 mm in length), barnacles, empty Ifremaria shell.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-138	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1678	3	43.61	151	40.337	-3.73	151.67	MD 138/33	1 scale worm.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-139	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1670	3	43.61	151	40.324	-3.73	151.67	MD 139/34	1 Ifremaria (90 mm in length), 1 crab, 2 galatheids, barnacles.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-139	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1670	3	43.61	151	40.324	-3.73	151.67	MD 139/35	tubeworm (like millipede) and 4 egg sacs (3 empty egg sacs).	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart
MD-140	Binatang 2000	29/04/2000	Dredge	Roger Ruin	1703	3	43.15	151	40.464	-3.72	151.67	MD 140/36	a piece of gigantic snail outer skin.	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart
MP-07	Binatang 2000	28/04/2000	Geophysical Tow	Pual Ridge	1676	3	43.43	151	39.351	-3.72	151.66	MP 07/37	1 bright red prawn	Jessie Wama, PNG Geol Survey		CSIRO Marine Research, Hobart
BD-22	Bismarck 2002	22/03/2002	Dredge	Satanic Mills	1678	3	43.61	151	40.343	-3.73	151.67		brittle star, a spaghetti worm, and fragments of mussel shell and hairy mussel body attached to dacite	Ray Binns, CSIRO	frozen	CSIRO Expl & Mining, Sydney

Appendix 2

Baseline Environmental Study
Eastern Manus Basin, Papua New Guinea
Module 2: Detailed Scoping Study

DRAFT

Confidential Report P2006/90

Baseline Environmental Study
Eastern Manus Basin, Papua New Guinea

Module 2

Detailed Scoping Study

Authors

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March 2006

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1. Executive Summary

Results of the preliminary scoping study in Module1 of the Environmental Baseline Study of the Eastern Manus Basin indicated a considerably larger volume of available information and data than was initially envisaged. The information and data were in various stages of completeness, and therefore influenced the work plan for the detailed scoping study in Module 2, the subject of this report.

Work undertaken in Module 2 comprised detailed scoping investigations in four main areas that were highlighted in Module 1:

(i) animal diversity,
(ii) CTD-hydrocasts (hydrothermal plumes),
(iii) sediments
(iv) dive footage

A fifth area of interest, microbiological diversity, was not investigated at the request of the client.

1.1 Summary and Conclusions

Animal Diversity

1. Animals from CSIRO Exploration and Mining's collections were consolidated and examined. Since the animals collected by CSIRO were largely 'by catch' rather than dedicated biological survey, they represent a less than ideal sample of what is likely to be the real biological diversity. Therefore numerical data have not been included since the collection methods do not allow for a sense of the population densities of the animals involved.

2. This report, however, adds substantially to the previous Japanese submersible surveys at DESMOS and PACMANUS and provides the first summary of animal diversity at SuSu. The assemblage of animals at DESMOS, PACMANUS and SuSu is broadly similar to those described in more detailed studies of the West Pacific vent sites such as the North Fiji and Lau back-arc basins and further north near Japan.

3. Further study of the genetic diversity of organisms across a range of West Pacific hydrothermal vents is required to properly assess the degree of endemism in the Eastern Manus Basin. This could be accomplished based on some of the specimens recovered by CSIRO and now in the collections of the Australian and South Australian Museums.

CTD-hydrocasts (hydrothermal plumes)

1. Of 240 mostly CSIRO CTD hydrocasts in the Bismarck Sea, ~ 30% have been deployed in the in the Pual Ridge (PACMANUS) region and ~ 17% in the SuSu Knolls region. There is an abundance of potential data in the CTD-hydrocasts from both areas in the form of water and filter samples.

2. However, apart from on board interpretation of hydrothermal plumes, there are only two main plume-related studies: one of Pual Ridge – a PhD study involving examination of samples

collected during two of the PACMANUS cruises; and a CSIRO study of the plume at SuSu Knolls. Hence the data are grossly under utilized with respect to understanding natural input to the environment.

3. At SuSu in particular, plume particulates have not been characterized (e.g., no data on size, shape, composition, concentration and flux of particulates). Similarly, the chemistry of the plume has not been analysed in detail, apart from a 1998 CSIRO study which focused on the distribution of the main path finder elements such as Fe, Mn and Al. A suite of other elements (B, Ba, Be, Ca, Cd, Co, Cr, Cu, K, Li, Mg, Mo, Na, Ni, P, Pb, S, Si, Sr, Ti, V and Zn) have been analysed, but not been plotted nor evaluated. However, only some of the data may be useful as concentrations may be below detection limits.

Sediments

1. Two contrasted "mudline" sediment types are present in the region – hemipelagic oozes are widespread, while sandy volcaniclastic sediments ("tuffite" in part) derived from catastrophic submarine volcanic or hydrothermal eruptions dominate the SuSu Knolls region. The two variants are clearly distinguished mineralogically and geochemically.

2. Fine-grained cohesive muds associated with the volcaniclastic silts and sands are not normal hemipelagic sediment, but rather slowly-settled material also derived from submarine eruptions including altered volcanic debris – an important conclusion for understanding Suzette geology in particular.

3. For both bottom sediment types, hemipelagic ooze at PACMANUS and volcaniclastic at Suzette, distinct enrichments in chalcophile elements distinguish proximal sediments from distal and "background" sediments. The enrichment profiles differ, however, between the two sites, Suzette being characterised (based on limited analyses) more by elements such as As and Sb, presumably contained in sulfosalts.

4. A gaps audit establishes several areas where further interpretation or new analytical work will contribute to (1) environmental baseline understandings of the Suzette exploration site, and (2) possible exploration methodology for the longer term future.

Dive Footage

1. CSIRO posses full video footage from 16 submersible dives at PACMANUS, 8 at DESMOS, 4 at Vienna Woods and one dive at Axial Seamount 3° 33'. Because of the relative stability of the viewing platform, this footage is of a much higher quality than that recorded by any of the deep tow systems and therefore preferable for the purposes of detailed observation of geology and fauna. No submersible footage for SuSu knolls is held by CSIRO.

2. Through a process of prioritization, around 40 tapes have been selected to provide a reasonable coverage of both areas of interest (Pual Ridge and SuSu Knolls).

1.2 Recommendations

Animal Diversity

1. The Australian Museum should be approached to conduct a thorough search of its collections. An attempt should be made to locate 'lost' material, particularly that preserved in ethanol which can be used for DNA sequencing.

2. Re-analyse the gene data found in Kojima *et al*. (2000) data on *Ifremeria* data and possibly also other papers on siboglinids and *Alvinoconcha*. These are of direct relevance to the issue of endemism in the Eastern Manus Basin.

3. Sequence DNA from collections of material of the mussel *Bathymodiolus*, the snails *Ifremeria* and *Alvinoconcha*, the vestimentiferan worm *Alaysia*, and the crustaceans *Munidopsis*, *Alvinocaris* and *Chorocaris* and *Austinograea*. Sufficient material has been preserved in ethanol to make a useful comparison with specimens collected from the Fiji and Lau basins.

4. An initial assessment of the quality of the preserved material will require the attempted extraction of DNA from samples and then amplification of a particular target gene (or genes). Ideally about 10-15 animals per species should be tried.

    a) For SuSu, there are 10 or more specimens of *Munidopsis* (squat lobsters), *Alvinocaris* (shrimp), and 1-5 specimens of important animals such as *Bathymodiolus* (mussel = 1 specimen), *Chorocaris* (shrimp = 2 specimens), *Ifremeria* (snail = 2 specimens).

    b) For PACMANUS, there is more material with 10 or more specimens of *Bathymodiolus* (mussel), *Munidopsis* (squat lobsters), *Alvinocaris* (shrimp), *Ifremeria* (snail), *Alaysia* (vestimentiferan) and 1 specimen of *Alvinoconcha* (snail).

    c) For both SuSu and PACMANUS around 76 DNA extraction attempts could be made. The second phase would be the actual sequencing of a target gene (Cytochrome oxidase 1) and costs would depend on the success of the first phase.

5. Subject to checking the quality of the DNA in the material preserved in ethanol, investigate the possibility of collaboration with colleagues in the USA who have material from these regions to make DNA sequences available for comparison with PACMANUS and SuSu material.

CTD Hydrocasts (hydrothermal plumes)

1. In the SuSu Knolls area, re-evaluate hydrothermal plume data (chemical analyses, CTD data, particulates), including data from Binatang 2000 and Bismarck 2002 cruises, with an aim of modeling the flux and chemical composition of hydrothermal fluid and particulate material into the environment. This modeling will enable order of magnitude estimates of the "ambient" input of naturally occurring toxic and other elements into the marine environment.

2. In detail this work will comprise SEM examination of particulates from the SuSu plume near field in samples from CTD-hydrocasts MH082, MH094 and MH096, and from the outer limits of the plume in MH097.

3. Determination of the presence or absence of an identifiable plume associated with Suzette requires additional work; and accordingly CTD-light transmission data around SuSu should be re-examined with this specific objective. This activity requires quite time consuming recalculation (lag corrections) of all CTD positions and careful comparison of the profiles.

4. If available, the CTD light transmission data from Placer's *Genesis* expedition could be incorporated as well as visual estimates of black smoker and grey smoker flux from ROV videos from Placer's more recent work around SuSu Knolls.

5. Similar re-evaluation of the PACMANUS plumes is warranted based on new data from the Binatang 2000 and Bismarck 2002 expeditions. However, the PACMANUS area is possibly a lower priority for the company.

Sediments

In order of priority, the following recommendations are made for sediments:

1. In the SuSu Knolls region, only eight of the 38 volcaniclastic sediments analysed by ICP-AES have also been analysed by the ICP-MS method. At the Suzette field, the proportion is only 2 in 9. This means data are lacking for a number of significant trace elements, including Rb, As, Cd, In, Sb, rare earth elements (REE), Tl, Bi, Th and U. The deficient 30 samples should be analysed by ICP-MS, together with 5 samples to allow interlaboratory comparison of results.

2. Nine CSIRO operations (mainly post 2000) in the SuSu Knolls area yielded mudline sediment samples of which none have so far been analysed by any method. Analysis of all these samples by both ICP-AES and ICP-MS methods are highly desirable for the environmental baseline project.

3. Geochemical profiles for two cores, MS-52 and MS-53, recovered during the Binatang-2000 cruise from the large basin east of Pual Ridge and from the smaller basin east of Umbo Knolls, respectively, would provide further historical understanding of hemipelagic sedimentation over the last 2000 to 3000 years. A total of 30 samples from the two cores will provide detailed coverage. The suggested studies of MS-52 and MS-53 may not have immediate relevance to the Joint Venture activities, so are assigned low priority.

4. In addition, detailed mineralogical and sedimentological assessments of samples from potential monitoring sites (should mining proceed) are proposed

Dive Footage

1. As a minimum requirement, it is recommended that all 40 tapes ranked 1 be duplicated to DVD and re-examined to provide an overview of the observed geology and fauna at PACMANUS and SuSu Knolls.

2. The cost of handling and duplication, at $80 per DVD, is $3200. Note that the rate per DVD is higher than quoted previously, due to the much smaller number of DVDs to be burned.

3. A quotation for examination and logging of these DVDs can be prepared at the client's request and will be dependent on the nature and detail of information require

1.3 Proposed Plan and Budget Module 3

An indicative budget is given below in Table1.1.

Table 1.1 Budget for Module 3, Environmental Baseline Study of the Eastern Manus Basin. High priority activities = yellow; lower priority activities or indicative budget only subject to final work program = light blue

Module 3 Activity	Estimated Cost
1 Sediments (Binns)	
High priority:	
14 samples ICP-AES @ $110/sample	$1,540
44 samples ICP-MS @ $50/sample	$2,200
sample retrival	$2,000
plotting and interpretation (5 days)	$10,000
Lower Priority	
79 samples ICP-AES	$8,690
79 samples ICP-MS	$3,950
sample/pulp retrieval	$2,000
plotting and interpretation (10 days)	$20,000
2 CTD Hydrocasts (McConachy)	
SuSu Knolls Plume	
Plume particulate charcterisation (sample preparation, SEM studies, interpretation)	$10,000
Retrieval and Evalaution of CTD and Light transmission data	$15,000
Plume water analyses	$2,000
Modelling of particulate and fluid flux to natural environment	$30,000
Pual Ridge Plumes	
Plume particulate charcterisation (sample preparation, SEM studies, interpretation)	$10,000
Retrieval and Evalaution of CTD and Light transmission data	$15,000
Plume water analyses	$2,000
Modelling of particulate and fluid flux to natural environment	$30,000
3 Dive Tapes and Camera Tows (Yeats)	
copy 40 Rank 1 tapes onto DVD	$3,200
Indicative only. Quotation for examination and logging will depend on the nature and detial of information required by the client	$30,000
4 Animal Diversity (Rouse)	
Find missing sampes at Australian Museum	
PACMANUS and SuSu animals	
76 x DNA extraction and amplification	$7,000
Indicative only. DNA sequencing of target genes (dependent on success of DNA extraction and amplification)	$10,000
interpretation and report compilation	$13,000
5 Microbiological Diversity (Roberston & Nichols)	
Deferred	
Travel	$6,000
Materials	$5,000
Total (all studies)	**$238,580**
Total (priority studies in yellow)	**$106,940**

2. Introduction

Placer Dome has reached an agreement with Nautilus Minerals Limited to explore the eastern Manus Basin for deposits of gold-rich massive sulfides with a publicly stated objective of commercial production by the end of this current decade. The companies have approached CSIRO to assist with a baseline environmental study, an important and necessary component of the exploration and mining process.

CSIRO has a large proprietary database and information concerning research cruise and survey operations in the Manus Basin. Significant base line information could be gleaned from these databases and literature to provide a snapshot of the environment prior to mining and identify gaps in knowledge and data that will require addressing.

CSIRO reached an agreement with Placer Dome to undertake a base line environmental study planned in 3 stages or modules.

Module 1: Initial scoping study to determine breadth of data
Module 2: Detailed assessment of data with recommendations for future work
Module 3: Baseline Environmental study

Module 1 was completed and delivered to Placer Dome in July 2005. Soon after, the company gave the go ahead for Module 2. The scope of Module 2 was revised to exclude a detailed assessment of microbiology.

In November 2005 an interim progress report of Module 2, specifically the section ‘Animal Diversity’ was delivered to the company.

This report represents the results of work undertaken for Module 2 (and for completeness includes the previously issued section ‘Animal Diversity’) and brings together a more detailed assessment of relevant data and makes recommendations of future work for Module 3.

3. Animal Diversity

3.1 Introduction to animals at East Manus Basin hydrothermal vents

The deep sea is generally nutrient poor and, being dark and cold, there may be a low density and diversity of animal life. Therefore, the discovery of diverse and dense animal communities around hot hydrothermal vents on the East Pacific Rise in 1977 (Corliss *et al.* 1979) was astounding.

The animals associated with hydrothermal vents live directly or indirectly on bacteria that break down hydrogen sulphide being emitted by the vents. This means they are completely independent from energy derived from the sun and unlike all other animal life. Many animals (e.g., gastropods and bivalve molluscs and vestimentiferan tube worms) have obligate symbiotic associations with the chemoautotrophic bacteria using the sulphide found in hydrothermal vents and hence they and their animal hosts cannot survive elsewhere. The animals with bacterial symbionts, as well as free-living chemoautotrophic bacteria, tend to support complex communities of other organisms that are usually only found at vents. This means that hydrothermal vents are inclined to be small areas of high populations densities and biological diversity that will be very sensitive to disturbance. The distribution of animals around hydrothermal vents depends on the nature of the hydrothermal flow. Hot, localized, emissions of water (Black or white smokers) may reach temperatures in excess of 300 C°; far to hot for any animals to tolerate. However, some do live surprisingly close to this flow (alvinellid worms, alvinocarid shrimps) and the temperature of the water rapidly drops away from the flow so that the chimneys formed by the hydrothermal flow may be covered with life. More diffuse flow may also occur over wide areas where broad dense assemblages of animals (e.g. mussel beds) may be found in the water that may be 5-30 C°. Proper assessment of the distribution of these animal communities requires surveys by submersibles of video tows. However where this is not available, a detailed understanding of the patterns of hydrothermal flow may allow for good prediction of animal occurrence.

The diversity of animals at hydrothermal vents has been best studied in the eastern Pacific on the East Pacific Rise and Galapagos Rift. In the western Pacific there have been some detailed surveys of hydrothermal vents in the North Fiji and Lau back-arc basins. There are quite different communities of animals living at these vents compared with the eastern Pacific. Surveys of the Eastern Manus Basin to date suggest the communities of animals around the hydrothermal vents are quite similar to those of North Fiji and Lau. The hydrothermal activity may be chimneys formed by black or white smokers, or broader areas of diffuse flow. Figure 1 shows organisms found around the hydrothermal vents of the Eastern Manus Basin. In Figure 3.2, more detailed photographs are shown of specimens collected from East Manus Basin hydrothermal vents.. The focus is larger animals, although numerous species of small animals are also found in association with these, since these are the only ones that have been collected to date

In the western Pacific, molluscs are the dominant animals associated with hydrothermal vents, in terms of diversity and abundance. Mussels in the genus *Bathymodiolus* can form large beds in areas of diffuse hydrothermal flow (Figure 3.1A, B, C, G). The mussels have a symbiotic relationship with bacteria which pack their gills filaments. These mussels provide a complex habitat that is then the home to numerous small organisms such as polychaete and other worms, other small molluscs and various crustaceans including squat lobsters and crabs (Fig. 3.1A, B, E, H). The latter are probably predators or scavengers on the mussels.

At the DESMOS hydrothermal vents large clams in the genus *Calyptogena* have been reported (Ohta and Hashimoto 1997). The clams are also known to harbor symbiotic bacteria and form large beds at some of the east Pacific hydrothermal vents; however, the clams have not been noted at PACMANUS or Su Su knoll vents. Gastropod snails are the other major mollusk group at hydrothermal vents and two forms are found that also have symbiotic bacteria. *Alvinoconcha hessleri* (the hairy shell snail) is often found in aggregations around areas of diffuse hydrothermal flow (Fig. 3.1B) and the snails are then often surrounded by a ring of another snail species, *Ifremeria nautilei* (Figs 3.1A, B, D; 3.2B). Both species have their digestive glands packed with bacteria and require hydrogen sulphide to survive. Predatory or scavenging snails such as *Eosipho* (Fig. 1C) and *Phymorhynchus* (Fig. 3.2D) are common as are small 'limpets' that presumably graze on free-living bacteria (Fig. 3.2E).

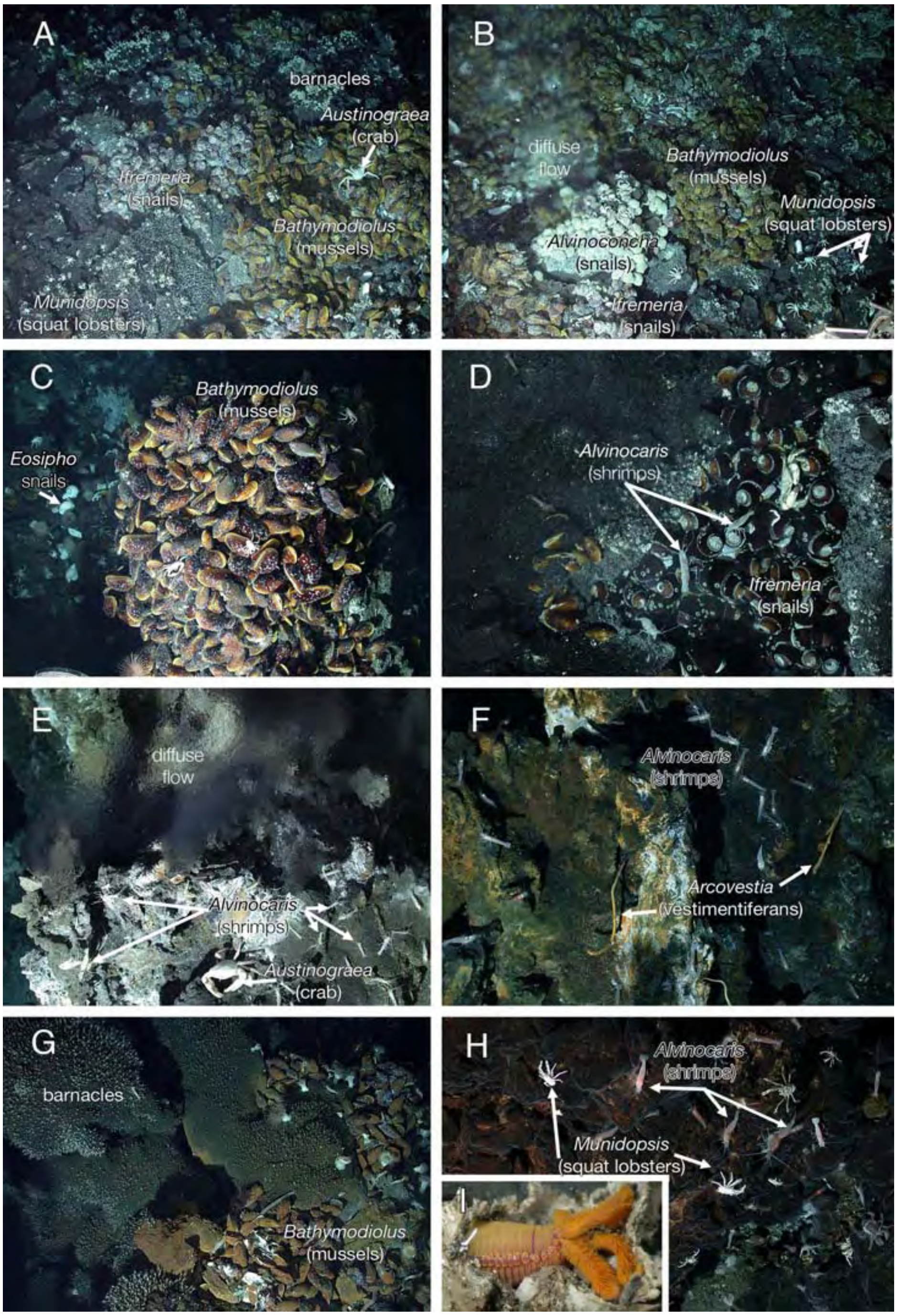


Figure 3.1. Photographs taken by Jason II of hydrothermal vents organisms at the Fiji and Lau basins May 2005. A. Area of diffuse flow where mussel beds form and assemblages of snails gather; both utilizing symbiotic bacteria. Crabs, squat lobsters and barnacles are also common around vents. B. The snail *Alvinoconcha* prefers hotter vent flow than *Ifremeria* with mussels favoring even cooler flow. C. Mussel clump with predatory snails *Eosipho* in the background. D. *Alvinocaris* shrimps can be found close to hot vent flow grazing on bacteria, but here are clustering around *Ifremeria* and mussels. E. Diffuse warm vent flow with numerous *Alvinocaris* nearby. F. Vestimentiferan tubeworms use symbiotic bacteria and can form large clumps around diffuse flow or adjacent to 'smokers'. G. Barnacles attach to lava and form dense carpets around vents in the West Pacific. H. Squat lobsters and shrimps are the most numerous crustaceans around vents. Alvinellid worms (Pompeii worms) can live large masses very close to hot vent flow and can tolerate temperatures up to 100C. They eat bacteria and are only found close to smokers. A-H © Woods Hole Oceanographic Institution; I © G.Rouse.

Figure 3.2. Animals from hydrothermal vents. A-F; H-J from PACMANUS vents. G, K & L are from the Lau basin (© G. Rouse 2005) but close relatives occur in the East Manus Basin.

In the east Pacific, giant vestimentiferan tubeworms such as Riftia can dominate hydrothermal vent communities. These worms are filled with sulphide-digesting bacteria. East Pacific vestimentiferans tend to be smaller (still reaching 30-40 cm long or more) and may be scattered (Fig. 3.1F), but large clumps of worms can be found (Fig. 3.2F). At least three species of vestimentiferan are known from the Manus Basin. Many other worms, such as Alvinellidae (Pompeii worms) (Fig. 3.1I), are present at Manus Basin hydrothermal vents and appear to be obligately associated with them, even though they may not have symbiotic bacteria. Most of the worms are too small to have been sampled using the methods employed to date in the Eastern Manus Basin. A variety of crustaceans are known from vents including crabs (Figs 3.1A, E; 3.2I), squat lobsters (Figs 3.1A, B, H; 3.2J), shrimps (Figs 3.1D, E, F, H; 3.2K, L). Some of these shrimps can often be found very close to the hot vent plumes (Fig. 3.1E). Barnacles, both stalked (goose) and unstalked (balanomorph) barnacles are very common in the vicinity of hydrothermal vents of the western Pacific (Figs 3.1G, 3.2H). This is in contrast to the eastern Pacific where they do occur, but with lower density and less diversity.

3.2 Update of Literature Survey

In Module 1, Dr Greg Rouse collated and reviewed data published in refereed literature on animals collected from hydrothermal vents areas in the Eastern Manus Basin. Two relevant papers were not available at the time. These were reports of submersible surveys by Ohta *et al*. (1997) of the DESMOS site, and Hashimoto *et al*. (1998) of PACMANUS which describe in broad terms the fauna associated with these sites. Findings from these reports are included in Table 1.

3.3 Identification of animal material collected by CSIRO

The cruises PACMANUS 1, II, III, IV and Binatang 2000 were primarily geological cruises, but some biological material was collected by dredge or grab. Most of this material was collected from hydrothermal vents in the PACMANUS and SuSu Knolls areas. The biological material (218 entries) was reported as being primarily deposited at the Australian Museum, Sydney (178 entries), with the remainder held at CSIRO Marine Research, Hobart (see Appendix 1).

Recent attempts to identify the material held at Australian Museum have revealed that around half of the material listed in Appendix 1 cannot be located at the Museum (see Appendix 1). Investigations are continuing into the location of this material.

The material from the Binatang 2000 cruise held at CSIRO Marine research was retrieved from archival storage, packed in ethanol and transferred to the South Australian Museum for long term storage This material was identified as part of Module 2. Some of the material listed as being collected on the Binatang 2000 expedition; however, was not sent from CSIRO Hobart to the South Australian Museum.

The status of the identifications is noted in Appendix 1. Some material (barnacles) should be sent to experts on the groups for further study. Most material had been preserved in formalin and therefore is of no use for DNA analysis. Some material was preserved using ethanol and it may be used to assess possible endemism of species on the Eastern Manus Basin (see below). It should be noted that the material collected by CSIRO was largely ‘by catch’ rather than dedicated biological survey. Hence the material available to identify represents a very patchy sample of what is likely to be the real biological diversity. The identifications and distributions have been summarized in Table 3.1. Numerical data has not been included since the collection methods do not allow for a sense of the population densities of the animals involved.

Observations of fauna made by Ohta *et al.* (1997) and Hashimoto *et al*. (1998) at the DESMOS and PACMANUS sites respectively have also been included in Table 1. Their observations were made using the submersible *Shinkai* and serve to fill in some of the gaps in the CSIRO material. The overall composition of animals at the DESMOS, PACMANUS and SuSu is similar to that of the North Fiji and Lau back-arc basins described by Desbruyères *et al*. (1994), though the actual composition at the 'species' level requires further assessment..

Mussels from the genus *Bathymodiolus* are clearly common at PACMANUS and SuSu. This *Bathymodiolus* would appear to be an undescribed species. Several specimens of *Bathypecten* (form of scallop) were found from the Snowcap site and these are the first record of this genus away from the East Pacific Rise, and so are probably a new species.

It is interesting that mussels were not noted from DESMOS and Ohta *et al*. (1997) instead found that a clam, *Calyptogena,* dominated at this site and that the assemblage was quite different in this sense from PACMANUS. Ohta *et al*. (1997) also did not note the large gastropod snails *Alvinoconcha* and *Ifremeria* that are found at PACMANUS and SuSu Knoll. *Alvinoconcha hessleri* appears to be a wide ranging species (Kojima *et al*. 2001b), while *Ifremeria* may be a different species to that found in North Fiji and Lau (see below). Other molluscs that are similar to those found at the North Fiji and Lau back-arc basins were also found (*Eosipho, Phymorhynchus, Lepetodrilus*). Whether these are new species or the same as those further east needs further study. Crustaceans such as crabs, squat lobsters, shrimps and barnacles were all groups that have been found at vent sites in the southwest Pacific such as North Fiji, Lau and Mariana. One of the barnacles found (*Eochionelasmus ohtai manusensi)* appears to be unique to the East Manus Basin but further collections and DNA data may be needed to confirm this. Other barnacles may need further examination by a specialist (e.g., Dr Bill Newman, Scripps Oceanographic Institution). Whether the shrimps, squat lobsters and crab represent new species requires further study.

The species names used in Table 3.1 were used for specimens collected in other parts of the southwest Pacific and these crustaceans could be new species (see Future work). Annelid worms are one of the most diverse groups found at hydrothermal vents. They are under-represented in the CSIRO material because they are often fairly small, soft-bodied and fragile. Three species of vestimentiferan tube worm; however, were found in the samples. These have been studied by genetic techniques (Kojima *et al*. 2001a; Kojima *et al*. 2003) and there are numerous species across the Western Pacific vents in the genera *Lamellibrachia* and *Alaysia*. These include two endemic forms of *Lamellibrachia* and *Alaysia* (as yet undescribed) and in the Manus Basin. Specimens of both these were found the CSIRO material. The genetics of these forms has been studied (see below). Other vent associated organisms from the CSIRO-collection (Table 1) were too few to draw any major conclusions.

Table 3.1. Details of biological materials examined/commented in Module 2.

Major Group	Species	SITE								
		DESMOS	Pual Fork	PACMANUS Snowcap, Tsukushi	PACMANUS Satanic Mills	PACMANUS Roman Ruins	SuSu+ SouthSu	Umb Knoll	Yuam Ridge	Sonne Pimple
Mollusca (Bivalvia)	*Bathymodiolus* sp.			x*	x*		x			
	Bathypecten new species			x						
	Calyptogena new species?	#								
	Unidentified bivalves			*	*		x			
Mollusca (Gastropoda)	*Alvinoconcha hessleri*			*	x	x	x			
	Ifremeria cf. *nautilei*			x*	x*	x	x			
	Phymorhynchus wareni	x		x*						
	Lepetodrilus spp.			x		x	x			
	Fucaria mystax	x		x						
	Eosipho cf. *desbruyeresi*				x		x			
	Unidentified gastropods			*	x*	x	x			
Crustacea Caridea (shrimps)	*Alvinocaris* cf. *longirostis*	x#		x*?		x	x			
	Chorocaris cf. *vandoverae*			*?	x		x			
Crustacea Galtheoidea (squat lobsters)	*Munida* cf. *magniatennulata*			x						
	Munidopsis cf. *lauensis*	x#	x	*	x*	x	x			
Crustacea Brachyura (crabs)	*Austinograea* cf. *alaysae*			*	x*	x	x			
Crustacea Cirripedia (barnacles)	Barnacles, stalked	#		*	*		x			
	Eochionelasmus ohtai manusensi			*	x	x	x	x	x	
Annelida Vestimentifera	*Alaysia* new species			x*	x	x	x			
	Arcovestia ivanovi	x#		x*	x*					
	Lamellibrachia sp.			x*						
Annelidae Phyllodocida	Nereidididae				*		x			
	Glyceridae *Glycera*						x			
	Polynoidae *Thermopolynoe*	#		*	x					
Annelida Spionida	*Phyllochaetopterus*			x			x			
Annelida Terebelliformia	Ampharetidae (*Amathys*?) (Nimab; non-vent?)			*	*					
	Paralvinella cf. *hessleri*	#		*	*					
Echinodermata Holothuroidea	apodid			*	*				x	
Echinodermata Asteroidea	*Astropecten* (Scarp; non-vent)									x
Echinodermata Ophiuroidea	Snake stars (Lunar Cone; non-vent)									
	Brittle star									x
Teleosti Zoarcidae				*	*					

X = Animal specimens collected by CSIRO dredging or grabs and held at Australian Museum or South Australian Museum. *= observation by submersible in Hashimoto et al. (1998) at Snowcap and Satanic Mills; # Ohta *et al*. (1997) at DESMOS. Identifications by G.Rouse; for details see Appendix 1

3.4 Possible Gene Flow Among Western Pacific Hydrothermal vents

Possible gene flow among western Pacific hydrothermal vents was briefly outlined in Module 1. Some animal species appear to have wide geographical distribution over a range of West Pacific hydrothermal vent systems, while others appear to have a high degree of endemism, and so are only found in geographically limited areas. In extreme cases, distribution may be limited to a few venting areas in a restricted locality. To date little has been done to assess this phenomenon, which has major implications for conserving biodiversity if hydrothermal vents are disturbed by human activities.

In a study of mitochondrial gene sequences by Kojima *et al*. (2001b), none of the specimens of the gastropod mollusc genus *Alviniconcha* collected in the Manus Basin (see Fig. 3.2C) differed genetically from the dominant group from the North Fiji Basin and so the name *Alvinoconcha hessleri* is applied across a wide geographic range. A similar result was found for a collection of vestimentiferan worms (Sibiglinidae: Annelida) referred to as *Escarpia* sp. 1. by Kojima *et al*. (2002) (but is probably *Paraescarpia echinospica*; (Southward *et al*., 2002)). This species has a range from cold seep areas in Japanese and Papua-New Guinean waters as well as the hotter hydrothermal vent fields in the Okinawa Trough and the Manus Basin. Distributions such as this suggest that if a vent area is disturbed, so that the animals there die because the sulphide flow they need is disrupted, then new colonization could occur by larval forms arriving from other vents.

3.5 Possible Endemism

One of the *Lamellibrachia* sp. (similar to Fig. 3.2G) found at PACMANUS is similar to those found at cold seeps near the north coast of Papua New Guinea (Kojima *et al*. 2003), while the other, from the DESMOS vents, is unique to that site. A similar story emerges with the gastropod mollusc *Ifremeria nautilei* (Fig. 3.2B) between the Manus and North Fiji Basins based on a study by Kojima *et al*. (2000). This is shown in Figure 3 where DNA sequences from a range of *Ifremeria* collected from the North Fiji Basin all cluster together, while those from PACMANUS formed a distinct group. This suggests that the PACMANUS *Ifremeria* may be a separate species to those of North Fiji. However, the analysis performed by Kojima *et al*. (2000) needs further assessment and it is not certain whether there are two separate species. If they are separate species, then disturbance of vents in the PACMANUS region may be such that *Ifremeria* might not be able to recolonise the vents.

Figure 3. Evolutionary tree of specimens of *Ifremeria* from PACMANUS and North Fiji; from Kojima *et al*. (2000). There is no gene flow between the two sites; all the PACMANUS specimens cluster together as do those of North Fiji. If there was gene flow from one place to another there would mixing of locations on the tree.

Thus, while some species appear to have wide distribution on the West Pacific hydrothermal vent systems, others appear have a high degree endemism, in that they are only found in geographically limited areas. This potentially may be limited to a few venting areas in a restricted locality. Further study of genetic diversity of organisms across a range of West Pacific hydrothermal vents is needed to properly assess the degree of endemism in areas such as the Eastern Manus Basin. This could be accomplished based on some of the specimens taken by the CSIRO and now in the collections of the Australian and South Australian Museums.

3.6 Summary and Conclusions

This report adds substantially to the previous Japanese submersible surveys at DESMOS and PACMANUS and provides the first summary of animal diversity at SuSu. It identifies material collected by dredge over a series of CSIRO cruises that is currently housed in several Australian Museums. In general, the assemblage of animals at DESMOS, PACMANUS and SuSu is broadly similar to more detailed studies of the West Pacific vents sites such as North Fiji and Lau back-arc basins or further north near Japan. Most of the names used in this report are based on animals collected from these areas.

Further assessment based on DNA sequence date would be required to assess if there are species endemic (restricted distribution of a species to a small area) to the Eastern Manus Basin or even possibly to a localized area of hydrothermal activity (e.g. PACMANUS or SuSu). Alternatively, they may be broadly distributed and gene flow may occur across sites from North Fiji and Lau to the

Eastern Manus Basin. In the event of disturbance to a site then the question becomes one of whether recolonization of the site can occur. This then depends of larvae (offspring) of animals from other vent areas settling at the disturbed site. This requires an assessment of endemism of species.

The identity of the animals discussed here suggests that they will only be found at or near to hydrothermal vent activity and hence may be susceptible to disturbance of hydrothermal flow. The more mobile animals (e.g. crustaceans) may be able to move to new flow areas; while immobile animals (e.g. mussels, vestimentiferans) would simply die.

A detailed understanding of the active hydrothermal activity at a proposed mining area may allow for boundaries to be set up around active areas (both smokers and diffuse flow) that may limit the effect on animal communities.

3.7 Recommended Future work

1. An attempt should be made to locate 'lost' material, particularly that preserved in ethanol which can be used for DNA sequencing. Work in Module 2 established that biological materials from CSIRO cruises to the Manus Basin were either sent to the Australian Museum or to CSIRO Marine in Hobart. The Australian Museum should be approached to conduct a thorough search of its collections.

2. Re-analyse the gene data found in Kojima *et al*. (2000) data on *Ifremeria* data and possibly also other papers on siboglinids and *Alvinoconcha* (Kojima *et al*. 2001a; Kojima *et al*. 2001b; Kojima *et al*. 2002; Kojima *et al*. 2003). These are of direct relevance to the issue of endemism in the Eastern Manus Basin and would involve a few days work.

3. Sequence DNA from collections of material of the mussel *Bathymodiolus*, the snails *Ifremeria* and *Alvinoconcha*, the vestimentiferan worm *Alaysia*, and the crustaceans *Munidopsis*, *Alvinocaris* and *Chorocaris* and *Austinograea*. Sufficient material has been preserved in ethanol to make a useful comparison with specimens collected from the Fiji and Lau basins.

4. An initial assessment of the quality of the preserved material will require the attempted extraction of DNA from samples and then amplification of a particular target gene (or genes). Ideally about 10-15 animals per species should be tried.

d) For SuSu there are 10 or more specimens of *Munidopsis* (squat lobsters), *Alvinocaris* (shrimp), and 1-5 specimens of important animals such as *Bathymodiolus* (mussel = 1 specimen), *Chorocaris* (shrimp = 2 specimens), *Ifremeria* (snail = 2 specimens).

e) For the PACMANUS region there is more material with 10 or more specimens of *Bathymodiolus* (mussel), *Munidopsis* (squat lobsters), *Alvinocaris* (shrimp), *Ifremeria* (snail), *Alaysia* (vestimentiferan) and 1 specimen of *Alvinoconcha* (snail).

f) For both SuSu and PACMANUS around 76 DNA extraction attempts could be made. For the specimens available, this would take several weeks of work for a technician. The second phase would be the actual sequencing of a target gene (Cytochrome oxidase 1) and costs would depend on the success of the first phase.

4. Investigate the possibility of collaboration with colleagues in the USA who have material from these regions to make DNA sequences available for comparison with PACMANUS and SuSu material. The quality of the DNA in the material preserved in ethanol would need to be investigated first.

4. CTD-Hydrocasts: Water Analyses and Filter Samples

In Module 1 we reported that approximately 220 conductivity-temperature-depth (CTD) hydrocasts have been deployed throughout the Bismarck Sea region to measure variations with depth of salinity, temperature and, in most instances, light transmission. The majority are located in the Eastern Manus Basin.

A further 20 CTD-hydrocasts in the Bismarck Sea and surrounds were found during Module 2, bringing the total to 240. The survey included CSIRO Exploration and Mining-led cruises and others which have involved the study of hydrothermal plumes and seafloor hydrothermal activity. Full details of the CTD hydrocasts are tabled in Appendix 2. There are doubtless more CTD operations from cruises which have had other oceanographic objectives but due to project time considerations they have not been pursued.

Nearly 50% of the CTD hydrocasts have been deployed in the Eastern Manus Basin, ~ 30% in the Pual Ridge (PACMANUS) region and ~ 17% in the Su Su Knolls region. The remainder are scattered throughout the Bismarck Sea with local clusters of deployments in the west around Schouten and Manam Islands where enigmatic large-area particulate-rich plumes have been mapped and sampled (McConachy *et al*., 2006).

The position of CTD-hydrocasts is shown in Figure 4.1 and a summary of those which have been sampled for water analyses and particulates (filters) is shown on Table 4.1

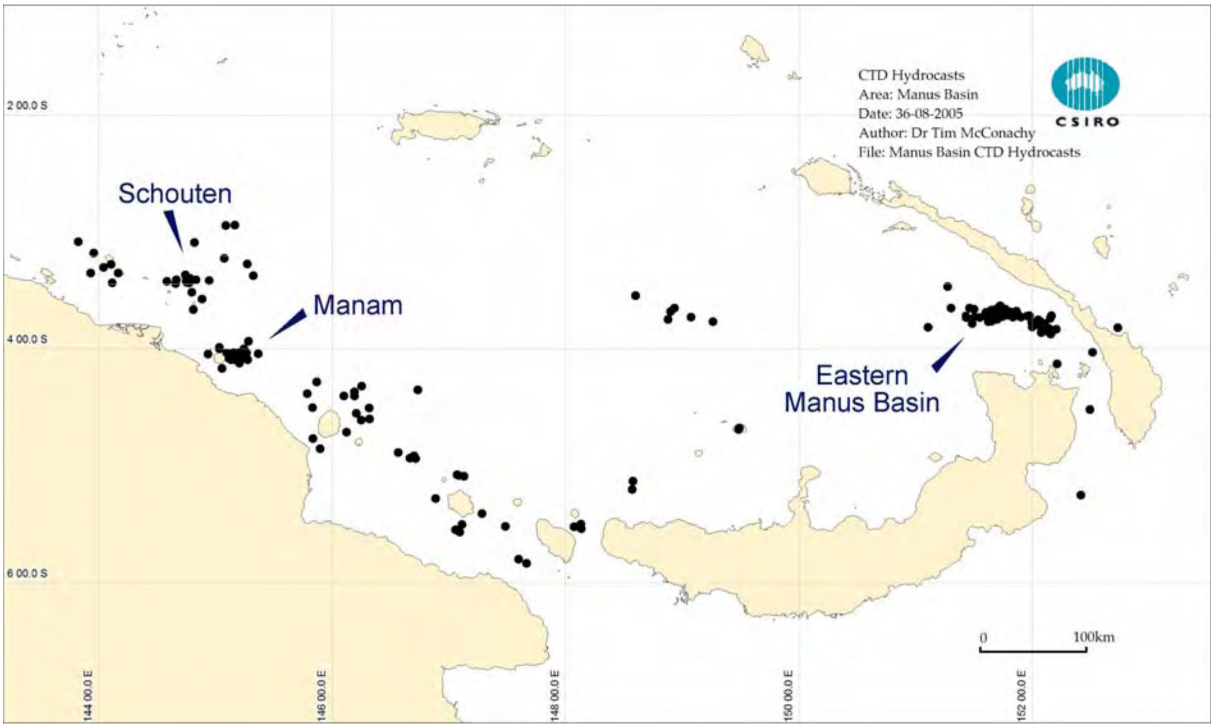


Figure 4.1 Locations of 240 CTD-hydrocasts. About half are located in the Pual Ridge and SuSu Knolls areas in the Eastern Manus Basin. Clusters in the western Bismarck Sea around Schouten and Manam Islands were deployed during the CSIRO-led Bismarck 2002 cruise (FR02-2002).

Table 4.1: Summary of CTD-hydrocasts in the Bismarck Sea

Operations	**Regional Total**	**Pual Ridge**	**Su Su Knolls**	**Other**
Number of Operations	240	74	40	126
Percent of CTD Hydrocasts conducted		30.8%	16.7%	52.5%
Number of Operations with Water Analyses	74	39	14	21
Percent of Regions' Operations with Water Analyses	30.8%	52.7%	35.0%	16.7%
Percent of Total Water Analyses		52.7%	18.9%	28.4%
Number of Operations with Filters	62	23	11	28
Percent of Regions' Operations with Filters	25.8%	31.1%	27.5%	22.2%
Percent of Total CTD with Filter Samples		37.1%	17.7%	45.2%

In the Eastern Manus Basin approximately 205 unfiltered and 130 filtered water samples (~335 samples in total) have been collected but 74 (~20%) have been chemically analysed, with the primary focus on pathfinder elements, such as Mn and Fe.

4.1 Water Analyses

Seventy-four (31%) of all the 240 CTD Hydrocasts have water analyses of one or more samples. Of these 53 (70%) are located in the Eastern Manus Basin - 39 (53%) were taken in the Pual Ridge region and 14 (19%) in the Su Su Knolls region. Away from the Eastern Manus Basin, water analyses have been done on samples collected near Lihir Island, east of New Ireland, and around Schouten and Manam Islands in the west Bismarck Sea and Garove Island in the central part of the Bismarck Sea (Figure 4.2).

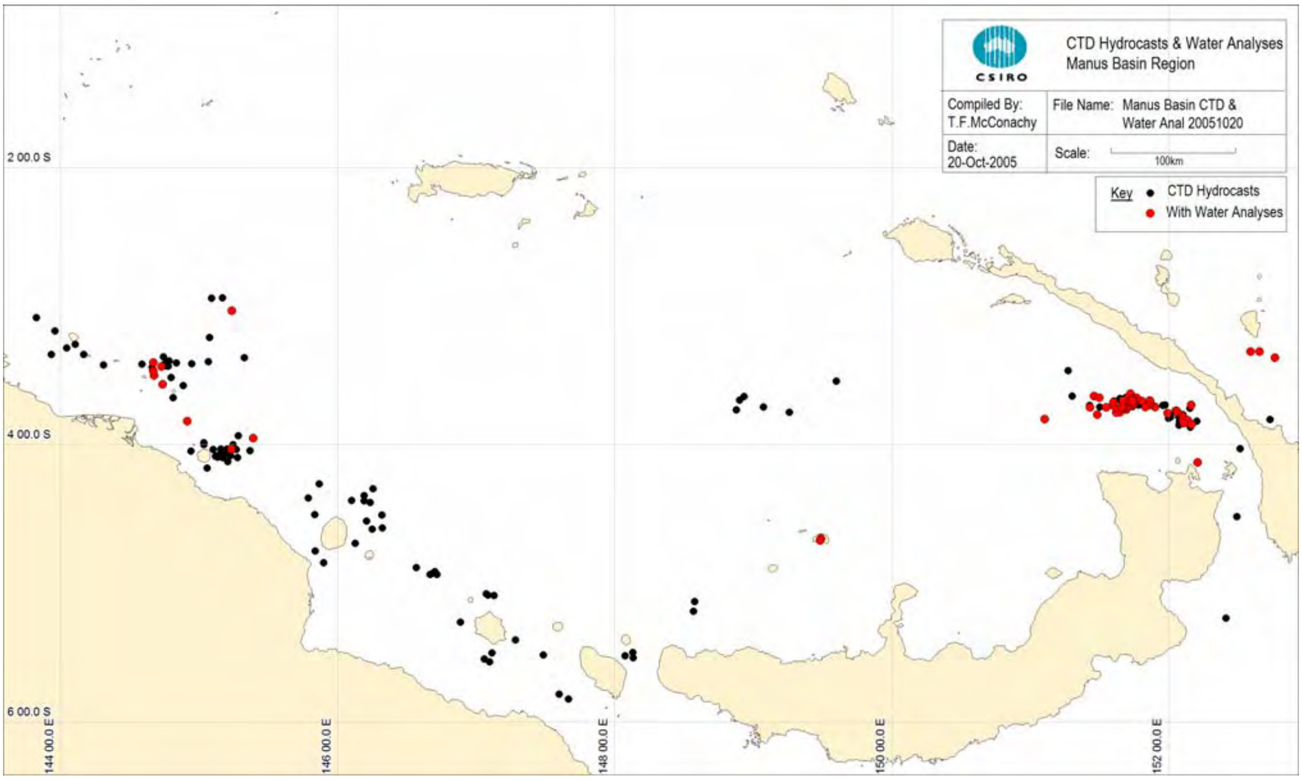


Figure 4.2 CTD-hydrocasts with analysed water samples (red dots). See Figure 4.3 which shows enlargement of the Eastern Manus Basin.

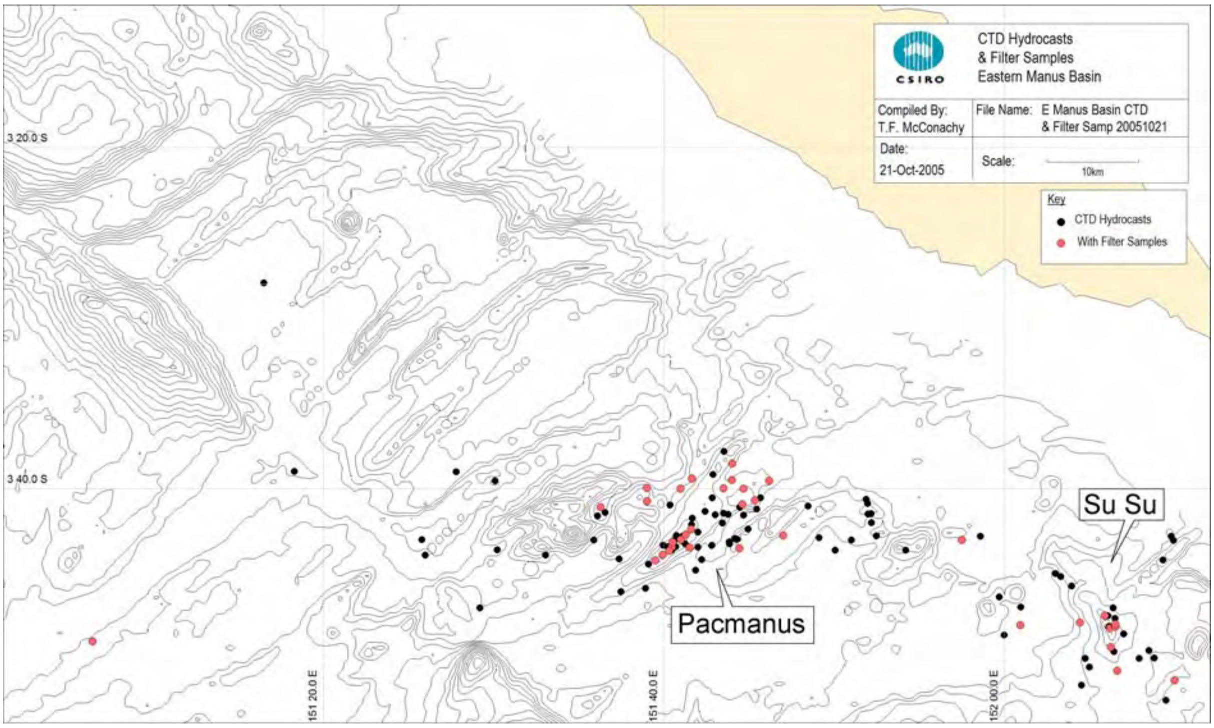


Figure 4.3 CTD-hydrocasts in the eastern Manus basin with water analyses shown as red dots.

4.2 Filter Samples

Sixty two (25%) of the 240 CTD-hydrocasts have at least 1 filter sample taken (Figure 4.4). In contrast to the water analyses, 21 filters were collected from CTD Hydrocasts in areas away from Pual Ridge and Su Su Knolls, notably in the western Bismarck Sea around Schouten and Manam Islands, due to sampling of enigmatic particulate-rich plumes referred to previously (McConachy *et al*., 2006). Surprisingly relatively few CTD-hydrocasts have been sampled for particulates from the Pual Ridge (23) and SuSu Knolls regions (11), representing around 30% of the total deployments in each area.

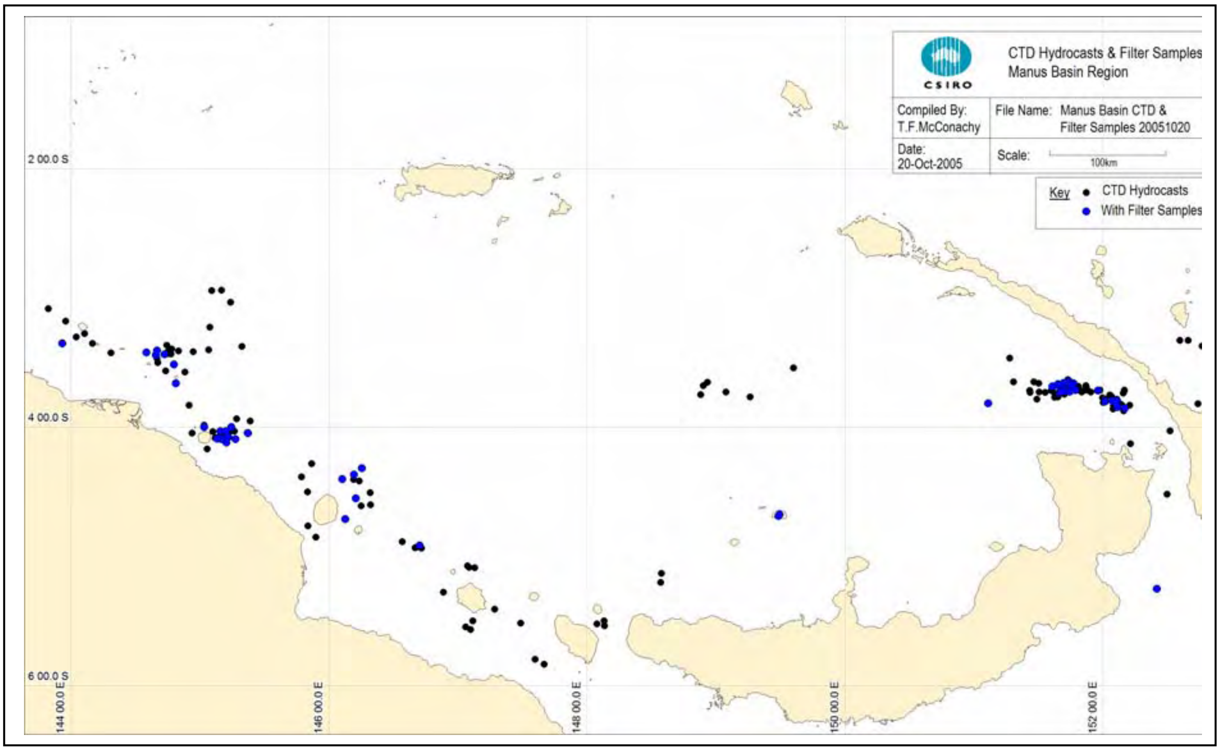


Figure 4.4 CTD-hydrocasts from which particulate samples (filter) have been collected (blue dots). See Figure 3.5 for enlargement of the Eastern Manus Basin.

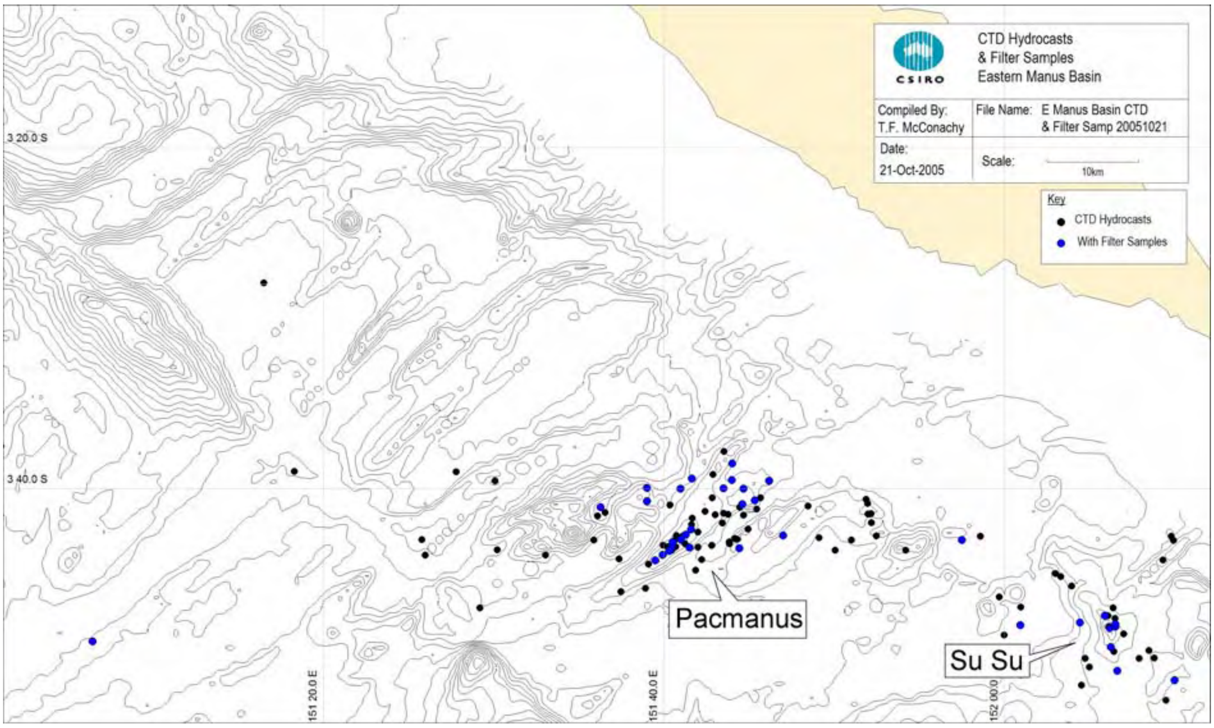


Figure 4.5 CTD-hydrocasts from which particulate samples (filter) have been collected (blue dots) in the Eastern Manus Basin.

4.3 Pual Ridge

Considerable plume mapping (via tow-yows and single dips) has been carried out over Pual Ridge. Positions of CTD-hydrocasts and those from which water and filter samples have been collected are shown in Figure 4.6 and 4.7, respectively. A deep hydrothermal plume was mapped over Pual Ridge at around 1710 m depth in the Binatang 2000 yoyage which is possibly sourced form a new site north of PACMANUS (Figure 4.8)

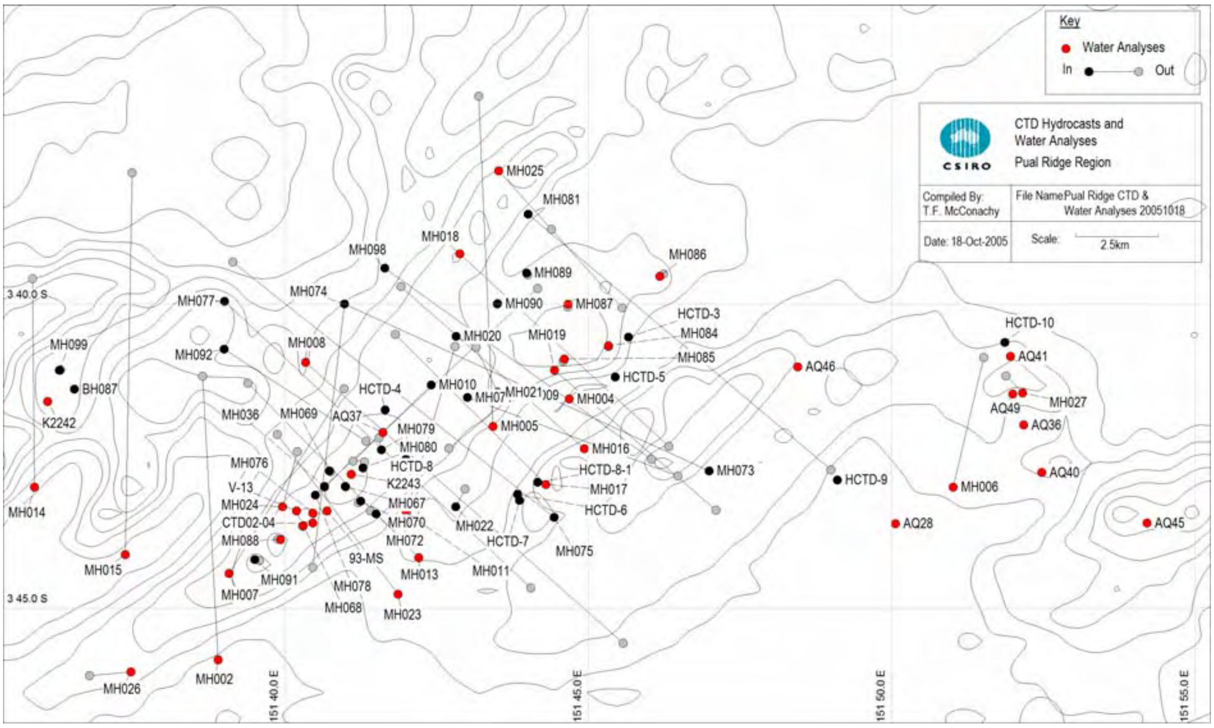


Figure 4.6 CTD-hydrocasts over Pual Ridge showing those with water analyses (red dots). Start and finish of tow-yows , shown as solid dots and open dots, respectively, are the ship position without lag corrections for the position of the CTD.

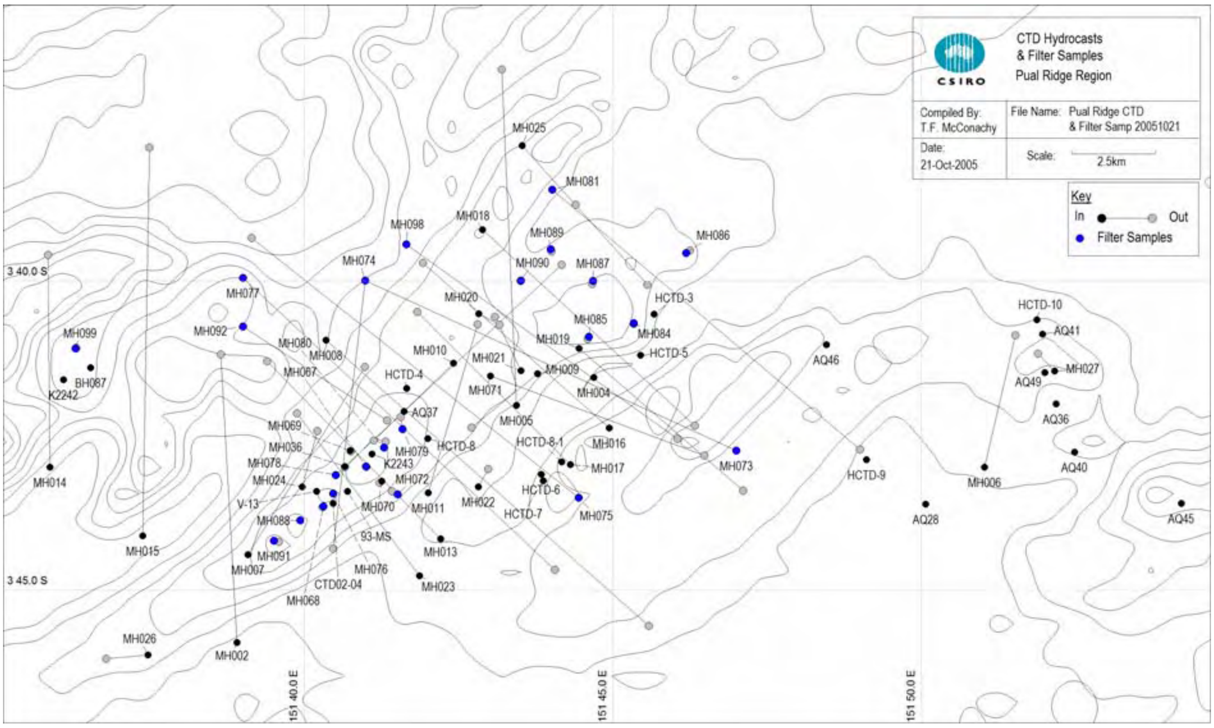


Figure 4.7 CTD-hydrocasts over Pual Ridge showing those with filter samples (blue dots). Start and finish of ship's positions (not corrected for lag) during tow-yows are shown as solid dots and open dots, respectively.

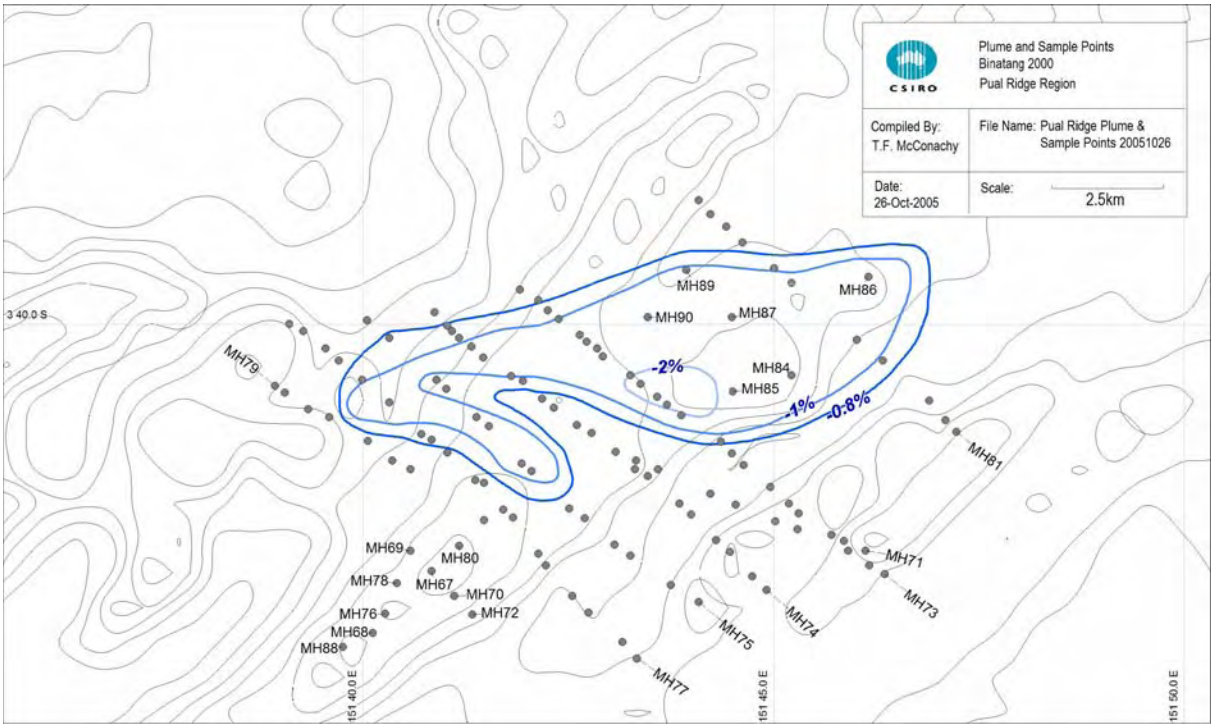


Figure 4.8 CTD-hydrocasts operations and sample points over Pual Ridge showing 1710 m deep hydrothermal plume defined by light transmissivity (Tx) during the Binatang 2000 cruise. Grey dots are lag corrected CTD positions (FR08-2000, after R.A. Binns).

4.4 Su Su Knolls

The SuSu Knolls plume is arguably the most particulate- and methane-rich hydrothermal plume found anywhere in the oceans. It contains concentrations of methane (and ethane and butane) approximately an order of magnitude higher than other plumes mapped in the Manus Basin and elsewhere along the Australian-Pacific plate boundary (400 v 40 nl/l). Secular changes in direction and intensity have been mapped in previous Franklin cruises (FR05/1993, FR10/1996, FR09/1997, FR03/2000 and FR02/2002). Unusual, broadband interference on the ship's echo sounders during FR10/1996 were attributed to "whistling vents" on South Su, caused by a rapid escape of steam at structures akin to the screaming fumaroles of land volcanoes. However, this phenomenon was absent in later cruises. In FR02/2002, the plume was not detected where expected but it was present again during the 2005 *Genesis* cruise (RA Binns, pers. comm.).

Details of CTD-hydrocasts and those with water analyses and filters are shown in Figures 4.9 and 4.10. Mapping results of the SuSu plume in the years 1996 and 1997 are shown in Figure 4.11; and various chemical analyses (Atomic Emission Spectroscopy) are shown in Figure 4.12. These figures show an abundance of potential information on hydrothermal plumes in the SuSu Knolls area. However, apart from an extended abstract and poster by McDonald et al., 1998, very little other analysis or synthesis has been completed.

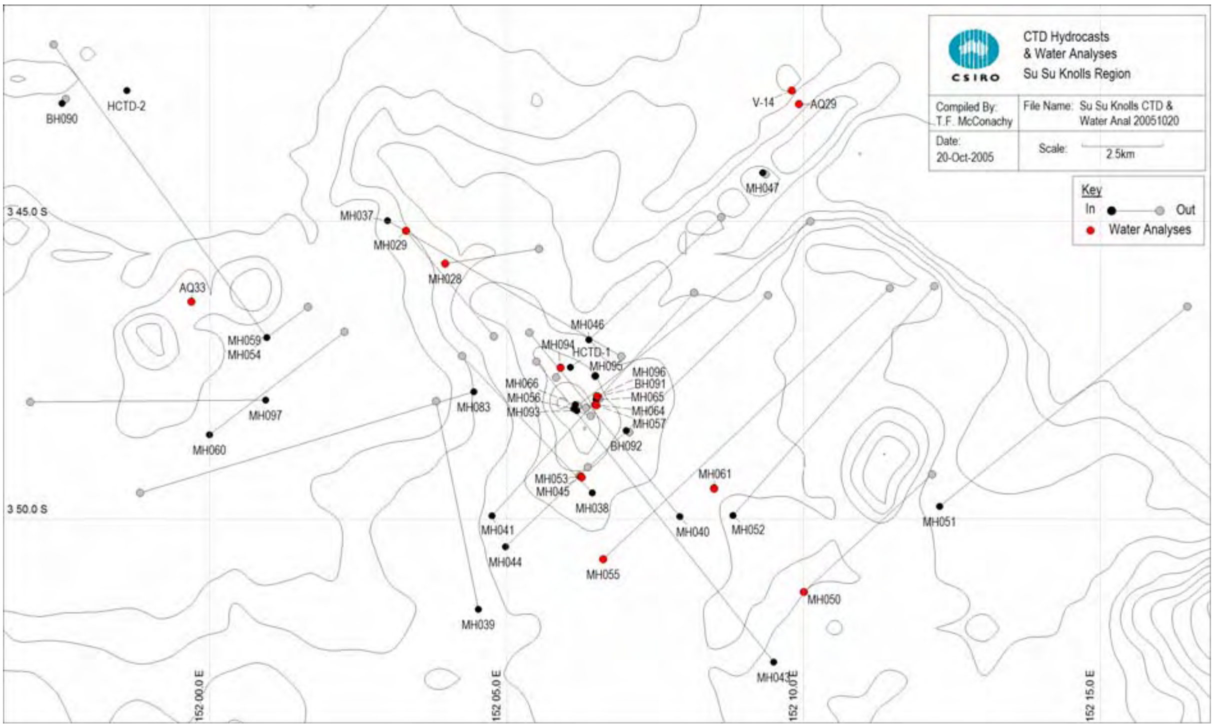


Figure 4.9 CTD-hydrocasts in the SuSu Knolls area showing those with water analyses (red dots). Ship's position (not lag corrected for position of CTD) at start and finish of tow-yows are shown as solid dots and open dots, respectively.

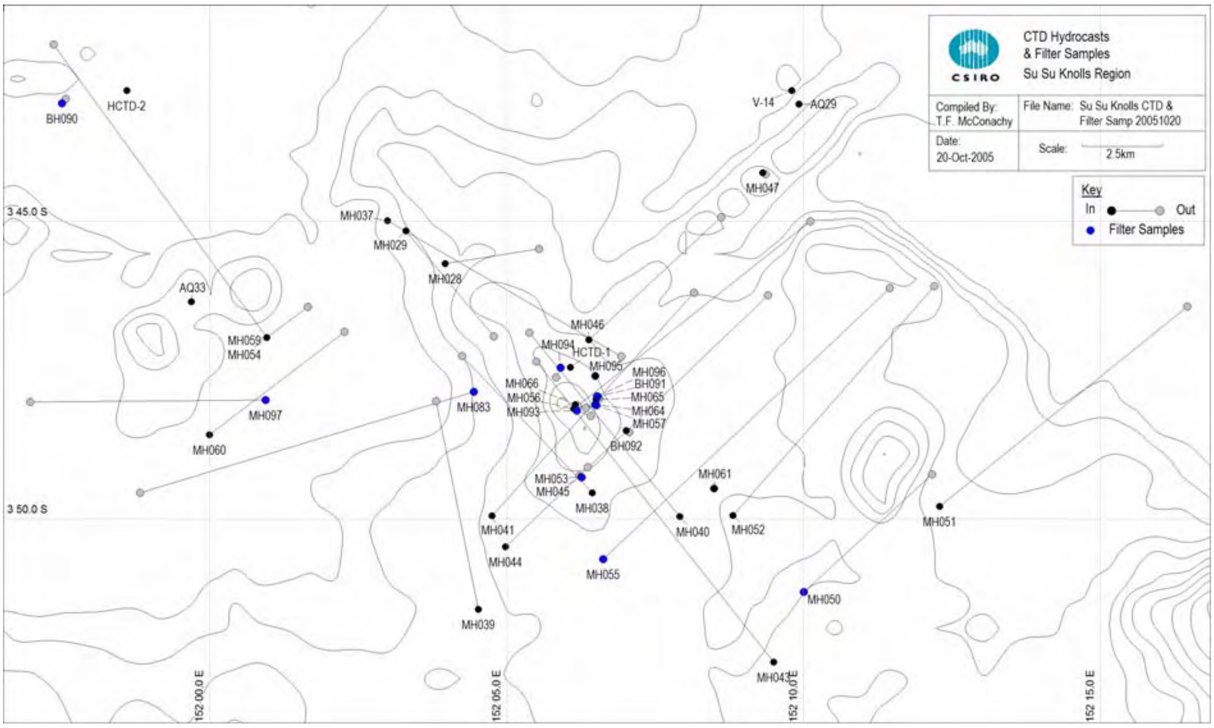


Figure 4.10 CTD-hydrocasts over SuSu Knolls showing those with filter samples (blue dots). Ship's position (not lag corrected for position of CTD) at start and finish of tow-yows are shown as solid dots and open dots, respectively.

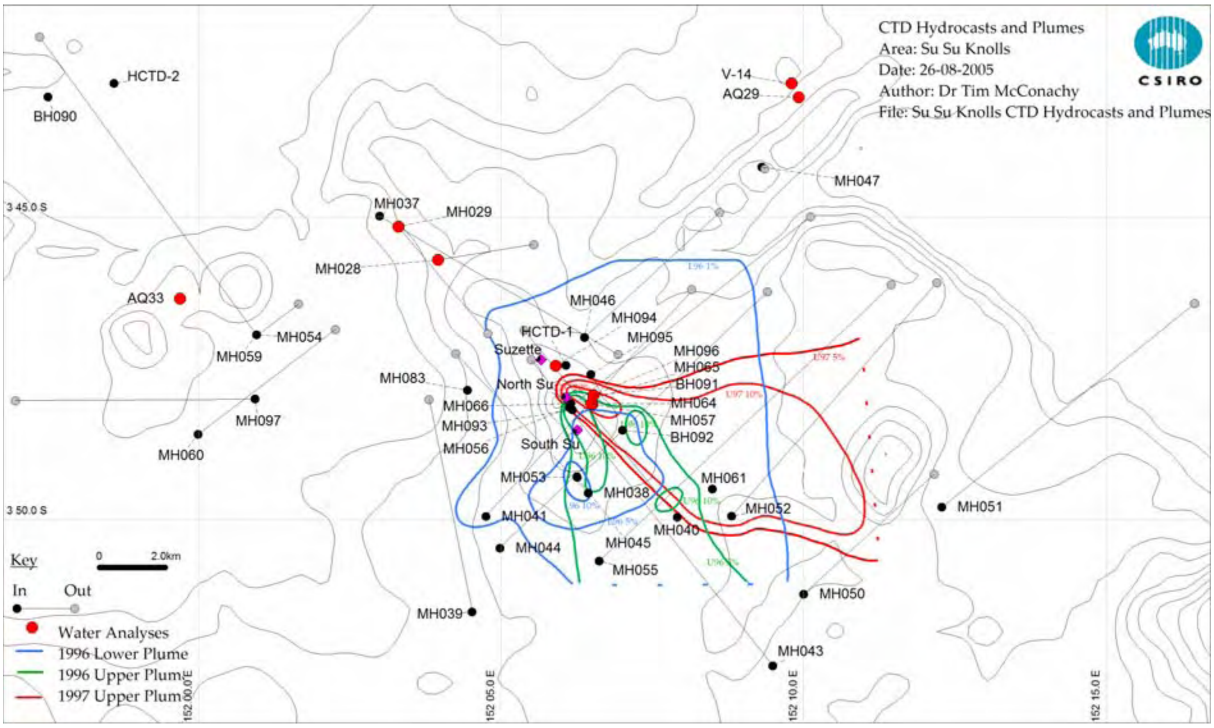
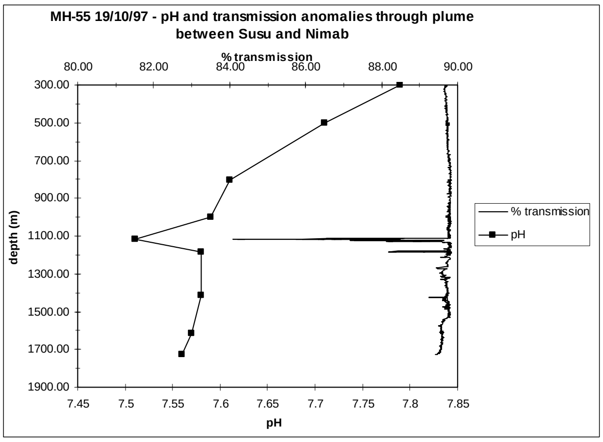
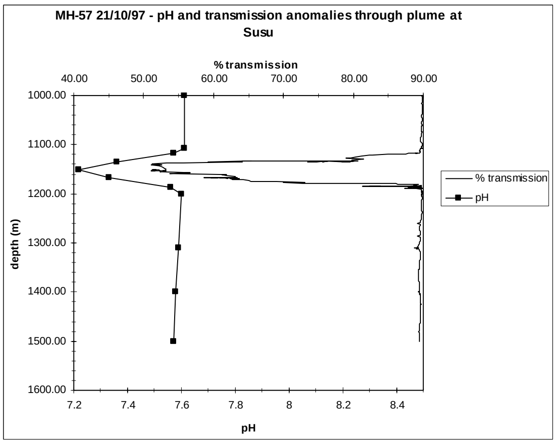
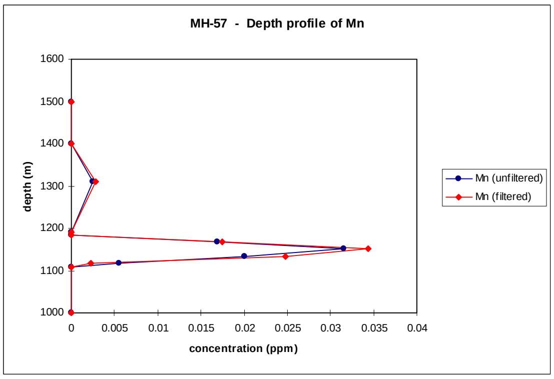
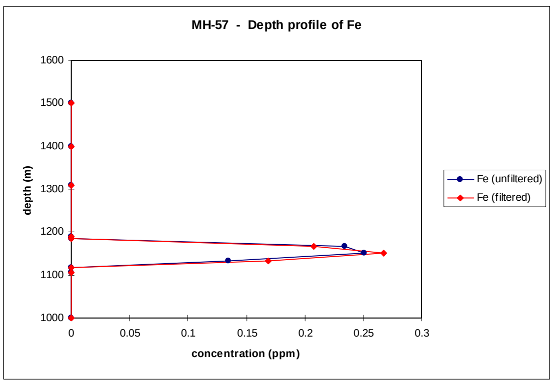


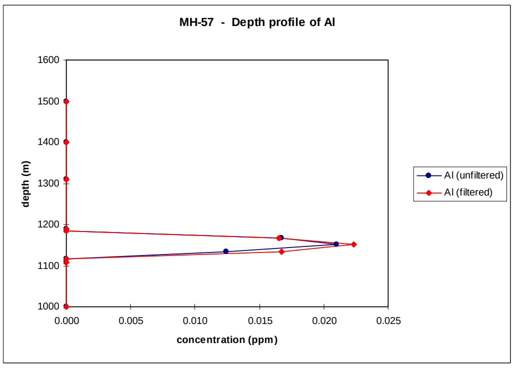
Figure 4.11 SuSu Knolls showing CTD-hydrocasts and the 1996 and 1997 plume outlines from McDonald *et al*., 1998. Ship's position (not lag corrected for position of CTD) at start and finish of tow-yows are shown as solid dots and open dots, respectively.

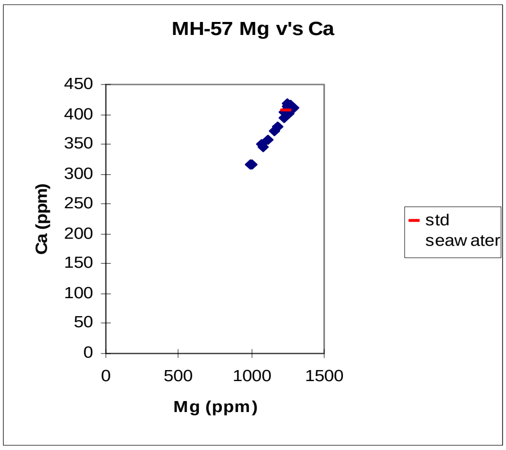


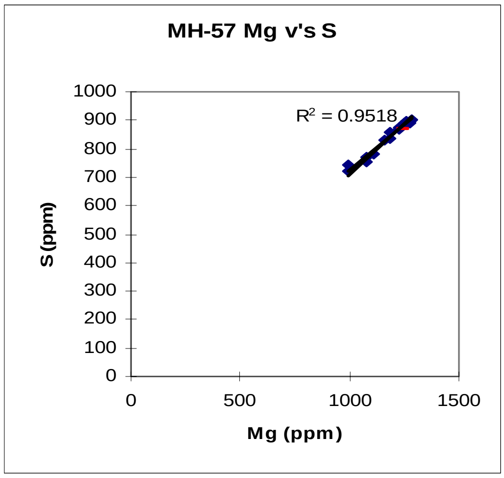












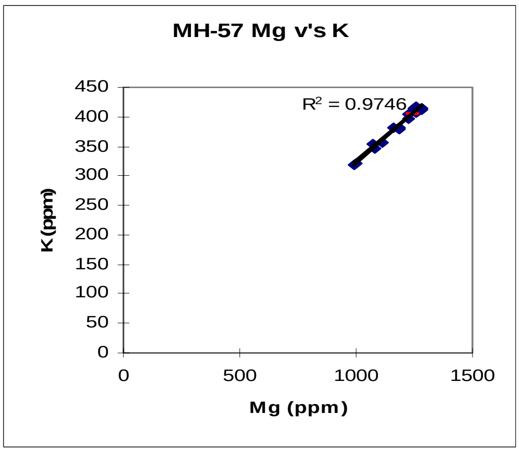


Figure 4.12 Examples of chemical data at SuSu Knolls plume (CSIRO).

McDonald *et al*. (1998) reported that in 1996 detailed plume mapping at SuSu revealed two distinct levels, a subcircular plume (~-17% Tx) between 1300-1600 m depth, centred on the southwestern flank of South Su, and an asymmetric south-southwest trending plume (-33% Tx) between 1050 and 1150 m depth, with maximum intensity near the crest of North Su. When remapped 11 months later in October 1997, the lower plume had disappeared, apart from a small remnant with only 0.8% intensity immediately between North Su and South Su, while the upper plume had increased to -44% light transmission over the crest of North Su. However, it was sharply cut off to the north and, and its orientation had shifted to the East (Figure 3.11). The plume remained quite strong (Tx = -2%) some 18 km to the east.

Inspection of transmissometer profiles in MH-037 and MH-038 pasted into cruise logs for tow-yos and dips around the Suzette-SuSu area reveal a plume associated with Suzette, at 1420 mbsl but proceeding south, this gets confused with the 1996 "lower plume" centred on South Su.

Transmissometer profiles for MH-40, MH-43, MH-44, MH-46, or the 2nd half of MH-41, which would help resolve the two plumes are stored electronically in Hobart. Knowing whether there is an identifiable plume associated with Suzette is considered to be important for a base line environmental study.

Table 4.2 SuSu plume: Samples from peak light transmission (Tx), 1 and 10 km downcurrent from North Su in 1997

	1 km	**Times Above background**	**10 km**
Tx	-40%		-5%
*p*H	-0.37 *p*H unit		-0.13 *p*H unit
Fe	0.27 ppm	135	0.09 ppm
Mn	0.034 ppm	170	0.016 ppm
Al	0.022	11	0.010 ppm

Samples collected closer to the presumed source of the plume typically smelled of H_2S, and have negative dissolved oxygen contents.

Three years later, during Binatang 2000, a very intense (-20%) light transmission anomaly was measured near the summit of North Su and filters from within the plume showed pale yellow brown colouration. However, 10 days later it was absent in the same position but found to have moved due to bottom currents. A small number of water samples from Binatang 2000 have been analysed but the results have not been interpreted. Two years later during the Bismarck 2002 expedition, no plume was found.

4.5 Discussion

Apart from on board interpretation of hydrothermal plumes, there are only two main plume-related studies: one of Pual Ridge – a PhD study involving examination of samples collected during two of the PACMANUS cruises (Scott *et al*., 1992; Ortega-Osorio et al., 1994 and 1997, Ortega-Osorio and Scott, 1994,1995 and 2001); and the CSIRO study (McDonald *et al*., 1998) of the plume at

SuSu knolls – CSIRO study.

To the best of our knowledge, at SuSu in particular, plume particulates have not been characterized (e.g., no data on size, shape, composition, concentration and flux of particulates). Similarly the chemistry of the plume has not been analysed in much detail, again, apart from the work by McDonald et al. (1998) which focused on the distribution of the main path finder elements such as Fe, Mn and Al. A suite of other elements (B, Ba, Be, Ca, Cd, Co, Cr, Cu, K, Li, Mg, Mo, Na, Ni, P, Pb, S, Si, Sr, Ti, V and Zn) have been analysed, but not been plotted nor evaluated for CTD-hydrocasts MH045, MH050, MH055, MH057 and MH061. The plots of Mg v Ca, Mg v S and Mg v K shown in the right hand column in Figure 4.12 demonstrate a linear correlation projected to zero Mg (i.e., assuming an undiluted hydrothermal fluid has zero Mg) that could be used to ascertain the chemical composition of the end member hydrothermal fluid. The flux of major and minor elements into the water column in the ambient environment could be modeled.

4.6 Recommendations

6. In the SuSu Knolls area, re-evaluate hydrothermal plume data (chemical analyses, CTD data, particulates) including the data from Binatang 2000 and Bismarck 2002 cruises with an aim of modeling the amount and chemical composition of hydrothermal fluid and particulate flux into the environment. This modeling will enable order of magnitude estimates of the “ambient” input of naturally occurring toxic and other elements into the natural environment.

7. Knowing whether there is an identifiable plume associated with Suzette requires follow up; and accordingly CTD-Tx data around SuSu should be re-examined with this specific objective. This activity requires quite time consuming recalculation (lag corrections) of all the actual CTD positions and the profiles carefully compared.

8. In detail this work will comprise: SEM examination of particulates from the SuSu plume near field in samples from CTD-hydrocasts MH082, MH094 and MH096, and from the outer limits of the plume in MH097; evaluating chemical analyses from Binatang 2000 and replotting light transmission and CTD data.

9. If available the CTD light transmission data from Placer’s *Genesis* expedition could be incorporated as well as visual estimates of black smoker and grey smoker flux from ROV videos from Placer’s more recent work around SuSu Knolls.

10. Similar re evaluation of the PACMANUS plumes is warranted based on the new data collected after the studies done by Ortega-Osorio at University of Toronto. However, if the PACMANUS area is a lower priority for the company, then this work is also a lower priority.

5. Sediment Geochemistry – Eastern Manus Basin

5.1 Summary

An accompanying Excel spreadsheet (Appendix 3) compiles all CSIRO analyses of sediments from the Eastern Manus Basin. All samples were analysed by ICP-AES for major elements (excluding SiO_2) and some trace elements (including Cu and Zn). Most from the PACMANUS vicinity and western sector of the basin, but only some from the eastern sector and SuSu Knolls region, were also analysed by ICP-MS for low-level trace elements including rare-earth elements. Selected samples only were analysed for SiO_2 by XRF, and for Au by NAA. Operations are also identified for which no analyses of sediments have yet been conducted.

Two contrasted "mudline" sediment types are present in the region – hemipelagic oozes are widespread, while volcaniclastic sediments ("tuffite" in part) derived from catastrophic submarine volcanic or hydrothermal eruptions dominate the SuSu Knolls region. The two variants are clearly distinguished mineralogically and geochemically. Fine-grained cohesive muds associated with the volcaniclastic silts and sands are not normal hemipelagic sediment, but rather slowly-settled material also derived from submarine eruptions including altered volcanic debris – an important conclusion for understanding Suzette geology in particular.

For both bottom sediment types, hemipelagic ooze at PACMANUS and volcaniclastic at Suzette, distinct enrichments in chalcophile elements distinguish proximal sediments from distal and "background" sediments. The enrichment profiles differ, however, between the two sites, Suzette being characterised more by elements contained in sulfosalts.

A gaps audit establishes several areas where further interpretation or new analytical work will contribute to (1) environmental baseline understandings of the Suzette exploration site, and (2) possible exploration methodology for the longer term future.

Specific recommendations for further analytical work are listed, with priorities assigned to various items.

- Top priority: ICP-MS analysis of volcaniclastic sediments in the SuSu region so far analysed only by ICP-MS, and analysis by both methods of samples from operations in the same region where no analyses were performed previously.
- Second priority: analysis of extra mudline sediments from West Su Basin especially, and from other sites where gaps become filled or improved definition of background geochemistry will arise
- Third priority: analysis of subsurface sediments in two gravity cores, for historical assessments.

In addition, detailed mineralogical and sedimentological assessments of samples from potential monitoring sites (should mining proceed) are proposed.

5.2 Scope of Report

The following tasks relating to baseline studies of bottom sediments were recommended for Module 2

- Compile updated list of CSIRO chemical analyses
- From onboard and laboratory records, compile confidence factors that individual analyses represent the topmost few cm of "mudline" sediment
- Prepare new element distribution maps for the Pual Ridge and SuSu Knolls areas
- Assess gaps in knowledge and formulate a listing of desirable new analyses

The report below covers each of these topics. Compilation of element distribution maps was confined to copper, zinc, and lead, the "commodity traces".

5.3 Geochemical Database

The geochemical database is provided as an Excel spreadsheet "Sediment Geochemistry EMB.xls". This contains five worksheets as follows:

1) All sediments – includes sediments contaminated with fragments of chimney, Fe-oxyhydroxides, or Mn oxides, and deeper sediments from gravity cores, as well as an ash layer
2) Mudline analyses – of samples known or considered to represent mudline material
3) Hempelagic mudline sediments
4) Volcaniclastic mudline sediments
5) Average compositions – allowing various comparisons

The distinction between hemipelagic and volcaniclastic sediments is discussed further below. The first four worksheets provide sample details and locations, analytical methods, plus columns listing lithology (lithol) and sample type (combining a mudline confidence assessment and the sampling method). Abbreviations are as follows:

Analytical methods

- *XRF* – X-ray fluorescence spectrometry (XRF)
- *aes* – inductively coupled plasma atomic emission spectrometry (ICP-AES)
- *ms* - inductively coupled plasma mass spectrometry (ICP-MS)
- *naa* – neutron activation (NAA)

Lithology

- *HEMI* – hemipelagic ooze
- *VOLC* – volcaniclastic sands, silts and muds
- *MIX* – apparent mixtures, e.g. hemipelagic and volcaniclastic sediment
- *CONT* – sediments contaminated with chimney or Fe-Mn oxide fragments
- *ASH* – pale volcanic ash layers (pumiceous, exotic, e.g. from Rabaul)

Type

- *A* – definitely a mudline sample
- *B* – most probably a mudline sample
- *C* – uncertain, but likely to be comparable with mudline sediment
- *D* – definitely not a mudline sample
- *X* – contaminated or ash layer
- *1* – collected by gravity corer
- *2* – collected in a sediment trap on dredge ring
- *3* – collected in dredge chainbag
- *4* – collected by Smith McIntyre grab
- *5* – collected on camera cage or by submersible

Figure 5.1 provides an overview of sample distributions relative to East Manus Basin bathymetry. Hemipelagic sediments (green), volcaniclastic sediments (red), and samples not yet analysed (yellow) are distinguished, but note that some yellow dots obscure red and green dots, so the Excel file is more definitive.

5.3.1 Note regarding locations

Two typographical errors in the files of operation locations provided with the Module 1 report are now corrected (MD-121, and MG-25R). Dredge locations cited are the "on bottom" position; haul directions are given in the Module 1 listings

5.3.2 Notes on the sediment collection and analytical program

Of the methods for collecting sediments, the gravity corer and Smith-McIntyre grab provided the most unequivocal mudline samples and for these the topmost layer (normally ~1 cm) was subsampled for chemical and other analyses. For hemipelagic sediments, this mudline material is normally sloppy to poorly consolidated, and distinctively brown to red-brown in colour. In longer sediment cores the mudline sediment passes downward to a more coherent brown mud or clay, then at depths varying between 10 cm and 20 cm to pale olive-green clays as a consequence of reduction of Fe^3 to Fe^2 by breakdown of organic matter. Many mudline sediments collected in the deeper sub-basins are the hemipelagic tops of turbidite layers that grade downwards to sandy bases.

The sediment traps fitted to the dredge ring generally filled and clogged up on first impact with the sea floor, so this kind of sample could also be assigned with reasonable confidence to the mudline, especially (for hemipelagics) if it possessed the appropriate colour and sloppiness. For hemipelagic samples taken from the dredge bag, preference was given to softer, brown material likely on the above basis to represent the mudline.

Gravity cores of volcaniclastic sediments do not show the same systematic depth profile as those of hemipelagic sediments. Accordingly it is less possible to assign confidence regarding mudline provenance on the basis of colour or lithology, and the latter is therefore based more on the collection method.   .

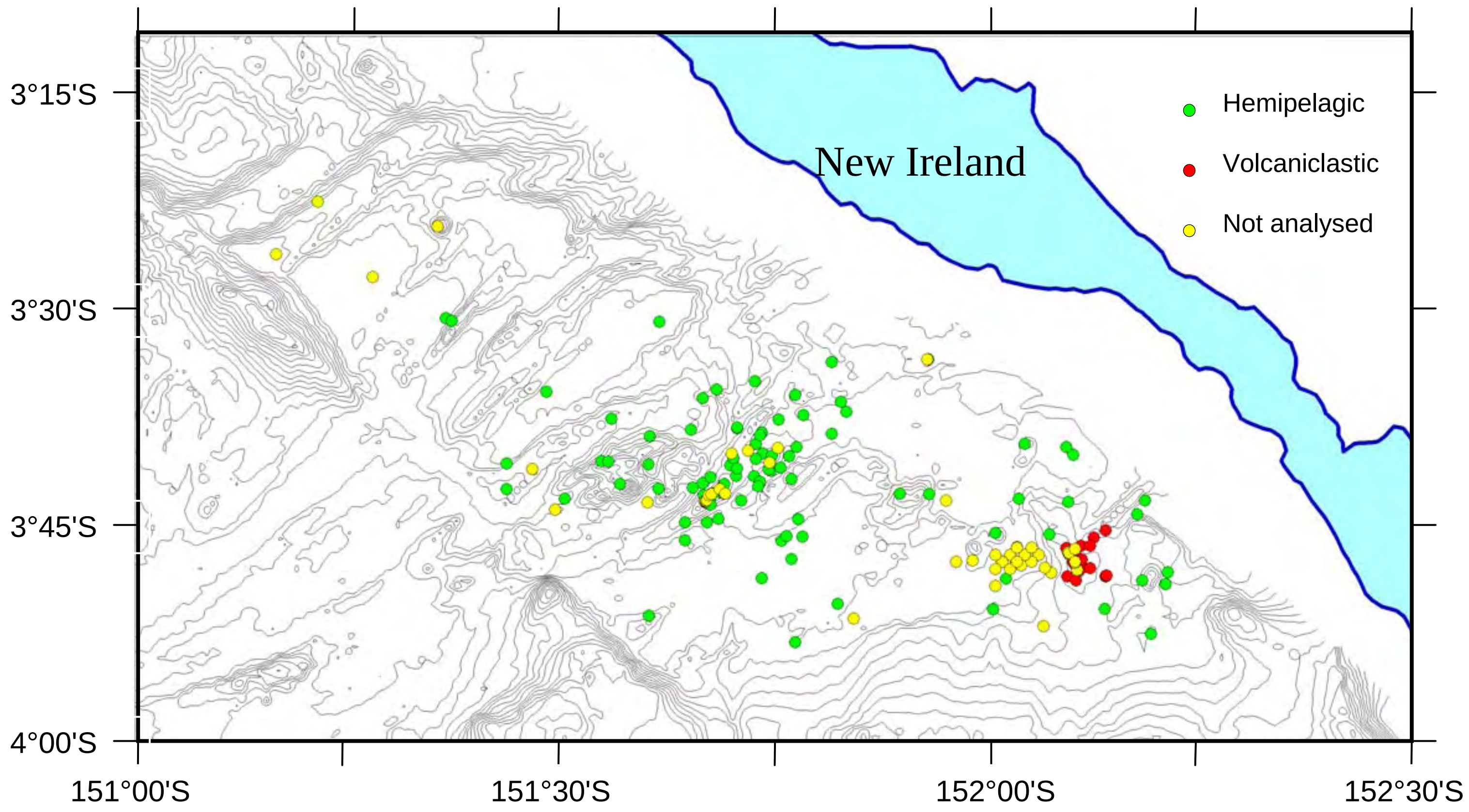


Figure 5.1. Distribution of analysed hemipelagic and volcaniclastic mudline sediments, and of samples not yet analysed in the Eastern Manus Basin, PNG.

The gravity corer, sediment traps, and grab were constructed from stainless steel, hence their samples will be uncontaminated by Cu, Zn or Pb. Samples from the dredge bag are potentially contaminated by Pb from the depressor weight or by Zn from the galvanised steel ring and chainbag. In reality, such contamination is not evident. Sediment subsamples intended for analysis were taken on board ship usually immediately and otherwise within 24 hours of the respective operation, and sealed in polycarbonate vials or other containers.

Two main analytical programs on Eastern Manus sediments were conducted at CSIRO, the first in 1993-1997 based on samples from the PACMANUS-I, II and III cruises and focussed on the western part of the basin, and the second in 1998-2000 emphasising volcaniclastic sediments around SuSu Knolls collected during PACMANUS III and IV. Financial constraints at the time of the second program meant that only a selection of samples from what has become the main locus of commercial activities were analysed by ICP-MS methods.

XRF analyses were conducted only for a selection of samples (Syriac Sebastian, uncompleted thesis project), from which the SiO_2 data are cited in the spreadsheet. Gold analyses by NAA were also performed only on a selection of samples chosen largely to compare background and proximal hydrothermal sites. All analytical data cited are considered reliable, apart from Ag where most analyses are below the nominal detection limit of ICP-AES.

5.4 Distinction Between Hemipelagic and Volcaniclastic Sediments

Hemipelagic sediments range from muds to silty muds and are brown or red-brown at the mudline changing relatively sharply at 10-20 cm depth to more reduced, pale olive-green clays. Mineralogically they are dominated by clay minerals (>60%), mainly smectite but locally with saponite, chlorite, and kaolin (Syriac Sebastian, uncompleted thesis project). Biogenic carbonate (foram tests and coccoliths) and rarer siliceous diatom tests are ubiquitous with varying but relatively low abundance. The lithic component includes (1) grains of plagioclase, pyroxene, and volcanic glass (andesite-dacite-rhyodacite) probably dispersed as fine hyaloclasts from nearby submarine volcanic edifices, (2) siliceous pumice, probably exotic and derived from subaerial caldera-forming eruptions, and (3) quartz and rare hornblende grains of possibly terrigenous provenance (since these minerals are unknown as phenocrysts in submarine lavas from the eastern Manus Basin. Thin, sharply-defined layers of dark glassy hyaloclastite occur in cores taken close to volcanic edifices, and sharply defined pale grey layers 1 cm or less thick of pumiceous ash are present in samples from the eastern side of Eastern Manus Basin (mega-eruptions of Rabaul and Tavui calderas?). These latter were avoided in the analysed samples. Also avoided where possible were thin dark brown to black layers in cores, thought to represent Mn and/or Fe oxide enrichments reflecting periods of extensive hydrothermal activity and plume fallout (most of which, however, have not been studied in that context).

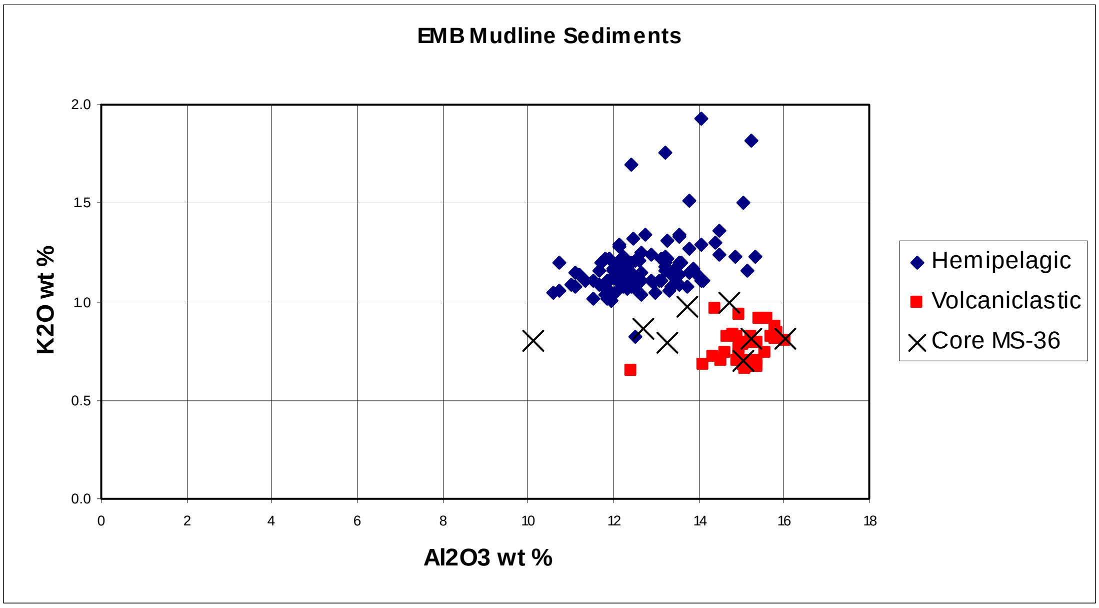
By contrast, volcaniclastic sediments in the SuSu Knolls region range from unconsolidated or poorly consolidated sands and silts to more cohesive silty clays, typically black or very dark to moderately deep grey in colour but sometimes paler grey and occasionally brown. Clay minerals are lacking to subordinate, and the main constituents are grains of plagioclase, pyroxenes, and lesser magnetite, plus particles of glassy to microlite-rich andesite-dacite lava and, importantly, of altered volcanic rocks with clays and disseminated sulfides. These sediments form relatively thick deposits over SuSu Knolls and their eastern flanks, with a layered structure (e.g., 8 beds within 30 cm in core MS-36 at Suzette). The upper >15 cm of sediments in West Su Basin appear to be reworked equivalents of the same material. Binns (2004) considers that these deposits originate from explosive eruptions at South Su and/or North Su. Since altered volcanic clasts with sulfides are an important component, overpressure in hydrothermal fluids as distinct from igneous fluids is the possible cause.

The two sedimentological variants show contrasted geochemistries reflecting their mineralogical differences (see sheet 5 of the Excel spreadsheet). Relative to hemipelagic sediments, volcaniclastic deposits at SuSu Knolls and vicinity are richer, on average, in Si, Al, and S. They are depleted in K and in most other lithophile elements, especially Mn (except for one brown silty mud from MS-43 in West Su Basin. Useful distinguishing elements besides those mentioned include the trace alkalis, Li and Rb, and Y.

Figure 5.2 illustrates a variety of plots in which hemipelagic and volcaniclastic mudline sediments fall into distinct fields with little overlap. In a 75 cm gravity core (MS-36) taken adjacent to chimneys at Suzette there are 8 black to dark grey beds (including a topmost unit reworked during recovery) varying from poorly consolidated sand to more cohesive silt and silty clay. Some lower beds contain cm-sized volcanic clasts and chimney fragments. Samples from the lower 7 beds (see sheet 1 of the Excel spreadsheet) tend to fall in the volcaniclastic field on many diagrams of Figure 5.1, but the finer grained units bridge the gap between volcaniclastic and hemipelagic in some plots. The way they do so, however, suggests these finer units are not simple mixtures of the two sediment categories. Rather, it is suggested they formed by slower deposition after eruptive episodes of fine grained material enriched by elutriation in hydrothermal clays derived from, or from the same source as, the sand-size grains of altered volcanic. The distinction is quite important, for it means there is no requirement for prolonged hiatuses between eruptive episodes to allow build-up of genuine hemipelagic material. This probably applies also to the semi-cohesive, finer grained sediments encountered in drill cores and box core samples during the recent Solwara expedition – they are not true hemipelagic sediments, but an integral part of the volcaniclastic sequence. These materials constitute a potential mining problem at Suzette.

5.5 Compositional Variations Related to Topographic and Hydrothermal Settings

For the “background” hemipelagic sediment collection, it is instructive to enquire whether those deposited on elevated volcanic edifices are similar to or different from those deposited in the deeper sediment basins where gravity cores indicate the mudline hemipelagic sediments are often the tops of turbidite units with graded bedding. Comparative average data are listed in sheet 5 of the Excel spreadsheet. Overall, sediments from the two settings are very similar on average despite considerable individual variation within both groups. Hemipelagic sediments on the edifices are slightly enriched on average in Si, Ca, and trace chalcophile metals (Cu, Zn, Au, Pb), and slightly depleted on average in Al, Mn, Mo, and S. Although these differences are barely significant statistically, they may reflect the preferential development of hydrothermal activity at edifice crests. Scarp sediments are similar to those from basins.



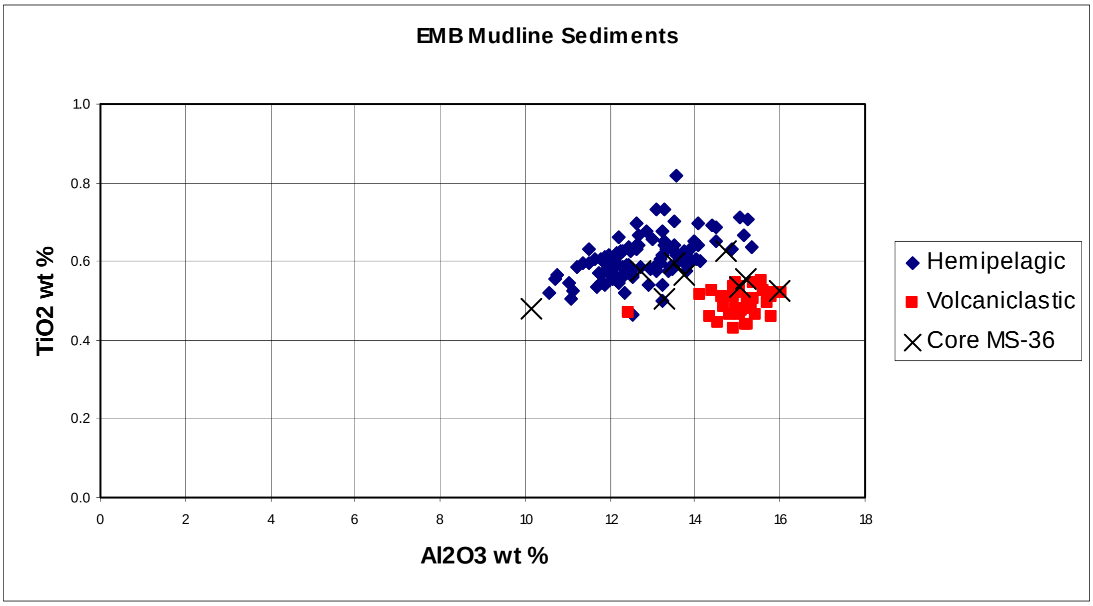
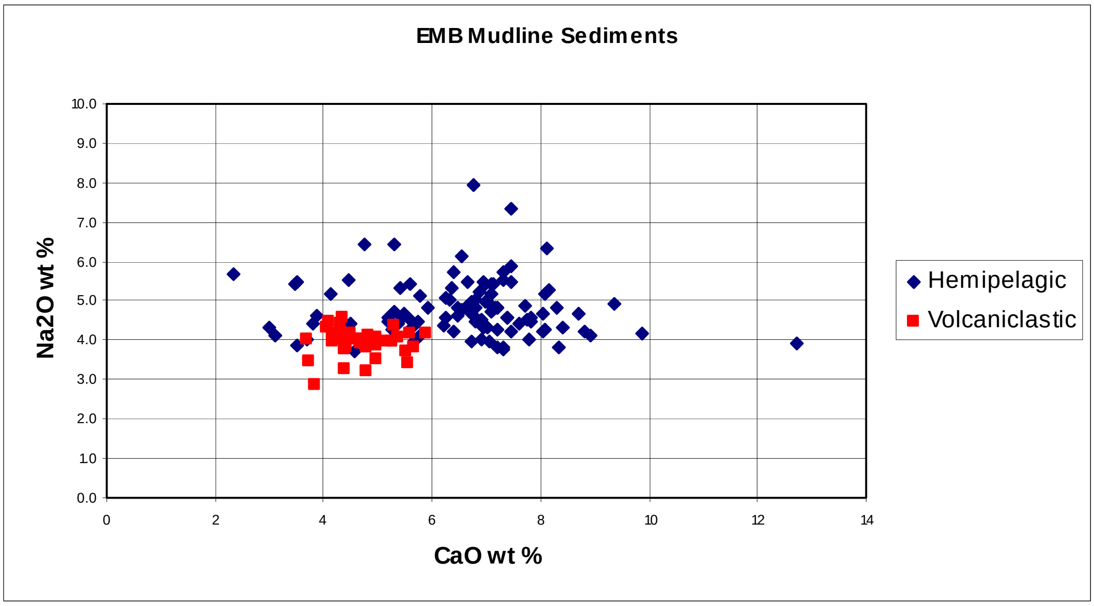


Figure 5.2. Plots showing the contrasted compositions of hemipelagic and volcaniclastic mudline sediments. Sub-seafloor samples from Core MS-36 at Suzette (crosses) include samples bridging the gap but which appear not to be simple mixtures of volcaniclastic and hemipelagic material. Continued on following pages.



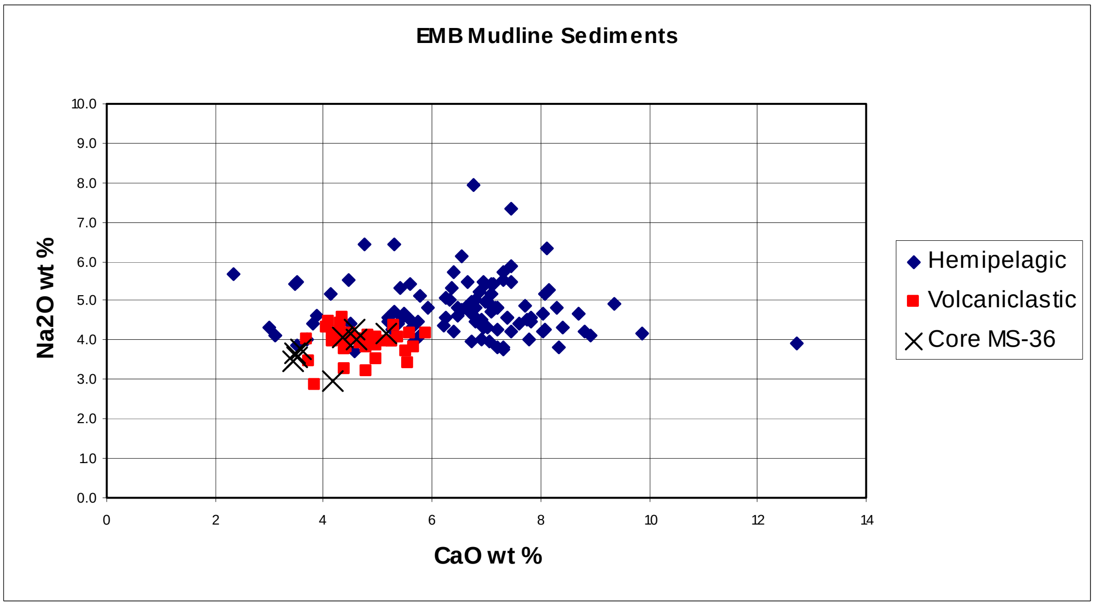
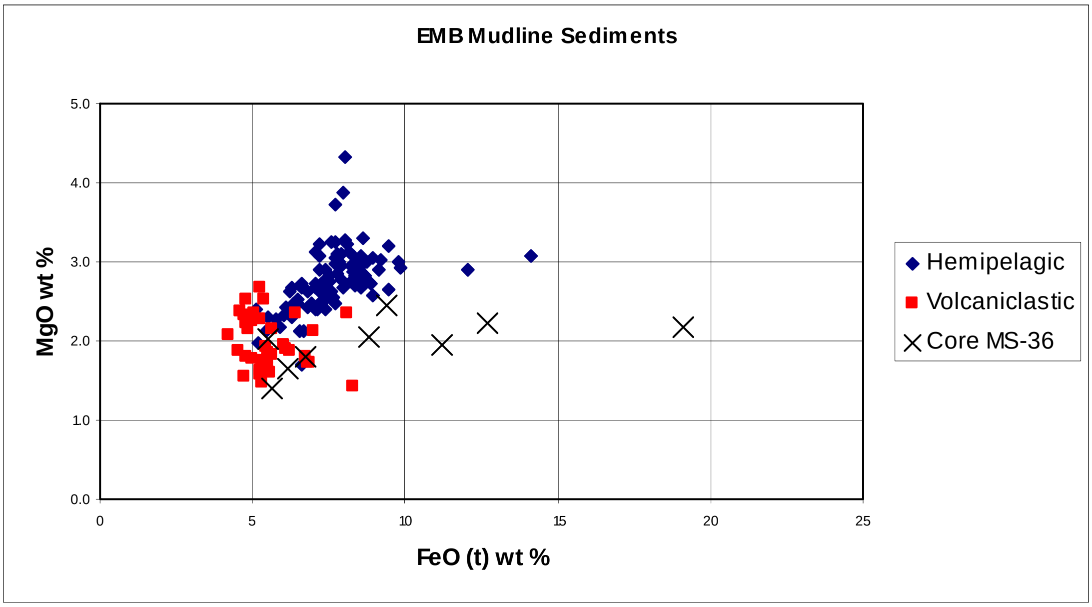


Figure 5.2 (continued). Plots showing the contrasted compositions of hemipelagic and volcaniclastic mudline sediments. Sub-seafloor samples from Core MS-36 at Suzette (crosses) include samples bridging the gap but which appear not to be simple mixtures of volcaniclastic and hemipelagic material. Continued on following pages.



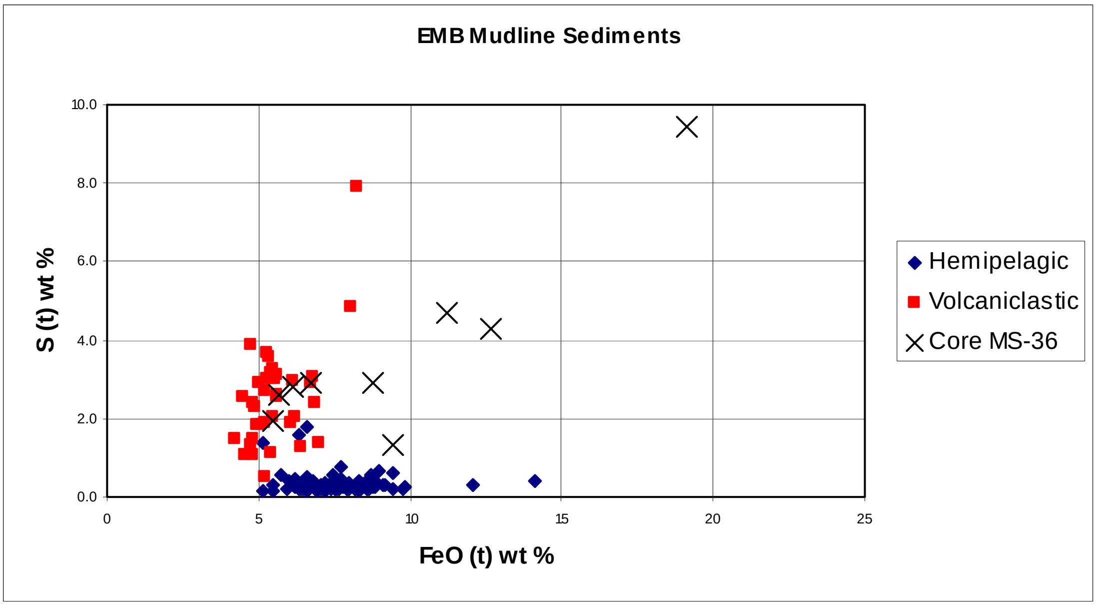
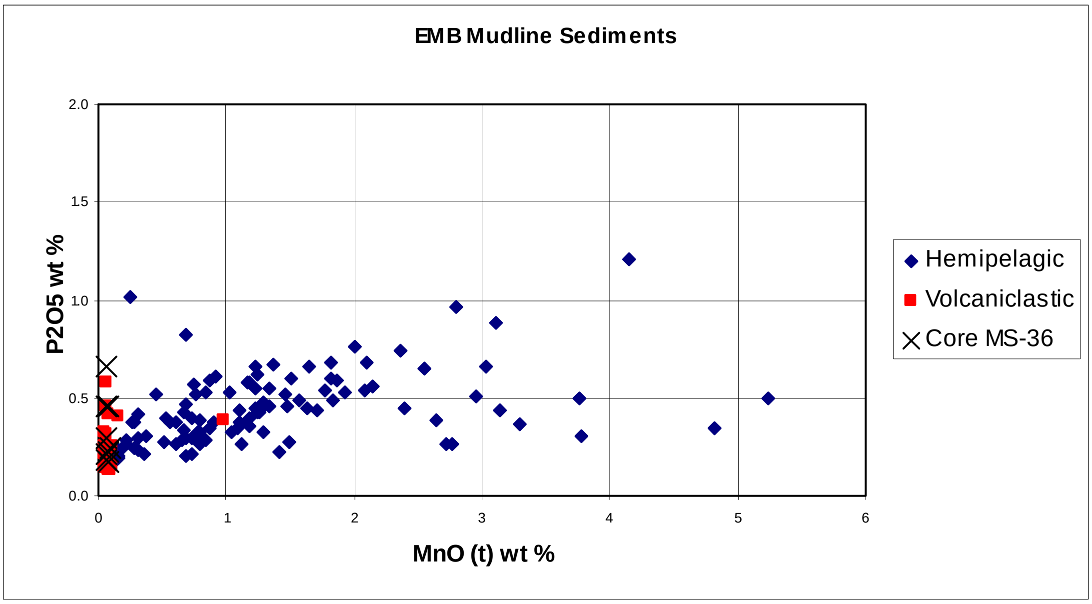


Figure 5.2 (continued). Plots showing the contrasted compositions of hemipelagic and volcaniclastic mudline sediments. Sub-seafloor samples from Core MS-36 at Suzette (crosses) include samples bridging the gap but which appear not to be simple mixtures of volcaniclastic and hemipelagic material. Elevated Fe in these and several volcaniclastic samples arise from pyrite, while that in several hemipelagic samples is probably due to admixed Fe-oxyhydroxides. Continued on following pages.



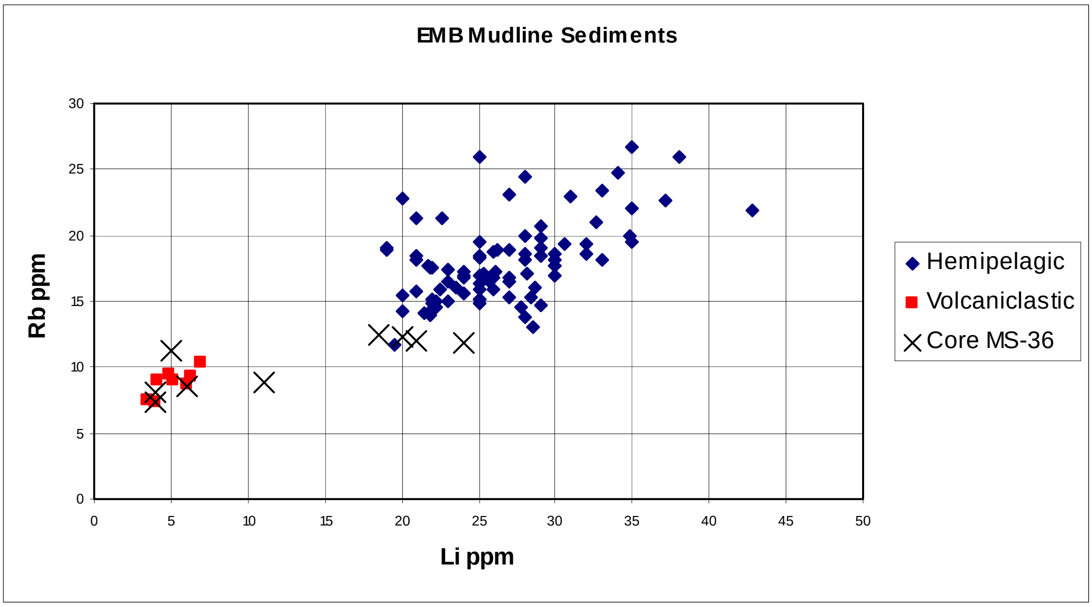
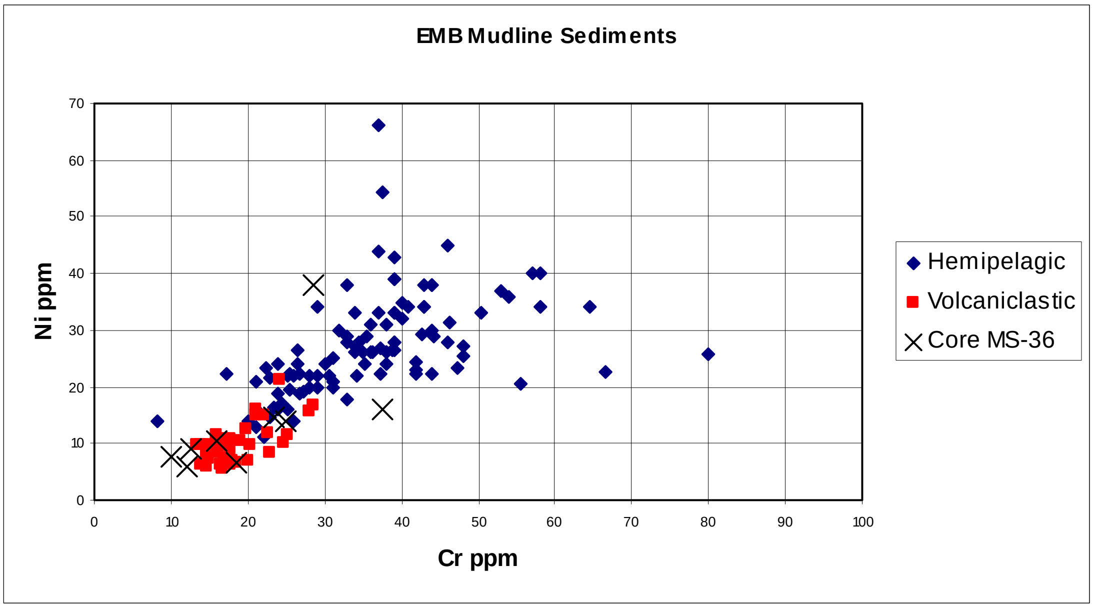


Figure 5.2 (continued). Plots showing the contrasted compositions of hemipelagic and volcaniclastic mudline sediments. Sub-seafloor samples from Core MS-36 at Suzette (crosses) include samples bridging the gap but which appear not to be simple mixtures of volcaniclastic and hemipelagic material. **Continued on following pages.**



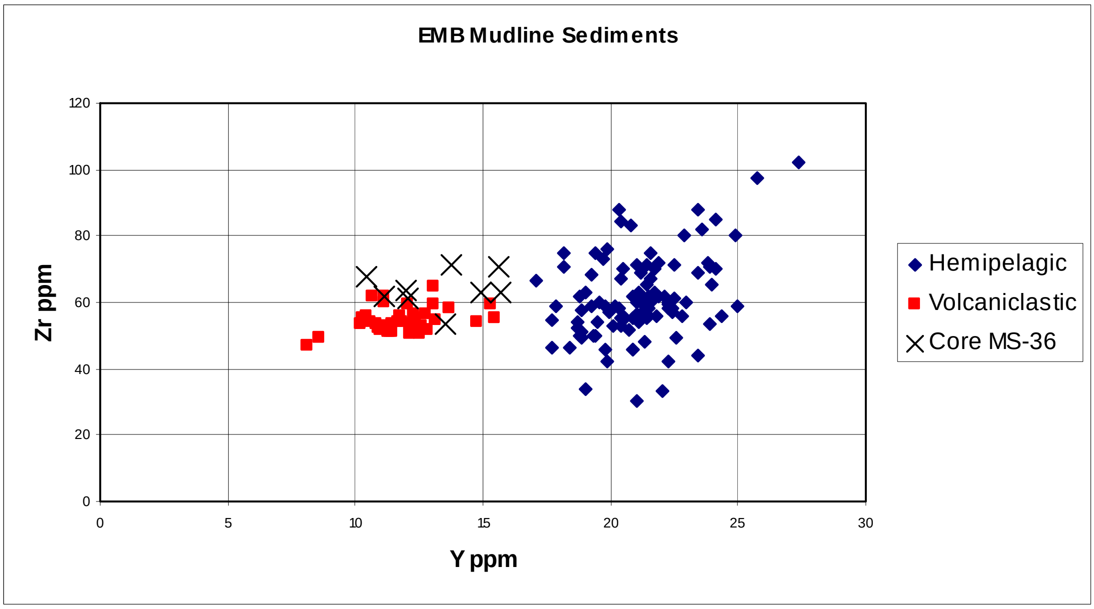
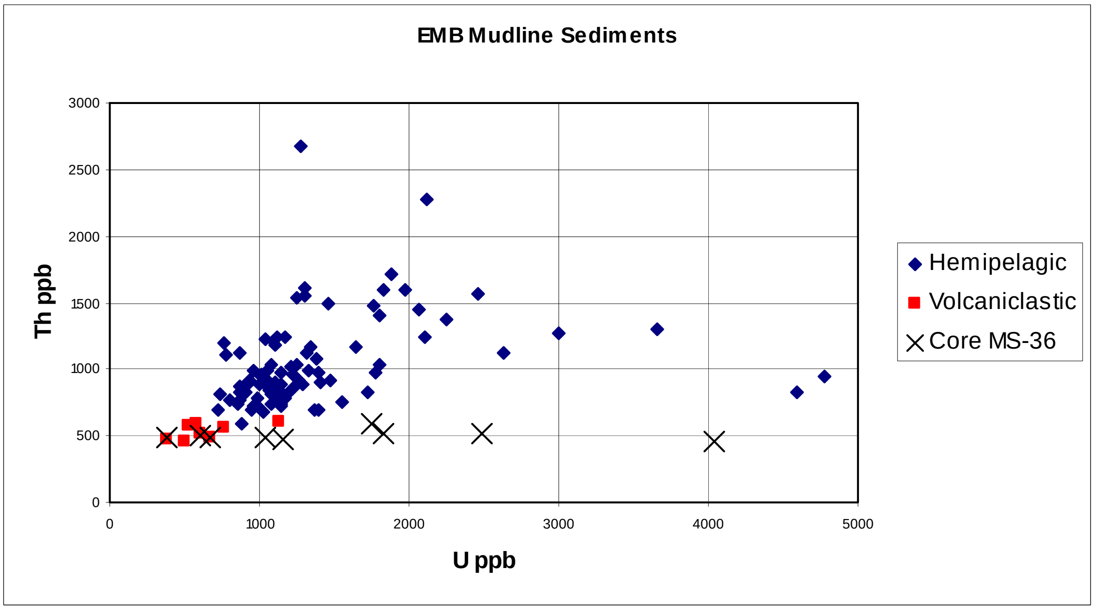


Figure 5.2 (continued). Plots showing the contrasted compositions of hemipelagic and volcaniclastic mudline sediments. Sub-seafloor samples from Core MS-36 at Suzette (crosses) include samples bridging the gap but which appear not to be simple mixtures of volcaniclastic and hemipelagic material. Continued on next page.



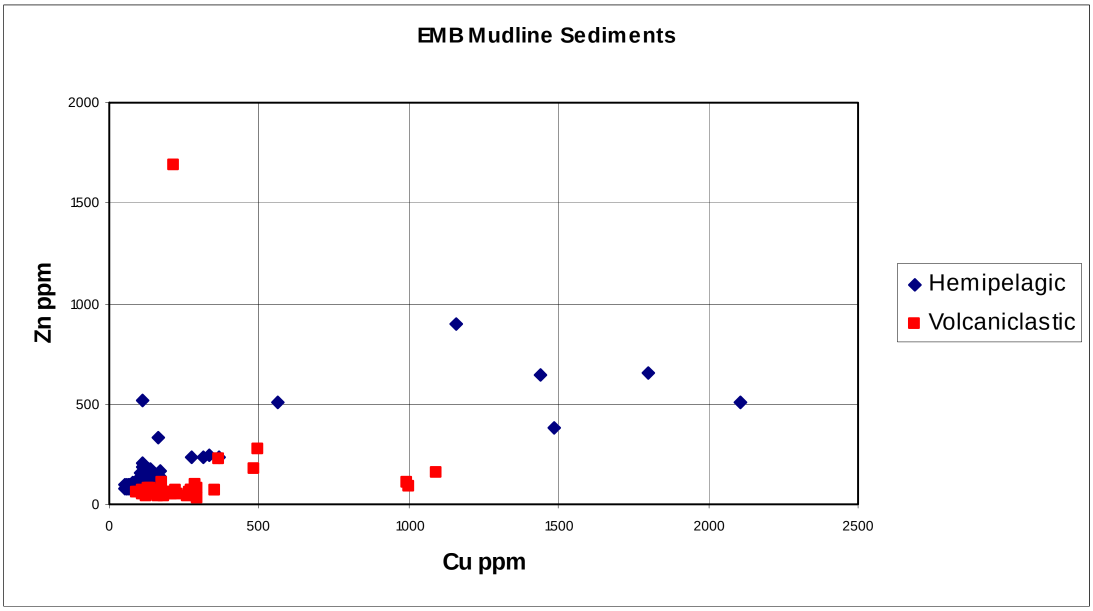


Figure 5.2 (continued). Plots showing the contrasted compositions of hemipelagic and volcaniclastic mudline sediments. Samples enriched in U, Cu and Zn are from hydrothermal sites or their close vicinity.

It is notable that the abundances of Mn and many trace elements such as Cr, Ni, Cu, Au, Pb and to a lesser extent Zn in “background” hemipelagic sediments distinctly exceed typical levels in East Manus basin submarine volcanic rocks. Accordingly, they cannot be explained by the small hyaloclastic component of such sediments. Whether they reflect basin-wide settling of hydrothermal plume particulates, or scavenging by clays or Mn oxides of these elements dissolved in seawater warrants further study, not entirely of academic interest alone. A contoured plot of Mn distribution (Figure 5.3) shows a curious and so far unexplained latitudinal variation, possibly related to proximity of land. Fallout of particulates from distal hydrothermal plumes seems not adequate as an explanation of the Mn distribution.

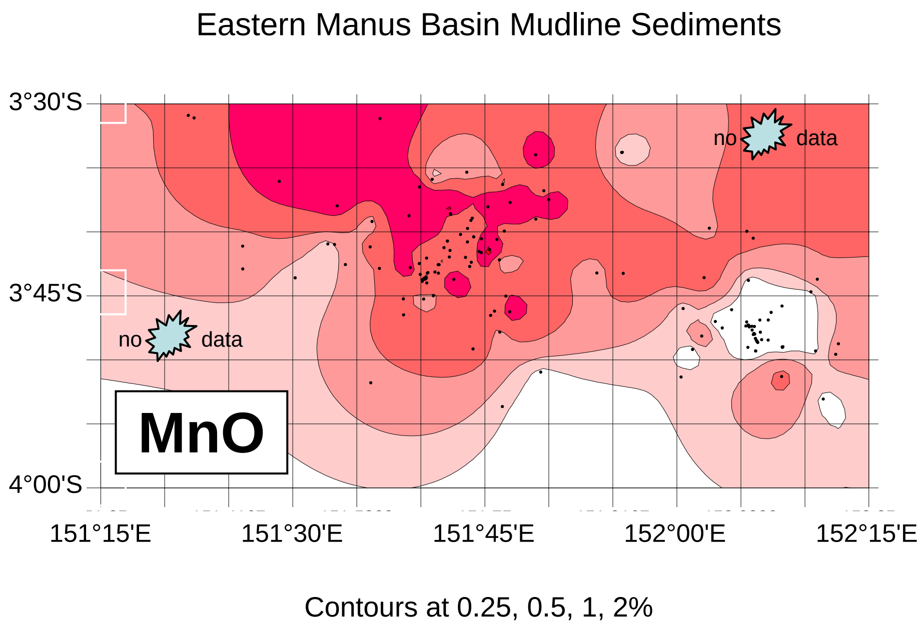


Figure 5.3. Distribution of MnO in mudline sediments of the Eastern Manus Basin (modelled by SURFER with the kriging option), showing an unexplained latitudinal increase northwards. Volcaniclastic sediments at SuSu Knolls form a conspicuous low-Mn hole in the pattern, and PACMANUS (plus Pual Ridge to the northeast) also occupies a zone of depressed Mn content. Considering known orientations of hydrothermal plumes, it is most unlikely that the Mn distribution reflects fallout of extreme distal plume particulates. Blue starbursts indicate areas where the contours are artefacts of the program.

Comparative data for both hemipelagic and volcaniclastic sediments from “background” sites, sites closer to hydrothermal activity, and the PACMANUS and Suzette chimney fields are also provided in sheet 5 of the Excel spreadsheet. For the hemipelagic sediment group, those close to or within venting hydrothermal fields are slightly enriched in Si, and distinctly enriched in S, Cu, Zn, As, Mo, Cd, In, Sb, Te, Ba, Au, Tl, Bi, Pb, and U, although in some cases the standard deviations are high. Apart from Si and Ba (contained within chimneys in opaline silica and barite gangues respectively), these are all elements that are enriched in the sulphide component of chimneys, although at differing levels for the various PACMANUS fields (e.g. U enrichment is more prominent at Roman Ruins). The enrichments can be present in samples sufficiently remote from chimneys that they must represent settling of “smoke” or plume particulates rather than physical mixtures with material from disintegrating chimneys.

For several PACMANUS samples in the CONTAM group in sheet 1 of the spreadsheet (MD59, MD-60, MD-62, MD-81, MG-2, MG-15), however, large chimney fragments are present and exceptional geochemical anomalies arise. Except for the two grabs, not taken close to known chimneys, the contamination is probably artificially caused by the sampling process.

For the volcaniclastic sediments in the SuSu Knolls region, the contrast between proximal and distal sites is not so marked, nor is it systematic. Mudline sample MD-75 and deeper samples from core MS-36 at PACMANUS contain chimney fragments: the core occurrences must reflect natural rather than artificial disintegration of nearby chimneys. A close correlation (Figure 5.4) exists between gold and copper contents (and more imperfectly between these and Ba), suggesting either that natural contamination with chimney fragments is the dominant process generally, or if the source is plume particulate matter then these particles are composites very similar to chimneys.

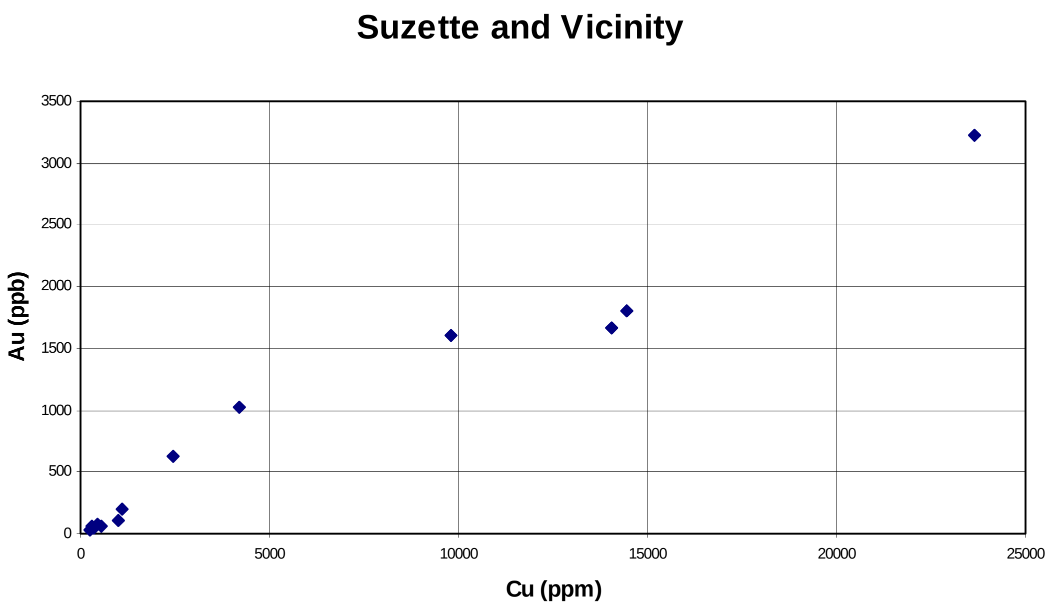


Figure 5.4. Correlation between Cu and Au in volcaniclastic sediments from Suzette and vicinity (including MS-36 sub-seafloor). The ratio is similar to that in Suzette chimneys.

Disregarding the more conspicuously contaminated samples, volcaniclastic sediments at Suzette are extremely enriched in Sb, Tl, and Pb, moderately enriched in Cu, Zn, and Ba, and mildly enriched in S, As and In relative to remote equivalents. The enrichment patterns at Suzette differ from those at PACMANUS, hinting at a higher role for sulfosalts in dispersed “smoke”. Unlike Roman Ruins, U is not enriched at Suzette.

Hemipelagic sediments from basins adjacent to hydrothermal sites are slightly enriched on average in S, Cu and Zn relative to their “background” equivalents, reflecting distal plume fallout. The standard deviations are high and the differences have little statistical significance, but individual analyses have value for assessing geochemical anomalies associated with hydrothermal sites.

5.6 Element Distribution Maps

The distribution of chalcophile elements in bottom sediments has been suggested as an exploration approach to finding hydrothermal site, the rationale being that these settle in a zonal arrangement from plumes rising above those sites. Using SURFER and its kriging option, contoured diagrams have been prepared for Cu, Zn and Pb over the entire Eastern Manus Basin (Figures 5.5, 5.6, and 5.7: hemipelagic and volcaniclastic sediments are combined), and for these elements plus Ba in volcaniclastic sediments from the vicinity of SuSu Knolls (Figures 5.8, 5.9, 5.10, and 5.11). Data for Cu, Zn and Pb for the PACMANUS region were re-plotted but since no new analyses were available the results are essentially the same as those provided in the "P2+ Memoir".

It should be noted that the kriging procedure provides a general rather than detailed distribution map. Contour artefacts can arise where data are widely scattered, and especially at the edges of maps.

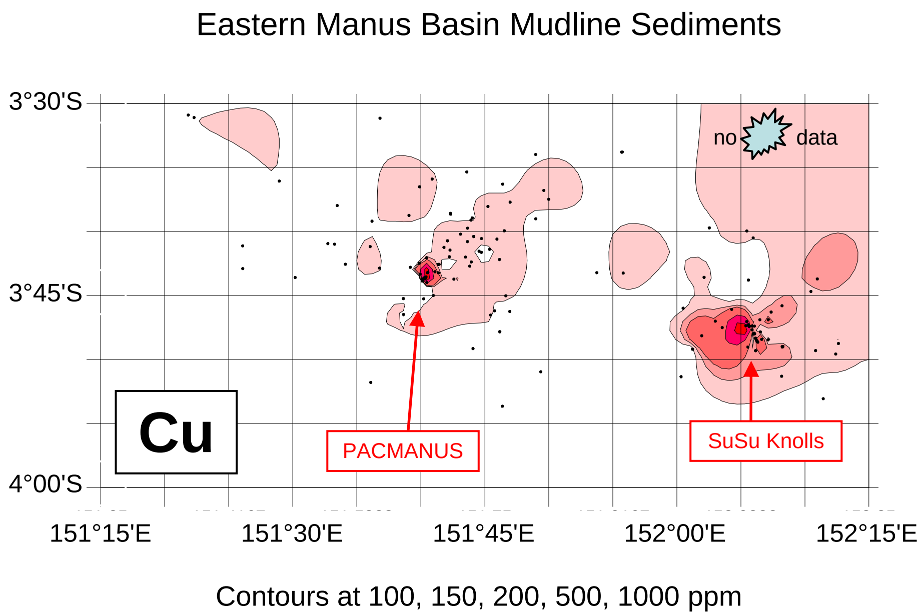
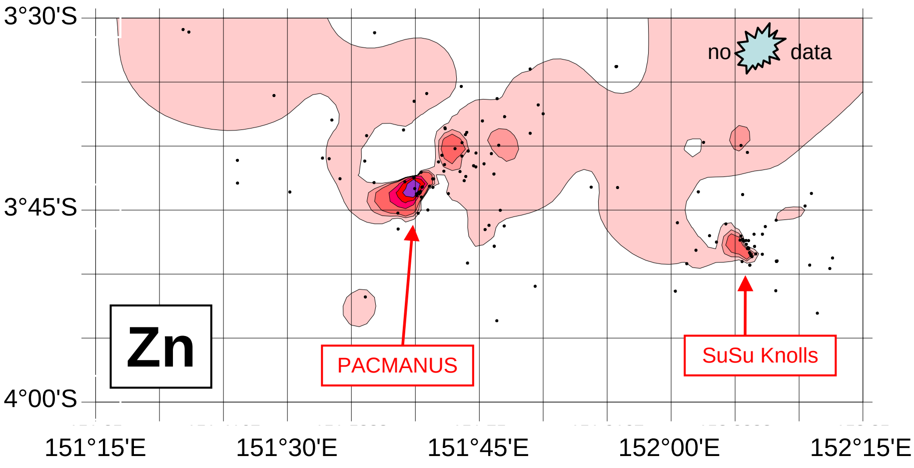


Figure 5.5. Distribution of Cu in mudline sediments across the Eastern Manus Basin. Black dots denote sample positions

5.6.1 Regional distribution patterns

Figure 5.5 reveals pronounced Cu anomalies around the PACMANUS and SuSu Knolls hydrothermal sites, dictated largely by elevated contents in uncontaminated sediments proximal to the chimney fields. In each case there seems to be a less intense distal anomaly defined by the 100 ppm Cu contour, extending in north-easterly directions, possibly reflecting plume dispersal by currents with that orientation. However, 120 ppm Cu (not illustrated) is a more realistic threshold value in this context for hemipelagic sediments around PACMANUS and this still defines a low=level anomaly northeast from PACMANUS along Pual Ridge. The broader extent of the 150 ppm contour at SuSu Knolls reflects the distribution of volcaniclastic sediments, which have higher average Cu (97 ppm) than hemipelagics (179 ppm) at background sites. in which case dispersal is limited at only at SuSu Knolls. At present there are too few “background” volcaniclastic sediments analysed to set a valid threshold, which could be as high as 300-500 ppm Cu.

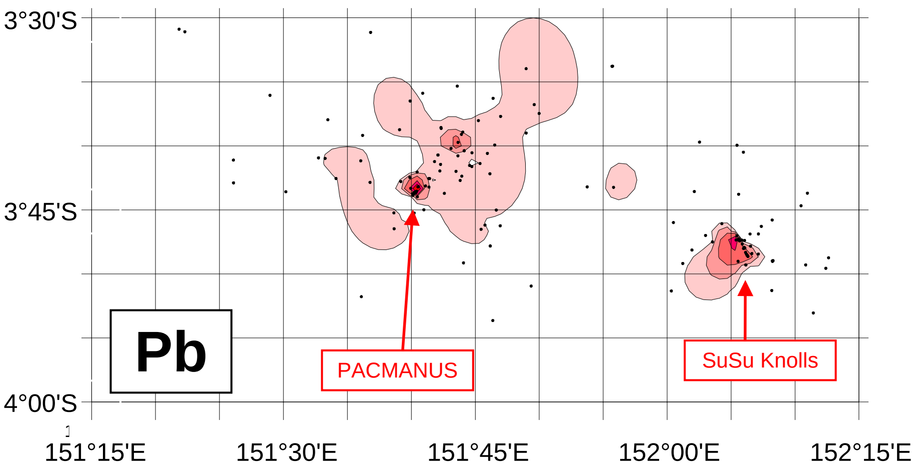
Eastern Manus Basin Mudline Sediments



Contours at 100, 150, 200, 500, 1000, 2000 ppm

Figure 5.6. Distribution of Zn in mudline sediments across the Eastern Manus Basin. Black dots denote sample positions.

Eastern Manus Basin Mudline Sediments



Contours at 25, 50, 100, 200, 400 ppm

Figure 5.7. Distribution of Pb in mudline sediments across the Eastern Manus Basin. Black dots denote sample positions.

Zinc distribution (Figure 5.6) is anomalous over a relatively restricted area at SuSu Knolls, and forms a larger anomaly than Cu at PACMANUS which extends both northeast and southwest. The threshold value for hemipelagic sediments (150-200 ppm Zn) is higher than that indicated by inadequate data for volcaniclastic sediments (~80 ppm Zn). A broad east-west band of sediments with >100 ppm Zn reflects the latitudinal anomaly in MnO (Figure 5.3), and is equally unexplained. Lead (Figure 5.7), with a threshold value of ~30 ppm for hemipelagic sediments and ~20 ppm for volcaniclastic sediments, also shows pronounced anomalies around both PACMANUS and SuSu Knolls, with a broad northeast-trending distal halo at the former site.

For both Zn and Pb, but not for Cu, there are significant anomalies just north of the North Pual site discovered in 2002, although these arise from a single sample (MD-13). No other anomalies of possible exploration significance appear to be represented in the distribution maps, but further work might be warranted on the present of any future expanded geochemical database to better define threshold levels.

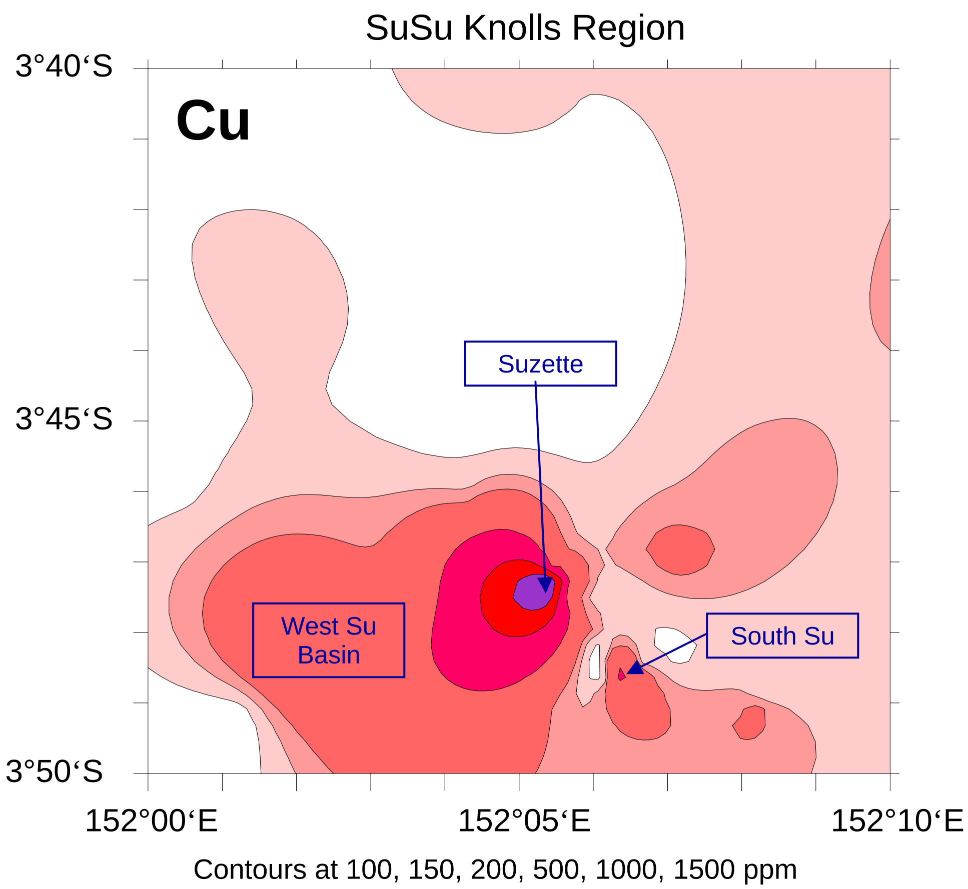


Figure 5.8. Distribution of Cu in mudline sediments, SuSu Knolls region.

5.6.2 Element distribution patterns at SuSu Knolls

The larger-scale maps of Cu, Zn, and Pb distribution around SuSu Knolls (Figures 5.8, 5.9 and 5.10) reveal that Cu dispersal emanates mainly from Suzette, while dispersal of Zn is from both Suzette and South Su, and dispersal of Pb is primarily from South Su. North Su, which is the source of a particularly intense east-trending hydrothermal plume at 1100-1200 m depth, appears unreflected by any geochemical anomaly. These results are a little puzzling in terms of the limited sampling of sulfides conducted at North Su and South Su - Cu-dominated assemblages with enargite rather than Pb-Zn mineralisation.

The mapped Cu anomaly extends west into West Su Basin but as indicated above this partly reflects the higher average Cu content of volcaniclastic sediments which appear to have been reworked into the basin. Barium (Figure 5.11) is also elevated over West Su Basin as well as at Suzette (where barite is the principal chimney gangue), and there is a pronounced high caused by gravity core MS-43. Most grab and corer samples from a close spaced West Su Basin remain to be analysed, and there could be exploration merit in investigating these in terms of possible hydrothermal sites west of West Su Basin (for which there are also hints in CTD data).

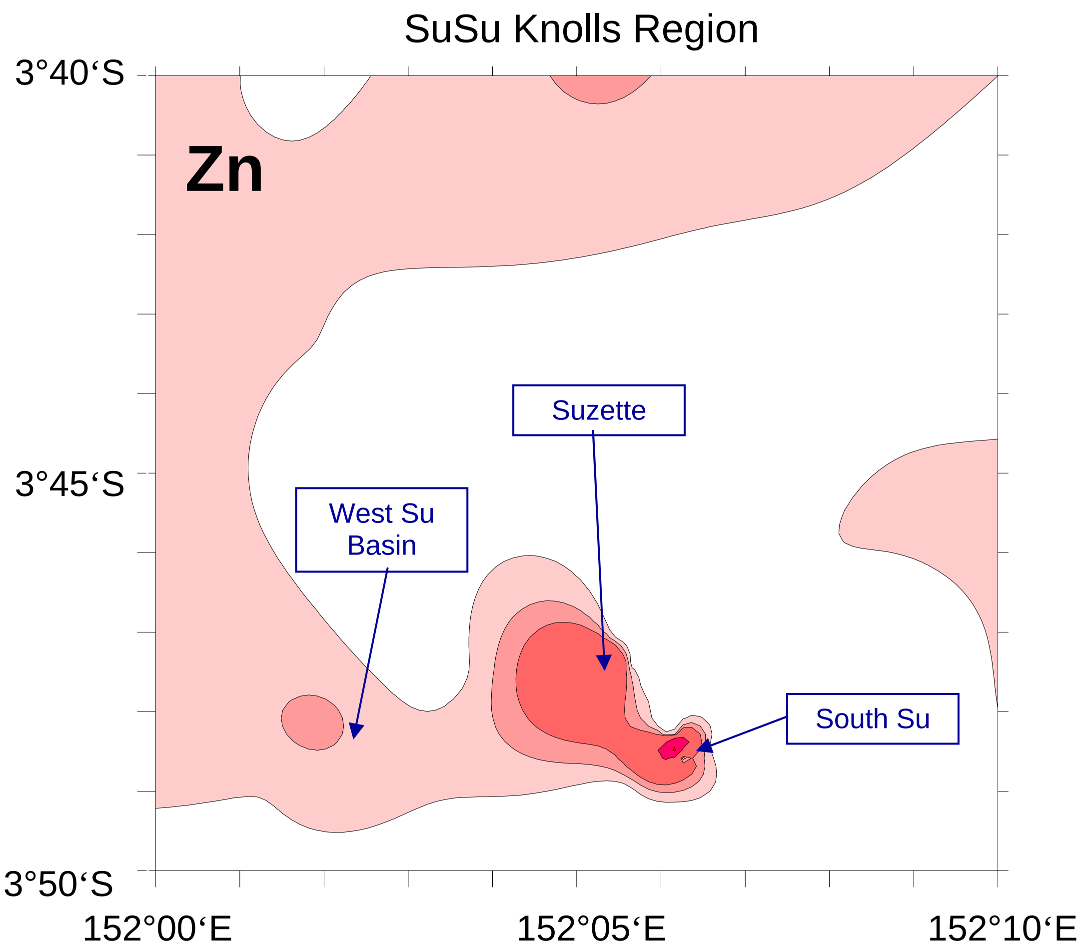


Figure 5.9. Distribution of Zn in mudline sediments, SuSu Knolls region.

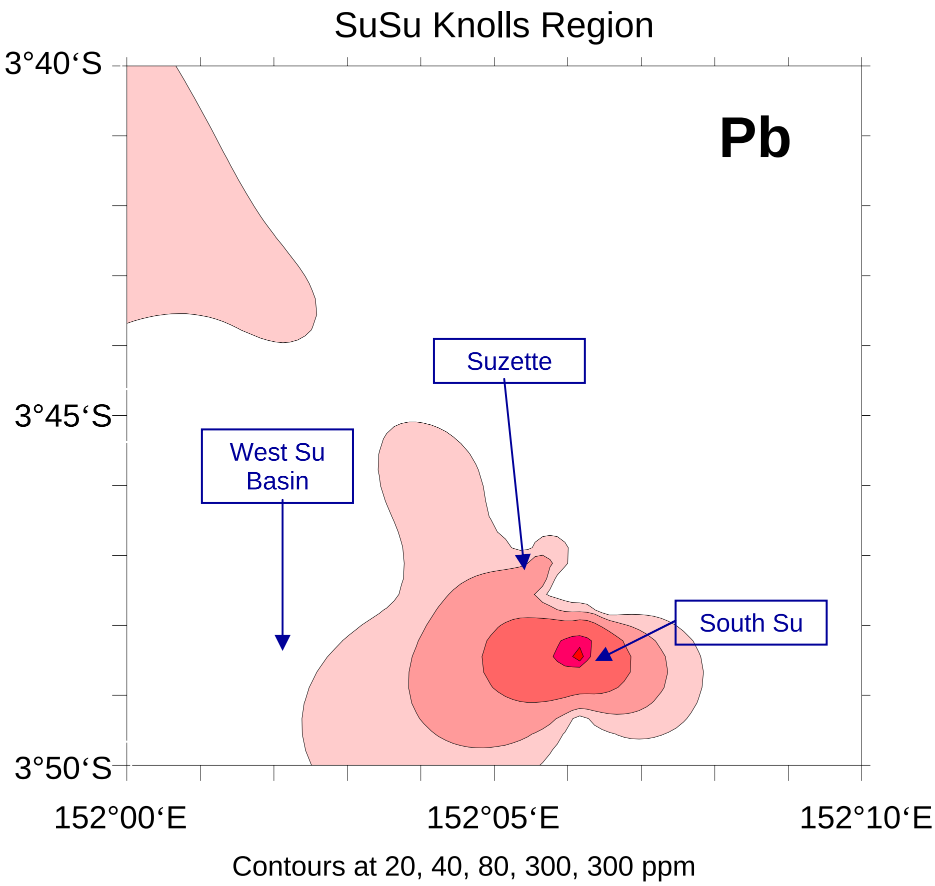


Figure 5.10. Distribution of Pb in mudline sediments, SuSu Knolls region.

5.7 Gaps Analysis

The present database of sediment compositions in the Eastern Manus Basin is probably sufficient to provide "broad-brush" answers to questions posed by interests of the Placer Dome – Nautilus Joint Venture. Refinements are possible and desirable in the context of the baseline environment, and could also be made in the context of future exploration outside PACMANUS and Suzette. Both issues would require more precise definition of geochemical statistics including definition of thresholds, and this would preferably be performed after acquiring more analytical data on the existing sample collection. For defining possible environmental monitoring stations (a topic for Module 3) there may be a need for further sampling of specific localities.

5.7.1 ICP-MS analysis of volcaniclastic sediments at SuSu Knolls

Only eight of the 38 volcaniclastic sediments from the SuSu Knolls region analysed by ICP-AES have also been analysed by the ICP-MS method. At the Suzette field, the proportion is only 2 in 9. This means data are lacking for a number of significant trace elements, including Rb, As, Cd, In, Sb, rare earth elements (REE), Tl, Bi, Th and U. It is strongly recommended that the deficient 30 samples be analysed by ICP-MS, together with say 5 samples to allow interlaboratory comparison of results. Top priority. Analyses for Au and SiO_2 might also be considered – lower priority.

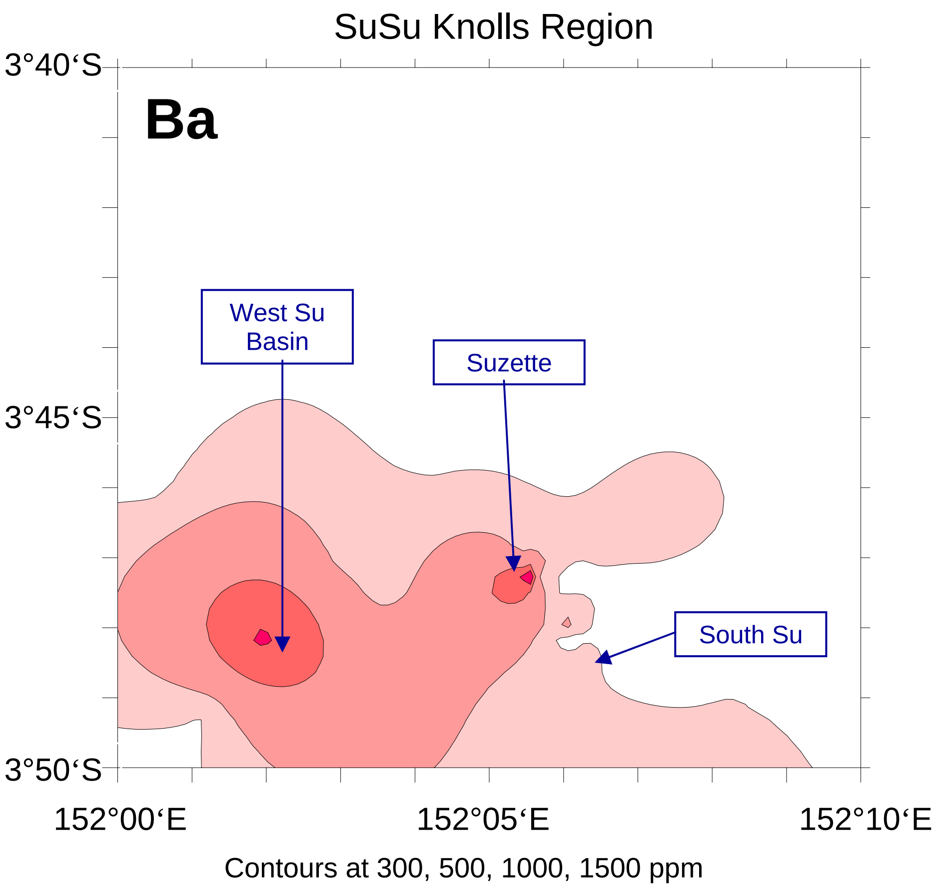


Figure 5.11. Distribution of Ba in mudline sediments, SuSu Knolls region.

5.7.2 Additional mudline and core samples from SuSu Knolls region

Nine CSIRO operations (mainly post 2000) in the SuSu Knolls area yielded mudline sediment samples of which none have so far been analysed by any method. Four of these are at Suzette. Operation MG-37 conducted ~800m east of Suzette warrants special attention as a possible monitoring site; three layers, represented by 4 onboard subsamples, are present in the minicores. Analysis of all these samples by both ICP-AES and ICP-MS methods are highly desirable for the environmental baseline project. These studies also have high priority in view of commercial focus on this area, but should perhaps be reviewed in the light of sampling undertaken from *DP Hunter* and the subsequent analytical program at James Cook University North Queensland.

5.7.3 Core MS-36, Suzette

Gravity core MS-36 (85 cm) in volcaniclastic sediments at Suzette was sampled at 21 positions, of which 9 samples covering the 7 undisturbed beds were analysed at CSIRO. All 21 samples have been analysed by XRF and NAA by the University of Toronto group, but certain “environmental” elements such as Cd, Sb, and Tl (requiring ICP-MS) were not included. ICP analysis of the remaining 12 samples would have a low priority, unless these extra elements attained environmental prominence and time-sequence considerations became important.

5.7.4 West Su Basin

Because mudline sediment in core MS-43 was anomalous in Cu and Ba, extensive grid sampling by grab and some additional gravity cores was conducted in the West Su Basin during the Binatang-2000 cruise to test for possible sediment-hosted mineralisation. It was concluded, however, that the geochemical anomalies arise from dispersal and possibly turbidite transport of altered volcanic debris from the major volcanic or hydrothermal eruptions at North Su. Analytical and sedimentological studies would provide a very detailed baseline dataset for this basin 1 mile to 5 miles westward from Suzette. The priority for such work is greatly increased if current monitoring during the SOLWARA expedition confirmed that any future mining wastes might be transported in that direction. Alternatively the study would provide an exceptionally detailed "background" study involving volcaniclastic materials, more so than anything similar so far conducted.

Mudline samples from 17 operations in West Su Basin remain to be analysed by ICP-AES and ICP-MS (at least). For most of these, some 2 or 3 additional onboard minicore subsamples at various depths (to ~ 15cm) are also available.

Rather than embark immediately on an investigation of all available samples, it is recommended that, say, three of the grab collections be selected and analysed – say 10-12 samples. In addition to this, 20 sediment layers in 75 cm Core MS-55 in West Su Basin were sampled at 34 positions. An initial 10-12 of these samples would provide a novel historical study of the more recent basin fill for a potential background monitoring site.

5.8 Expansion of the regional mudline database

The principal gap at present is in the far western end of the Eastern Manus Basin (Figure 5.1), where no mudline sediments have yet been analysed (operations MD-50, MD-51, MS-56, MS-57). It is not anticipated that these will yield hydrothermal indications, but their analysis will enhance the validity of "background" and "threshold" data for the entire basin.

Although a number of sediment samples (~5) from hydrothermal sites at PACMANUS remain unanalysed, these have low priority since the sites are already well represented. In the northern sector of Pual Ridge, however, there are 3 additional operations (MD-141, MD-142, MD-146) conducted in 2000 that would allow more refined assessment of element dispersals in the vicinity of the lately-discovered North Pual hydrothermal site.

Six further sites scattered across the central East Manus Basin likewise yielded samples that would improve the overall geochemical understanding of mudline sediment geochemistry. The priority for such work depends on the importance assigned to further refinements by Placer Dome, and may be initially lowish.

5.8.1 Sediment cores MS-52, Central Basin, and MS-53, East Umbo Basin

Geochemical profiles for these two cores, taken during the Binatang-2000 cruise from the large basin east of Pual Ridge and from the smaller basin east of Umbo Knolls, respectively, would provide further historical understanding of hemipelagic sedimentation over the last 2000 to 3000 years. MS-53 is from the same site as hydrocast BH-90 (Bismarck-2002 cruise), which recorded a pronounced plume anomaly of unknown source. The core contains numerous dark “metalliferous layers”. MS-52 lacks these layers.

MS-52 recovered a 34 cm core with 9 “beds”, from which 10 subsamples were taken on board. MS-53 recovered 48.5 cm, with 19 “beds” from which 38 samples were prepared. A total of 30 samples from the two cores will provide detailed coverage.

The suggested studies of MS-52 and MS-53 may not have immediate relevance to the Joint Venture activities, so are assigned low priority.

Table 5.1 summarises these recommendations and estimates the cost of commercial analyses (including REE, but not Au). There will also be personnel costs associated with retrieving the samples from Perth storage, and of interpreting and reporting resultant data.

5.9 Recommended Further Work, Module 3

We recommend that the above analytical program be undertaken, certainly the items listed as priority A in Table 5.1.

A second task, to be undertaken in consultation with company personnel, is to select candidate sites for establishment of monitoring stations, where the effects of future mining can be measured in the context of baseline data. At each of these, the mineralogy and sedimentology of sediment samples will be carefully documented by optical, XRD, SEM and grainsize analysis.

Finally, we suggest discussing whether there is a need to extend geochemical or mineralogical studies to the extensive collections at Suzette made during the Solwara expedition

Table 5.1 Summary of Recommended Further work

Item	Description	Priority	Number ICP-AES	Number ICP-MS	Estimated cost of analyses
5.7.1	ICP-MS on SuSu area sediments already analysed by ICP-AES	A+ Will permit assessment of low-level trace elements for this region		30	$1,200
5.7.2	SuSu samples not yet analysed	A Better baseline definition, with coverage of possible monitor sites to east	9	9	$1,350
5.7.3	Core MS-36, Suzette, extra samples	C-	12	12	$1,800
5.7.4	West Su Basin, mudline sediments	B Increased priority if bottom currents set to west	12	12	$1,800
5.7.4	West Su Basin, core MS-55	C+	12	12	$1,800
5.8	Expand regional coverage, mudline sediments	B-	13	13	$1,950
5.8.1	Cores MS-52, MS-53	C	30	30	$4,500
	Interlaboratory checks	A+	5	5	$750
		Total Priority A	14	44	**$3,300**
		Total all tasks	93	123	**$13,350**

6. Dive Footage

As noted in the Module 1 Report, CSIRO posses full video footage from 16 submersible dives at PACMANUS, 8 at DESMOS, 4 at Vienna Woods and one dive(Manusflux Dive 295) at Axial Seamount 3° 33' (renamed "Munkalin" (= razorback ridge)). Because of the relatively stability of the viewing platform, this footage is of a much higher quality than that recorded by any of the deep tow systems and therefore preferable for the purposes of detailed observation of geology and fauna. No submersible footage for SuSu knolls is held by CSIRO. Therefore the best available media to observe fauna and geology there is the lower quality deep-tow footage.

Module 1 recommended, as an initial measure, that all submersible video footage held by CSIRO and all deep-tow footage over SuSu Knolls be duplicated to DVD. The estimated cost of this exercise was approximately $17 500, which was unacceptably high to the client. The focus of this portion of Module 2 of the project is therefore to provide a recommendation for reasonable coverage of both areas of interest (Pual Ridge and SuSu Knolls) from a minimal number of tapes.

Table 6.1 provides a ranked list, from 1 (most useful) to 5 (least useful) for all submarine video footage of the Woodlark and Manus Basins held by CSIRO.

6.1 Methodology

The following methodology was used to prepare the list:

- All tows with failed or very poor quality footage are given a ranking of 5.
- All video footage of areas other than the priority targets of PACMANUS and SuSu Knolls have been given a ranking of 5.
- All duplicate videos have been given a ranking of 5.
- At PACMANUS, where, as discussed above, submersible dive footage is available, all deep tow footage has been ranked 4.
- Existing logs (of variable quality, due to lack of editorial control) and dive tracks for the sixteen submersible dives at PACMANUS have been examined and a summary prepared. Based on this information, the videos have been ranked from 1 to 3 (Table 6.2). All priority 1 tapes should be examined in order to provide visual coverage of all known hydrothermal sites in the field.
- Existing logs of deep tow camera tracks at SuSu Knolls have been examined and a summary prepared. Based on this information, the videos have been ranked from 1 to 3 (Table 6.3). Again, all priority 1 tapes should be examined.
- Footage from the KORDI deep tow camera system (KODOS 99-1 expedition, see Table 6.1) has not been logged previously and CSIRO does not have the equipment to view it. However, this footage is likely to be higher quality than that from the CSIRO or UBC/Toronto systems and has therefore been ranked 1 (best available footage) for SuSu Knolls and 3 (equivalent to lowest priority submersible footage) for PACMANUS.

6.2 Recommendations

As a minimum requirement, it is recommended that all 40 tapes ranked 1 be duplicated to DVD and re-examined to provide an overview of the observed geology and fauna at PACMANUS and SuSu Knolls.

The cost of handling and duplication, at $80 per DVD, is estimated to be approximately $3200. Note that the rate per DVD is higher than quoted previously, due to the much smaller number of DVDs to be burned.

A quotation for examination and logging of these DVDs can be prepared at the client’s request and will be dependent on the nature and detail of information required.

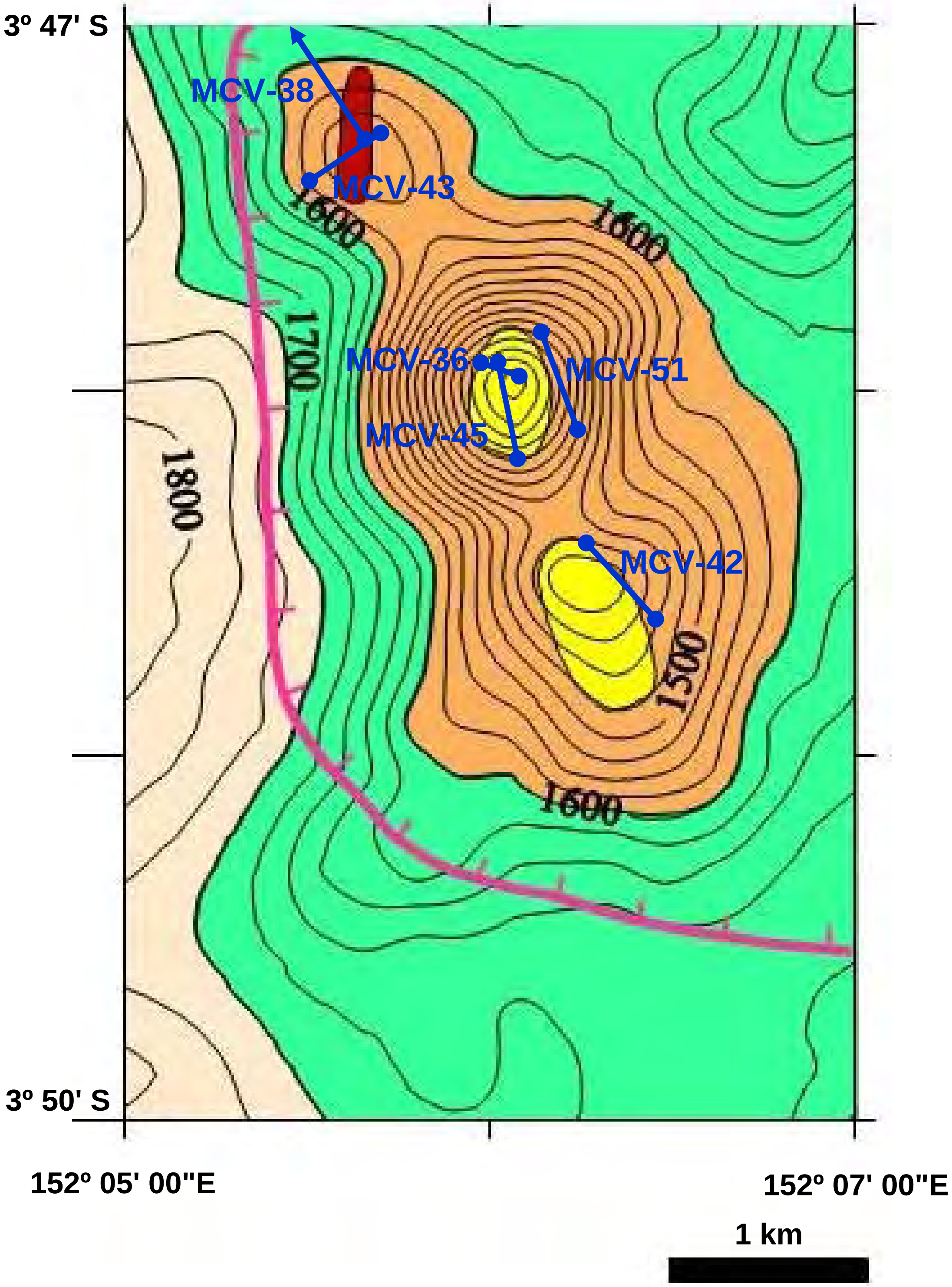


Figure 6.1 Summarised geology and bathymetry of SuSu Knolls, showing approximate tracks of priority 1 deep tow video footage. Note that MCV-38 continues northwards beyond the margin of the map (indicated by an arrow). Suzette sulfide chimney field shown in red, North Su and South Su hydrothermal fields (alteration, scattered chimneys, mounds and vents) in yellow, porphyritic dacite in orange, and andesite and basaltic andesite in green. The pink line designates the extent of the hyaloclastite apron around the edifice.

Table 6.1: List of videos held in the CSIRO collection, ranked according to duplication priority, from 1 (highest priority) to 5 (lowest).

Priority	Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
1	1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1041:11 - 1236:55
1	1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1237:37 - 1432:52
1	1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1433:21 - 1618:34
1	1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1041:13 - 1237:54
1	1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1238:37 - 1433:51
1	1995	Manusflux	Shinkai 6500	Dive 297	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1434:21 - 1618:14
1	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 36	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 38	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 42	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 43	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 45	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 51	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
1	1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	1 of 3	PAL VHS Colour 120min	10:27 - 12:27
1	1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	2 of 3	PAL VHS Colour 120min	12:27 - 14:27
1	1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	3 of 3	PAL VHS Colour 30min	14:27 - 14:58
1	1998	Bioaccess 98	Shinkai 2000	Dive 1069	PACMANUS	1 of 3	PAL VHS Colour 120min	10:19 - 12:18
1	1998	Bioaccess 98	Shinkai 2000	Dive 1069	PACMANUS	2 of 3	PAL VHS Colour 120min	12:18 - 14:18
1	1998	Bioaccess 98	Shinkai 2000	Dive 1069	PACMANUS	3 of 3	PAL VHS Colour 60min	14:18 - 14:48
1	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 1	SuSu	1 of 2	PAL Video8 B&W 120min	
1	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 1	SuSu	2 of 2	PAL Video8 B&W 120min	
1	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 1	SuSu	1 of 1	PAL Video8 Colour 120min	
2	1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1047:19 - 1250:27
2	1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1255:43 - 1456:26
2	1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1456:49 - 1611:13
2	1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1047:22 - 1250:33
2	1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1256:11 - 1455:52
2	1995	Manusflux	Shinkai 6500	Dive 301	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1456:00 - 1611:10
2	1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1050:42 - 1250:56
2	1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1251:25 - 1452:02
2	1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1452:36 - 1608:04
2	1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1050:40 - 1251:40
2	1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1252:09 - 1451:24
2	1995	Manusflux	Shinkai 6500	Dive 304	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1451:49 - 1608:05
2	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 34	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
2	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 37	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
2	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 40	Suzette	1 of 1	NTSC Video8 Colour 120min	
2	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 44	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
2	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 54	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
2	1998	Bioaccess 98	Shinkai 2000	Dive 1065	PACMANUS	1 of 3	PAL VHS Colour 150min	10:25 - 12:25
2	1998	Bioaccess 98	Shinkai 2000	Dive 1065	PACMANUS	2 of 3	PAL VHS Colour 120min	12:25 - 14:25
2	1998	Bioaccess 98	Shinkai 2000	Dive 1065	PACMANUS	3 of 3	PAL VHS Colour 60min	14:25 - 15:02
2	1998	Bioaccess 98	Shinkai 2000	Dive 1067	PACMANUS	1 of 3	PAL VHS Colour 180min	10:20 - 12:14
2	1998	Bioaccess 98	Shinkai 2000	Dive 1067	PACMANUS	2 of 3	PAL VHS Colour 150min	12:14 - 14:10
2	1998	Bioaccess 98	Shinkai 2000	Dive 1067	PACMANUS	3 of 3	PAL VHS Colour 60min	14:10 - 14:55
2	1998	Bioaccess 98	Shinkai 2000	Dive 1074	PACMANUS	1 of 3	PAL VHS Colour 120min	10:14 - 12:13
2	1998	Bioaccess 98	Shinkai 2000	Dive 1074	PACMANUS	2 of 3	PAL VHS Colour 120min	12:13 - 14:14
2	1998	Bioaccess 98	Shinkai 2000	Dive 1074	PACMANUS	3 of 3	PAL VHS Colour 150min	14:14 - 14:53
2	1998	Bioaccess 98	Shinkai 2000	Dive 1075	PACMANUS	1 of 3	PAL VHS Colour 150min	10:58 - 12:56
2	1998	Bioaccess 98	Shinkai 2000	Dive 1075	PACMANUS	2 of 3	PAL VHS Colour 150min	12:56 - 14:56
2	1998	Bioaccess 98	Shinkai 2000	Dive 1075	PACMANUS	3 of 3	PAL VHS Colour 60min	14:56 - 15:18
3	1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	
3	1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	

Priority	Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
3	1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	
3	1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	
3	1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	
3	1995	Manusflux	Shinkai 6500	Dive 299	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	
3	1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	1 of 6	NTSC Hi8 Colour 120min	1040:14 - 1241:06
3	1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	2 of 6	NTSC Hi8 Colour 120min	1241:26 - 1440:48
3	1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	3 of 6	NTSC Hi8 Colour 120min	1441:30 - 1608:05
3	1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	4 of 6	NTSC Hi8 Colour 120min	1045:15 - 1242:04
3	1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	5 of 6	NTSC Hi8 Colour 120min	1242:24 - 1441:36
3	1995	Manusflux	Shinkai 6500	Dive 305	Pacmanus	6 of 6	NTSC Hi8 Colour 120min	1442:09 - 1608:14
3	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 31	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
3	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 32	North Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
3	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 33	South Su	1 of 1	NTSC Video8 Colour 120min	Colour stills available
3	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 46	Suzette	1 of 1	NTSC Video8 Colour 120min	Colour stills available
3	1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	1 of 4	PAL VHS Colour 105min	9:16 - 10:29
3	1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	2 of 4	PAL VHS Colour 120min	10:29 - 12:29
3	1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	3 of 4	PAL VHS Colour 120min	12:29 - 14:27
3	1998	Bioaccess 98	Shinkai 2000	Dive 1062	PACMANUS	4 of 4	PAL VHS Colour 90min	14:27 - 14:55
3	1998	Bioaccess 98	Shinkai 2000	Dive 1063	Roman Ruins	1 of 3	PAL VHS Colour 120min	10:29 - 12:30
3	1998	Bioaccess 98	Shinkai 2000	Dive 1063	Roman Ruins	2 of 3	PAL VHS Colour 150min	12:30 - 14:23
3	1998	Bioaccess 98	Shinkai 2000	Dive 1063	Roman Ruins	3 of 3	PAL VHS Colour 60min	14:23 - 14:51
3	1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	1 of 4	PAL VHS Colour 90min	9:16 - 10:19
3	1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	2 of 4	PAL VHS Colour 120min	10:19 - 12:23
3	1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	3 of 4	PAL VHS Colour 120min	12:23 - 14:24
3	1998	Bioaccess 98	Shinkai 2000	Dive 1070	PACMANUS	4 of 4	PAL VHS Colour 90min	14:24 - 15:16
3	1998	Bioaccess 98	Shinkai 2000	Dive 1071	PACMANUS	1 of 3	PAL VHS Colour 150min	10:25 - 12:25
3	1998	Bioaccess 98	Shinkai 2000	Dive 1071	PACMANUS	2 of 3	PAL VHS Colour 120min	12:25 - 14:21
3	1998	Bioaccess 98	Shinkai 2000	Dive 1071	PACMANUS	3 of 3	PAL VHS Colour 60min	14:21 - 14:41
3	1998	Bioaccess 98	Shinkai 2000	Dive 1076	PACMANUS	1 of 3	PAL VHS Colour 120min	10:34 - 12:35
3	1998	Bioaccess 98	Shinkai 2000	Dive 1076	PACMANUS	2 of 3	PAL VHS Colour 150min	12:35 - 14:39
3	1998	Bioaccess 98	Shinkai 2000	Dive 1076	PACMANUS	3 of 3	PAL VHS Colour 60min	14:39 - 14:44
3	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 2-1	Satanic Mills	1 of 1	PAL Video8 B&W 120min	
3	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 2-1	Satanic Mills	1 of 1	PAL Video8 Colour 120min	
3	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 3	Roman Ruins	1 of 1	PAL Video8 B&W 120min	
3	1999	KODOS 99-1	KORDI Deeptow camera	HDSC 3	Roman Ruins	1 of 1	PAL Video8 Colour 120min	
4	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 3	Pual Ridge, PACMANUS Site	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 5	Pual Ridge, PACMANUS Site	1 of 1	NTSC Video8 Colour 90min	Colour stills available
4	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 9	PACMANUS Deposit, Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
4	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 10	PACMANUS Deposit, Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
4	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 11	PACMANUS Deposit, Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 14	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 15	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 17	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 18	PACMANUS	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1994	Sonne-Edison SO-94	TV Guided Grab	Various	PACMANUS vicinity	1 of 3	PAL VHS	95 GTV (0136 – 0240); 83 GTVA (0651 – 0701); copy of 84 GTVA (0829 – 0857); start of 85 GTVA (10:19 - 10:33)
4	1994	Sonne-Edison SO-94	TV Guided Grab	Various	PACMANUS vicinity	2 of 3	PAL VHS	84 GTVA (08:29 - 08:5); 85 GTVA (10:17 - 12:51)
4	1994	Sonne-Edison SO-94	TV Guided Grab	Various	PACMANUS vicinity	3 of 3	PAL VHS	89 GTVA (0242 – 0326); 90 GTVA (1449 – 0519); 91 GTVA (0712 – 0913)
4	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 24	NE of Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 26	North of Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 28	Roman Ruins	1 of 1	NTSC Video8 Colour 120min	

Priority	Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
4	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 49	Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 50	Crest of Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 52	Crest of Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
4	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 53	Roman Ruins	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1986	PACLARK	UBC/Toronto Deep Tow System	C 1A	Woodlark Basin - East Basin		NO VIDEO	Colour stills available
5	1986	PACLARK	UBC/Toronto Deep Tow System	C 2	Woodlark Basin - east of Franklin Seamount		NO VIDEO	Colour stills available
5	1986	PACLARK	UBC/Toronto Deep Tow System	C 3	Woodlark Basin - West Basin		NO VIDEO	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 4	Woodlark Basin - north wall of South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 5	Woodlark Basin - North Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 6	Woodlark Basin - Goodenough Bay graben	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 7	Woodlark Basin - Goodenough Bay	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 8	Woodlark Basin - ridge north of Craig Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 9	Woodlark Basin - Craig Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 10	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 11	Woodlark Basin - Dobu Szeamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 12	Woodlark Basin - Doby Seamount - South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 13	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 14	Woodlark Basin - north wall od South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 15	Woodlark Basin - north wall of South Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 16	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 17	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 18	Woodlark Basin - North Valley	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 19	Woodlark Basin - Northwest Basin	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 20	Woodlark Basin - South Valley	1 of 1	NTSC Video8 Colour 120min	
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 21	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 22	Woodlark Basin - Dobu Seamount	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 24	Woodlark Basin - Franklin Seamount		NO VIDEO	Colour stills available
5	1988	PACLARK II	UBC/Toronto Deep Tow System	CV 25	Woodlark Basin - Franklin Seamount	1 of 1	NTSC Video8 Colour 120min	
5	1990	SUPACLARK			Woodlark Basin	1 of 11	PAL Video8 Colour 90min	Deck shots
5	1990	SUPACLARK	MIR	MIR Dive	Franklin Seamount	2 of 11	PAL Video8 Colour 90min	MIR 2 Dive 1 at Franklin Seamount
5	1990	SUPACLARK			Woodlark Basin	3 of 11	PAL Video8 Colour 90min	MIR recovery and deployment deck shots
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	4 of 11	PAL Video8 Colour 90min	MIR Dive 1, Franklin Seamount
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	5 of 11	PAL Video8 Colour 90min	MIR Dive 2, Franklin Smt; Dive 3, Dobu Smt
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	6 of 11	PAL Video8 Colour 90min	MIR Dive 3, Dobu Smt
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	7 of 11	PAL Video8 Colour 90min	MIR Dive 4, Dobu Smt; Dive 5, Franklin Smt
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	8 of 11	PAL Video8 Colour 90min	MIR Dive 5, Franklin Smt
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	9 of 11	PAL Video8 Colour 90min	MIR Dive 6, East Valley; Dive 7, Fran klin Smt
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	10 of 11	PAL Video8 Colour 90min	MIR Dive 7, Franklin Smt
5	1990	SUPACLARK	MIR	MIR Dive	Woodlark Basin	12 of 11	PAL Video8 Colour 90min	Selections from Dives 1 and 7; Honiara arrival
5	1991	PACLARK V	UBC/Toronto Deep Tow System	CV 26	Graben southeast of Franklin Seamount	1 of 1	NTSC Video8 Colour 120min	
5	1991	PACLARK V	UBC/Toronto Deep Tow System	CV 27	Ridge north of East Basin	1 of 1	NTSC Video8 Colour 90min	
5	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 2	Southern Kumul Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 4	Graben between Pual Ridge and Area D	1 of 1	NTSC Video8 Colour 90min	Colour stills available
5	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 6	Northeast Arm of Pual Ridge	1 of 1	NTSC Video8 Colour 90min	
5	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 7	Between arms of 'Y', Northern Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
5	1991	PACMANUS I	UBC/Toronto Deep Tow System	MCV 8	Eastern foot of western arm, North Pual Ridge	1 of 1	NTSC Video8 Colour 90min	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 12	PACMANUS		NO VIDEO	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 13	PACMANUS		NO VIDEO	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 16	NW Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 19	SE Yuam Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 20	NW Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 21	SE Yuam Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available

Priority	Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 22	NW Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1993	PACMANUS II	UBC/Toronto Deep Tow System	MCV 23	Tumai Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 294	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 295	Axial Volcano 3 33'	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 295	Axial Volcano 3 33'	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 295	Axial Volcano 3 33'	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 295	Axial Volcano 3 33'	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 295	Axial Volcano 3 33'	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 295	Axial Volcano 3 33'	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 296	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 298	Desmos	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 298	Desmos	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 298	Desmos	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 298	Desmos	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 298	Desmos	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 298	Desmos	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 300	Desmos	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 300	Desmos	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 300	Desmos	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 300	Desmos	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 300	Desmos	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 300	Desmos	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 302	Desmos	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 302	Desmos	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 302	Desmos	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 302	Desmos	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 302	Desmos	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 302	Desmos	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 303	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 306	Desmos	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 306	Desmos	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 306	Desmos	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 306	Desmos	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 306	Desmos	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 306	Desmos	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	

Priority	Year	Cruise	Submersible/Camera	Operation	Area	Tape #	Format	Additional Information (where present)
5	1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 307	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	1 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	2 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	3 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	4 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	5 of 6	NTSC Hi8 Colour 120min	
5	1995	Manusflux	Shinkai 6500	Dive 308	Vienna Woods	6 of 6	NTSC Hi8 Colour 120min	
5	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 25	SuSu Knolls		NO VIDEO	Colour stills available
5	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 27	SE Yuam Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 29	NE Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 30	Sonne Pimple	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1996	PACMANUS III	UBC/Toronto Deep Tow System	MCV 39	South Su		NO VIDEO	Colour stills available
5	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 41	Nimab	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 47	Sonne Pimple	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1997	PACMANUS IV	UBC/Toronto Deep Tow System	MCV 48	Flank of Pual Ridge	1 of 1	NTSC Video8 Colour 120min	Colour stills available
5	1998	Bioaccess 98	Shinkai 2000	Dive 1064	DESMOS	1 of 2	PAL VHS Colour 120min	11:45 - 13:44
5	1998	Bioaccess 98	Shinkai 2000	Dive 1064	DESMOS	2 of 2	PAL VHS Colour 120min	13:44 - 15:41
5	1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	1 of 3	NTSC SVHS Colour 120min	10:27 - 12:27
5	1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	2 of 3	NTSC SVHS Colour 120min	12:27 - 14:27
5	1998	Bioaccess 98	Shinkai 2000	Dive 1066	PACMANUS	3 of 3	NTSC SVHS Colour 30min	14:27 - 14:58
5	1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	1 of 4	PAL VHS Colour 150min	9:21 - 10:39
5	1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	2 of 4	PAL VHS Colour 150min	10:39 - 12:44
5	1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	3 of 4	PAL VHS Colour 120min	12:44 - 14:44
5	1998	Bioaccess 98	Shinkai 2000	Dive 1068	DESMOS	4 of 4	PAL VHS Colour 30min	14:44 - 15:05
5	1998	Bioaccess 98	Shinkai 2000	Dive 1072	DESMOS	1 of 3	PAL VHS Colour 120min	11:41 - 13:41
5	1998	Bioaccess 98	Shinkai 2000	Dive 1072	DESMOS	2 of 3	PAL VHS Colour 120min	13:41 - 15:41
5	1998	Bioaccess 98	Shinkai 2000	Dive 1072	DESMOS	3 of 3	PAL VHS Colour 30min	15:41 - 15:57
5	1998	Bioaccess 98	Shinkai 2000	Dive 1073	DESMOS	1 of 3	PAL VHS Colour 120min	10:27 - 12:27
5	1998	Bioaccess 98	Shinkai 2000	Dive 1073	DESMOS	2 of 3	PAL VHS Colour 120min	12:27 - 14:27
5	1998	Bioaccess 98	Shinkai 2000	Dive 1073	DESMOS	3 of 3	PAL VHS Colour 60min	14:27 - 14:50
5	2000	Binatang	CSIRO Deep Tow Camera	MCV 55	North Su	1 of 1	PAL Mini DV Colour 120min	Focus Problems
5	2000	Binatang	CSIRO Deep Tow Camera	MP 3	Southern Pual Ridge	1 of 1	PAL Mini DV Colour 120min	Focus Problems; Physics tow mostly too high for good images
5	2000	Binatang	CSIRO Deep Tow Camera	MP 4	Southern Pual Ridge	1 of 1	PAL Mini DV Colour 120min	Physics tow mostly too high for good images
5	2000	Binatang	CSIRO Deep Tow Camera	MP 11	Southern Pual Ridge, PACMANUS	1 of 1	PAL Mini DV Colour 120min	Physics tow mostly too high for good images
5	2002	Bismarck	CSIRO Deep Tow Camera	BV01	Caldera of Northeast Karkar Seamount	1 of 1	PAL Mini DV Colour 80min	
5	2002	Bismarck	CSIRO Deep Tow Camera	BV02	North Bam Ridge	1 of 1	PAL Mini DV Colour 120min	
5	2002	Bismarck	CSIRO Deep Tow Camera	BV03	North Bam Ridge	1 of 1	PAL Mini DV Colour 80min	
5	2002	Bismarck	CSIRO Deep Tow Camera	BV04	East of Manam Island		NO VIDEO	Camera damaged during operation - tape unreadable
5	2002	Bismarck	CSIRO Deep Tow Camera	BV05	East of Manam Island	1 of 1	PAL Mini DV Colour 120min	
5	2002	Bismarck	CSIRO Deep Tow Camera	BV06	Northwest Karkar Seamount	1 of 1	PAL Mini DV Colour 120min	
5	2002	Bismarck	CSIRO Deep Tow Camera	BV07	Northeast Arm of Pual Ridge	1 of 1	PAL Mini DV Colour 80min	
5	2002	Bismarck	CSIRO Deep Tow Camera	BV08	Pual Fork	1 of 1	PAL Mini DV Colour 80min	

Table 6.2: Priority ranking and summary of dive log observations for *Shinkai* submersible dive videos from PACMANUS, divided according to the 4 main chimney fields. Grey shaded cells indicate fields not visited during a specific dive. Note that the quality of existing logs varies widely for this footage, with some dive observers relying only on notes made during their dive and others reviewing the tapes in detail post-dive.

Dive No.	Tsukushi	Snowcap	Satanic Mills	Roman Ruins/Rogers Ruins	Ranking
297		abundant fauna, few to no chimneys	abundant fauna, some chimneys, lots of venting, lava flows	some chimney clusters, lava, some fauna	1
299		no chimneys, lots of lava, not much fauna, lots of sampling activity			3
301			lava flows shown, some chimneys, relatively little diversity in fauna, lots of sampling	lots of lava, blocky, platey...etc, few chimneys, little fauna	2
304				lots of chimneys, little diversity in fauna	2
305		few chimneys (most of them small and/or dead), little diversity in fauna			3
1062		no chimneys, little fauna	some small chimneys, some fauna		3
1063				lots of chimneys, good fauna, volcanics	1
1065	some acitve chimneys, venting, no fauna	no chimneys, some fauna	abundant chimneys present, some fauna		2
1066	abundant chimneys, little fauna, some volcanics	abundant chimneys, relatively abundant fauna, some volcanics	excellent footage of chimneys, abundant fauna, volcanics		1
1067	some chimneys, little fauna, lots of sampling activity	few chimneys for majority of video, abundant fauna, volcanics			2
1069	little emphasis on chimneys, lots of fauna (in detail), volcanics	no chimneys, abundant fauna, some volcanics	some chimneys (little emphasis), detailed descriptions of fauna		1
1070	few chimneys, some fauna		no chimneys, some fauna		3
1071		one chimney, some fauna	some chimneys, some fauna (overall diversity low)		3
1074	lots of chimneys, little to no fauna logged	nothing recorded	some chimneys (though hard to tell extent, due to brievity of logs), little fauna		2
1075		few chimneys, some fauna (low diversity)	few chimneys, some volcanics, abundant fauna		2
1076		no chimneys, good fauna	no chimneys, few fauna	chimney fields present (no emphasis placed on them in logs), fauna	3

Table 6.3: Priority ranking and summary for deep tow videos from SuSu, divided according to the 3 main volcanic cones.

Operation	Location	Summary	Ranking
MCV 31	South Su	Heavily sedimented, scattered fauna	3
MCV 32	North Su	Poor footage (possibly in plume for part of tow)	3
MCV 33	South Su	Mostly flown too high, heavily sedimented, possible chimney	3
MCV 34	Suzette	Chimneys, chimney debris and talus, possible plume, scattered fauna	2
MCV 36	North Su	Shimmering water, hydrothermal crusts, mounds and sediment, scattered fauna	1
MCV 37	South Su	Camera mostly anchored, some active vents, scattered fauna	2
MCV 38	Suzette	Active vent field with fauna, sedimented	1
MCV 40	Suzette	Heavily sedimented, dead fauna, bacterial (?) floc	2
MCV 42	South Su	Active spires and mounds, shimering water, blocky lava, abundant fauna and bacteria	1
MCV 43	Suzette	Heavily sedimented, extinct and active spires, abundant fauna	1
MCV 44	Suzette	Heavily sedimented with scattered extinct spires	2
MCV 45	North Su	Mounds and spires, crusts, bacteria, scattered fauna	1
MCV 46	Suzette	Heavily sedimented	3
MCV 51	North Su	Crusts, volcanic flows and talus, active venting, bacteria, fauna	1
MCV 54	North Su	Heavily sedimented with highly variable relief, active hydrothermal field at end of tape	2

7. Notes on Authors

Dr Timothy F. McConachy (Head of Seabed Ore Systems; Senior Principal Research Scientist)
BSc Hons 1 (Univ. New England) 1975; PhD (Toronto, Canada; including Woods Hole Oceanographic Institution, MA, USA) 1988. MGSA, FAusIMM (CP), FSEG, MAGU. Seabed Ore Systems team leader since 2001. Formerly Chief Geologist/General Manager Australia region for Rio Tinto Exploration Pty Limited which included 24 years experience in global mineral exploration and management, and leading roles in discoveries in Australia, Indonesia and PNG. Seagoing experience includes 14 cruises, four as chief scientist in Papua New Guinea, Solomon Islands, Vanuatu, Indonesia and New Zealand. Current interests include modern hydrothermal ore-forming environments and their relationships to ancient ore deposits.

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Dr Raymond A. Binns (Retired Chief Research Scientist, Honorary Research Fellow)
BSc (Sydney) 1959; PhD (Cambridge, UK) 1962. FGS, FSEG, FAusIMM, FTSE. Led the Seabed Ore Systems team 1986 – 2001. Formerly Assistant Chief, CSIRO Division of Mineralogy and Geochemistry (1977-1985); Reader in Geology, University of Western Australia (1971-77); Lecturer to Associate Professor of Geology, University of New England (1962-70). Seagoing experience includes 19 cruises, most as Chief or Co-chief scientist, including ODP Leg 193. Current research interests include modern hydrothermal ore-forming environments; petrology and geochemistry of mineralized environments.

Dr Greg W. Rouse (Senior Research Scientist, South Australian Museum)
B.Sc. (Univ. Qld) 1982; M.Sc. (Univ. Qld) 1985; PhD. (Univ. Sydney) 1991. At the South Australian Museum since 2001. Previously postdoctoral fellow at the Smithsonian Institution (1991-1994) and University of Sydney (1994-2001). Expertise on marine invertebrate diversity, particularly polychaete annelid worms. Has research experience on deep sea fauna including hydrothermal vents on United States-NSF funded cruises to the Pacific Antarctic Ridge and the North Fiji and Lau Basins. Greg has recently accepted a Professorial position at Scripps Institute of Oceanography.

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Appendix 1

Animal Collection

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to	Material found in Marine Invertebrate section of Australian Museum	Checked by Greg Rouse (Oct 2005).
MD-1	PACMANUS I	1991	Dredge	Marmin Knolls, Central	1542	3	42.74	151	34.18	-3.71	151.57		One fish 30 cm long and another 2 cm long among gravelly basaltic rocks with brown mud. The fish lay on top of the gravel in the dredge, so may have been collected during ascent.	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-2	PACMANUS I	1991	Dredge	Marmin Knolls, west	1903	3	40.94	151	32.88	-3.68	151.55		Unidentified small animal with angular dacite fragments and a small amount of ooze	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-3	PACMANUS I	1991	Dredge	Marmin Knolls, east	1902	3	42.89	151	37.1	-3.71	151.62		Small starfish, worm, shell fragments and some wood mixed with sloppy brown mud and dacite fragments	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-4	PACMANUS I	1991	Dredge	Pual Ridge, west flank north of PACMANUS	1794	3	42.46	151	40.5	-3.71	151.68		A small worm connected to a basaltic andesite fragment coated with brown mud.	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-5	PACMANUS I	1991	Dredge	Yuam Ridge, SW	2037	3	42.49	151	44.21	-3.71	151.74		Numerous living tube-worms and dead casings. Numerous white galatheid crabs (some in roe), white prawns, 3-4 tiny yellow gastropod shells. Two small fish 10 cm long (vent fish?)	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-8	PACMANUS I	1991	Dredge	Pual Fork, NE of Sonne on extension of main ridge	1860	3	41.91	151	42.51	-3.70	151.71		Worm casing on grey-black dacite fragment	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-9	PACMANUS I	1991	Dredge	DESMOS	1957	3	41.52	151	52.19	-3.69	151.87		Tube-worms and galatheid crabs in fish-net liner, probably remaining from MD-9. Coconut husk and small pieces of wood mixed with small pumice fragments.	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		*Alvinocaris longirostis*?11 specimens P61038
MD-9	PACMANUS I	1991	Dredge	DESMOS	1957	3	41.52	151	52.19	-3.69	151.87		Tube-worms and galatheid crabs in fish-net liner, probably remaining from MD-9. Coconut husk and small pieces of wood mixed with small pumice fragments.	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum	galatheids found,also has carid? In jar	*Alvinocaris longirostis*? 2 specimens. Also *Arcovestia ivanovi* ; 1 whole juvenile plus tube fragments. Numerous labelled as *Munidopsis* sp. But is it *lauensis?* (>50), or Munida? Now in Ethanol.
MD-9	PACMANUS I	1991	Dredge	DESMOS	1957	3	41.52	151	52.19	-3.69	151.87		Tube-worms and galatheid crabs in fish-net liner, probably remaining from MD-9. Coconut husk and small pieces of wood mixed with small pumice fragments.	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		2 specimens of *Phymorhnchus cf. wareni* (described from Lihir) C. 305523. 1 specimens Lepetodrilus? C. 305249
MD-9	PACMANUS I	1991	Dredge	DESMOS	1957	3	41.52	151	52.19	-3.69	151.87		Tube-worms and galatheid crabs in fish-net liner, probably remaining from MD-9. Coconut husk and small pieces of wood mixed with small pumice fragments.	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		9 specimens of Trochidae. C. 305251. Ridges running around shell. Check Fucaria mystax from Lihir. Warén, A. & Bouchet, P. 2001 Gastropoda and Monoplacophora from hydrothermal vents and seeps; new taxa and records. Veliger 44, 116-231.
MD-11	PACMANUS I	1991	Dredge	Pual Fork, near foot of NW Pual	2005	3	39.04	151	44.35	-3.65	151.74		One small fish 2 cm long mixed in with rock fragments	Chris Taylor, CSIRIO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to	Material found in Marine Invertebrate section of Australian Museum	Checked by Greg Rouse (Oct 2005).
MD-12	PACMANUS I	1991	Dredge	Pual Fork	1844	3	40.78	151	42.28	-3.68	151.70		One pink galatheid crab, broken mussel shells, 1 small gastropod (alive), 2 soft worms, 1 worm casing. One small jar of ooze was preserved.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum	galatheid found	3 broken galatheids; Munidopsis?P. 48087. Det R. Sprinthorpe. No other material.
MD-19	PACMANUS I	1991	Dredge	PACMANUS, NE of Satanic Mills	1659	3	43.72	151	40.13	-3.73	151.67		One live large, coiled, gastropod 4 cm across was caught between the strobe battery and frame of the cage. The coordinates given refer to a collision observed on video at 0757 when the camera collided with a chimney, dislodging numerous bouyant gastropods adhering to it.	Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum		Not found
MD-20	PACMANUS I	1991	Dredge	PACMANUS, just NE of Snowcap	1673	3	43.74	151	40.07	-3.73	151.67			Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum	galatheid found	Munida magniatennulata Baba and Turkay 1992. Det S. Ahyong P48088
MD-20	PACMANUS I	1991	Dredge	PACMANUS, just NE of Snowcap	1673	3	43.74	151	40.07	-3.73	151.67			Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum		dry shell fragments ifremaria nautilei
MCV-11	PACMANUS I	1991	Camera tow	PACMANUS	1690	3	43.37	151	40.34	-3.72	151.67			Chris Taylor, CSIRO	formaldehyde solution	Dr W. Ponder, Aust Museum		2 specimens Lepetodrilus? C. 305250
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-1	6 white galatheid crabs in 2 plastic vials.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-2	1 gastropod, olive green-greyshell, in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		1 specimens of Trochidae. C. 305252. Ridges running around shell. Check Fucaria mystax from Lihir. Warén, A. & Bouchet, P. 2001 Gastropoda and Monoplacophora from hydrothermal vents and seeps; new taxa and records. Veliger 44, 116-231.
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-3	3 mm diameter, round, light green soft "cling-ons" with central black spot, attached to dacite. 3 specimens in plastic bag.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		egg masses molluscan, on rock
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-4	Molluscs, with light brown shells 2 specimens with intact shell 4 specimens total in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		4 specimens Bathymodiolus
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-5	Tube worms, green-brown colour. 3 specimens in plastic bag.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-24	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, SE flank	1837	3	43.72	151	40.17	-3.73	151.67	MD-24-6	Clam shell (broken), grey and white in colour. 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-26	PACMANUS II	1993	Dredge	Twin Knolls, N of PACMANUS	1837	3	42.47	151	39.93	-3.71	151.67	MD-26-1	Red shrimp, 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-1	Brown "sea slug" 2 mm long appendages. 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-2	Gastropod, black and brown spiral shell (9-12 mm long). 2 specimens in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-3	Oyster? shells adhering to dacite glass and hyaloclastite. Shells are white with a blue-grey tint and a pearly lustre. 9 specimens in a plastic bag.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to	Material found in Marine Invertebrate section of Australian Museum	Checked by Greg Rouse (Oct 2005).
MD-27	PACMANUS II	1993	Dredge	PACMANUS, Snowcap, E side	1692	3	43.60	151	40.3	-3.73	151.67	MD-27-4	Single shells of same type as in MD-27-3. 20 specimens in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-1	Large gastropod with black-brown shell. Black colour appears to be a coating. 1 specimen in a plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-2	Broken shell pieces similar to MD-28-1. Shells have brown exterior and white interior. 7 pieces in a plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-3	Brown molluscs, same as MD-24: 4.24-30 mm long shells. 3 specimens, 2 adhering to dacite chips, 2 intact, in plastic vial	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		3 specimens Bathymodiolus
MD-28	PACMANUS II	1993	Dredge	PACMANUS, NE side of Satanic Mills	1666	3	43.65	151	40.25	-3.73	151.67	MD-28-4	White galatheid crab, 20x9 mm carapace in plastic vial. other 2 black-brown tube worms, 2	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-29	PACMANUS II	1993	Dredge	NE arm Pual, W side north knoll	1783	3	41.46	151	42.38	-3.69	151.71	MD-29-1	Red "shrimp", 20x5mm carapace, 13 mm long tail. In plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-29	PACMANUS II	1993	Dredge	NE arm Pual, W side north knoll	1783	3	41.46	151	42.38	-3.69	151.71	MD-29-2	Red shrimp, 1 specimen in plastic vial.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-32	PACMANUS II	1993	Dredge	Basement scarp, S of Yuam Ridge	1922	3	44.82	151	46.41	-3.75	151.77	MD-32-1	Black, carbonaceous worm burrows, 35-100mm long, 7-15 mm diameter with central conduits 2-5 mm in diameter. 5 specimens in glass jar.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-35	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills	1660	3	43.67	151	40.26	-3.73	151.67	MD-35-1	1 specimen of gastropod, dark	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-35	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills	1660	3	43.67	151	40.26	-3.73	151.67	MD-35-2	1 specimen of gastropod with	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		I specimen *Eosipho desbruyeresi* C. 305254
MD-35	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills	1660	3	43.67	151	40.26	-3.73	151.67	MD-35-3	7 small specimens of fibrous,	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-36	PACMANUS II	1993	Dredge	NW base of cone nr E foot of Pual Ridge, E of Sonne	2091	3	43.09	151	42.89	-3.72	151.71	MD-36-1	1 specimen of black vesicular	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-36	PACMANUS II	1993	Dredge	NW base of cone nr E foot of Pual Ridge, E of Sonne	2091	3	43.09	151	42.89	-3.72	151.71	MD-36-2	1 specimen of gastropod, dark	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-40	PACMANUS II	1993	Dredge	Basement ridge near Djaul Flt, 10nm S of Pual Ridge	2056	3	52.07	151	36.31	-3.87	151.61	MD-40-1	1 star-fish specimen. Yellow	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-1	smashed up gastropod, black	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-2	mollusc-brown shell with	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		1 specimens Bathymodiolus
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-3	white galatheid crab, 10x5 mm	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-4	along length of worm ~2 mm	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		1 specimen of Ctenopelta sp? ID Winsont Ponder. C. 305242 Is an East Pacific Rise genus so maybe not.

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MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-5	1 specimen of brown coloured	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-6	90 mm long shell (soft)	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-7	oyster? shell attached to small	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-8	soft shelled and soft bodied	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-41	PACMANUS II	1993	Dredge	PACMANUS, Satanic Mills (near 297/1 juvenile vent?)	1715	3	43.71	151	40.34	-3.73	151.67	MD-41-9	5 specimens of minute single	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Ctenopelta porifera 3 specimens ID W. Ponder. C. 305241
MD-42	PACMANUS II	1993	Dredge	Far SW end of Pual Ridge	2112	3	45.99	151	35.27	-3.77	151.59	MD-42-1	~23 cm long worm? or tail of	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-42	PACMANUS II	1993	Dredge	Far SW end of Pual Ridge	2112	3	45.99	151	35.27	-3.77	151.59	MD-42-2	purplish-blue coloured, soft	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-43	PACMANUS II	1993	Dredge	Umbo Knolls, E flank of East Knoll	1600	3	43.23	151	55.45	-3.72	151.92	MD-43-1	1 specimen of red shrimp.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney	barnacles found station MD-43-21	10 large specimens Balanomorph or Neobrachylepas. Two specimens need to get Bill Newman to check.
MD-43	PACMANUS II	1993	Dredge	Umbo Knolls, E flank of East Knoll	1600	3	43.23	151	55.45	-3.72	151.92	MD-43-2	1 sided piece of mollusc shell	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-44	PACMANUS II	1993	Dredge	NW end, Tumai Ridge	1837	3	43.78	152	2.6	-3.73	152.04	MD-44-1	1 specimen of bivalve shells .	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-44	PACMANUS II	1993	Dredge	NW end, Tumai Ridge	1837	3	43.78	152	2.6	-3.73	152.04	MD-44-2	1 specimen of segmented semi-	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-44	PACMANUS II	1993	Dredge	NW end, Tumai Ridge	1837	3	43.78	152	2.6	-3.73	152.04	MD-44-3	10 cm long piece of black dead	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-45	PACMANUS II	1993	Dredge	Tumai Ridge, centre	1581	3	46.34	152	4.73	-3.77	152.08	MD-45-1	1 specimen of shrimp, dull	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-45	PACMANUS II	1993	Dredge	Tumai Ridge, centre	1581	3	46.34	152	4.73	-3.77	152.08	MD-45-2	1 specimen of yellowish	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-4	PACMANUS II	1993	Grab	PACMANUS, 400m WSW of Roman, towards Satanic	1680	3	43.31	151	40.38	-3.72	151.67	MG-4-1	40 mm long khaki-light brown	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-6	PACMANUS II	1993	Grab	PACMANUS, 200m SE of Tsukushi	1731	3	43.71	151	40.16	-3.73	151.67	MG-6-1	mollusc shell pieces, echinoid	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-10	PACMANUS II	1993	Grab	Enclosed basin near Twin Knolls	1948	3	42.03	151	40.5	-3.70	151.68	MG-10-1	1 specimen , of tube worm ,	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-10	PACMANUS II	1993	Grab	Enclosed basin near Twin Knolls	1948	3	42.03	151	40.5	-3.70	151.68	MG-10-2	one bag of calcareous ooze in	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-10	PACMANUS II	1993	Grab	Enclosed basin near Twin Knolls	1948	3	42.03	151	40.5	-3.70	151.68	MG-10-2	mud oozes in 2 large plastic	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-1	a branch of black coral ?, 60	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-2	70 mm long tube cast ? with 6	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found

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MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-3	a shell fragment. 11x8 mm	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-12	PACMANUS II	1993	Grab	S end of Pual fork	1872	3	41.19	151	41.83	-3.69	151.70	MG-12-4	2 ooze samples in 2 plastic bags for Australian Museum.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MG-13	PACMANUS II	1993	Grab	Head of West Valley, SW of Twin Knolls	2203	3	42.74	151	39.29	-3.71	151.65	MG-13-1	2 small plastic bags half-full of mud for Australian Museum, 1 with formalin and other without.	Roger Moss, Univ of Toronto	formalin solution (10%)	Australian Museum Sydney		Not found
MD-46	PACMANUS III	1/12/1996	Dredge	Caldera, East Sherburne	1819	3	44.90	148	52.8	-3.75	148.88	MD46/1	Mashed red prawn	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-46	PACMANUS III	1/12/1996	Dredge	Caldera, East Sherburne	1819	3	44.90	148	52.8	-3.75	148.88	MD46/2	Part of small prawn	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-47	PACMANUS III	1/12/1996	Dredge	Large seamount, East Sherburne	1116	3	41.72	148	55.92	-3.70	148.93	MD47/3	Ooze +rocks + Formalin	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Sediment
MD-47	PACMANUS III	1/12/1996	Dredge	Large seamount, East Sherburne	1116	3	41.72	148	55.92	-3.70	148.93	MD47/4	Ooze + rocks No Formalin	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Sediment
MD-47	PACMANUS III	1/12/1996	Dredge	Large seamount, East Sherburne	1116	3	41.72	148	55.92	-3.70	148.93	MD47/5	Coral and tubeworms	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		coral and unide calcareous tube.
MD-50	PACMANUS III	2/12/1996	Dredge	Scarp, far NW of East Manus Basin	2103	3	22.78	151	12.84	-3.38	151.21	MD50/6	Orange Starfish 10cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	starfish found	Asteroidea; Astropecten. Non-vent
MD-53	PACMANUS III	3/12/1996	Dredge	Sonne Pimple, Pual Ridge	1676	3	42.61	151	41.35	-3.71	151.69	MD53/8	Small starfish 2cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	starfish found	Ophiuroidea sp. (send to Tim O'hara)
MD-53	PACMANUS III	3/12/1996	Dredge	Sonne Pimple, Pual Ridge	1676	3	42.61	151	41.35	-3.71	151.69	MD53/9	1 small tubeworm 2cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-55	PACMANUS III	4/12/1996	Dredge	SuSu Knolls, SW slope South Su	1658	3	49.00	152	5.59	-3.82	152.09	MD55/10	Small crab,	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-55	PACMANUS III	4/12/1996	Dredge	SuSu Knolls, SW slope South Su	1658	3	49.00	152	5.59	-3.82	152.09	MD55/11	small worm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-57	PACMANUS III	6/12/1996	Dredge	PACMANUS (W side Snowcap)	1648	3	43.70	151	40.13	-3.73	151.67	MD/14	1 small rock, mussels attached + 1 small lobster 2cm + many snail shells + 1 Ophioroid	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		1 specimen Bathymodiolus (undescibed?); periostracum of Ifremaria.
MD-58	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1687	3	43.24	151	40.51	-3.72	151.68	MD58/33	2 Large snails, 2 crabs and 1 small prawn	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	crabs found, prawn found	Austinograea alaysae Det. S. Ahyong P. 69326
MD-58	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1687	3	43.24	151	40.51	-3.72	151.68	MD58/33	2 Large snails, 2 crabs and 1 small prawn	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	crabs found, prawn found	Alvinocaris longirostis? 1 specimen
MD-58	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1687	3	43.24	151	40.51	-3.72	151.68	MD58/33	2 Large snails, 2 crabs and 1 small prawn	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	crabs found, prawn found	2 specimens Alvinoconcha hessleri and 5 limpets, Lepetodrilus?
MD-61	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1689	3	43.25	151	40.51	-3.72	151.68	MD61/17	Small shells + 1 galatheid	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheid found, barnacles found	Balanomorph or Neobrachylepas. Two specimens need to get Bill Newman to check.
MD-61	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1689	3	43.25	151	40.51	-3.72	151.68	MD61/17	Small shells + 1 galatheid	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheid found, barnacles found	1 specimen of Munidopsis cf. lauensis
MD-61	PACMANUS III	6/12/1996	Dredge	PACMANUS (Roman Ruins)	1689	3	43.25	151	40.51	-3.72	151.68	MD61/17	Small shells + 1 galatheid	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheid found, barnacles found	Dried Ifremaria shell fragments

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MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/19	Galatheids + crabs	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheids found	20 or specimens of Munidopsis cf. lauensis
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/20	Snails + shells 1 Alvinicocha 1 Ifremeria	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheids found	2 specimens of Munidopsis cf. lauensis
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/20	Snails + shells 1 Alvinicocha 1 Ifremeria	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		2 specimens of Alvinoconcha hessleri
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/21	1 fish - Vent fish	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-62	PACMANUS III	7/12/1996	Dredge	PACMANUS (Satanic Mills)	1689	3	43.25	151	40.51	-3.72	151.68	MD62/22	Unidentified	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-65	PACMANUS	7/12/1996	Dredge	PACMANUS, Snowcap SE	1652	3	43.71	151	40.13			MD-65			? Now in ethaonl		galatheids found	Munidopsis cf. lauensis. ID G.R. 5 specimens
MD-65	PACMANUS	7/12/1996	Dredge	PACMANUS, Snowcap SE	1652	3	43.71	151	40.13			MD-65			? Now in ethaonl			Bathymodiolus and Ifremaria shell fragments.
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/23	Galatheids	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/24	Tubeworms without rocks	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/25	Tubeworms with rocks	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-66	PACMANUS III	7/12/1996	Dredge	Knoll on eastern flank of Pual Ridge, E of Roman	1734	3	43.21	151	41.41	-3.72	151.69	MD66/26	Snail shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-69	PACMANUS III	8/12/1996	Dredge	Basement scarp SE of Yuam Ridge	2087	3	46.10	151	45.65	-3.77	151.76	MD69/27	1 Small jelly fish	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	starfish found, not jelly fish	Strange apodid holothurian. Send to D. Pawson (Smithsonian?).
MD-69	PACMANUS III	8/12/1996	Dredge	Basement scarp SE of Yuam Ridge	2087	3	46.10	151	45.65	-3.77	151.76	MD69/27	1 Small jelly fish	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	starfish found, not jelly fish	Asteroidea; Non-vent?
MD-70	PACMANUS III	8/12/1996	Dredge	Cone in East Valley, S of PACMANUS	2033	3	45.23	151	40.24	-3.75	151.67	MD70/28	1 Octopus leg 10cm long	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-73	PACMANUS III	10/12/1996	Dredge	Nimab, SW foot	1356	3	49.29	152	10.85	-3.82	152.18	MD73/29	1 small tubeworm casing	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	worm tube found	1 specimens Ampharetidae polychaete; possibly undescribed, possibly *Amathys*
MD-74	PACMANUS III	10/12/1996	Dredge	Basement scarp near Weitin Fault/Bugave Ridge	1780	3	44.70	152	10.44	-3.75	152.17	MD74/30	1 small fish 10cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-76	PACMANUS III	11/12/1996	Dredge	SuSu Knolls, Suzette	1511	3	47.40	152	5.66	-3.79	152.09	MD76/34	2 snails, 1 galatheid, pieces of wood, tubeworms and snail shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		1 Alvinoconcha, 1 Ifremaria; 1 Eosipho
MD-77	PACMANUS III	11/12/1996	Dredge	South Su	1321	3	48.52	152	6.26	-3.81	152.10	MD77/35	1 tubeworm 6cm long, many small lobsters 2-3cm or galatheids	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	polychaete found, galatheids found	Polychaete is *Glycera* sp
MD-77	PACMANUS III	11/12/1996	Dredge	South Su	1321	3	48.52	152	6.26	-3.81	152.10	MD77/35	1 tubeworm 6cm long, many small lobsters 2-3cm or galatheids	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	polychaete found, galatheids found	Galatheids are Munidopsis cf. lauensis ID Shane Ahyong P. 64925; I shell in another vial from Mollusc section. Some sort of Rhyncopelta or Peltospira
MD-77	PACMANUS III	11/12/1996	Dredge	South Su	1321	3	48.52	152	6.26	-3.81	152.10	MD77/36	1 piece of wood 13cm long	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Signs of boring but no obvious animals.
MD-79	PACMANUS III	12/12/1996	Dredge	Lunar Cone	1867	3	39.71	152	2.56	-3.66	152.04	MD79/37	Brittle starfish, worm casings, plant material	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	sample found ophiuroids	Several snake stars (ophiuoridea wrapped around gorgonian).
MD-81	PACMANUS III	12/12/1996	Dredge	SuSu Knolls, Suzette	1505	3	47.29	152	5.6	-3.79	152.09	MD81/38	1 medium prawn, 1 small lobster ?, mussel shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to	Material found in Marine Invertebrate section of Australian Museum	Checked by Greg Rouse (Oct 2005).
MD-82	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, S flank of South Su	1339	3	48.64	152	5.3	-3.81	152.09	MD82/39	Many mussels and mussel shells,	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheid found	*Munidopsis* sp. ID G.R.
MD-82	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, S flank of South Su	1339	3	48.64	152	5.3	-3.81	152.09	MD82/39	Many mussels and mussel shells,	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Many *Bathymodilus*
MD-82	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, S flank of South Su	1339	3	48.64	152	5.3	-3.81	152.09	MD82/40	Snails, (1 hairy), small crab 4cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	crab found	1 specimen Austinograea alaysae det S. Ahyong. P69325
MD-82	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, S flank of South Su	1339	3	48.64	152	5.3	-3.81	152.09	MD82/40		Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Jar containing 4 specimens Bathymodiolus (undescribed??) and 1 Ifremaria. Several balanomorph barnacles on the Bathymodiolus
MD-83	PACMANUS III	13/12/1996	Dredge	SuSu Knolls, North Su crest	1174	3	47.97	152	6.05	-3.80	152.10	MD83/41	1 small trevally 3.5cm, 1 small worm 4cm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MD-84	PACMANUS III	13/12/1996	Dredge	Tavui Caldera (Rabaul)	918	4	6.49	152	10.7	-4.11	152.18	MD84/42	1 sea slug 4cm, 2 small red prawns 2cm, 2 cone shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	samples found holothurian, decapoda	Two unidentiable shrimp GR
MD-84	PACMANUS III	13/12/1996	Dredge	Tavui Caldera (Rabaul)	918	4	6.49	152	10.7	-4.11	152.18	MD84/42	1 sea slug 4cm, 2 small red prawns 2cm, 2 cone shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	samples found holothurian, decapoda	Holothurian bad condition; non-vent?
MD-84	PACMANUS III	13/12/1996	Dredge	Tavui Caldera (Rabaul)	918	4	6.49	152	10.7	-4.11	152.18	MD84/45		Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	samples found holothurian, decapoda	2 bivalves and 2 certh looking gastropods. Needs further ID.
MG-15	PACMANUS III	6/12/1996	Grab	PACMANUS, east side of Snowcap	1684	3	43.65	151	40.34	-3.73	151.67	MG/12	Mussel shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MG-16	PACMANUS III	6/12/1996	Grab	PACMANUS. Snowcap	1647	3	43.69	151	40.21	-3.73	151.67	MG/13	Mussel + Galatheids + worms	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		1 small Bathymodiolus
MG-17	PACMANUS III	6/12/1996	Grab	PACMANUS, Roman Ruins	1689	3	43.25	151	40.51	-3.72	151.68	MG17/15	Small tubeworm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MG-18	PACMANUS III	6/12/1996	Grab	PACMANUS. 200 m E of Snowcap, 150m S of Satanic	1642	3	43.65	151	40.17	-3.73	151.67	MG18/18	Small snail shells	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		Not found
MG-19	PACMANUS III	10/12/1996	Grab	South Su crest	1318	3	48.52	152	6.26	-3.81	152.10	MG19/31	1 Galatheid and a tubeworm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	galatheid found	I galatheid indeterminable; smashed.
MG-20	PACMANUS III	11/12/1996	Grab	Suzette	1516	3	47.40	152	5.66	-3.79	152.09	MG12/32	1 Tubeworm	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney	sample found	Two tubes containing *Phyllochaetopterus* sp. Chaetopteridae
MS-23	PACMANUS III	3/12/1996	Core	PACMANUS, Snowcap	1636	3	49.69	151	40.2	-3.83	151.67	MS23/7	Clam shell, soft body parts which blocked corer nozzle	Chris Taylor, CSIRO	formalin solution (10%)	Australian Museum Sydney		1 specimen Bathymodiolus (undescibed?)
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/1	3 tube worms 40cm, 2x15cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/2	1 large vial of gray mud + Formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Sediment
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/3	1 red shrimp 5cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	carid found	1 specimen *Alvinocaris* cf. *longirostris*
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/4	6 white shell fragments up to 2cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/5	2 worm casts	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-86	PACMANUS IV	17/10/1997	Dredge	NW of Suzette	1588.3	3	47.06	152	5.427	-3.78	152.09	MD86/6	3 pieces of crab (galatheid?)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found

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MD-87	PACMANUS IV	17/10/1997	Dredge	Small volcano S of Nimab	1507	3	53.10	152	0.7854	-3.89	152.01	MD87/10	Shell fragments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Old dead Eosipho? Another vial with possible scaphopod or Ditrupa (Serpulidae). Third vial with bivalve and crab carapace
MD-88	PACMANUS IV	18/10/1997	Dredge	Crest of Nimab	1038	3	49.22	152	11.223	-3.82	152.19	MD88/11	Assorted worms and basal attachments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-88	PACMANUS IV	18/10/1997	Dredge	Crest of Nimab	1038	3	49.22	152	11.223	-3.82	152.19	MD88/12	1 large vial mud + Formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment
MD-88	PACMANUS IV	18/10/1997	Dredge	Crest of Nimab	1038	3	49.22	152	11.223	-3.82	152.19	MD88/13	1 large jelly fish (25cm) and 1 seed pod	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-89	PACMANUS IV	18/10/1997	Dredge	?	1668	3	46.11	152	4.371			MD89	sediment sample from wood		ethanol solution (95%)	Australian Museum Sydney		No obvious animals
MD-90	PACMANUS IV	19/10/1997	Dredge	East Tumbo Knoll	1660	3	46.22	152	0.655	-3.77	152.01	MD90/16	1 large vial mud + Formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment
MD-90	PACMANUS IV	19/10/1997	Dredge	East Tumbo Knoll	1660	3	46.22	152	0.655	-3.77	152.01	MD90/17	1 small worm case	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-91	PACMANUS IV	19/10/1997	Dredge	SuSu Knolls, crest of South Su	1323	3	48.55	152	6.262	-3.81	152.10	MD91/22	1 small vial with mussel shell peelings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		1 specimen Bathymodiolus (undescibed?)
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/23	1 small bucket 1/2 full of galatheid crabs (1 to 2cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	large jar of galatheids found	Munidopsis cf. lauensis. ID G.R. 50 more specimens
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/24	1 large vial with 10 shrimp (one red), 1 tropical fish (3cm), 1 black fish (1cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	carids found	*Alvinocaris longirostis*? 10 specimens.
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/25	1 small vial of tube worms	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/26	1 large vial of mussels and their shell peelings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment in one jar; other has Bathymodiolus fragments and peristracum of other bivalves?
MD-92	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1340	3	48.47	152	6.203	-3.81	152.10	MD92/27	1 small vial of tube worms and basal attachments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-95	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1350	3	48.54	152	6.268	-3.81	152.10	MD95/28	2 Large snails, 2 crabs and 1 small prawn	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		white flocculent material
MD-95	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, crest of South Su	1350	3	48.54	152	6.268	-3.81	152.10	MD95/29	1 large vial with tube worm casings, snail shell fragments and mussel shell pieces	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment and a few shell fragments; other jar had two Ifremeria
MD-96	PACMANUS IV	21/10/1997	Dredge	SuSu Knolls, crest of North Su	1175	3	47.94	152	6.042	-3.80	152.10	MD96/30	1 med. vial with 5 shrimp, 6 galatheids, 1 fish (2cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	galatheids found, carids found	5 specimens of *Munidopsis* cf. *lauensis* In Ethanol
MD-96	PACMANUS IV	21/10/1997	Dredge	SuSu Knolls, crest of North Su	1175	3	47.94	152	6.042	-3.80	152.10	MD96/30	1 med. vial with 5 shrimp, 6 galatheids, 1 fish (2cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	galatheids found, carids found	5 specimens of *Chorocaris* cf. *vandoverae* sp. In Ethanol
MD-94	PACMANUS IV	20/10/1997	Dredge	SuSu Knolls, Suzette	1533.5	3	47.36	152	5.616	-3.79	152.09	MD94/31	Mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		1 anterior end of Nereididae and one bivalve and sediment.
MD-97	PACMANUS IV	21/10/1997	Dredge	SuSu Knolls, crest of North Su	1170.3	3	47.98	152	6.037	-3.80	152.10	MD97/32	1 shrimp (2cm) and piece of sea grass	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-100	PACMANUS IV	22/10/1997	Dredge	PACMANUS, S side of Roman Ruins	1697	3	43.28	151	40.533	-3.72	151.68	MD100/33	1 small vial with piece of sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found

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MD-101	PACMANUS IV	23/10/1997	Dredge	Western Marmin Knollis, ridge	1635	3	41.02	151	33.266	-3.68	151.55	MD101/34	1 small vial with mussel shell coating, tube worm casing and 2 centipedes	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Fragments of *Alvinoconcha* periostracum
MD-102	PACMANUS IV	23/10/1997	Dredge	PACMANUS, Roman Ruins	1693	3	43.27	151	49.469	-3.72	151.82	MD102/35	8 barnacles associated with dead chimney fragments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	barnacles found	Balanomorph or Neobrachylepas. 10 specimens need to get Bill Newman to check. P. 54442.
MD-104	PACMANUS IV	24/10/1997	Dredge	Ridge near NW end of Weitin Fault	1899	3	33.79	151	55.699	-3.56	151.93	MD104/36	tube worm casings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-105	PACMANUS IV	24/10/1997	Dredge	Ridge near NW end of Weitin Fault	1893	3	33.80	151	55.743	-3.56	151.93	MD105/37	1 tiny bivalve (0.5cm) and mussel shell coatings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		unid bivalve
MD-105	PACMANUS IV	24/10/1997	Dredge	Ridge near NW end of Weitin Fault	1893	3	33.80	151	55.743	-3.56	151.93	MD105/38	1 large vial of olive/brown mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment
MD-106	PACMANUS IV	24/10/1997	Dredge	Young lava field NW end of Tumai Ridge	1936	3	43.83	152	5.626	-3.73	152.09	MD106/39	1 tube worm casing	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-107	PACMANUS IV	24/10/1997	Dredge	Small volcano S of SuSu Knolls	1668	3	52.54	152	3.891	-3.88	152.06	MD107/40	1 bivalve	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		I bivalve white. Not *Calyptogena*
MD-110	PACMANUS IV	25/10/1997	Dredge	PACMANUS, 400m W of Tsukushi	1671	3	43.76	151	39.84	-3.73	151.66	MD110/41	1 red shrimp, 1 clear worm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	carid found	1 specimen *Alvinocaris* cf. *longirostris*
MD-106	PACMANUS IV	24/10/1997	Dredge	Small volcano S of SuSu Knolls	1936	3	43.83	152	5.626	-3.73	152.09	MD106/42	1 vial of mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment
MD-112	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Roman Ruins	1690.5	3	43.26	151	40.475	-3.72	151.67	MD112/43	1 large bucket with 12 large snails, 3 crabs, 1 sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	crabs found, barnacles on loan to Di Jones (WAM)	Crabs are Austinogrea alayseae. # det Shane Ahyong P. 69324; Large jar in Mollusc section of Ifremaria nautilei (10 specimens). Barnacles not seen on loan P54441.
MD-112	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Roman Ruins	1690.5	3	43.26	151	40.475	-3.72	151.67	MD112/43	1 large bucket with 12 large snails, 3 crabs, 1 sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Several Lepetodrilus?
MD-113	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Rogers Ruins	1657	3	43.15	151	40.453	-3.72	151.67	MD113/44	1 large snail (10 cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Two specimens Ifremaria nautilei. Maybe worth sequencing to check status of Olgaconcha tufari but check Kojima et al. 2000
MD-113	PACMANUS IV	26/10/1997	Dredge	PACMANUS, Rogers Ruins	1657	3	43.15	151	40.453	-3.72	151.67	MD113/45	2 large snails and 1 barnacle	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		white flocculent material
MD-116	PACMANUS IV	28/10/1997	Dredge	SuSu Knolls, Crest of North Su	1174.3	3	48.01	152	6.073	-3.80	152.10	MD116/47	2 shrimp and 3 pieces of sea cucumber	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	1 carid found	1 specimen *Alvinocaris* cf. *longirostris*
MD-117	PACMANUS IV	28/10/1997	Dredge	SuSu Knolls, Crest of North Su	1176	3	47.99	152	6.038	-3.80	152.10	MD117/48	9 shrimp, assorted sizes	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney	carids found	*Alvinocaris longirostis*? 10 specimens.
MD-118	PACMANUS IV	29/10/1997	Dredge	Seamount between New Ireland & Bougainville	611.5	5	31.48	153	54.088	-5.52	153.90	MD118/49	1 small vial with coral and sponge pieces (limestone talus)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-119	PACMANUS IV	29/10/1997	Dredge	Seamount between New Ireland & Bougainville	1080	5	31.03	153	54.134	-5.52	153.90	MD119/50	Coral pieces, 4 shell fragments, rugose coral	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		bivalve, non-vent
D-46	PACMANUS IV	31/10/1997	Dredge	NE Seamount, Misima Is cluster	2050	10	34.61	153	42.327	-10.58	153.71	D46/51	1 large vial pale brown mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment
D-46	PACMANUS IV	31/10/1997	Dredge	NE Seamount, Misima Is cluster	2050	10	34.61	153	42.327	-10.58	153.71	D46/52	18 cm long pink worm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MG-23	PACMANUS IV	17/10/1997	Grab	Base of SE face of Nimab Knoll	1806.3	3	48.58	152	12.785	-3.81	152.21	MG23/7	1 large vial of olive and brown mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment

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MG-23	PACMANUS IV	17/10/1997	Grab	Base of SE face of Nimab Knoll	1806.3	3	48.58	152	12.785	-3.81	152.21	MG23/8	4 tube worms from 2 to 5cm	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MG-23	PACMANUS IV	17/10/1997	Grab	Base of SE face of Nimab Knoll	1806.3	3	48.58	152	12.785	-3.81	152.21	MG23/9	Assorted small shells, coelenterate spines, sea urchin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		small amoount of unidentifiable spines in two jars
MG-24	PACMANUS IV	19/10/1997	Grab	Suzette	1516.8	3	47.36	152	5.645	-3.79	152.09	MG24/18	1 long worm (20cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MG-24	PACMANUS IV	19/10/1997	Grab	Suzette	1516.8	3	47.36	152	5.645	-3.79	152.09	MG24/19	Worm fragments and casings	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MG-24	PACMANUS IV	19/10/1997	Grab	Suzette	1516.8	3	47.36	152	5.645	-3.79	152.09	MG24/20	Mud + formalin	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		sediment
MG-26	PACMANUS IV	19/10/1997	Grab	Suzette	1528	3	47.37	152	5.861	-3.79	152.10	MG26/14	Worm casings and shell fragments	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MCV-42	PACMANUS IV	18/10/1997	Camera tow	Traverse across the crest of South Su	2448	3	48.48	152	6.212	-3.81	152.10	MCV42/15	1 shell fragment (1cm)	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MCV-43	PACMANUS IV	19/10/1997	Camera tow	Traverse across Suzette field START	1523	3	47.32	152	5.717	-3.79	152.10	MCV43/21	Barnacles from chimney piece that surfaced on camera cage	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Balanomorph or Neobrachylepas. 8 specimens need to get Bill Newman to check. Large specimens same as MD61 and MD 102?. P. 5443.
MH-59	PACMANUS IV	27/10/1997	CTD Hydrocast TowYo	SE Umbo Knolls	1944.5	3	45.72	151	54.737	-3.76	151.91	MH59/ 46	1 small fish (2cm) caught in tiny foam cup	Ann Marie Huff, Univ of Toronto	ethanol solution (95%)	Australian Museum Sydney		Not found
MD-120	Binatang 2000	19/04/2000	Dredge	SuSu Knolls, Crest of North Su	1161	3	47.96	152	6.047	-3.80	152.10	MD 120/01	5 small prawns, 1 galatheid, 2 worm, 1 scale-worm	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		*Chorocaris* x 5; *Munidopsis;* 1 scaleworm unidentified
MD-121	Binatang 2000	19/04/2000	Dredge	SuSu Knolls, Suzette	1514	3	43.37	152	5.617	-3.72	152.09	MD 121/02	1 barnacle, 1 prawn;	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		1 balanomorph barnacle; *Eochionelasmus?* (ask Bill Newman)
MD-121	Binatang 2000	19/04/2000	Dredge	Suzette	1514	3	43.37	152	5.617	-3.72	152.09	MD 121/03	10 giant snail frozen, Ifremaria (7) and Alviniconcha (3)	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		1 *Lepetpdrilus;* rest not found
MD-121	Binatang 2000	19/04/2000	Dredge	Suzette	1514	3	43.37	152	5.617	-3.72	152.09	MD 121/04	2 giant snail, Ifremaria	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		Not found
MD-122	Binatang 2000	19/04/2000	Dredge	South Su	1405	3	48.78	152	6.404	-3.81	152.11	MD 122/05	2 tubeworm, 1 worm, 1 bivalve	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Alaysia tube; 3 Nereididae, I white bivalve not identified
MG-44	Binatang 2000	20/04/200	Dredge	West Su Basin	2079	3	47.50	152	1.496	-3.79	152.02	MG 44/06	3 tubeworm casings	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		unidentifable fragments; black
MD-123	Binatang 2000	20/04/2000	Dredge	Suzette	1513	3	47.33	152	5.598	-3.79	152.09	MD 123/07	3 tubeworm burrowed in a piece of rock	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Stalked barnacles. 2 stalks of adults without body and one complete samll specimen (send to Bill Newman)
MD-123	Binatang 2000	20/04/2000	Dredge	Suzette	1513	3	47.33	152	5.598	-3.79	152.09	MD 123/08	1 empty giant snail shell Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-123	Binatang 2000	20/04/2000	Dredge	Suzette	1513	3	47.33	152	5.598	-3.79	152.09	MD 123/09	1 giant snail Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/10	1 bivalve, 5 mussel	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/11	1 jar of mussels attached to rock pieces	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to	Material found in Marine Invertebrate section of Australian Museum	Checked by Greg Rouse (Oct 2005).
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/12	2 living tubeworm and 3 tubeworm casings	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/13	1 bucket full of mussels of varies sizes	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		6 *Munidopsis;* 2 x *Bathypecten;* 3 *Phymorhynchus;* 30 *Bathymodiolus;* 4 *Alaysis;* 1 *Lamellibrachia*
MD-124	Binatang 2000	21/04/2000	Dredge	Snowcap	1664	3	43.68	151	40.168	-3.73	151.67	MD 124/14	8 galatheid, 1 starfish, 2 Whelk?	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MG-49	Binatang 2000	21/04/2000	Grab	Snowcap	1645	3	43.68	151	40.179	-3.73	151.67	MG 44/15	4 tubeworm	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		1 tube chaetopterid polychaete
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/16	1 bucket full of tubeworm of varies sizes and species	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		20 *Alaysia;* 10 *Arcovestia*
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/17	1 mussel, 3 galatheid	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		1 bivalve unid; 3 *Munidopsis;* 13 *Bathymodilus*
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/18	2 tubeworms burrowed into a piece of rock	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		unidentifiable tubes
MD-125	Binatang 2000	21/04/2000	Dredge	Snowcap	1642	3	43.72	151	40.222	-3.73	151.67	MD 125/19	a gigantic tubeworm 20 mm in diameter	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		empty Lamellibrachia tube
MG-50	Binatang 2000	21/04/2000	Grab	Snowcap	1643	3	43.69	151	40.157	-3.73	151.67	MG 50/20	2 tubeworms	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MG-52	Binatang 2000	22/04/2000	Grab	Tsukushi	1666	3	43.77	151	40.032	-3.73	151.67	MG 50/21	1 fossilized gigantic snail covered with Fe oxy-hydroxide	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-126	Binatang 2000	22/04/2000	Dredge	Roman Ruins	1694	3	43.26	151	40.519	-3.72	151.68	MD 126/22	1 gigantic snail, Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		*Ifremeria;* broken dried
MD-127	Binatang 2000	22/04/2000	Dredge	Roman Ruins	1528	3	43.23	151	40.487	-3.72	151.67	MD 127/23	1 small bright red prawn and 4 galatheids	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		4 *Munidopsis* and one unidentified shrimp
MD-131	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1698	3	43.26	151	40.508	-3.72	151.68	MD 131/24	2 pieces of gigantic snail outer shell epidermis and a piece of grab claw	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		*Ifremeria* pieces and *Austinograea* claw.
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.476	-3.72	151.67	MD 133/25	1 gigantic snail, Alviniconcha	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		*1 Alviniconcha*
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/26 (1 of 2)	frozen gigantic snail empty shells, Ifremaria	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		3 x *Ifremaria;* with tissue
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/26 (2 of 2)	Ifremaria	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		One *Ifremaria* plus 1 *Munidopsis*
MD-133	Binatang 2000	25/04/2000	Dredge	Roman Ruins	1691	3	43.25	151	40.478	-3.72	151.67	MD 133/27	1 galatheid	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-134	Binatang 2000	26/04/2000	Dredge	Roman Ruins	1691	3	43.23	151	40.487	-3.72	151.67	MD 134/28	pieces of tubeworm castings, 2 crushed barnacles, 1 galatheid	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		*Alaysia* tube fragments; 1 *Munidopsis* ; Large barnacle *Eochionelasmus?*
MD-135	Binatang 2000	26/04/2000	Dredge	Roger Ruins	1691	3	43.23	151	40.487	-3.72	151.67	MD 135/29	1 bright red small prawn, 2 galatheids, crushed barnacle pieces with scales (goose-bumps), small crab	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		2 *Munidopsis;* 1 *Austinograea;* barnacle fragments
MD-135	Binatang 2000	26/04/2000	Dredge	Roger Ruins	1691	3	43.23	151	40.487	-3.72	151.67	MD 135/30	3 Alviniconcha	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found

Operation	Cruise	Date	Type	Area	Depth (m)	Lat Deg (S)	Lat Min	Long Deg (E)	Long Min	Dec. Latitude	Dec. Longitude	Sample Number	Fauna Recovery	On Board Description	Preservation	Sent to	Material found in Marine Invertebrate section of Australian Museum	Checked by Greg Rouse (Oct 2005).
MD-137	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1691	3	43.23	151	40.487	-3.72	151.67	MD 137/31	1 spaghetti tubeworm.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		1 *Alaysia* and 1 *Arcovestia*
MD-138	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1678	3	43.61	151	40.337	-3.73	151.67	MD 138/32	1 small, bright red prawn, 1 galatheid (~70 mm in length), barnacles, empty Ifremaria shell.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		1 small shrimp; 1 *Munidopsis*; 2 *Eochionelasmus?* 2 *Ifremaria*
MD-138	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1678	3	43.61	151	40.337	-3.73	151.67	MD 138/33	1 scale worm.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		*Thermopolynoe branchiata*
MD-139	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1670	3	43.61	151	40.324	-3.73	151.67	MD 139/34	1 Ifremaria (90 mm in length), 1 crab, 2 galatheids, barnacles.	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		1 dry *Alvinoconcha*; 1 *Austinograea*; 5 *Munidopsis*; 1 scaleworm; *Eochionelasmus?*
MD-139	Binatang 2000	29/04/2000	Dredge	Satanic Mills	1670	3	43.61	151	40.324	-3.73	151.67	MD 139/35	tubeworm (like millipede) and 4 egg sacs (3 empty egg sacs).	Jessie Wama, PNG Geol Survey	ethanol solution	CSIRO Marine Research, Hobart		Not found
MD-140	Binatang 2000	29/04/2000	Dredge	Roger Ruin	1703	3	43.15	151	40.464	-3.72	151.67	MD 140/36	a piece of gigantic snail outer skin.	Jessie Wama, PNG Geol Survey	frozen	CSIRO Marine Research, Hobart		Ifremeria; broken dried
MP-07	Binatang 2000	28/04/2000	Geophysical Tow	Pual Ridge	1676	3	43.43	151	39.351	-3.72	151.66	MP 07/37	1 bright red prawn	Jessie Wama, PNG Geol Survey		CSIRO Marine Research, Hobart		Not found
BD-22	Bismarck 2002	22/03/2002	Dredge	Satanic Mills	1678	3	43.61	151	40.343	-3.73	151.67		brittle star, a spaghetti worm, and fragments of mussel shell and hairy mussel body attached to dacite	Ray Binns, CSIRO	frozen	CSIRO Expl & Mining, Sydney		Not found
MD-14				slope of NW spur of Pual idge, Eastern Manus Basin	1929-1748	3	39.08	151	43.78						dry			scaphopod?

Appendix 2

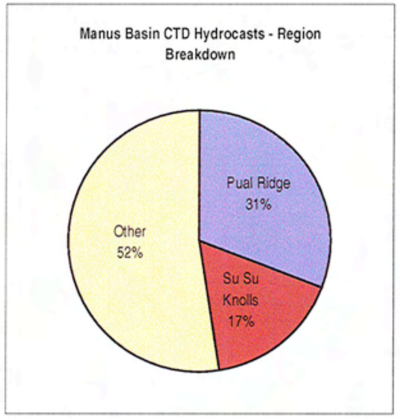
CTD Hydrocasts

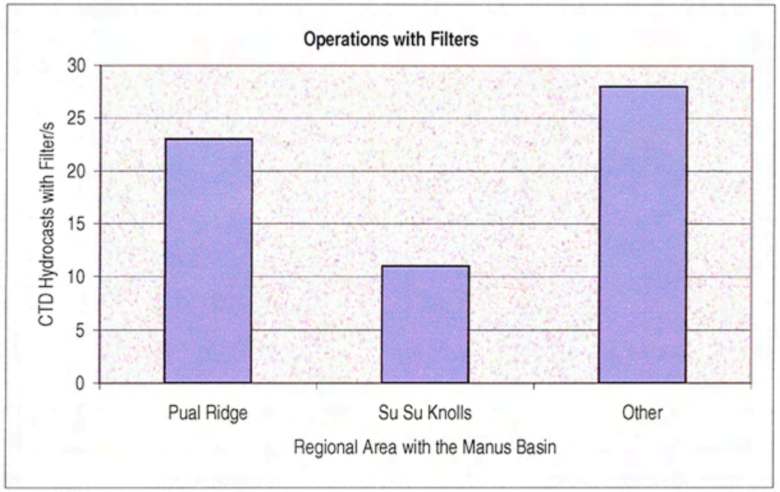
Operation	Cruise	Date	Type	Area	Area Region	Time In	Time Out	Start depth (m)	End depth (m)	Time In Lat Deg (S)	Time In Lat Min	Time In Long Deg (E)	Time In Long Min	Time Out Lat Deg	Time Out Lat Min	Time Out Long Deg	Time Out Long Min	Time In Dec. Latitude	Time In Dec. Longitude	Time Out Dec. Latitude	Time Out Dec. Longitude	Light Transmission Anomalies	Anomaly Depth (m)	Water Analyses	Filter Samples	Comments	Other Notes
K2242	21st Cruise 1990 (Akad. Keldysh)	1990	Dip	Marmin Knolls, Enclosed basin	Pual Ridge					3	41.6	151	36.1					-3.69	151.60			moderate*	1550-1700*	Mn CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	* nephelometer, broader signals
K2243	21st Cruise 1990 (Akad. Keldysh)	1990	Dip	North east crestal knoll, near PACMANUS	Pual Ridge					3	42.8	151	41.1					-3.71	151.69			moderate*	1550-1700*	Mn CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
K2245	21st Cruise 1990 (Akad. Keldysh)	1990	Dip	Djual Fault scarp						3	47	151	29.2					-3.78	151.49			weak*	1500	Mn CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
K2247	21st Cruise 1990 (Akad. Keldysh)	1990	Dip	Graben 1, west of Kumul Trough						3	39	151	27.8					-3.65	151.46			strong*	1600-1750*	Mn CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ27	Aquarius 1990 (Hakuho Maru)	1990	Dp	Kumul Trough				2494		3	39.55	151	30.06					-3.66	151.50			none* (CH4, Mn)		Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	* No transmissometer Anomalies read off an EW profile - we don't have actual data
AQ28	Aquarius 1990 (Hakuho Maru)	1990	Dp	Central Basin (SW of DESMOS, E of Yuam)	Pual Ridge			2143		3	43.61	151	50.07					-3.73	151.83			weak (CH4, Mn)	?	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ29	Aquarius 1990 (Hakuho Maru)	1990	Dp	Bugave Ridge	Su Su			1968		3	43.03	152	9.92					-3.72	152.17			weak (CH4, Mn)	1050, 1650	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ33	Aquarius 1990 (Hakuho Maru)	1990	Dp	Turnbo Knolls	Su Su			1926		3	46.35	151	59.69					-3.77	151.99			weak (CH4, Mn)	750, 1550	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ36	Aquarius 1990 (Hakuho Maru)	1990	Dp	DESMOS	Pual Ridge			2078		3	41.99	151	52.18					-3.70	151.87			v strong (CH4, Mn)	1700	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ37	Aquarius 1990 (Hakuho Maru)	1990	Dp	Pual Ridge, head of fork	Pual Ridge			1739		3	42.11	151	41.62					-3.70	151.69			v strong (CH4, Mn)	1600	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ40	Aquarius 1990 (Hakuho Maru)	1990	Dp	South of DESMOS	Pual Ridge			1962		3	42.77	151	52.48					-3.71	151.87			weak (CH4, Mn)	?	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ41	Aquarius 1990 (Hakuho Maru)	1990	Dp	Crescent rise N of DESMOS	Pual Ridge			1915		3	40.86	151	51.96					-3.68	151.87			weak (CH4, Mn)	?	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ45	Aquarius 1990 (Hakuho Maru)	1990	Dp	Umbo Kolls	Pual Ridge			1685		3	43.6	151	54.21					-3.73	151.90			strong (CH4, Mn)	1650	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ46	Aquarius 1990 (Hakuho Maru)	1990	Dp	Yuam Ridge, NE tip	Pual Ridge			1983		3	41.03	151	48.46					-3.68	151.81			strong (CH4, Mn)	1800	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
AQ49	Aquarius 1990 (Hakuho Maru)	1990	Dp	DESMOS	Pual Ridge			1964		3	41.48	151	52					-3.69	151.87			v strong (CH4, Mn)	1964	Mn, Al, CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
MH062	Binatang 2000	4-Feb-00		North George Basin						4	31.1	152	29.7					-4.52	152.50								
MH063	Binatang 2000	18-Apr-00	Single Dip	South George Basin		1:04	3:23	3563	3563	5	15.084	152	24.942	5	15.002	152	25	-5.25	152.42	-5.25	152.42	weak (0.1-0.3%)	2600, 2480 and 1575		4	Anomaly 750-850m not recorded on the up cast, due to absorption of instrument? 10 raw, 1 blank, 4 filters	
MH064	Binatang 2000	18-Apr-00	Single Dip	North Su	Su Su	18:54	20:17	1543	1412	3	48.08	152	6.49	3	48.14	152	6.33	-3.80	152.11	-3.80	152.11	strong (9.4%)	1200-1195, to 2000	1196m had distinct H2S smell	1	Plume between 1996 (1100m and 1350m) and below the plume mapped in 1997. 3 unfiltered, 1 filtered, 1 filter samples	
MH065	Binatang 2000	19-Apr-00	Single Dip	North Su	Su Su	2:50	3:08	?		3	48	152	6.5	?				-3.80	152.11							Aborted. No samples	
MH066	Binatang 2000	20-Apr-00	Single Dip	North Su	Su Su	22:05	22:36	1365	1289	3	48.08	152	6.15	3	48.1	152	6.2	-3.80	152.10	-3.80	152.10	strong	1200-1270, 1300			Problem with main CTD, cast terminated. No samples.	
MH067	Binatang 2000	21-Apr-00	Single Dip	SnowCap	Pual Ridge	7:35	8:27	1657	1668	3	42.998	151	41.003	3	43.007	151	41.007	-3.72	151.68	-3.72	151.68	weak (0.3%)	1661 very close to bottom.		1	14 mab bottles fired. 1 raw, 1 filtered, 1 filter	
MH068	Binatang 2000	21-Apr-00	Single Dip	SnowCap	Pual Ridge	9:38	10:24	1678	1678	3	43.644	151	40.31	3	43.657	151	40.297	-3.73	151.67	-3.73	151.67	weak (0.3%)	1575-1679	ICP AES multi element (5 filtered and unfiltered)	5	Oxygen depletion in plume. Peak Tx at 1600m, and second lower one at 1679m. Except for sample at 1531m, 6 bottles fired in plume.	
MH069	Binatang 2000	21-Apr-00	Single Dip	Pacmanus	Pual Ridge	21:10	21:40	1685	1684	3	42.744	151	40.743	3	42.759	151	40.757	-3.71	151.68	-3.71	151.68	weak (0.3%)				One bottle fired at 10 mab. One unfiltered sample. No filtered or filter	
MH070	Binatang 2000	21-Apr-00	Single Dip	Pacmanus	Pual Ridge	22:39	0:30	1690	1660	3	43.237	151	41.256	3	43.262	151	41.218	-3.72	151.69	-3.72	151.69						
MH071	Binatang 2000	22-Apr-00	Tow-yo	NE Pual Ridge	Pual Ridge	0:35	5:15	1860	1751	3	41.537	151	43.016	3	42.823	151	46.482	-3.69	151.72	-3.71	151.77	eak to moderate	1600, 1700			Plume at around 1600m, strongest in valley between Pual and Yuan Ridges. lower plume at about 1700m over Pual Ridge. No samples.	
MH072	Binatang 2000	22-Apr-00	Single Dip	South East Pacmanus	Pual Ridge	21:52	23:00	1786	1727	3	43.449	151	41.513	3	43.403	151	41.419	-3.72	151.69	-3.72	151.69	weak (0.3%)	1638.00		1	3 raw, 1 filtered, 1 blank, 1 filter (2 litre) samples.	
MH073	Binatang 2000	23-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	3:46	6:21	1937	2063	3	42.742	151	47	3	39.996	151	40.987	-3.71	151.78	-3.67	151.68	weak			4	Plume has complex pattern from SE to NW. Best developed over Pual ridge. 7 raw, 7 filtered, 4 filters (2 litre).	
MH074	Binatang 2000	23-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	6:21	12:43	2063	1909	3	39.996	151	40.987	3	44.33	151	40.466	-3.67	151.68	-3.74	151.67	weak			3	6 raw, 6 filtered, 3 filters (2 litre).	
MH075	Binatang 2000	23-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	23:52	5:32	2006	2344	3	43.509	151	44.444	3	39.308	151	39.151	-3.73	151.74	-3.66	151.65	weak			5	9 raw, 9 filtered, 5 filters (2 litre).	
MH076	Binatang 2000	24-Apr-00	Single Dip	Satanic Mills	Pual Ridge	15:56	17:13	1687		3	43.441	151	40.469			1687		-3.72	151.67			moderate to strong (2.1%)	1588-1659	ICP AES multi element (3 filtered and unfiltered)	1	Good colouration on filter at 1632m within the plume. Biologists collected (filtered) water from nearly all bottles triggered in plume. 3 raw, 3 filtered, 1	
MH077	Binatang 2000	25-Apr-00	Tow-yo	NE Pual Ridge	Pual Ridge	0:11	6:21	1884	1970	3	39.953	151	39.01	3	44.668	151	44.061	-3.67	151.65	-3.74	151.73	weak to moderate			4	Samples in plume pale brown with visible tiny particles. 10 raw, 10 filtered, 4	
MH078	Binatang 2000	25-Apr-00	Single Dip	Roman Ruins	Pual Ridge	11:34	12:44	1690	1682	3	43.141	151	40.51	3	43.012	151	40.658	-3.72	151.68	-3.72	151.68	weak (0.3%)	1660-1670		2	3 raw, 3 filtered, 2 filters (2 litre).	
MH079	Binatang 2000	25-Apr-00	Single Dip	Sonne Pimple	Pual Ridge	16:11	17:23	1714	1708	3	42.399	151	41.595	3	42.199	151	41.562	-3.71	151.69	-3.70	151.69	weak to moderate (1%)	1630-1735		2	2 raw, 2 filtered, 2 filters (2 and 1.5 litre).	
MH080	Binatang 2000	25-Apr-00	Single Dip	Sonne Pimple	Pual Ridge	18:29	19:23	1676	1676	3	42.696	151	41.293	3	42.596	151	41.32	-3.71	151.69	-3.71	151.69	weak (0.5%)	1620-1682		2	2 raw, 2 filtered, 2 filters (2 and 1.5 litre).	
MH081	Binatang 2000	26-Apr-00	Tow-yo	NE Pual Ridge	Pual Ridge	5:19	9:53	1687	2086	3	38.523	151	44.016	3	42.726	151	49.003	-3.64	151.73	-3.71	151.82	weak to moderate (up to 2.3%)	1609-1860		4	10 raw, 10 filtered, 4 filters (2 litre).	
MH082	Binatang 2000	26-Apr-00	Single Dip	North Su		15:23	16:45	1237	1240	3	48.954	151	6.442	3	48.101	151	6.213	-3.82	151.11	-3.80	151.10	strong (20%)	1141-1184	0.16ppm H2S in sample from plume 1154m; ICP AES multi element (2 filtered and unfiltered samples)	3	5 raw, 5 filtered, 3 filters (2, 2.3 and 2.25 litre).	
MH083	Binatang 2000	27-Apr-00	Single Dip	West Su Basin	Su Su	0:24	6:29	1860	2016	3	47.864	152	4.443	3	49.565	151	58.823	-3.80	152.07	-3.83	151.98	weak (up to 1%)	1660-1760		4	Surprising amount of particulate matter given strength of plume. 4 raw, 4 filtered, 4 filters (2 litre).	
MH084	Binatang 2000	28-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	3:40	5:05	1802	1807	3	40.683	151	45.338	3	40.698	151	45.338	-3.68	151.76	-3.68	151.76	weak to moderate (up to 1.7%)	1630-1740	ICP AES multi element (5 filtered and unfiltered samples)	5	All filters in plume good colouration. 5 raw, 5 filtered, 5 filters (2 litre).	
MH085	Binatang 2000	28-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	5:34	6:54	1864	1859	3	40.901	151	44.609	3	40.938	151	44.594	-3.68	151.74	-3.68	151.74	moderate (up to 2%)	1643-1750	oxygen-depletion in plume; ICP AES multi-element (5 filtered and unfiltered samples)	5	All filters in plume good colouration, at about the same intensity as MH 84. 5 raw, 5 filtered, 5 filters (2 litre).	
MH086	Binatang 2000	28-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	10:32	11:31	1920	1952	3	39.547	151	46.186	3	39.506	151	46.246	-3.66	151.77	-3.66	151.77	moderate (up to 2%)	peaks at 1650,1698, 210 m thick	oxygen-depletion in plume; ICP AES multi element (4 filtered and unfiltered samples)	4	10 raw, 4 filtered, 4 filters (2 litre).	
MH087	Binatang 2000	29-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	8:04	9:23	1907	1896	3	40.003	151	44.676	3	40.049	151	44.669	-3.67	151.74	-3.67	151.74	moderate (up to 2%)	1710-<1897	oxygen-depletion in plume; ICP AES multi-element (2 filtered & unfiltered samples)	3	3 raw, 3 filtered, 3 filters (2 litre).	
MH088	Binatang 2000	29-Apr-00	Single Dip	Tsukushi	Pual Ridge	11:14	12:21			3	43.874	151	39.938	4	43.864	151	39.89	-3.73	151.67	-3.73	151.66	weak (0.5%)	1610-1670	oxygen-depletion in plume	3	Bottom hugging plume. 3 raw, 3 filtered, 3 filters (2 litre).	
MH089	Binatang 2000	30-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	1:40	3:00	1982	1976	3	39.487	151	43.992	3	39.522	151	44.008	-3.66	151.73	-3.66	151.73	moderate (up to 1.5%)	1620-1740		5	7 raw, 7 filtered, 5 filters (2 litre).	
MH090	Binatang 2000	30-Apr-00	Single Dip	NE Pual Ridge	Pual Ridge	5:53	6:40	1942	1939	3	39.992	151	43.512	3	39.998	151	43.505	-3.67	151.73	-3.67	151.73	moderate (1.4% at 1730)	1500-1600		1	1 raw, 1 filtered, 1 filter (2 litre), plume only.	
MH091	Binatang 2000	30-Apr-00	Single Dip	Pacmanus	Pual Ridge	16:32	17::34	1654	1652	3	44.202	151	39.507	3	44.218	151	39.589	-3.74	151.66	-3.74	151.66	weak (0.6%)			3	3 raw, 3 filtered, 3 filters (2 litre).	
MH092	Binatang 2000	30-Apr-00	Tow-yo	Marmin Knolls	Pual Ridge	21:20	23:52	2053	1700	3	40.74	151	39.007	3	42.254	151	41.341	-3.68	151.65	-3.70	151.69	weak to moderate (up to 1.1%)	1700.00		2	5 raw, 5 filtered, 2 filters (2 litre).	
MH093	Binatang 2000	1-May-00	Single Dip	Su Su Plume	Su Su	11:12	12:54	1212	1484	3	48.184	152	6.177	3	48.271	152	6.413	-3.80	152.10	-3.80	152.11	weak (0.7-0.9%)	1120-1150		4	6 raw, 6 filtered, 4 filter (2l)	Strong plume at 1200 m not present
MH094	Binatang 2000	1-May-00	Single Dip	North Su	Su Su	14:41	15:36	1557	1549	3	47.46	152	5.903	3	47.623	152	5.827	-3.79	152.10	-3.79	152.10	v weak	peaks at 1141, 1452	mild H_2S smell 0.02ppm H_2S	2	Filters have an fairly even yellow brown film with a few specks, 6 raw, 6 filtered, 2 filters (2l)	
MH095	Binatang 2000	1-May-00	Single Dip	North Su	Su Su	17:17	17:44	1648	1655	3	47.6	152	6.486	3	47.601	152	6.491	-3.79	152.11	-3.79	152.11	moderate (3%)	1170-1230			no samples	
MH096	Binatang 2000	1-May-00	Single Dip	North Su	Su Su	18:42	19:30	1544	1531	3	47.942	152	6.525	3	47.938	152	6.514	-3.80	152.11	-3.80	152.11	strong (12%) and thin	1170-1180	strong smell of H_2S, 0.2ppm H2S at 1168m; ICP AES multi element (3 filtered and unfiltered samples)	2	3 raw, 3 filtered , 2 filters (2l, 1l)	strong directional current pushing the plume in an easterly direction
MH097	Binatang 2000	2-May-00	Tow-yo	West Su Basin	Su Su	0:30	4:00	2048	2057	3	48.004	152	0.936	3	48.037	152	56.973	-3.80	152.02	-3.80	151.95	weak (0.1 to 0.3%)	1610-1700		1	3 raw, 3 filtered, 1 filter (2l)	
MH098	Binatang 2000	2-May-00	Tow-yo	NE Pual Ridge	Pual Ridge	23:49	3:42	2077	1659	3	39.409	151	41.652	3	42.554	151	46.045	-3.66	151.69	-3.71	151.77	moderate to strong (3.6%)	1700-1750		3	8 raw, 8 filtered, 3 filters (2l)	
MH099	Binatang 2000	3-May-00	Single Dip	Marmin Knolls	Pual Ridge	8:00	8:58	2266	2266	3	41.091	151	36.293	3	41.091	151	36.304	-3.68	151.60	-3.68	151.61	weak to moderate (1.3%)	1660			unexpectedly strong anomaly at the top of a "plume fog" was recorded at 1660m. No brine pool is present. 3 raw, 3 filtered, filters (2l)	
MH100	Binatang 2000	3-May-00	Single Dip	West EMB		20:02	20:12	2527		3	27.941	151	16.503					-3.47	151.28							operation was aborted at 250m	
MV-05				Snowcap				1643		3	43.658	151	40.224													fluid was slightly turbid and smelled of H2S (analysed at 0.06mMol/cubic meter). The filters were strongly coloured with brown particulates. Temp	
	Binatang 2000																	151.67	3.73								
MV-06				North Su				1190		3	47.913	152	6.071													Niskin bottle fired on third pogo, following an apparent 0.2°C anomaly, having just climbed a 40m high scarp. Temperature anomaly dropped just	
	Binatang 2000																	152.10	3.80							No sample collected due to equipment malfunction	
MV-07	Binatang 2000			North Su						3	48.026	152	6.107					152.10	3.80							No mention of this VUNL in daily narrative, but exists in table of VUNL	
MV-08	Binatang 2000			Snowcap				1647		3	43.692	151	40.167					151.67	3.73							reference water samples collected	
BH001	Bismarck 2002	4-Mar-02	Single Dip	Vitiaz Knoll		18:52	20:27	1297	1296	5	47.83	147	35.89	5	47.49	147	35.38	-5.80	147.60	-5.79	147.59	none					
BH002	Bismarck 2002	4-Mar-02	Single Dip	Vitiaz Knoll		23:54	0:37	1133	1140	5	50.02	147	40.02	5	50.07	147	39.92	-5.83	147.67	-5.83	147.67	none					
BH003	Bismarck 2002	5-Mar-02	Single Dip	SE Long Island		5:41	6:45	1488	1492	5	30.99	147	29.06	5	30.98	147	29	-5.52	147.48	-5.52	147.48	none				reference water samples collected	
BH004	Bismarck 2002	5-Mar-02	Single Dip	Long Island		9:56	10:45	1379	1374	5	24.53	147	16.99	5	24.47	147	17.05	-5.41	147.28	-5.41	147.28	none					
BH005	Bismarck 2002	5-Mar-02	Single Dip	Long Island		12:18	13:11	1189	1193	5	30	147	6.87	5	30.9	147	6.75	-5.50	147.11	-5.52	147.11	none					
BH006	Bismarck 2002	5-Mar-02	Single Dip	South Long Knoll		16:40	17:34	1391	nd	5	32.72	147	3.58	5	33	147	2.91	-5.55	147.06	-5.55	147.05	none					
BH007	Bismarck 2002	5-Mar-02	Single Dip	South Long Knoll		19:53	20:55	1361	nd	5	33.97	147	5.72	5	34.03	147	5.6	-5.57	147.10	-5.57	147.09	none					
BH008	Bismarck 2002	6-Mar-02	Single Dip	Long Island		0:08	1:01	1247	1261	5	16.7	146	53.16	5	17.44	146	53	-5.28	146.89	-5.29	146.88	none					
BH009	Bismarck 2002	6-Mar-02	Single Dip	Long Island		3:31	4:20	1169	1160	5	4.46	147	4.35	5	4.67	147	4.38	-5.07	147.07	-5.08	147.07	none					
BH010	Bismarck 2002	6-Mar-02	Single Dip	North Long Knoll		6:00	6:55	1233	1233	5	5.24	147	7.7	5	5.25	147	7.72	-5.09	147.13	-5.09	147.13	none					
BH011	Bismarck 2002	6-Mar-02	Single Dip	North Long Knoll		9:52	10:33	913	898	5	5	147	5.06	5	5	147	5.68	-5.08	147.08	-5.08	147.09	none					
BH012	Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef		14:11	15:15	1377	1368	4	56.02	146	39.98	4	56.36	146	40.05	-4.93	146.67	-4.94	146.67	none					
BH013	Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef		17:45	18:26	561	558	4	54.88	146	42.08	4	54.19	146	42.06	-4.91	146.70	-4.90	146.70	moderate (1.5%)	5-10mab		5	nephel layer, probably not hydrothermal plume.	
BH014	Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef		20:38	21:31	1073	1190	4	56.15	146	42.96	4	56.39	146	42.85	-4.94	146.72	-4.94	146.71	none					
BH015	Bismarck 2002	6-Mar-02	Single Dip	Hankow Reef		23:44	0:23	1047	1120	4	55.56	146	41.17	4	54.6	146	41.1	-4.93	146.69	-4.91	146.69	none					
BH016	Bismarck 2002	7-Mar-02	Single Dip	Greg Bank		7:09	8:33	1795	1834	4	35.96	146	19.29	4	35.53	146	19.95	-4.60	146.32	-4.59	146.33	none					
BH017	Bismarck 2002	7-Mar-02	Single Dip	Greg Bank		11:40	15:08	1816	1814	4	36.45	146	14.97	4	36.62	146	14.99	-4.61	146.25	-4.61	146.25	none					
BH018	Bismarck 2002	7-Mar-02	Single Dip	Greg Bank		18:54	20:09	1786	1756	4	33.02	146	12.55	4	32.96	146	12.65	-4.55	146.21	-4.55	146.21	weak (0.3%)	1125.00		5	no samples	
BH019	Bismarck 2002	7-Mar-02	Single Dip	Greg Bank		23:58	0:59	1845	1845	4	30.33	146	19.15	4	30.84	146	19.37	-4.51	146.32	-4.66	146.32	weak (0.1%)	1151.00				
BH020	Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt		5:15	5:39	945	960	4	21.01	146	44.05	4	24.97	146	14.05	-4.35	146.73	-4.42	146.23	none					
BH021	Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt		10:40	11:58	1828	1780	4	24.03	146	6.07	4	23.8	146	6.31	-4.40	146.10	-4.40	146.11	weak (0.3%)	1225.00		7		
BH022	Bismarck 2002	8-Mar-02	Single Dip	"Mud Volcano"		15:12	16:30	1870	1869	4	18.99	146	15.27	4	18.99	146	15.31	-4.32	146.25	-4.32	146.26	weak peaks (0.1%)	1170, 1220, 1300		3		
BH023	Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt		19:29	20:15	803	793	4	24.19	146	11.47	4	24.18	146	11.43	-4.40	146.19	-4.40	146.19	none					

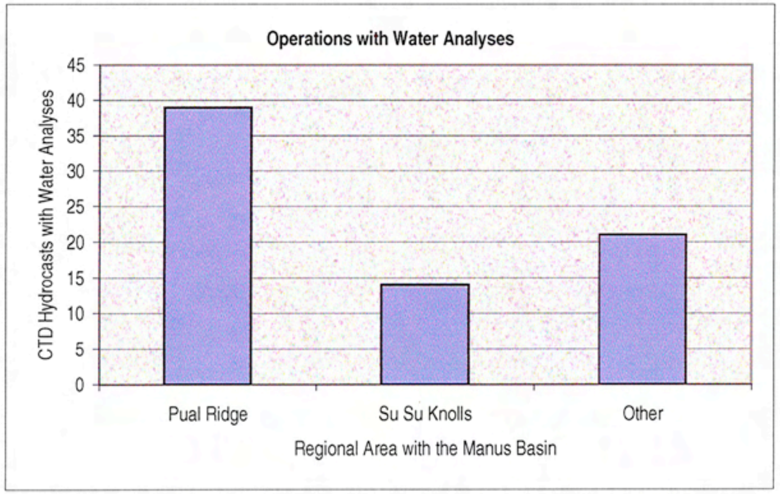
BH024	Bismarck 2002	8-Mar-02	Single Dip	Northeast Karkar Smt		22:10	23:21	1442	1437	4	21.98	146	11.51	4	22.01	146	11.5	-4.37	146.19	-4.37	146.19	v weak (0.1%)	1100.00		4	dubious result	
BH025	Bismarck 2002	9-Mar-02	Single Dip	Karkar Island		6:12	7:22	1654	1661	4	42.67	146	7.49	4	42.17	146	7.68	-4.71	146.12	-4.70	146.13	weak (0.3%)	800, 870, 945		9		
BH026	Bismarck 2002	9-Mar-02	Single Dip	Isumrud Strait		9:16	10:09	661	796	4	51.11	145	53.88	4	51.17	145	53.77	-4.85	145.90	-4.85	145.90	weak (0.2%)	380.00				
BH027	Bismarck 2002	9-Mar-02	Single Dip	Isumrud Strait		11:38	12:10	761	744	4	45.9	145	50.2	4	44.03	145	49.93	-4.77	145.84	-4.73	145.83	weak (0.2%)	340.00			body of apparently clearer water below 690m, and near-bottom nephel layer	
BH028	Bismarck 2002	9-Mar-02	Single Dip	Karkar Island		15:45	16:46	1263	1266	4	30.12	145	50.03	4	30	145	49.98	-4.50	145.83	-4.50	145.83	weak (0.6%)	900.00			narrow anomaly at 900m during downcast was not repeated on upcast	
BH029	Bismarck 2002	9-Mar-02	Single Dip	East Manam		22:53	23:57	1918	1918	4	5.46	145	16.57	4	5.41	145	16.51	-4.09	145.28	-4.09	145.28	weak (to 0.5%)	1260-1360		8	3 significant Tx anomalies; broad anomaly below 1800m.	
BH030	Bismarck 2002	10-Mar-02	Single Dip	East Manam		3:30	4:07	1643	1643	4	5.48	145	10	4	5.51	145	9.98	-4.09	145.17	-4.09	145.17	moderate to strong (to 1.2%)	1235.00		10	an irregular Tx profile at deeper levels	
BH031	Bismarck 2002	10-Mar-02	Single Dip	East Manam		9:16	10:18	1448	1450	4	7.2	145	12.31	4	7.17	145	12.36	-4.12	145.21	-4.12	145.21	weak (0.6%)	1250.00		2	subdued and bifurcated anomaly	
BH032	Bismarck 2002	10-Mar-02	Single Dip	East Manam		11:02	12:25	1867	1872	4	4.5	145	13.02	4	4.5	145	13.04	-4.08	145.22	-4.08	145.22	strong (1.7%)	1280.00		1		
BH033	Bismarck 2002	10-Mar-02	Single Dip	East Manam		13:08	14:05	1838	1843	4	1.9	145	9.43	4	1.96	145	9.52	-4.03	145.16	-4.03	145.16	strong (2.0%), weak (0.8%)	1260, 1330		1 filter examined by SEM	plus deeper irregularities in Tx profile	
BH034	Bismarck 2002	10-Mar-02	Single Dip	East Manam		16:07	17:08	1467	1489	4	4.95	145	7	4	4.99	145	7.06	-4.08	145.12	-4.08	145.12	v weak	1225.00				
BH035	Bismarck 2002	10-Mar-02	Single Dip	East Manam		18:40	19:30	1660	1658	4	5.44	145	8.02	4	5.48	145	8.04	-4.09	145.13	-4.09	145.13	weak (0.5%)	1224.00		1		
BH036	Bismarck 2002	10-Mar-02	Single Dip	East Manam		21:55	22:52	1420	1388	4	1.99	145	5.98	4	1.83	145	5.81	-4.03	145.10	-4.03	145.10	weak (0.5%), faint (0.2%)	1060, 1250				
BH037	Bismarck 2002	10-Mar-02	Single Dip	East Manam		23:30	0:47	1825	1836	3	59.96	145	1.98	3	59.74	145	8.04	-4.00	145.03	-4.00	145.13	strong (1.5%), weak to "fuzzy"	1250, 1300, 1320, 1500-1625		2		
BH038	Bismarck 2002	11-Mar-02	Single Dip	Manam Island		1:45	2:49	1833	1632	3	59.05	145	2	3	59.21	145	3.03	-3.98	145.03	-3.99	145.05	none				jagged profile suggested some mixing of deep water masses.	
BH039	Bismarck 2002	11-Mar-02	Single Dip	Bam Island		6:39	7:37	1381	1382	3	39.69	144	48.71	3	39.7	144	48.7	-3.66	144.81	-3.66	144.81	strong (>2%), weak (0.2%)	1218-1325, 693		2	bottom-hugging Tx anomaly to 5mab;	
BH040	Bismarck 2002	11-Mar-02	Single Dip	Bam Island		8:42	9:48	1559	1590	3	34.43	144	53.03	3	34.47	144	53.14	-3.57	144.88	-3.57	144.89	numerous weak	800-1600			plethora of minor anomalies from 800m to 1600m including a nephel layer 9m	
BH041	Bismarck 2002	11-Mar-02	Single Dip	North Bam Seamount		12:10	13:35	1475	1492	3	30.85	144	47.86	3	30.7	144	48.15	-3.51	144.80	-3.51	144.80	numerous (1.6%), (1.8%) (0.8%)	730, 820, 1300		1	similar to BH040	
BH042	Bismarck 2002	11-Mar-02	Single Dip	East Schouten Ridge		16:24	17:27	1411	1385	3	24.54	144	50.02	3	24.58	144	49.98	-3.41	144.83	-3.41	144.83	numerous weak (0.2%)	875, 1030, 1100			a distinct 0.2% transmissivity anomaly at 875m and smaller anomalies at 1030	
BH043	Bismarck 2002	11-Mar-02	Single Dip	East Schouten Ridge		23:03	0:05	1453	1460	3	26.09	144	6.91	3	26.14	144	37.57	-3.43	144.12	-3.44	144.63	multi strong (1.5%, 2.3%, 2.2%)	740,820, 890, 1130, 1200, 1260	ICP-MS (UTS) selected multi element	3		
BH044	Bismarck 2002	12-Mar-02	Single Dip	East Schouten Ridge		4:56	6:11	614	608	3	16.31	145	16.32	3	16.55	144	6.26	-3.27	145.27	-3.28	144.10	numerous weak (0.7%, 0.5%)	864, 813, 1450-1750				
BH045	Bismarck 2002	12-Mar-02	Single Dip	East Schouten Ridge		8:57	9:56	1424	1420	3	24.89	144	56.81	3	24.89	144	56.8	-3.41	144.95	-3.41	144.95	faint-weak	870, 1060, 1300				
BH046	Bismarck 2002	12-Mar-02	Single Dip	Wei Island		12:00	13:30	1726	983	3	25.19	144	35.16	3	25.4	144	29.02	-3.42	144.59	-3.42	144.48	numerous (1%, 1.4%, 1.2%, 1%, 0.7%)	185, 673, 718, 775, 947		1		
BH047	Bismarck 2002	12-Mar-02	Single Dip	Wei Island		14:40	15:29	1669	1324	3	5.29	144	49.23	3	14.3	144	0.82	-3.09	144.82	-3.24	144.01	weak	630, 850				
BH048	Bismarck 2002	12-Mar-02	Single Dip	Vokeo Island		19:31	19:59	614	608	3	16.51	144	6.31	3	16.552	144	6.263	-3.28	144.11	-3.28	144.10	none				probable nephel layer close to bottom, possibly due to outwash from Vokeo	
BH049	Bismarck 2002	12-Mar-02	Single Dip	West Schouten Ridge		19:35	20:31	1399	1400	3	10.71	143	57.49	3	10.71	143	57.55	-3.18	143.96	-3.18	143.96	none				apparent body of lower transmissivity water was recorded between 1180m	
BH050	Bismarck 2002	12-Mar-02	Single Dip	West Schouten Ridge		21:39	22:36	1696	1693	3	4.98	143	49.46	3	5.07	143	49.44	-3.08	143.82	-3.08	143.82	none					
BH051	Bismarck 2002	13-Mar-02	Single Dip	SW Vokeo		4:25	5:30	2241	2232	3	20.98	143	55.96	3	21.043	143	55.978	-3.35	143.93	-3.35	143.93	numerous (to 1.5%)	650, 660, 700-870		1	some anomalies may represent sediment transported from the New Guinea	
BH052	Bismarck 2002	13-Mar-02	Single Dip	W Koil		9:45	10:35	1099	1096	3	20.98	144	10	3	20.93	144	10	-3.35	144.17	-3.35	144.17	numerous weak (0.4%)	600, 660, 800				
BH053	Bismarck 2002	13-Mar-02	Single Dip	SW Vokeo		13:33	14:09	1969	1963	3	18.06	144	2.48	3	18.04	144	2.5	-3.30	144.04	-3.30	144.04	v weak	1250-1969			faint signal at 180m	
BH054	Bismarck 2002	14-Mar-02	Single Dip	East Schouten Ridge		5:25	6:39	1573	1540	3	26.489	144	39.496	3	26.984	144	37.828	-3.44	144.66	-3.45	144.63	Strong (2%), (1%), (4%)	1070, 1140, 1220		2	Surprisingly, no Tx anomalies in expected depth range.	
BH055	Bismarck 2002	14-Mar-02	Single Dip	East Schouten Ridge		10:29	11:18	1170	1162	3	26.02	144	46.54	3	26.03	144	46.47	-3.43	144.78	-3.43	144.77	moderate (1.2%)	913.00				
BH056	Bismarck 2002	14-Mar-02	Tow-yo	East Schouten Ridge		12:02	14:37	1612	1484	3	25.06	144	45	3	27.18	144	45.48	-3.42	144.75	-3.45	144.76	weak	870-950, 1120-1200				
BH057	Bismarck 2002	14-Mar-02	Tow-yo	East Schouten Ridge		15:25	18:00	1838	1165	3	23.77	144	46.89	3	26.48	144	47	-3.40	144.78	-3.44	144.78	weak	920, 1150				
BH058	Bismarck 2002	15-Mar-02	Tow-yo	East Schouten Ridge		0:45	5:07	1250	1524	3	25.85	144	45.27	3	26.321	144	43.182	-3.43	144.75	-3.44	144.72	numerous weak, moderate	830-870, 880, 1170				
BH059	Bismarck 2002	15-Mar-02	Tow-yo	East Schouten Ridge		7:15	10:29	1983	1524	3	24.43	144	40	3	27.91	144	39.99	-3.41	144.67	-3.47	144.67	numerous strong (7%)	1000, 1070, 1200, 1240	ICP-MS (UTS) selected multi element	2	Entered S end of low-salinity, muddy Sepik River plume. The 1000m anomaly	
BH060	Bismarck 2002	15-Mar-02	Single Dip	East Schouten Ridge		19:01	19:54	2091	1524	3	22.025	144	44.51	3	22.03	144	44.45	-3.37	144.74	-3.37	144.74	numerous weak-moderate (1.1%)	890, 920, 1125			absent in first two casts but appeared suddenly on third	
BH061	Bismarck 2002	16-Mar-02	Single Dip	Central Bismarck B		6:10	7:28	2054	1524	3	13.51	145	4.51	3	13.5	145	4.5	-3.23	145.08	-3.23	145.08	faint-weak	860, 1750				
BH062	Bismarck 2002	16-Mar-02	Single Dip	Betano Seamount		13:45	15:18	1147	1524	2	56.59	145	5.4	2	56.76	145	2.52	-2.94	145.09	-2.95	145.04	none				tiny Tx at 740m	
BH063	Bismarck 2002	16-Mar-02	Single Dip	Betano Seamount		16:55	17:59	1638	1524	2	56.46	145	10	2	56.5	145	10	-2.94	145.17	-2.94	145.17	none					
BH064	Bismarck 2002	16-Mar-02	Single Dip	Central Bismarck C		22:31	23:48	2129	1524	3	22.38	145	19.52	3	22.17	145	19.33	-3.37	145.33	-3.37	145.32	none					
BH065	Bismarck 2002	17-Mar-02	Single Dip	East Manam		7:53	8:49	1938	1524	4	1.94	145	13.97	4	1.77	145	13.62	-4.03	145.23	-4.03	145.23	weak-moderate (1.7%), (1.5%)	1310, 1525, 1410	ICP-MS (UTS) selected multi element			
BH066	Bismarck 2002	17-Mar-02	Single Dip	East Manam		10:15	11:35	1976	1524	4	1.95	145	16.01	4	2.1	145	16.31	-4.03	145.27	-4.04	145.27	weak-strong (0.6%) (2.0%)	1350, 1425, 1520				
BH067	Bismarck 2002	17-Mar-02	Single Dip	East Manam		13:04	14:29	1888	1890	4	1.88	145	11.94	4	1.01	145	11.55	-4.03	145.20	-4.02	145.19	strong-weak (1.4%) (0.6%)	1340, 1530		1 filter examined by SEM		
BH068	Bismarck 2002	17-Mar-02	Single Dip	East Manam		20:17	21:02	1866	1866	4	4.51	145	13.01	4	4.52	145	13.1	-4.08	145.22	-4.08	145.22	moderate (1%)	1260-1330		1		
BH069	Bismarck 2002	17-Mar-02	Single Dip	East Manam		0:38	1:17	1941	1942	3	59.99	145	14.6	3	0.05	145	13.98	-4.00	145.24	-3.00	145.23	numerous (1.5%, 0.4%, 0.5%, 0.4%)	1306, 1450, 1560, 1920		1 filter examined by SEM		
BH070	Bismarck 2002	18-Mar-02	Tow-yo	East Manam		3:40	7:50	1857	1941	4	3.97	145	11.43	4	1.32	145	14.14	-4.07	145.19	-4.02	145.24	numerous (to 2%)	1250, 1340, 1350, 1520, 1540				
BH071	Bismarck 2002	18-Mar-02	Tow-yo	East Manam		12:25	17:14	1859	1940	4	4.68	145	13.54	4	3.49	145	13.99	-4.08	145.23	-4.06	145.23	numerous weak	1125, 1150, 1200-1300, 1280, 1500				
BH072	Bismarck 2002	18-Mar-02	Single Dip	East Manam		20:38	21:58	2050	2051	4	2.5	145	22.01	4	2.37	145	21.93	-4.04	145.37	-4.04	145.37	moderate (1.5%)	1340.00		1 filter examined by SEM		
BH073	Bismarck 2002	19-Mar-02	Single Dip	East Manam		1:17	2:28	1762	1749	4	3.74	145	9.23	4	3.64	145	9.17	-4.06	145.15	-4.06	145.15	weak-moderate (to 0.8%)	1160, 1250, 1320				
BH074	Bismarck 2002	19-Mar-02	Single Dip	Stephan Strait		8:00	8:46	1304	1299	4	10.05	145	3.43	4	9.87	145	2.43	-4.17	145.06	-4.16	145.04	none				very slight disturbances to the profile at 850m and 1070m	
BH075	Bismarck 2002	19-Mar-02	Single Dip	W Manam		9:53	10:27	900	900	4	2.69	144	56.3	4	2.71	144	56.45	-4.04	144.94	-4.05	144.94	none					
BH076	Bismarck 2002	19-Mar-02	Single Dip	East Manam		13:01	14:18	2008	2007	3	56.06	145	16.96	3	56	145	16.97	-3.93	145.28	-3.93	145.28	moderate (1%)	1390.00			faint anomalies at 1325 and 1500m	
BH077	Bismarck 2002	19-Mar-02	Single Dip	Northwest Karkar Smt		0:30	1:34	1400	1391	4	22.99	145	47.24	4	23.08	145	46.95	-4.38	145.79	-4.38	145.78	none					
BH078	Bismarck 2002	19-Mar-02	Single Dip	Northwest Karkar Smt		4:15	4:57	1820	1890	4	16.95	145	52.01	4	17	145	52.04	-4.28	145.87	-4.28	145.87	none					
BH079	Bismarck 2002	20-Mar-02	Single Dip	West Hankow Smt		21:38	22:44	1778	1778	4	53.08	146	33.98	4	53.21	146	33.79	-4.88	146.57	-4.89	146.56	none				sharp but very faint transmissivity anomaly at 700m (0.2%)	
BH080	Bismarck 2002	20-Mar-02	Single Dip	Ritter		12:40	13:19	871	872	5	31.32	148	4.5	5	31.39	148	4.14	-5.52	148.08	-5.52	148.07	none					
BH081	Bismarck 2002	21-Mar-02	Single Dip	Ritter		16:06	16:46	880	887	5	32.23	148	8.08	5	32.23	148	8.1	-5.54	148.13	-5.54	148.14	none					
BH082	Bismarck 2002	21-Mar-02	Single Dip	Ritter		17:20	17:50	903	903	5	29.9	148	7.89	5	29.9	148	7.9	-5.50	148.13	-5.50	148.13	none					
BH083	Bismarck 2002	21-Mar-02	Single Dip	Cape Gloucester site		21:18	21:56	900	895	5	12	148	34.22	5	12.06	148	34.2	-5.20	148.57	-5.20	148.57	none				no transmissivity anomaly apart from a near-bottom nephel layer	
BH084	Bismarck 2002	22-Mar-02	Single Dip	Cape Gloucester site		5:15	5:43	803	809	5	7.88	148	34.64	5	7.89	148	34.61	-5.13	148.58	-5.13	148.58	none				faint nephel anomaly near bottom	
BH085	Bismarck 2002	22-Mar-02	Single Dip	Garove		11:48	12:01	140	140	4	40.53	149	29.48	4	40.48	149	29.47	-4.68	149.49	-4.67	149.49	strong (3%)	112-122 (18mab)	ICP AES (Fe, Mn, Si)	1	filter clogged	
BH086	Bismarck 2002	22-Mar-02	Single Dip	Garove		13:49	14:17	140	140	4	41.34	149	29	4	41.33	149	29.78	-4.69	149.48	-4.69	149.50	strong (6%)	160-230 (40mab)	ICP AES (Fe, Mn, Si)	1		
BH087	Bismarck 2002	23-Mar-02	Single Dip	PACMANUS area	Pual Ridge	12:40	14:30	2255	2144	3	41.4	151	36.54	3	41.08	151	36.31	-3.69	151.61	-3.68	151.61	none				The 1.3% anomaly recorded in 2000 (MH-99) but not in 1993 (MH-14) had again disappeared	
BH088	Bismarck 2002	23-Mar-02	Single Dip	Djaul Fault		20:33	22:11	2730	2730	3	42.99	151	25.79	3	42.83	151	25.82	-3.72	151.43	-3.71	151.43	none				minor fluctuations in the transmissivity profile between 2030m and 2280m	
BH089	Bismarck 2002	23-Mar-02	Single Dip	Djaul Fault		23:13	1:10	2707	2710	3	38.98	151	18.29	3	38.99	151	18.31	-3.65	151.30	-3.65	151.31	strong and broad (2%)	2400-2709 (5mab)			possibly arises from a turbidite flow generated by the seismicity	
BH090	Bismarck 2002	24-Mar-02	Single Dip	Umbo Basin	Su Su	21:23	22:46	2108	2151	3	43.02	151	57.51	3	42.94	151	57.57	-3.72	151.96	-3.72	151.96	strong (to 1.4%)	1590-1800		1 filter examined by SEM	A weak Tx peak at 520m	
BH091	Bismarck 2002	24-Mar-02	Single Dip	SuSu Knolls	Su Su	23:49	0:49	1558	1559	3	47.95	152	6.53	3	47.98	152	6.56	-3.80	152.11	-3.80	152.11	none				2000 plume not present. Faint Tx peaks at 1280m, 1320m and 1470m	
BH092	Bismarck 2002	25-Mar-02	Single Dip	SuSu Knolls	Su Su	1:12	2:10	1635	1635	3	48.52	152	7.01	3	48.54	152	7.06	-3.81	152.12	-3.81	152.12	none				2000 plume not present. Faint Tx peaks at 1240m, 1270m and 1470m	
CTD02-01	DaeYang02 (Onnuri)	26-Aug-02	Dip	Edison Seamount		10:42	12:17	1580	1527	3	19.67	152	35.654	3	18.646	152	34.827	-3.33	152.59	-3.31	152.58			He		Dissolved oxygen profile is interesting showing a number of maxima and minima in the water column below thermocline. No obvious light transmission	
CTD02-02	DaeYang02 (Onnuri)	26-Aug-02	Dip	Conical Seamount		13:18	14:21	1058	1296	3	19.676	152	39.519	3	18.573	152	39.199	-3.33	152.66	-3.31	152.65			He		A number of small light transmission anomalies between 600-700, associated with dissolved oxygen maxima. O2 maxima also at ~400m.	
CTD02-03	DaeYang02 (Onnuri)	30-Aug-02	Dip	Lihr		15:50	16:21		2181	3	22.233	152	46.067	3	21.471	152	46.418	-3.37	152.77	-3.36	152.77			He			
CTD02-04	DaeYang02 (Onnuri)	1-Sep-02	Dip	PACMANUS	Pual Ridge	16:02	18:27	1700		3	43.599	151	40.469	3	42.344	152	39.815	-3.73	151.67	-3.71	152.66			He ICP-MS (selected multi element, low level Mn)		Light transmission defined a 60m thick plume 180m above bottom, between 1520 and 1580m, 1.5km NW of Roman Ruins. Maximum transmission was 0.5%. 8 samples of unfiltered water were collected. On shore Mn analyses	
CTD02-05	DaeYang02 (Onnuri)	6-Sep-02	Dip	East Schouten Ridge		0:34	2:12	1506	1362	3	27.994	144	39.998	3	27.877	144	38.357	-3.47	144.67	-3.46	144.64			He		Light transmission anomalies were recorded in similar positions as BH59 (Bismarck 2002), but they are far less intense, by a factor of ~6	
CTD02-06	DaeYang02 (Onnuri)	6-Sep-02	Dip	East Schouten Ridge		2:55	4:16	1447	1382	3	30.05	144	40.43	3	29.083	144	39.211	-3.50	144.67	-3.48	144.65			He		A number of light transmission anomalies was recorded in similar positions to the previous CTD02-05 but overall they are slightly weaker	
CTD02-07	DaeYang02 (Onnuri)	6-Sep-02	Dip	Bam - East Schouten		5:00	6:07	1374	1431	3	33.877	144	44.034	3	32.348	144	43.718	-3.56	144.73	-3.54	144.73			He		Only very weak light transmission anomalies occur.	
CTD02-08	DaeYang02 (Onnuri)	6-Sep-02	Dip	Bam - Manam		8:38	9:55	1550	1583	3	49.792	144	54.853	3	48.715	144	53.958	-3.83	144.91	-3.81	144.90			He		Only extremely weak light transmission signal of <0.1% around 820m, in a correspondingly similar position to plumes at East Schouten. Tx also increases gradually over the final 60m of cast.	
CTD02-09	DaeYang02 (Onnuri)	6-Sep-02	Dip	East Manam		13:08	14:52	2045	2042	3	57.067	145	23.339	3	56.564	145	22.617	-3.95	145.39	-3.94	145.38			He		No significant light transmission anomalies were recorded, however, minor blip at 1540m of 0.1% corresponds to the 1550m plume recorded in Bismarck 2002, and 20mab of 0.2% Unusual oxygen depletion zones between 500-	
CTD02-10	DaeYang02 (Onnuri)	6-Sep-02	Dip	East Manam		15:14	17:08	1931	1910	3	2.057	145	14.168	3	0.691	145	13.083	-3.03	145.24	-3.01	145.22			He		There is strong layering in the photic zone 0-160m with a sharp well defined light transmission anomaly (Tx=2%), oxygenated, low salinity water, and bottom boundary. This boundary is also the top of the New Guinea Coastal	
CTD02-11	DaeYang02 (Onnuri)	6-Sep-02	Dip	East Manam		17:40	18:55		1340?	4	4.798	145	7.124	4	3.932	145	6.388	-4.08	145.12	-4.07	145.11						
93-MS	Edison 1994 (Sonne)	1994	Dip	Just NE of PACMANUS	Pual Ridge			1728		3	43.4	151	40.7					-3.72	151.68			strong	1575	CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	water samples taken
HCTD-1	Kodos 1999 (Onnuri)	1999	Dip	SuSu knolls, "eye of plume"	Su Su			1572		3	47.45	152	6.07					-3.79	152.10			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	(transmissometer carried, many water samples taken
HCTD-10	Kodos 1999 (Onnuri)	1999	Dip	DESMOS	Pual Ridge			1902		3	40.63	151	51.87					-3.68	151.86			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-2	Kodos 1999 (Onnuri)	1999	Dip	SuSu knolls, "eye of plume"	Su Su					3	42.8	151	58.6					-3.71	151.98			no info*				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	*Position cited is "in water",well west of SuSu! We don't have max
HCTD-3	Kodos 1999 (Onnuri)	1999	Dip	Northeast of PACMANUS	Pual Ridge			1918		3	40.54	151	45.67					-3.68	151.76			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-4	Kodos 1999 (Onnuri)	1999	Dip	Northeast of PACMANUS	Pual Ridge			1758		3	41.74	151	41.66					-3.70	151.69			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-5	Kodos 1999 (Onnuri)	1999	Dip	Northeast of PACMANUS	Pual Ridge			2178		3	41.2	151	45.45					-3.69	151.76			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	

HCTD-6	Kodos 1999 (Onnuri)	1999	Dip	East of PACMANUS	Pual Ridge			1953		3	43.13	151	43.84					-3.72	151.73			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-7	Kodos 1999 (Onnuri)	1999	Dip	East of PACMANUS	Pual Ridge			2122		3	43.23	151	43.87					-3.72	151.73			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-8	Kodos 1999 (Onnuri)	1999	Dip	East of PACMANUS	Pual Ridge			1671		3	42.55	151	42					-3.71	151.70			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-8-1	Kodos 1999 (Onnuri)	1999	Dip	East of PACMANUS	Pual Ridge			1873		3	42.93	151	44.17					-3.72	151.74			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
HCTD-9	Kodos 1999 (Onnuri)	1999	Dip	SW of DESMOS	Pual Ridge			2111		3	42.89	151	49.11					-3.71	151.82			no info				NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	
MH001	Pacmanus I	29-Sep-91	Tow-yo	Marmin Knolls		4:17	9:08	2178	2615	3	43.9	151	33.05	3	39.29	151	32.75	-3.73	151.55	-3.65	151.55	0.5 to 1.0% magnitude transmissivity anomaly	below 1500 on all 4 downcasts	CH4		A total of 7 yo-yos were done and samples were taken during the upcast 3 and upcast 5.	
MH002	Pacmanus I	29-Sep-91	Tow-yo	Marmin Knolls	Pual Ridge	23:00	4:07	2189	1804	3	45.85	151	38.91	3	41.19	151	38.65	-3.76	151.65	-3.69	151.64	none observed		CH4		9 to-yows; samples were taken during upcasts 7 and 9.	
MH003	Pacmanus I	30-Sep-91	Tow-yo	Kumul Ridge		12:33	17:30	2558	2473	3	43.9	151	25.98	3	40.44	151	28.81	-3.73	151.43	-3.67	151.48	none observed		CH4		Eleven bottles were fired during the second up cast.	
MH004	Pacmanus I	1-Oct-91	Tow-yo	Pual Ridge	Pual Ridge	23:15	4:30	2202	2061	3	41.56	151	44.69	3	38.77	151	44.4	-3.69	151.74	-3.65	151.74	A weak transmissivity anomaly of approximately 0.25% was observed in casts 5 and 6.		CH4		7 yo-yos was conducted and samples were taken during the upcast 5.	
MH005	Pacmanus I	2-Oct-91	Tow-yo	Pual Ridge	Pual Ridge	23:14	5:06	1910	1781	3	42.01	151	43.44	3	36.58	151	43.2	-3.70	151.72	-3.61	151.72	Present along whole transect.		CH4		9 yo-yos. Samples were taken during the upcast 5.	
MH006	Pacmanus I	3-Oct-91	Tow-yo	DESMOS	Pual Ridge	18:20	19:53	2070	1949	3	43.01	151	51.02	3	40.88	151	51.52	-3.72	151.85	-3.68	151.86	strong, 2 distinct and strong spikes of up to 2.5%	1500-1700	CH4		TA. Bottles were fired above, within and below the plume.	
MH007	Pacmanus I	5-Oct-91	Tow-yo	PACMANUS	Pual Ridge	20:35	2:39	1691	1901	3	44.43	151	39.09	3	41.39	151	40.98	-3.74	151.65	-3.69	151.68	up to >1%		CH4		7 yo-yos A transmissivity	
MH008	Pacmanus I	6-Oct-91	Tow-yo	PACMANUS	Pual Ridge	22:18	4:00	2096	2115	3	40.96	151	40.35	3	45.58	151	45.58	-3.68	151.67	-3.76	151.76	observed from upcast 4 to last (12)		CH4		12 yo-yos	
MH009	Pacmanus I	6-Oct-91	Tow-yo	PACMANUS	Pual Ridge	22:12	0:12	1943	1874	3	41.5	151	43.78	3	42.37	151	42.71	-3.69	151.73	-3.71	151.71	weak				No bottles fired due to change in course.	
MH010	Pacmanus I	7-Oct-91	Tow-yo	PACMANUS	Pual Ridge	0:48	3:49	1864	1679	3	41.33	151	42.42	3	42.58	151	41.13	-3.69	151.71	-3.71	151.69					No bottles fired due to change in course.	
MH011	Pacmanus I	7-Oct-91	Tow-yo	PACMANUS	Pual Ridge	4:40	6:44	2099	1839	3	43.43	151	42.01	3	40.7	151	42.81	-3.72	151.70	-3.68	151.71	weak, weaker to N		CH4		3 to-yows, 7 bottles fired.	
MH012	Pacmanus II	8-Jun-93	Tow-yo	Tavui caldera, N of Rabaul		2:55	5:20	1089	519	4	7.68	152	12.72	4	7.5	152	14.6	-4.13	152.21	-4.13	152.24	none		CH4		7 to-yows, 3 samples only.	
MH013	Pacmanus II	9-Jun-93	Tow-yo	PACMANUS	Pual Ridge	1:30	4:15	2100	1802	3	44.17	151	42.21	3	41.3	151	39.4	-3.74	151.70	-3.69	151.66	weak, 0.02C temp anomaly		CH4		6 tow-yos	
MH014	Pacmanus II	9-Jun-93	Tow-yo	Pual Ridge	Pual Ridge	20:25	0:00	2177	2050	3	43.01	151	35.88	3	39.58	151	35.85	-3.72	151.60	-3.66	151.60	weak		CH4		11 samples	
MH015	Pacmanus II	10-Jun-93	Tow-yo	PACMANUS	Pual Ridge	2:05	7:13	2344	2000	3	44.12	151	37.38	3	37.84	151	37.49	-3.74	151.62	-3.63	151.62	weak but persistent		CH4		12 to-yows, 11 samples.	
MH016	Pacmanus II	10-Jun-93	Tow-yo	PACMANUS	Pual Ridge	19:40	0:00	1920	nd	3	42.38	151	44.94	3	39.71	151	41.92	-3.71	151.75	-3.66	151.70	weak to moderate (up to 1%), then v. weak		CH4		10 to-yows,	
MH017	Pacmanus II	11-Jun-93	Tow-yo	PACMANUS	Pual Ridge	1:10	6:09	1856	1860	3	42.97	151	44.31	3	40.5	151	41.83	-3.72	151.74	-3.68	151.70	weak		CH4		13 to-yows, 11 samples.	
MH018	Pacmanus II	12-Jun-93	Tow-yo	PACMANUS	Pual Ridge	11:40	5:34	1749	1640	3	39.17	151	42.89	3	42.34	151	46.33	-3.65	151.71	-3.71	151.77	moderate (1%)		CH4		17 to-yows, 11 samples.	
MH019	Pacmanus II	12-Jun-93	Tow-yo	PACMANUS	Pual Ridge	22:06	3:31	1845	1960	3	41.09	151	44.45	3	43.39	151	47.11	-3.68	151.74	-3.72	151.79	weak to moderate		CH4		7 samples	
MH020	Pacmanus II	13-Jun-93	Tow-yo	PACMANUS	Pual Ridge	15:55	16:47	1860	1900	3	40.53	151	42.83	3	40.71	151	43.16	-3.68	151.71	-3.68	151.72					ship drifted, no samples.	
MH021	Pacmanus II	14-Jun-93	Tow-yo	PACMANUS	Pual Ridge	10:10	12:11	1869	1910	3	41.45	151	43.51	3	40.58	151	43.09	-3.69	151.73	-3.68	151.72	weak getting stronger				CTD hit bottom, no samples.	
MH022	Pacmanus II	14-Jun-93	Tow-yo	PACMANUS (test)	Pual Ridge	18:45	19:45	nd	nd	3	43.33	151	42.82	3	43.04	151	42.98	-3.72	151.71	-3.72	151.72	weak				No samples	
MH023	Pacmanus II	15-Jun-93	Tow-yo	PACMANUS	Pual Ridge	3:50	9:33	2060	nd	3	44.77	151	41.87	3	42.14	151	39.88	-3.75	151.70	-3.70	151.66	weak to moderate (0.05-1.5%)		CH4		17 to-yows, 11 samples.	
MH024	Pacmanus II	15-Jun-93	Single Dip	PACMANUS	Pual Ridge	19:38	21:42		1866	3	43.33	151	39.97	3	42.43	151	40.21	-3.72	151.67	-3.71	151.67	weak?		CH4		6 Ti bottles fired (D. Morgan, New Mexico tech.)	
MH025	Pacmanus II	16-Jun-93	Tow-yo	PACMANUS	Pual Ridge	11:10	15:19	nd	2000	3	37.81	151	43.53	3	40.06	151	45.56	-3.63	151.73	-3.67	151.76	weak		CH4		10 Tow-yod, 4 samples.	
MH026	Pacmanus II	18-Jun-93	Single Dip	SW Pual Ridge	Pual Ridge	5:19	6:46	nd	nd	3	46.05	151	37.47	3	46.11	151	36.79	-3.77	151.62	-3.77	151.61	v weak ("slight bulge" 0.1%)	1600-1700	CH4		2samples	
MH027	Pacmanus II	18-Jun-93	Tow-yo	DESMOS	Pual Ridge	17:23	18:47	nd	nd	3	41.46	151	52.16	3	41.18	151	51.89	-3.69	151.87	-3.69	151.86	strong 3%	1530-1690	CH4			
MH028	Pacmanus II	19-Jun-93	Tow-yo	SuSu	Su Su	3:20	5:35	1825	nd	3	45.71	152	3.96	3	45.46	152	5.54	-3.76	152.07	-3.76	152.09	weak (0.7%), weaker eastwards	1300-1480	CH4 (highly anomalous to 393 nl/l)			
MH029	Pacmanus II	19-Jun-93	Tow-yo	SuSu	Su Su	6:06	8:37	nd	nd	3	45.16	152	3.3	3	46.93	152	4.78	-3.75	152.06	-3.78	152.08	moderate to 1.9%	1440-1700	CH4 (highly anomalous to 343 nl/l)		ethane, butane also detected	
MH030	Pacmanus III	1-Dec-96	Tow-yo	East Sherburne Zone		1:20	3:36	nd	nd	3	44.86	148	52.82					-3.75	148.88			none				Sr isotope sample at 1788 m	
MH031	Pacmanus III	1-Dec-96	Single Dip	Giant Seamount, East Sherburne		8:25	9:35	1768	1771	3	39.04	148	56.01	3	39.03	148	56.02	-3.65	148.93	-3.65	148.93	none				Sr isotope sample at 1771 m	
MH032	Pacmanus III	1-Dec-96	Single Dip	Giant Seamount, East Sherburne		11:50	12:29	931	nd	3	40.69	148	54.12	3	40.68	148	54.08	-3.68	148.90	-3.68	148.90	v weak (0.4%)	300-800				
MH033	Pacmanus III	1-Dec-96	Single Dip	East Sherburne Zone		14:00	15:17	nd	nd	3	43.61	149	4.57	3	43.58	149	4.44	-3.73	149.08	-3.73	149.07	none				no samples	malfunction of transmissomter
MH034	Pacmanus III	1-Dec-96	Single Dip	East Sherburne Zone		21:00	22:50	2167	2170	3	46	149	15.8	3	46.06	149	15.8	-3.77	149.26	-3.77	149.26	none				no samples	
MH035	Pacmanus III	2-Dec-96	Single Dip	Willaumez Extension Zone		3:14	5:14	2400	2358	3	32.53	148	36	3	30.92	149	35.72	-3.54	148.60	-3.52	149.60	none				5 samples, 2 for Sr	
MH036	Pacmanus III	3-Dec-96	Tow-yo	PACMANUS	Pual Ridge	9:01	13:00	1686	1676	3	43	151	40.66	3	39.74	151	44.17	-3.72	151.68	-3.66	151.74	weak to absent				3 samples, 2 for Sr	
MH037	Pacmanus III	4-Dec-96	Tow-yo	SuSu	Su Su	1:49	6:53	1904	1768	3	44.99	152	2.99	3	47.27	152	6.90	-3.75	152.05	-3.79	152.12	weak to strong (3.8%)				7 samples, all filtered	
MH038	Pacmanus III	4-Dec-96	Tow-yo	SuSu	Su Su	7:36	10:28	1689	1864	3	49.56	152	6.44	3	47.26	152	4.25	-3.83	152.11	-3.79	152.07	v strong (>17.5%)					
MH039	Pacmanus III	4-Dec-96	Tow-yo	SuSu	Su Su	11:21	15:40	1704	2039	3	51.52	152	4.52	3	48.02	152	3.81	-3.86	152.08	-3.80	152.06	strong (up to 8.2%)	1375 mab to bottom			no samples	
MH040	Pacmanus III	4-Dec-96	Tow-yo	SuSu	Su Su	16:30	20:24	1713	1640	3	49.96	152	7.91	3	46.87	152	5.38	-3.83	152.13	-3.78	152.09	strong (>15%)	1000 mab to bottom			no samples	
MH041	Pacmanus III	5-Dec-96	Tow-yo	SuSu	Su Su	8:45	13:50	1784	nd	3	49.95	152	4.75	3	46.2	152	8.15	-3.83	152.08	-3.77	152.14	v strong (up to 33%)	1025-1235, 1275 to bottom			no samples	
MH042	Pacmanus III	5-Dec-96	Single Dip	concealed intrusion		17:54	19:20	2158	2158	3	49.16	152	44.09	3	49.21	152	44.61	-3.82	152.73	-3.82	152.74	none				2 samples, 1 Sr	
MH043	Pacmanus III	9-Dec-96	Tow-yo	SuSu	Su Su	7:55	13:59	1682	1247	3	52.41	152	9.49	3	47.36	152	5.5	-3.87	152.16	-3.79	152.09	v strong	980 mab to bottom			10 tow-yows, 7 samples, 2 filtered	
MH044	Pacmanus III	9-Dec-96	Tow-yo	SuSu	Su Su	20:48	2:26	1786	1789	3	50.47	152	4.98	3	46.24	152	9.4	-3.84	152.08	-3.77	152.16	v. strong (>17%)	1020-bottom			11 tow-yows, no samples	
MH045	Pacmanus III	10-Dec-96	Single Dip	SuSu	Su Su	21:24	22:48	1616	1639	3	49.3	152	6.26	3	49.28	152	6.22	-3.82	152.10	-3.82	152.10	v. strong (10%)	1000 mab- bottom	ICP AES multi element	4	10 samples, all filtered, 4 filters preserved in glutaraldehyde for G. Ferris' bacterial study UoI Toronto from 2x10 L Niskin bottles	
MH046	Pacmanus III	11-Dec-96	Tow-yo	Tumai	Su Su	6:30	9:12	1672	1765	3	46.99	152	6.38	3	44.93	152	8.61	-3.78	152.11	-3.75	152.14	weak, weaker to NE				4 dips, 6 samples	
MH047	Pacmanus III	13-Dec-96		Bugave Ridge	Su Su	0:50	1:56	1721	1728	3	44.18	152	9.31	3	44.21	152	9.36	-3.74	152.16	-3.74	152.16	v. weak (0.0.2%)				not pursued further	
MH048	Pacmanus III	13-Dec-96	Single Dip	Tavui caldera, N of Rabaul		10:47	11:36	1088	1087	4	7.63	152	12.72	4	7.53	152	12.79	-4.13	152.21	-4.13	152.21	none					
MH049	Pacmanus IV	16-Oct-97	Single Dip	Weiten Volcano		10:19	15:22	nd	5	4	1.66	152	31.06	3	59.519	152	30.216	-4.03	152.52	-3.99	152.50					3 dips Could not control ship in strong current, speed over ground ~ 4 kt caused CTD to kite up. Could not get CTD below about 480m. Run	
MH050	Pacmanus IV	16-Oct-97	Tow-yo	SuSu	Su Su	6:28	13:12	1695.8	nd	3	51.23	152	10	3	49.25	152	12.16	-3.86	152.17	-3.82	152.20	Strong (up to 8%)	1000-1200	pH, O2, ICP AES multi element	11?	7 dips, 11 samples, all filtered. pH anomaly of 0.13 (pH 7.39 vs background of 7.56) within plume.	Great difficulty filtering with Nucleopore filters even under very high vacuum of 600 mm Hg
MH051	Pacmanus IV	16-Oct-97	Tow-yo	Nimab	Su Su	11:13	16:16	1750	2042.8	3	49.794	152	12.285	3	46.43	152	16.46	-3.83	152.20	-3.77	152.27	Strong (up to 9%)diminishing to <2%	1060-1200			6 dips.	
MH052	Pacmanus IV	17-Oct-97	Tow-yo	SuSu	Su Su	0:28	4:04	1782.3	nd	3	49.94	152	8.81	3	46.09	152	12.2	-3.83	152.15	-3.77	152.20	Stong to 15.6%	1060-1205			12 dips	
MH053	Pacmanus IV	18-Oct-97	Single Dip	SuSu	Su Su	21:18	23:03	1646	nd	3	49.29	152	6.25	3	49.13	152	6.36	-3.82	152.10	-3.82	152.11	V. weak (0.5%)	1500-1650	pH, O2		This appears to be all that is left of the lower plume from 1996. There was no indication of the upper plume from 1996. pH measurements showed no	
MH054	Pacmanus IV	18-Oct-97	Tow-yo	Tumbo	Su Su	3:21 8:09	8:09	2050	nd	3	46.95	152	0.96	3	46.44	152	1.65	-3.78	152.02	-3.77	152.03	Weak (0.6 %)	1115-1160				
MH055	Pacmanus IV	19-Oct-97	Tow-yo	Between SuSu and Nimab	Su Su		1:40	1929.5	7	3	50.68	152	6.62	3	46.119	152	11.45	-3.84	152.11	-3.77	152.19	Dramatic jump to 14%.	1160-1165, generally lay between 1050 and 1175m and gradually decreased to 1.8% at the end of the track	pH	12?	8 dips, bottles removed after U8 and rosette redeployed with 3 bottles. 12 samples total. Temperature anomaly of +0.015°C on U6 and D7.	All samples filtered, pH of unfiltered water measured. Sample MH-55/5 from within plume has weak pH anomaly of 0.08 (pH 7.51 vs background 7.57 - 7.59). No other samples
MH056	Pacmanus IV	20-Oct-97	Tow-yo	SuSu	Su Su	0:43	1:55	1542.3	nd	3	48.15	152	6.13	3	45	152	10.11	-3.80	152.10	-3.75	152.17	V strong, 26% rapidly decreasing to 0.9%	1020-1360. Weaker 1420-1610, 1325-1425			7 dips, Temperature anomaly of +0.05°C in maximum particulate anomaly. 11 samples filtered and pH measured. pH anomaly of 0.37 units (pH 7.22 - 7.36 vs background value 7.59) measured within plume. Sample at 1167m depth warmer than others. Samples for further analysis acidified. Negative test for brine pool near bottom of enclosed basin.	
MH057	Pacmanus IV	21-Oct-97	Tow-yo	SuSu	Su Su	8:06	9:30	1540	nd	3	48.09	152	6.51					-3.80	152.11			v.v. strong (44%),	1105-1190	strong H2S odour, pH, O2, ICP AES multi element (esp. Fe, Mn, Al)	11?		
MH058	Pacmanus IV	22-Oct-97	Single Dip	Basin near PACMANUS		0:14	11:31	2524.8	1472 nd	3	43.59	151	30.21	3	43.41	151	30.24	-3.73	151.50	-3.72	151.50	none					
MH059	Pacmanus IV	27-Oct-97	Tow-yo	Umbo Knolls	Su Su	8:38	6:43	2024.8		3	46.95	152	0.96	3	42.03	151	57.37	-3.78	152.02	-3.70	151.96	weak (0.4%) upper, and lower (0.25%)	1135 - 1210, 1545 - 1610			4 dips, plume is probably from Desmos.	
MH060	Pacmanus IV	27-Oct-97	Tow-yo	Tumbo	Su Su	3:39	6:30	2026	6	3	48.59	151	59.99	3	46.858	152	2.264	-3.81	152.00	-3.78	152.04	none				3 dips.	
MH061	Pacmanus IV	27-Oct-97	Single Dip	SuSu	Su Su	9:41	10:57	1669	900	3	49.49	152	8.49	3	49.488	152	8.492	-3.82	152.14	-3.82	152.14	strong (5.3%)	1070-1105	ICP AES multi element		All samples to be filtered from outside of the plume were lost when	
MV-01	Pacmanus IV			Snowcap				1650		3	43.68	151	40.23					151.67	3.73							no temp anomaly, operation aborted due to damage to acoustic release mechanism; no sample collected	
MV-02	Pacmanus IV			Snowcap				1650		3	43.67	151	40.25					151.67	3.73							no temp anomaly, water sample collected at bottom and analysed by ICP AES	
MV-03	Pacmanus IV			Snowcap				1652		3	43.66	151	40.23					151.67	3.73							no temp anomaly, water sample collected 30 mab, analysed by ICP AES multi-	
MV-04	Pacmanus IV			Snowcap				1652		3	43.71	151	40.23					151.67	3.73							no temp anomaly, water sample collected at bottom and analysed by ICP AES	
V-13	Papatua 1986 (Thos. Washington)	1986		Pual Ridge, near PACMANUS	Pual Ridge					3	43.4	151	40.2					-3.72	151.67			moderate (CH4)	1650-1700	CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	No transmissometer
V-14	Papatua 1986 (Thos. Washington)	1986		Bugave Ridge	Su Su					3	42.8	152	9.8					-3.71	152.16			moderate (CH4)	1600	CH4		NB. Depth, Latitude and Longitude are for Mid Point (NOT start or finish)	No transmissometer

	Manus Basin	Pual Ridge	Su Su Knolls	Other
Number of Operations	240	74	40	126
Number of Operations with Filters	62	23	11	28
Number of Operations with Water Analyses	74	39	14	21
Percent of Regions' Operations with Filters	25.8%	31.1%	27.5%	22.2%
Percent of Total CTD with Filter Samples		37.1%	17.7%	45.2%
Percent of Regions' Operations with Water Analyses	30.8%	52.7%	35.0%	16.7%
Percent of Total Water Analyses		52.7%	18.9%	28.4%
Percent of CTD Hydrocasts conducted		30.8%	16.7%	52.5%







Appendix 3

Sediments

HEMIPELAGIC MUDLINE SEDIMENTS WITH CSIRO ANALYSES

CSIRO analysis #	Operation	Location	Sample description (onboard logbook)	Sample details (laboratory notes)	Lithol	Type
	PUAL RIDGE AND VICINITY					
	SW Pual Ridge					
107434A	MD-22	SW end Pual Ridge	brown mud from one sediment trap	sloppy reddish brown	HEMI	A2
	Tsukushi					
118460	MG-6	PACMANUS, 200m SE of Tsukushi	ooze from a minicore, centre of grab	dark brown ooze below reworked grit layer, very close to top	HEMI	A4
	Between Tsukushi and Snowcap					
134018	MG-34	PACMANUS, between Snowcap & Tsukushi	brown mud, top 1 cm of grab	red-brown	HEMI	A4
	Snowcap					
118325	MD-24	PACMANUS, Snowcap, SE flank	brown ooze with dacite hyaloclast chips, one sediment trap	red-brown sloppy ooze, sieved wet to remove rock chips	HEMI	A2
118336	MD-27	PACMANUS, Snowcap, E side	brown mud with dacite chips from a sediment trap	red-brown sloppy ooze, sieved wet to remove rock chips	HEMI	A2
132339	MG-15	PACMANUS, east side of Snowcap	Minicore sample, silty clay	dark grey, topmost layer of minicore	HEMI	A4
132350	MG-16	PACMANUS. Snowcap	Sloppy mud 0-2 cm	olive-brown-grey, topmost layer	HEMI	A4
	Between Snowcap and Satanic					
107424	MD-20	PACMANUS, just NE of Snowcap	brown mud picked from dacite block	silty, reddish brown.	HEMI	A3
132412	MG-18	PACMANUS. 200 m E of Snowcap, 150m S of Satanic	bulk top layer with coarse rock fragments	light brownish grey, larger rock chips removed	HEMI	A4
	Satanic					
118357	MD-28	PACMANUS, NE side of Satanic Mills	brown mud with dacite chips from a sediment trap	sieved wet to remove rock chips	HEMI	A2
118853	84-GTV	PACMANUS, SE side of Satanic Mills (juvenile vent?)	dark drab brown mud collected off rock	picked free of larger rocks, shells, tubeworm, some chitin remains	HEMI	A4
	Roman					
132358	MD-56	PACMANUS (Roman Ruins)	brown mud from a sed trap, dacite chips	dacite chips pcked out	HEMI	A2
	Roman vicinity					
133942	MD-98	PACMANUS, 150m NE of Roman Ruins	brown ooze, bottom of dredge bag		HEMI	B3
	NE Crestal Knoll, Pual					
132249	MCV-24	Sample plotted half-way along track	dark gritty mud from back of camera cage	dark brown	HEMI	B5
	Twin Knolls					
118335	MD-26	Twin Knolls, N of PACMANUS	dark brown mud with andesite glass chips from one sediment trap	sieved wet to remove rck fragments	HEMI	A2
118503	MG-10	Enclosed basin near Twin Knolls	minicore, dark chocolate-brown mud,	dark brown, clayey	HEMI	A4
118609	MG-13	Head of West Valley, SW of Twin Knolls	brown mud from minicore	dark brown	HEMI	A2
	Flanks of Pual Ridge					
107380	MD-16	PACMANUS, west flank Pual	brown mud from a sediment trap	rock chips picked out	HEMI	A2
132544	MD-66	Knoll on eastern flank of Pual Ridge, E of Roman	mud scraped off rock	dark brown	HEMI	A3
132108	299-Sed	PACMANUS - E Flank Pual, Sed in basket from crash	brown mud in basket from crash,		HEMI	A5
	Sonne Pimple					
132262	MD-53	Sonne Pimple, Pual Ridge	mud from a sed trap	brown	HEMI	A2
133980	MD-99	Sonne Pimple, Pual Ridge	brown mud (+rock chips?), bag		HEMI	A3
	Pual Fork					
107236A	MD-7	Pual Fork, east of North Pual	brown ooze from one sediment trap	sloppy dark brown mud, rock chips removed	HEMI	A2
107236B	MD-7	Pual Fork, east of North Pual	brown ooze from second sediment trap	sloppy dark brown mud, rock chips removed	HEMI	A2
107262A	MD-8	Pual Fork, NE of Sonne on extension of main ridge	brown mud from crevice in lava fragment	dark brown, larger rock chips removed	HEMI	A3
107310A	MD-12	Pual Fork	sloppy dark brown mud from one sediment trap	sloppy dark brown mud	HEMI	A2
107310Z	MD-12	Pual Fork	sloppy dark brOwn mud from one sediment trap; repeat analysis	duplicate analysis	HEMI	A2
107333A	MD-13	Pual Fork, 1 km N of North Pual	brown mud with andesite glass chips from sediment traps	sloppy dark brown, rock chips removed	HEMI	A2
118386	MD-29	NE arm Pual, W side north knoll	brown mud from a sediment trap	dark reddish brown, rock chips removed	HEMI	A2
118510	MG-12	S end of Pual fork	minicore of brown mud,	dark brown, whole minicore used	HEMI	A4
	NE Arm Pual					
107438A	MD-23	NE arm Pual Ridge, E flank of small S knoll	brown mud with dacite chips from a sediment trap	deep chocolate bown, larger rock chips removed	HEMI	A2
118495	MD-39	Knoll, far NE arm Pual Ridge	sloppy brown mud with dacite chips, at back of one sediment trap	very dark brown, negligible rocks	HEMI	A2
118875	88/DR	Far N of NE Pual Ridge, east flank	dark brown sloppy mud	fragments of glass picked out	HEMI	A3
	East Valley					
132591	MD-70	Cone in East Valley, S of PACMANUS	Mud from a sed trap	dark brown, rock chips picked out	HEMI	A2
	Scarps NE of Pual					
118862	86/DR	Lower scarp to NE of Pual Ridge	dark brown ooze from dredge bag, with rocks	dark drab brown, one rock chip removed	HEMI	B3
	NW Arm Pual					
107304A	MD-10	Basin at W foot of NW arm Pual Ridge	mud from sediment traps (composite?)	sloppy, deep brown	HEMI	A2
107305A	MD-11	Pual Fork, near foot of NW Pual	mottled light and dark mud from sediment traps (composite)	sloppy, dark brown selected	HEMI	A2
107348A	MD-14	NW arm Pual Ridge, east foot	brown mud from one sediment trap	red-brown, sloppy	HEMI	A2
107383A	MCV-8	E foot of NW Pual Ridge	brown mud from camera cage	subsample, no notes	HEMI	B5
	OTHER EDIFICES (West to East)					
	Marmin Knolls					
107038A	MD-1	Marmin Knolls, central	brown mud from one sediment trap	dark chocolate-brown, sloppy	HEMI	A2
107088A	MD-2	Marmin Knolls, west	dark brown mud from one sediment trap	dark brown	HEMI	A2
107090A	MD-3	Marmin Knolls, east	dark brown mud with basalt chips, bottom of dredge bag	dark brown, sloppy; negligible rock chips/	HEMI	A3
132473	MD-64	NW Marmin Knolls	"top layer mud (bulk)" - from dredge bag	dark brown silty clay	HEMI	A3
134035	MD-101	Western Marmin Knollls, ridge	brown mud from a sed trap		HEMI	A2
	West Hammer Knoll					
118489	MD-38	Knoll W of Hammer Handle scarp N of Pual Ridge	red-brown ahead of grey mud from one sediment trap	dark brown, back (top) layer	HEMI	A2
	Yuam					
107149	MD-5	Yuam Ridge, SW	brown mud from one sediment trap	medium to dark brown	HEMI	A2
107173A	MD-6	Yuam Ridge, central	brown mud from one sediment trap	dark brown	HEMI	A2

CSIRO analysis #	units method(s)	SiO2	TiO2	Al2O3	FeO(t)	MnO	MgO	CaO	Na2O	K2O	P2O5	S	Total %
		% xrf	% aes	% aes	% aes	% aes	% aes	% aes	% aes	% aes	% aes	% aes	Majors
107434A		44.68	0.66	12.66	7.51	0.90	2.75	6.72	4.99	1.25	0.38	0.19	82.70
118460			0.56	12.30	7.36	1.11	2.53	8.03	4.68	1.14	0.44	0.28	38.44
134018		46.76	0.59	12.13	6.57	1.18	2.12	6.54	4.79	1.28	0.36	0.20	82.52
118325			0.63	13.91	8.70	0.76	2.81	3.48	5.42	1.15	0.52	0.59	37.97
118336			0.57	12.53	8.33	1.48	2.70	6.86	5.20	1.11	0.46	0.43	39.67
132339			0.64	12.42	8.70	1.03	2.72	5.77	4.14	1.13	0.53	0.33	37.40
132350			0.70	13.50	5.13	0.38	2.41	3.12	4.13	1.10	0.30	1.38	32.14
107424			0.57	11.83	14.15	0.25	3.08	3.69	4.00	1.22	1.02	0.41	40.22
132412			0.60	11.79	9.44	0.83	2.66	7.31	3.78	1.03	0.52	0.60	38.58
118357			0.50	11.10	7.43	1.27	2.75	6.77	7.94	1.15	0.44	0.57	39.92
118853			0.59	12.73	6.57	0.21	1.71	3.88	4.61	1.34	0.27	1.80	33.71
132358			0.57	10.75	8.94	2.08	2.57	6.45	4.81	1.05	0.54	0.66	38.42
133942			0.63	12.47	6.65	0.87	2.13	6.27	5.08	1.32	0.34	0.21	35.97
132249			0.60	12.09	7.90	1.84	2.78	8.33	3.80	1.11	0.49	0.23	39.17
118335			0.59	12.43	8.71	0.75	2.82	8.39	4.33	1.08	0.56	0.24	39.90
118503			0.58	12.47	7.77	1.23	2.85	7.20	4.82	1.14	0.45	0.31	38.81
118609			0.54	11.80	8.26	3.03	3.08	6.36	5.34	1.07	0.66	0.33	40.46
107380			0.62	12.13	7.69	0.79	2.49	6.31	5.01	1.28	0.38	0.24	36.94
132544			0.63	12.65	7.20	1.03	2.89	8.09	4.26	1.11	0.32	0.17	38.35
132108			0.61	13.22	7.39	2.14	2.61	5.42	5.34	1.20	0.56	0.29	38.79
132262			0.61	11.86	7.40	1.19	2.90	8.82	4.20	1.10	0.40	0.28	38.76
133980			0.70	12.64	7.59	0.67	2.62	7.72	4.90	1.15	0.43	0.19	38.59
107236A			0.66	12.21	8.20	1.34	2.75	6.41	5.73	1.22	0.55	0.23	39.29
107236B			0.59	11.21	8.32	2.10	2.87	6.53	6.11	1.13	0.68	0.28	39.82
107262A			0.63	11.51	7.25	1.34	2.67	9.37	4.91	1.01	0.45	0.23	39.38
107310A			0.60	11.66	8.46	1.77	2.88	6.98	5.41	1.16	0.53	0.25	39.71
107310Z			0.56	12.13	8.49	1.92	2.94	7.21	4.81	1.09	0.52	0.29	39.97
107333A		37.63	0.60	11.34	8.47	1.37	2.60	7.32	5.73	1.11	0.67	0.30	77.33
118386			0.57	12.06	8.57	1.24	2.83	8.31	4.83	1.04	0.62	0.30	40.37
118510			0.55	12.22	8.23	1.30	2.94	7.10	5.15	1.15	0.48	0.32	39.43
107438A			0.60	11.96	7.65	1.16	2.55	7.09	5.41	1.12	0.58	0.21	38.34
118495			0.54	11.68	8.40	2.36	2.93	7.14	5.43	1.09	0.74	0.35	40.65
118875			0.56	12.05	8.82	1.24	2.74	7.03	4.95	1.12	0.65	0.28	39.44
132591			0.62	12.25	7.23	0.72	2.73	7.18	4.83	1.22	0.39	0.19	37.37
118862			0.54	11.84	12.07	1.23	2.90	7.59	4.45	1.01	0.55	0.28	42.46
107304A			0.59	11.93	8.51	1.19	2.93	6.66	5.50	1.22	0.58	0.24	39.34
107305A			0.57	11.72	8.55	0.92	2.69	6.62	4.81	1.19	0.61	0.21	37.89
107348A			0.55	10.72	9.84	0.68	2.92	7.47	5.90	1.19	0.83	0.28	40.38
107383A			0.59	11.51	8.51	1.46	2.97	7.46	5.47	1.11	0.52	0.25	39.85
107038A			0.64	12.66	7.60	0.61	3.25	9.86	4.17	1.04	0.27	0.24	40.34
107088A			0.68	13.21	6.49	0.28	2.47	6.69	4.74	1.76	0.24	0.19	36.76
107090A			0.56	12.53	8.00	1.08	4.33	8.69	4.66	0.82	0.35	0.21	41.22
132473		40.99	0.63	12.28	8.16	0.57	3.14	7.81	4.49	1.17	0.37	0.20	79.79
134035			0.64	12.62	7.51	0.52	2.82	8.06	4.23	1.21	0.28	0.18	38.08
118489			0.82	13.57	9.78	0.22	3.01	7.06	3.96	1.34	0.28	0.20	40.23
107149			0.60	12.00	8.37	1.51	2.84	6.94	5.47	1.16	0.60	0.27	39.75
107173A			0.60	11.98	8.86	0.46	2.74	7.83	4.60	1.17	0.52	0.26	39.01

CSIRO analysis #	Li	Be	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Rb	Sr	Y
	ppm aes	ppm aes	ppm aes	ppm aes	ppm aes	ppm aes & ms	ppm aes	ppm aes	ppm aes	ppm ms	ppm ms	ppm aes	ppm ms	ppm aes	ppm aes
107434A	26	1.1	19	220	44	17	22	110	116			<5.0	17.2	396	22.3
118460	23	0.7	17	196	35	20	26	276	236	13.1	5.8	49	17.5	448	21.6
134018	21	0.8	15	148	27	18	24	365	236	17.7	27.1	51	21.4	377	24.4
118325	29	1.4	24	255	65	20	34	1485	384	14.8	5.8	102	14.7	323	24.1
118336	25	0.8	18	216	39	21	39	1443	648	11.7	5.5	98	15.2	412	21.1
132339	23	0.7	18	229	38	23	26	2525	639	13.9	12.4	148	16.6	399	20.5
132350	22	1.5	22	174	56	18	21	1801	650	14.9	9.2	294	17.6	313	18.2
107424	23	1.1	21	326	43	14	29	4590	1600			349	15.9	445	21.0
132412	21	0.7	18	238	38	22	24	4272	1066	14.6	12.6	201	15.8	474	18.9
118357	22	0.7	15	187	98	17	85	2109	503	10.8	4.7	87	14.4	393	19.6
118853	22	0.9	23	167	67	13	23	1161	899	9.8	4.7	103	14.0	314	23.5
132358	20	0.7	16	227	37	19	66	4073	1369	13.8	12.8	308	15.4	646	18.8
133942	20	0.8	15	134	29	16	22	565	510	18.4	27.7	49	22.8	376	25.0
132249	24	0.6	18	233	39	23	39	317	234	13.7	9.8	60	16.8	477	19.3
118335	24	0.6	18	262	48	24	27	119	117	13.1	5.5	52	16.9	472	22.5
118503	27	0.7	18	219	40	23	32	126	131	13.3	5.7	41	16.8	422	21.5
118609	25	0.6	18	252	44	24	38	150	133	12.3	4.7	64	16.9	462	21.5
107380	26	1.2	18	213	42	12	22	96	8700			14	19.0	399	23.9
132544	25	0.7	20	218	44	24	38	150	149	14.5	11.4	37	18.2	387	19.5
132108	19	0.7	17	191	36	20	31	336	242	14.8	17.1	67	19.1	423	21.7
132262	24	0.6	18	230	38	23	55	166	330	13.5	10.2	53	16.1	426	18.9
133980	19	0.7	17	203	28	21	20	92	90	16.3	27.6	33	18.9	428	22.4
107236A	22	1.1	19	256	37	18	22	108	143			<5.0	17.5	405	22.3
107236B	22	1.0	19	261	42	17	23	111	117			<5.0	15.0	456	20.7
107262A	20	1.2	18	227	17	18	22	107	118			<5.0	14.2	430	21.0
107310A	25	1.1	20	267	42	20	24	121	170			<5.0	17.1	436	20.9
107310Z	25	0.6	19	260	40	26	35	133	174	12.6	5.1	60	14.8	454	21.3
107333A	22	1.1	19	268	47	17	23	108	189			<5.0	13.9	442	21.4
118386	23	0.6	18	263	39	24	28	120	168	12.6	4.6	50	15.0	486	21.1
118510	30	0.7	18	236	41	20	34	168	170	12.4	4.9	52	16.9	428	21.6
107438A	21	0.9	17	237	33	20	18	103	157			<5.0		418	18.9
118495	24	0.6	18	257	43	25	34	113	119	12.8	5.6	66	15.6	453	21.3
118875	24	0.7	18	268	44	22	30	110	207	12.9	5.7	64	15.6	451	23.0
132591	21	0.8	18	215	46	22	28	97	116	14.4	11.6	43	18.4	389	21.7
118862	27	0.6	19	255	53	25	37	132	131	12.6	5.6	60	15.3	445	20.6
107304A	33	1.1	19	254	34	22	22	96	112			<5.0	21.0	359	22.0
107305A	26	1.1	19	262	26	18	22	95	117			<5.0	16.5	371	23.4
107348A	28	1.3	19	290	39	17	26	100	119			27	15.3	384	23.9
107383A	28	1.1	20	269	26	18	27	109	520			<5.0	14.6	440	20.9
107038A	28	0.9	22	215	22	18	23	90	104			<5.0	13.7	414	18.7
107088A	23	1.1	19	163	24	14	19	72	90			<5.0	21.3	349	23.6
107090A	20	1.0	25	255	107	23	28	112	100			<5.0	11.7	346	18.4
132473	30	0.7	20	259	58	25	40	99	129	14.0	12.6	48	17.7	360	21.5
134035	29	0.7	19	191	35	23	28	81	107	15.1	24.1	23	18.4	398	21.4
118489	35	0.7	21	281	39	28	28	106	117	15.4	7.0	30	19.4	330	23.8
107149	28	1.1	19	268	35	20	24	121	132			<5.0	17.1	489	21.4
107173A	29	1.1	20	291	23	16	22	113	131			<5.0	16.1	394	22.6

Zr	Mo	Ag	Cd	In	Sb	Te	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Au	Tl	Pb	Bi	Th	U	Latitude		Longitude		Decimal	Decimal	Depth	LAT negative
ppm aes	ppm aes & ms	ppm aes	ppb aes & ms	ppb ms	ppb aes & ms	ppb ms	ppb ms	ppm aes	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppb naa	ppb ms	ppm aes & ms	ppb ms	ppb ms	ppb ms	deg	min	deg	min	Long	Lat	(m)	
58	2.1	5.5	433				753	300	8.44	16.45	2.67	12.96	3.24	1.04	3.68	0.641	4.42	0.864	2.67	0.365	2.24				34		830	909	3	45.235	151	38.635	151.64391	3.75391	1965	-3.75391
67	4.0	1.2	387				684	446	8.15	16.10	2.50	11.23	3.08	1.02	3.55	0.592	3.64	0.919	2.77	0.405	2.46			520	67	260	1126	1322	3	43.860	151	40.117	151.66862	3.73100	1665	-3.73100
56	6.4	2.2	603	254	962	542	1067	527	10.68	23.30	3.41	14.97	4.10	1.66	4.03	0.845	4.74	1.065	3.20	0.460	3.25			857	70	327	1085	1385	3	43.740	151	40.095	151.66825	3.72900	1667	-3.72900
70	10.2	1.1	475				841	935	8.28	15.94	2.47	11.17	2.93	1.13	3.74	0.674	4.02	1.046	3.02	0.420	2.76		266	1520	447	3059	1294	3663	3	43.698	151	40.223	151.67038	3.72830	1653	-3.72830
63	16.2	0.8	580				623	1024	7.79	14.39	2.17	10.12	2.55	0.98	3.02	0.542	3.16	0.841	2.45	0.367	2.42		165	2223	259	1881	1167	1650	3	43.675	151	40.214	151.67024	3.72791	1660	-3.72791
56	5.5	1.6	434	1023		3173	1512	2067	8.88	18.01	2.76	9.81	2.75	1.23	3.40	0.554	3.50	0.779	2.23	0.330	2.78			3134	266	2419	731	986	3	43.666	151	40.256	151.67093	3.72777	1653	-3.72777
71	41.2	3.0	2728	1088		3940	2716	2949	6.98	16.43	2.42	10.37	2.97	1.43	3.69	0.583	3.82	0.805	2.42	0.371	2.82			5848	253	2520	945	4779	3	43.695	151	40.205	151.67008	3.72825	1652	-3.72825
30	4.2	8.3	400				671	4060	8.10	14.06	2.33	10.47	2.76	1.76	3.19	0.552	3.71	0.792	2.36	0.324	2.02			743	560	9157	832	4594	3	43.602	151	40.281	151.67135	3.72671	1695	-3.72671
51	6.1	2.6	996	1723		5916	2167	3713	8.95	17.73	2.73	10.32	2.80	1.56	3.57	0.556	3.57	0.796	2.27	0.339	2.87			6156	447	5141	726	1143	3	43.699	151	40.310	151.67183	3.72832	1660	-3.72832
60	22.1	0.9	345				528	1060	7.24	13.07	2.02	8.91	2.55	0.90	2.83	0.478	3.11	0.826	2.41	0.338	2.19		173	1583	198	2386	914	1469	3	43.540	151	40.415	151.67358	3.72566	1688	-3.72566
88	107.3	5.2	8217				945	1453	7.56	17.00	2.60	11.53	3.23	1.27	3.92	0.680	4.09	1.111	3.19	0.505	3.29		184	27212	417	862	1490	31449	3	43.636	151	40.376	151.67293	3.72727	1710	-3.72727
50	19.3	2.6	810	2166		1267	4820	10818	9.69	17.61	2.70	11.27	2.91	2.74	4.04	0.575	3.61	0.785	2.31	0.345	2.81			15387	967	2273	750	1550	3	43.212	151	40.516	151.67526	3.72019	1689	-3.72019
59	7.9	2.6	578	308	1290	412	1203	1048	11.29	24.67	3.55	15.35	4.37	2.03	4.41	0.927	5.20	1.057	3.18	0.474	3.29			1361	116	310	1034	1247	3	43.183	151	40.558	151.67596	3.71972	1689	-3.71972
50	5.4	1.4	513	274		1183	939	435	8.61	17.70	2.70	10.95	3.01	1.04	3.41	0.577	3.79	0.811	2.34	0.348	2.72			1075	53	597	845	1063	3	43.135	151	41.108	151.68513	3.71892		-3.71892
61	2.7	0.8	420				537	292	7.55	14.17	2.24	10.05	2.63	0.88	3.08	0.549	3.40	0.894	2.70	0.374	2.70			256	30	119	1040	1075	3	42.470	151	39.882	151.66470	3.70783	1880	-3.70783
62	3.2	0.7	354				674	290	8.13	15.61	2.48	10.97	2.84	0.97	3.66	0.615	3.44	0.923	2.69	0.365	2.41			475	29	132	1016	1210	3	42.048	151	40.452	151.67420	3.70080	1939	-3.70080
58	8.1	0.0	493				582	305	7.59	13.47	2.22	8.87	2.19	0.76	2.88	0.564	3.27	0.905	2.63	0.365	2.24		19	1112	31	106	802	1122	3	42.788	151	39.180	151.65300	3.71313	2215	-3.71313
70	4.2	5.6	379				802	300	86.82	17.38	2.82	13.13	3.56	1.14	3.87	0.661	4.36	0.943	2.83	0.389	2.49			204	249		893	1038	3	43.317	151	39.950	151.66583	3.72195	1720	-3.72195
54	6.4	1.5	470	155		350	842	312	8.42	17.43	2.58	11.25	2.95	1.11	3.32	0.586	3.77	0.800	2.34	0.342	2.45			759	44	165	765	872	3	43.217	151	41.376	151.68960	3.72028	1716	-3.72028
70	7.8	0.0	389	212			699	572	8.44	17.55	2.70	12.25	3.15	1.20	3.88	0.653	4.03	0.859	2.65	0.377	2.50			631	71	454	914	931	3	43.979	151	40.470	151.67450	3.73298	1782	-3.73298
50	8.4	1.8	972	169		883	958	512	8.46	17.18	2.62	9.97	2.71	0.96	3.15	0.560	3.50	0.755	2.22	0.341	2.70			2354	83	137	730	966	3	42.560	151	41.359	151.68932	3.70933	1674	-3.70933
57	2.2	2.7	532	128	425	239	807	271	9.39	21.02	3.11	14.21	3.69	1.40	3.48	0.796	4.61	1.040	3.06	0.412	3.02			383	24	77	995	966	3	42.556	151	41.429	151.69048	3.70927	1668	-3.70927
60	9.2	4.3	536				625	273	8.12	15.43	2.55	12.13	3.13	1.05	3.77	0.631	4.17	0.905	2.56	0.360	2.20			357	33		809	1074	3	40.384	151	44.133	151.73555	3.67307	1880	-3.67307
52	6.0	5.4	632				710	283	8.33	15.37	2.24	12.78	2.82	1.06	4.08	0.656	4.15	0.917	2.27	0.323	2.51			493	37		820	1192	3	40.384	151	44.133	151.73555	3.67307	1880	-3.67307
57	14.4	6.7	772				468	245	6.88	13.13	2.42	10.03	2.92	0.95	2.94	0.511	3.56	0.695	2.38	0.344	1.65			582	35		681	1020	3	41.962	151	42.232	151.70387	3.69937	1830	-3.69937
46	8.8	5.0	461				778	326	8.39	15.20	2.43	12.49	3.11	0.99	3.74	0.621	4.00	0.872	2.47	0.328	2.20		43	724	50		777	1172	3	40.715	151	42.083	151.70138	3.67859	1872	-3.67859
57	8.7	3.8	715				732	312	8.84	16.58	2.60	11.64	2.93	1.02	3.70	0.677	4.00	0.984	2.75	0.421	2.35			1255	36	83	973	1397	3	40.715	151	42.083	151.70138	3.67859	1872	-3.67859
55	4.0	4.8	433				675	288	7.92	14.66	2.58	11.79	3.42	1.10	3.55	0.629	4.14	0.913	2.63	0.339	2.25				204		878	1234	3	39.727	151	43.647	151.72746	3.66212	1950	-3.66212
54	3.1	1.0	399				655	286	7.80	14.47	2.15	9.45	2.64	0.86	3.10	0.535	3.29	0.873	2.53	0.342	2.30			407	38	93	883	1151	3	41.447	151	42.282	151.70471	3.69078	1820	-3.69078
60	3.5	1.4	413				713	306	7.65	14.99	2.33	10.15	2.72	0.81	3.27	0.604	3.51	0.947	2.67	0.405	2.41		22	595	40	166	974	1149	3	41.228	151	41.815	151.69692	3.68713	1868	-3.68713
58	3.8	0.8	633				519	270	8.63	15.31	2.54	12.35	2.99	1.02	3.96	0.613	3.97	0.808	2.56	0.371	2.54			216	52		957	1224	3	41.991	151	43.490	151.72484	3.69985	1925	-3.69985
56	11.4	1.4	688				591	277	7.91	14.78	2.34	10.97	2.99	0.92	3.48	0.614	3.63	0.944	2.51	0.423	2.39			1457	30	114	1030	1807	3	40.537	151	44.737	151.74562	3.67562	1840	-3.67562
60	4.1	0.7	473				611	276	8.79	17.03	2.72	12.37	3.33	1.01	3.80	0.659	4.06	1.099	2.90	0.458	2.82			349	29	89	881	1288	3	39.936	151	46.520	151.77534	3.66560	2120	-3.66560
63	2.3	1.4	366	125		307	843	262	9.50	20.07	3.00	12.49	3.35	1.09	3.72	0.631	4.03	0.912	2.68	0.394	2.93			360	23	88	868	873	3	45.248	151	40.220	151.67034	3.75413	2036	-3.75413
55	4.6	0.3	322				589	245	7.88	14.66	2.32	10.85	2.86	0.92	2.97	0.495	3.43	0.943	2.64	0.361	2.25			329	29	108	829	1100	3	36.778	151	49.605	151.82675	3.61297	2130	-3.61297
33	4.7	4.6	1222				791	241	9.25	15.71	2.94	12.53	3.42	1.04	4.38	0.618	4.27	0.895	2.86	0.403	2.40		17	352	34		867	1073	3	38.644	151	42.333	151.70555	3.64407	2120	-3.64407
44	2.8	5.3	420				606	267	7.94	15.18	2.72	11.80	3.49	1.03	3.70	0.635	4.27	0.915	2.70	0.409	2.11				35		781	986	3	38.925	151	44.023	151.73371	3.64876	2050	-3.64876
53	2.1	9.5	459				668	262	8.10	15.65	2.58	12.99	3.39	1.08	3.85	0.707	4.61	0.954	2.72	0.374	2.45				35		700	942	3	39.102	151	43.918	151.73196	3.65169	2020	-3.65169
55	3.8	6.1	481				672	275	7.50	14.45	2.24	11.40	3.10	1.01	3.48	0.598	3.93	0.790	2.24	0.328	2.11			249	40		734	1145	3	40.2	151	43.1	151.71833	3.67000	~1890	-3.67000
53	1.4	3.8	339				603	260	6.05	12.78	2.41	9.90	3.22	0.96	3.37	0.531	3.48	0.679	2.44	0.319	1.57				24		822	871	3	42.549	151	34.106	151.56844	3.70914	1625	-3.70914
82	1.3	4.4	206				946	287	9.31	18.57	2.94	14.11	3.66	1.09	4.16	0.676	4.81	0.952	2.87	0.415	2.66				17		1124	865	3	40.940	151	32.742	151.54570	3.68233	1915	-3.68233
47	3.6	5.3	701				573	215	6.77	10.75	1.88	9.17	2.62	0.87	3.28	0.483	3.87	0.769	2.31	0.714	1.95				31		591	881	3	42.854	151	36.773	151.61289	3.71423	2200	-3.71423
56	1.8	1.8	422	122		397	847	266	9.25	18.62	2.85	11.28	3.03	0.97	3.57	0.612	3.96	0.837	2.52	0.368	2.56			326	19	99	810	737	3	39.183	151	36.190	151.60316	3.65306	2254	-3.65306
48	1.7	2.5	325	109	569	427	959	502	8.74	19.46	2.88	12.94	3.44	1.38	3.33	0.719	4.07	0.862	2.64	0.373	2.61			248	29	75	956	1017	3	40.983	151	33.263	151.55438	3.68306	1639	-3.68306
72	1.7	1.1	419				808	206	9.15	18.03	2.85	12.69	3.31	1.05	4.12	0.735	4.23	1.102	3.07	0.486	2.95			168	19	129	1245	1116	3	35.887	151	40.887	151.68146	3.59812	2150	-3.59812
56	2.9	4.8	581				754	300	8.27	15.52	2.75	12.22	3.62	1.14	3.55	0.666	4.30	0.964	2.73	0.359	2.33		23	387	46		919	1053	3	42.371	151	43.945	151.73241	3.70619	2170	-3.70619
49	1.5	4.5	253				572	234	6.30	12.84	2.71	9.69	3.47	1.01	2.75	0.607	4.07	0.720	2.97	0.411	1.84				34		903	1106	3	42.181	151	46.145	151.76908	3.70302	1900	-3.70302

	Umbo																																
118592	MD-43	Umbo Knolls, E flank of East Knoll	sloppy brown mud from one sediment trap	dark brown, some rock chips removed	HEMI	A2		0.54	12.22	9.11	1.65	2.91	6.81	4.82	1.10	0.66	0.30	40.12	26	0.6	19	269	43	25	34	125	122	12.7	4.7	67	16.8	408	22.3
134310	MD-115	Umbo Knolls, west peak	brown mud from chainbag		HEMI	B3	42.71	0.59	12.41	7.95	0.69	3.87	8.17	5.28	1.20	0.30	0.25	83.40	24	0.6	20	198	57	25	40	76	90	14.2	26.4	33	17.3	357	19.4
	Tumbo-Lunar-Tumai																																
133637	MD-90	East Tumbo Knoll	brown mud, bottom of dredge	brown	HEMI	B3		0.54	12.91	7.50	0.30	2.60	7.78	4.01	1.24	0.42	0.24	37.53	28	0.7	19	209	36	20	26	82	108			41		394	22.1
118605	MD-44	NW end, Tumai Ridge	sloppy brown mud from one sediment trap	dark brown, sloppy	HEMI	A2	39.25	0.58	12.94	7.89	1.57	2.95	6.78	5.03	1.10	0.49	0.33	78.91	27	0.6	19	225	38	23	31	116	99	14.0	5.4	43	16.5	425	20.2
132875	MD-79	Lunar Cone	Brown mud from dredge bag	brown	HEMI	A3	40.63	0.60	13.75	7.71	0.80	3.26	7.44	4.22	1.08	0.32	0.27	80.07	25	0.6	21	221	44	28	29	93	97			33		378	20.4
	Bugave Ridge & vicinity																																
132709	MD-74	Basement scarp near Weitin Fault/Bugave Ridge	mud from one sed trap	brown	HEMI	B2		0.67	15.15	7.71	0.16	3.05	5.77	4.11	1.16	0.19	0.77	38.74	43	0.6	23	201	30	27	22	135	103			20		341	19.3
134135	MD-106	Young lava field NW end of Tumai Ridge	brown mud from a sediment trap	brown	HEMI	A2		0.50	13.22	5.17	0.14	1.97	5.68	3.98	1.23	0.18	0.17	32.24	21	0.7	17	140	23	16	15	66	77			13		302	24.9
132688	MD-73	Nimab, SW foot	brown mud, sed trap	brown	HEMI	A2		0.61	14.04	6.59	0.17	2.66	8.92	4.13	1.11	0.24	0.49	38.96	25	0.7	20	177	31	23	21	102	87			24		422	17.8
133573	MD-88	Crest of Nimab	dark grey clay from one sed trap (others layered with brown)	dark grey selected	HEMI	C2		0.71	15.23	5.50	0.11	2.30	3.00	4.34	1.82	0.19	0.17	33.38	29	0.9	19	150	21	18	13	50	94			10		236	25.7
	Small volcanoes near SuSu Knolls																																
133556	MD-87	Small volcano S of Nimab	brown gritty mud from one sed trap		HEMI	A2	39.57	0.52	12.34	6.12	0.14	2.44	12.72	3.92	1.07	0.24	0.33	79.41	23	0.6	17	163	27	18	19	80	85			27		480	17.7
133620	MD-89	Small knoll, NW of SuSu Knolls	brown sloppy mud, bottom of dredge		HEMI	A3		0.54	13.22	6.35	0.18	2.47	7.21	4.28	1.18	0.25	0.36	36.05	28	0.7	18	179	31	23	25	163	101			29		362	21.4
134165	MD-108	Small volcano on scarp SW of SuSu Knolls	Brown mud from a sed trap	brown	HEMI	A2	47.86	0.47	12.51	5.91	0.31	2.17	7.38	4.55	1.20	0.24	0.23	82.83	24	0.7	17	161	25	16	22	70	84			26		372	21.0
	Basement Scarps																																
118428	MD-31	Basement scarp, S of Yuam Ridge	dark green-grey mud with brown patches, from one sediment trap	selected dark brown mud	HEMI	A2	37.75	0.62	13.59	8.76	1.81	3.00	5.30	4.74	1.19	0.68	0.27	77.72	29	0.7	19	244	39	24	33	119	141	13.6	6.6	52	19.1	402	23.4
118430	MD-32	Basement scarp, S of Yuam Ridge	"mixed olive-green and brown mud", from one sediment trap	selected dark brown mud, sloppy	HEMI	A2		0.54	11.89	8.49	2.00	2.96	7.32	5.50	1.06	0.76	0.36	40.89	25	0.6	18	252	39	23	33	113	121	12.6	5.3	70	15.9	473	21.8
118435	MD-33	Basement ridge, W foot (5th W), far NW EMVZ	brown before light green mud, from one sediment trap	selected dark brown mud, sloppy	HEMI	A2	41.16	0.58	13.48	7.12	1.12	2.68	6.94	4.32	1.16	0.26	0.21	79.03	29	0.6	19	180	29	25	34	82	104	14.4	5.6	22	18.4	385	21.2
118437	MD-34	Basement ridge (5th W of Kumul), far NW EMVZ	brown before light green-grey mud, from one sediment trap	sloppy, dark brown mud	HEMI	A2		0.65	13.96	7.80	1.49	3.11	7.01	4.34	1.13	0.27	0.24	40.02	32	0.6	21	220	33	27	38	101	120	15.2	5.8	18	18.6	390	20.9
118488	MD-37	W base of Hammer Handle, scarp N of Pual	grey/green to red-brown sloppy mud, from one sediment trap	selected chocolate brown mud	HEMI	A2		0.70	14.06	6.95	0.54	2.46	5.19	4.48	1.92	0.39	0.15	36.85	25	0.9	18	161	24	20	17	64	99	16.3	5.5	22	26.0	316	27.4
118516	MD-40	Basement ridge near Djaul Flt, 10nm S of Pual Ridge	dark brown mud with forams ahead of paler brown, from one sed trap	darkest brownvariant	HEMI	A2	38.57	0.62	13.76	7.07	0.72	2.40	6.40	4.21	1.52	0.29	0.19	75.75	27	0.8	18	160	24	23	24	84	109	14.0	4.3	19	23.1	371	24.1
132435	MD-63	Basement knoll/scarp, N end Kumul Trough	mud from a sed trap	dark brown with black laminae	HEMI	A2		0.63	12.25	8.12	2.96	3.22	5.93	4.81	1.10	0.51	0.23	39.75	28	0.6	20	268	46	26	45	112	114	16.0	13.5	56	18.7	426	20.4
132503	MD-67	Basement scarp, W side of Kumul Trough	mud from a sed trap	dark brown	HEMI	A2		0.62	13.57	6.62	0.69	2.72	6.90	4.01	1.09	0.21	0.14	36.56	25	0.7	20	192	33	23	29	75	91	15.2	11.7	24	18.5	329	18.7
132569	MD-69	Basement scarp SE of Yuam Ridge	Unconsolidated brown mud from a sed trap	dark brown	HEMI	A2		0.59	12.11	7.39	0.60	2.41	6.99	4.99	1.19	0.37	0.22	36.87	26	0.7	17	221	36	21	29	85	109	14.0	11.4	48	18.7	389	21.9
134132	MD-105	Ridge near NW end of Weitin Fault	brown mud from a sed trap		HEMI	A2	38.92	0.66	13.00	9.45	0.28	3.19	7.77	4.50	1.05	0.38	0.20	79.39	33	0.6	20	245	48	23	26	79	94	15.5	34.9	46	18.1	332	22.3
134185	MD-109	Scarp at SW margin Eastern Manus Basin	brown-olive mud from a sed trap	brown selected	HEMI	B2	41.81	0.69	14.41	6.83	0.31	2.43	7.33	3.83	1.30	0.30	0.32	79.55	38	0.8	17	160	24	19	16	64	80	18.5	25.2	22	26.0	394	21.2
	SEDIMENT BASIN SAMPLES																																
	Sediment Basins, west of Kumul																																
107178A	MS-3	Graben NW of Kumul	dark brown sloppy mud, 0-1 cm	chocolate brown	HEMI	A1		0.73	13.29	8.00	3.29	3.28	4.11	5.19	1.22	0.36	0.38	39.85	22	1.4	24	236	46	19	31	94	91		<5.0		17.7	298	24.0
	Sediment Basins, Kumul Trough and NE																																
107109A	MS-2	Kumul Trough	dark green-brown mud; 0-1 cm	dark greenish brown	HEMI	A1		0.68	14.50	6.19	0.72	2.40	5.60	4.53	1.36	0.21	0.36	36.54	37	1.2	19	149	24	13	17	62	79		<5.0		22.7	329	20.4
107211	MS-5	Enclosed basin between W Pual and Hammer Ridges	dark brown sloppy mud, 0-1 cm	dark greenish brown	HEMI	A1		0.65	13.27	6.78	4.82	2.62	2.35	5.68	1.31	0.34	0.40	38.21	31	1.3	18	183	27	15	19	87	95		<5.0		19.3	278	19.7
118634	MS-18	NE end Kumul Trough	brown mud, scattered forams, 0-2 cm	variation from light brown to olive-brown	HEMI	A1		0.63	14.86	6.39	2.72	2.49	4.56	3.70	1.23	0.27	0.22	37.06	34	0.8	18	162	26	20	22	73	85	16.4	3.9	23	24.7	314	20.8
132281	MS-22	N Kumul Trough	Unit 1, topmost (3-5.5 cm)	dark brown	HEMI	A1	39.40	0.68	12.87	7.92	2.64	3.09	5.47	4.69	1.11	0.39	0.22	78.48	30	0.6	21	242	37	27	44	100	113	15.9	12.5	50	18.2	387	20.4
	Sediment Basins, Marmin & vicinity																																
107099A	MS-1	Marmin Knolls, enclosed basin	dark green-brown mud; 0-1 cm	deep chocolate brown	HEMI	A1		0.57	11.96	7.70	1.27	3.73	8.07	5.18	1.00	0.43	0.25	40.16	22	1.0	22	231	80	21	26	104	103		<5.0		14.6	395	19.0
118647	MS-19	NE of Marmin Knolls	laminated brown mud, scattered forams, 0-3 cm	variable pale to medium brown	HEMI	A1		0.58	12.51	7.87	3.76	3.00	5.62	4.33	1.06	0.50	0.27	39.50	26	0.6	19	239	39	25	43	111	112	12.9	4.1	44	15.9	382	21.4
134143	MS-46	Enclosed basin, SW Marmin Knolls	0-5 cm		HEMI	A1		0.64	14.05	6.00	0.36	2.31	6.73	3.97	1.29	0.21	0.39	35.96	33	0.8	17	141	21	19	16	61	73	17.1	21.6	11	23.3	385	20.5
	Sediment Basins, NE of Pual Ridge & Pual Fork																																
118363	MS-13	Saddle in Pual Fork, 400m S of North Pual	mud with hyaloclastite, collapsed core	sieved wet to obtain mud sample	HEMI	B1		0.53	11.10	7.71	1.82	2.96	7.47	7.33	1.07	0.60	0.44	41.04	22	0.6	17	239	37	22	33	110	120	11.9	4.7	53	14.8	484	20.1
118517	MS-15	Basin NE of Pual fork	brown mud, 0-3 cm	dark brown	HEMI	A1		0.56	12.25	9.19	3.11	3.03	5.75	4.49	1.07	0.88	0.29	40.60	25	0.7	19	282	51	26	33	128	123	13.2	5.4	79	15.1	448	22.5
132637	MS-30	Basin NE of PACMANUS	Unit 1, 0-7 cm, brown mud (top of giant turbidite?)	pale brownish grey	HEMI	A1	33.02	0.52	10.59	8.91	4.15	3.06	4.75	6.44	1.05	1.20	0.37	74.06	22	0.6	18	293	58	21	34	115	120	14.0	13.1	109	15.1	478	19.9
132746	MS-31	Basin NE of PACMANUS	Unit 1, 0-7 cm, brown mud	dark brown, silty clay	HEMI	A1		0.59	12.31	7.20	1.86	2.63	5.61	5.42	1.17	0.59	0.32	37.70	27	0.7	17	220	38	20	26	89	114	14.8	10.8	63	18.9	406	19.8
132839	MS-32	Basin NE of PACMANUS	Unit 1, 0-8 cm	brownish grey	HEMI	A1		0.55	11.02	8.58	2.81	3.07	5.30	6.42	1.08	0.97	0.36	40.16	25	0.6	18	279	54	22	36	109	119	13.7	11.5	90	16.3	461	19.8
134275	MS-47	Shallow enclosed basin, NE along stike from NW Pual	0-5 cm		HEMI	A1		0.73	13.10	8.32	0.87	2.77	7.08	4.73	1.10	0.58	0.18	39.46	21	0.7	18	233	31	22	20	81	97	17.4	28.5	41	18.2	420	22.8
134331	MS-48	Large basin NE of Pual	0-4 cm		HEMI	A1	37.76	0.59	13.11	8.62	2.55	3.30	6.25	4.59	1.11	0.65	0.21	78.73	32	0.6	19	237	43	27	38	93	99	19.8	30.5	69	19.4	422	20.9
	East Valley Sediment Basin																																
107199A	MS-4	East Valley, enclosed basin	dark brown sloppy mud, 0-1 cm	chocolate brown	HEMI	A1		0.64	13.53	6.46	3.77	2.54	3.51	5.50	1.33	0.31	0.26	37.83	35	1.3	18	180	26	14	20	77	97		<5.0		20.0	291	19.9
107450	MS-6	Shallow enclosed basin S of Pual Ridge	dark brown clay, 0-1 cm	dark chocolate brown	HEMI	A1		0.61	11.96	7.21	1.63	3.08	8.11	6.35	1.00	0.44	0.32	40.73	29	0.9	19	224	21	17	21	95	96		<5.0		13.1	392	17.7
118370	MS-9	East Valley, E of PACMANUS	dark brown mud, 0-1 cm	variable dark brown	HEMI	A1		0.59	13.56	7.32	3.13	2.76	5.18	4.57	1.14	0.43	0.30	39.00	28	0.7	18	211	32	21	30	172	139	15.2	5.5	40	19.9	364	21.2
118360	MS-10	East Valley, S of PACMANUS	silt and very fine sand, collapsed in core liner	dark brown mud, rock chips, stick and chitin pieces removed	HEMI	B1		0.62	13.54	7.06	0.78	2.67	7.06	4.91	1.20	0.32	0.28	38.43	25	0.7	17	194	33	19	28	108	106	15.0	4.8	30	19.6	399	21.4
118474	MS-14	East Valley	silty foram mud, dark brown, 0-2 cm	dark brown mud, variagated colour	HEMI	A1		0.60	13.88	7.38	2.39	2.67	5.37	4.43	1.17	0.44	0.28	38.63	30	0.8	18	208	34	23	27	112	123	14.8	5.3	35	18.7	363	21.6
118530	MS-16	East Valley	dark brown mud, 0-2 cm	dark brown mud, variagated colour	HEMI	A1		0.58	13.38	7.08	5.24	2.72	3.82	4.43	1.13	0.50	0.27	39.15	29	0.7	17	203	34	22	33	95	106	15.4	4.1	40	20.7	338	21.0
118659	MS-20	East Valley	dark brown mud, scattered forams, 0-3 cm	brown mud	HEMI	A1		0.59	13.41	7.22	1.11	2.51	7.21	3.83	1.15	0.38	0.23	37.63	28	0.7	18	206	34	21	26	93	105	14.7	4.0	33	18.1	407	21.9
118931	97SL	East Valley	dark brown mud with dacite chips, near surface	dark brown ooze; rock chips and chitin fragments removed	HEMI	B1		0.60	13.19	7.94	0.68	2.68	6.80	4.45	1.22	0.46	0.28	38.29	29	0.7	18	235	36	22	26	97	111	13.9	4.5	44	19.7	411	22.5
	Sediment Basins, Yuam-DESMOS area																																
107445	MS-8	Sth of DESMOS	green-brown silty mud, 0-1 cm	greenish brown, not sloppy	HEMI	B1		0.71	15.04	6.30	0.15	2.30	6.46	4.61	1.51	0.20	0.20	37.49	43	1.1	18	139	8	10	14	50	78		<5.0		21.9	358	19.4
118618	MS-17	Sth of Yuam Ridge	dark brown mud, 0-2.5 cm	dark brown to olive brown	HEMI	A1		0.64	15.33	6.19	2.76	2.40	3.53	3.88	1.22	0.27	0.25	36.47	35	0.9	18	144	26	20	14	73	86	17.2	4.4	16	26.7	271	20.3
	Sediment Basins, Central area																																
132325	MS-25	Proposed EMB-5A site (ODP), Central basin	Unit 1, 0-7cm, sloppy brown mud		HEMI	A1		0.65	14.48	6.13	0.79	2.35	5.46	4.56	1.24	0.26	0.33	36.26	35	0.8	17	127	22	18	11	57	79	17.3	19.3	15	22.1	319	20.4
132335	MS-25	Proposed EMB-5A site (ODP), Central basin	Unit 15, 76-79 cm	mud, pale grey				0.57	12.40	7.13	0.26	2.39	4.45	5.54	1.69	0.38	0.24	35.06	28	0.9	16	192	29	15	20	64	93	13.9	10.4	31	24.5	281	22.9
132411	MS-27	Proposed EMB-5C site (ODP), Central basin	Unit 1, 0-9 cm	pale grey clayey silt	HEMI	A1		0.62	13.78	5.45	1.42	2.12	5.27	4.27	1.27	0.22	0.31	34.73	31	0.9	16	135	20	15	14	57	95	17.2	9.2	21	23.0	339	18.2
	Sediment Basins, Umbo-Tumai-Bugave																																
132925	MS-34	Basin north of Tumai Ridge	0-7 cm, no description		HEMI	A1		0.64	13.30	7.16	1.24	3.23	6.92	4.54	1.06	0.42	0.33	38.84	29	0.6	21	210	37	26	27	93	119			42		362	19.9
132986	MS-37	East Bugave nodal basin	Unit 1, 0-4 cm		HEMI	A1		0.60	14.12	6.31	0.85	2.32	4.49	4.42	1.11	0.28	1.60	36.10	16	0.7	18	181	25	22	16	178	69			19		366	17.1
134390	MS-49	Basin N of Tumai Ridge	0-5 cm	brown	HEMI	A1		0.63	13.34	7.08	1.71	3.13	6.22	4.38	1.07	0.44	0.33	38.34	26	0.6	21	209	39	24	27	134	175			40		379	20.4
	Sediment Basins, SuSu vicinity																																
132953	MS-38	Under SE fringe of SuSu plume	Core catcher + 3 cm of core barrel		HEMI	B1		0.58	13.11	5.75	1.29	2.28	5.77	5.13	1.22	0.33	0.58	36.04	20	0.7	17	176	27	20	22	118	94			33		398	19.2
133744	MS-41	Under Nimab Plume, S of Nimab	0-5 cm	brown top layer	HEMI	A1		0.61	13.20	6.26	0.67	2.66	7.39	4.56	1.16	0.33	0.42	37.26	24	0.7	19	180	30	23	24	115	98			40		405	19.0
133545	MG-23	Base of SE face of Nimab Knoll	Top layer (~8cm) brown mud	red-brown	HEMI	A4		0.58	13.80	6.21	0.65	2.63	6.77	4.61	1.15	0.28	0.44	37.12	21	0.7	19	182	28	21	22	97	79			28		386	18.8

NOTES
1. Sediment type - confidence it represents a mudline sample: A, definite; B, probable; C, uncertain; D, definitely not; X, contaminated
2. Sediment source: 1:, corer; 2, sediment trap on dredge; 3, dredge bag; 4, grab; 5, other.
3. Lithology code: HEMI, hemipelagic ooze; VOLC, colcaniclastic; MIX, mixture of hemipelagic and volcaniclastic; CONT, contaminated with sulfide or FeOxide particles
4. Analysis methods: xrf, x-ray fluorescence; aes, inductively coupled plasma atomic emission spectrometry; ms, inductively-coupled plasma mass spectrometry; naa, neutron activation.

High S

60	12.0	0.9	587				584	265	7.72	14.52	2.34	10.43	2.61	0.86	3.09	0.564	3.48	0.904	2.49	0.404	2.49		609	29	105	898	1408	3	43.240	151	55.808	151.93013	3.72067	1850	-3.72067
50	6.1	1.9	682	97	512	468	805	223	8.10	17.57	2.75	10.81	3.15	1.02	2.91	0.660	3.47	0.834	2.36	0.360	2.27		442	15	70	903	933	3	43.206	151	53.746	151.89577	3.72009	1562	-3.72009
62	0.4	2.7	892					252																12				3	45.989	152	0.491	152.00818	3.76649	1733	-3.76649
59	3.6	0.6	260				680	285	8.00	15.50	2.44	11.46	3.02	0.99	3.41	0.579	3.42	0.889	2.57	0.386	2.40		204	21	89	988	1058	3	43.571	152	2.125	152.03541	3.72619	2050	-3.72619
55	0.8	1.6	1022					229																				3	39.710	152	2.534	152.04224	3.66183	1890	-3.66183
59	0.8	1.5	508					262																				3	44.675	152	10.471	152.17451	3.74459	1756	-3.74459
80	0.6	1.2	27					239																				3	43.785	152	5.591	152.09319	3.72974	1946	-3.72974
59	1.0	1.5						271																				3	49.297	152	10.832	152.18054	3.82162	1320	-3.82162
97	1.1	1.8						308																				3	49.185	152	1.222	152.02037	3.81975	1040	-3.81975
54	0.3	1.9	771					246																1				3	53.054	152	11.432	152.19054	3.88423	1520	-3.88423
65	0.3	1.3						320																27				3	46.075	152	4.277	152.07128	3.76792	1715	-3.76792
60	1.0	1.5	854					239																				3	51.334	152	0.332	152.00554	3.85556	1874	-3.85556
69	7.8	0.8	319				704	342	9.20	16.39	2.60	11.22	3.04	1.00	3.30	0.626	3.66	0.953	2.67	0.358	2.56		312	40	157	1237	2105	3	46.518	151	45.450	151.75750	3.77530	2150	-3.77530
56	4.7	1.1	340				578	289	8.72	14.97	2.43	10.71	2.90	0.97	3.51	0.588	3.43	0.951	2.79	0.344	2.32		542	31	213	2669	1274	3	45.013	151	46.643	151.77738	3.75021	2000	-3.75021
62	2.6	1.2	296				694	322	7.44	14.04	2.21	10.50	2.83	0.94	3.34	0.565	3.47	0.839	2.63	0.396	2.44		196	10	71	1115	777	3	30.887	151	21.837	151.36395	3.51479	2560	-3.51479
62	3.6	1.4	334				750	297	8.56	14.87	2.31	11.25	2.93	0.96	3.45	0.604	3.60	0.953	2.58	0.398	2.32		426	18	97	1243	1173	3	31.085	151	22.290	151.37150	3.51809	2150	-3.51809
102	2.8	1.2	285				900	330	11.08	24.00	3.68	18.29	4.22	1.30	4.84	0.809	4.81	1.221	3.42	0.535	3.11	<5	175	12	63	1604	1308	3	35.335	151	43.591	151.72652	3.58891	1950	-3.58891
85	2.6	0.5	267				787	284	8.79	17.35	2.58	11.10	2.83	1.01	3.45	0.647	3.78	1.032	2.82	0.409	2.74		192	16	98	1228	1036	3	51.783	151	36.094	151.60157	3.86305	1950	-3.86305
53	6.8	0.7	372	106		362	864	313	9.19	17.75	2.70	11.57	3.22	1.08	3.73	0.627	3.83	0.866	2.43	0.382	2.74		893	35	84	738	856	3	36.498	151	39.903	151.66505	3.60827	2402	-3.60827
54	2.2	1.7	283	95		366	1009	277	8.01	16.44	2.49	10.31	2.75	0.90	3.28	0.541	3.51	0.773	2.25	0.344	2.32		200	13	49	689	721	3	41.113	151	26.093	151.43468	3.68521	2240	-3.68521
62	2.2	1.3	331	118		413	904	253	10.08	20.84	3.16	12.44	3.27	1.05	4.03	0.650	4.10	0.899	2.58	0.395	2.90		399	22	85	878	897	3	46.192	151	45.758	151.76263	3.76986	2090	-3.76986
42	1.8	2.9	330	109	532	448	860	176	9.37	20.12	3.07	13.30	3.67	1.31	3.68	0.806	4.52	0.968	2.87	0.397	2.76		178	19	59	921	1262	3	33.778	151	55.733	151.92888	3.56297	1892	-3.56297
60	1.4	2.6	706	108	705	387	1291	258	13.30	30.39	4.31	16.88	4.38	1.39	4.27	0.863	4.84	0.905	2.71	0.377	2.75		486	16	58	1569	2465	3	53.645	151	46.372	151.77287	3.89408	2090	-3.89408
66	13.1	13.6	155				769	278	8.16	16.02	2.66	12.34	3.38	1.09	3.81	0.637	4.47	0.903	2.62	0.348	1.97		97	21		823	1726	3	31.137	151	36.812	151.61354	3.51895	2450	-3.51895
84	3.7	4.2	258				1203	180	11.09	23.52	3.61	16.83	4.01	1.18	4.50	0.667	4.18	0.842	2.41	0.339	2.13			13		1492	1465	3	42.893	151	26.097	151.43496	3.71489	2724	-3.71489
73	44.5	3.3	477				851	292	8.71	17.66	2.85	12.88	3.49	1.01	3.72	0.560	3.77	0.738	2.34	0.324	1.93			28		1128	2630	3	38.571	151	42.317	151.70529	3.64285	2110	-3.64285
83	20.3	0.8	457				898	211	8.78	19.54	2.72	12.00	3.06	0.90	3.21	0.533	3.32	0.859	2.22	0.320	2.27		664	13	80	1406	1798	3	37.962	151	33.472	151.55787	3.63270	2612	-3.63270
55	5.9	1.2	322	112		677	909	327	9.63	17.76	2.79	11.05	2.96	1.01	3.65	0.620	3.91	0.837	2.45	0.359	2.67		519	23	82	773	808	3	36.050	151	28.949	151.48249	3.60083	2449	-3.60083
34	3.0	5.2	599				651	241	7.25	13.17	2.22	10.55	2.80	0.94	3.35	0.599	3.86	0.799	2.32	0.324	1.95		313	32		806	895	3	41.170	151	36.045	151.60075	3.68617	2265	-3.68617
60	19.3	1.8	835				575	287	8.84	15.78	2.49	11.52	3.01	0.98	3.42	0.608	3.69	1.008	2.68	0.398	2.57		2596	32	124	2278	2115	3	38.736	151	39.078	151.65130	3.64560	2405	-3.64560
70	2.2	1.8	560	88	471	299	1199	269	12.55	30.23	4.11	17.70	4.50	1.40	4.09	0.876	4.58	1.002	2.71	0.356	2.59		1016	14	85	1598	1825	3	43.585	151	30.191	151.50319	3.72641	2523	-3.72641
53	5.3	1.3	651				508	275	7.44	12.82	1.96	9.42	2.46	0.82	2.92	0.493	2.92	0.803	2.09	0.325	2.01		824	31	84	818	1154	3	40.780	151	43.642	151.72737	3.67967	1905	-3.67967
59	12.3	1.2	589				656	263	9.06	17.05	2.72	12.37	3.18	1.04	3.70	0.640	3.85	1.024	2.99	0.422	2.51		2010	28	97	982	1780	3	38.030	151	45.243	151.75405	3.63383	2087	-3.63383
42	10.2	1.5	457	119		675	809	249	9.10	17.20	2.67	10.62	3.15	1.01	3.56	0.619	3.84	0.798	2.40	0.350	2.86		1563	28	82	694	1400	3	37.698	151	46.975	151.78292	3.62830	2113	-3.62830
59	5.6	1.4	658	124		575	984	225	10.71	22.32	3.28	12.94	3.34	1.06	4.12	0.625	3.85	0.820	2.35	0.363	2.82		976	24	93	995	1328	3	38.998	151	48.976	151.81627	3.64997	2182	-3.64997
46	6.7	1.3	464	138		715	815	241	8.94	17.78	2.74	10.64	2.93	1.01	3.47	0.590	3.78	0.806	2.35	0.340	2.90		1129	26	101	741	1083	3	37.473	151	49.988	151.83314	3.62454	2175	-3.62454
56	2.3	2.3	476	121	569	496	772	275	9.71	21.54	3.17	13.38	3.78	1.40	3.75	0.814	4.28	0.923	2.75	0.383	2.69		347	22	66	890	999	3	36.287	151	46.391	151.77319	3.60478	2005	-3.60478
46	5.2	1.9	436	133	817	787	903	347	9.51	19.82	2.89	12.35	3.49	1.26	3.42	0.745	4.41	0.968	2.52	0.374	2.52		435	34	71	939	1012	3	33.974	151	48.974	151.81624	3.56623	2008	-3.56623
76	32.2	3.5	939				984	239	9.40	20.88	3.06	14.75	3.66	1.17	3.82	0.624	4.36	0.767	2.27	0.348	2.23		839	23		1591	1979	3	41.619	151	44.731	151.74552	3.69365	2206	-3.69365
46	10.4	4.8	655				581	249	6.77	12.66	2.13	10.11	2.71	0.90	3.17	0.510	3.63	0.718	2.14	0.292	1.76		1491	30		693	1373	3	46.475	151	38.654	151.64424	3.77459	2205	-3.77459
69	22.6	2.9	587				764	294	9.79	17.12	2.71	12.01	2.80	0.89	3.34	0.567	3.43	0.822	2.45	0.345	2.44		1170	35	101	1375	2247	3	43.713	151	42.584	151.70974	3.72854	2127	-3.72854
71	2.9	1.2	669				678	274	8.88	16.77	2.41	11.07	2.74	0.83	3.30	0.526	3.22	0.894	2.62	0.346	2.42		1197	23	113	1207	1093	3	44.994	151	40.981	151.68302	3.74990	2120	-3.74990
75	12.1	0.9	464				819	254	10.21	20.42	2.91	13.19	3.44	1.03	3.87	0.673	3.80	0.948	2.71	0.363	2.52		1162	26	85	1450	2068	3	40.587	151	45.944	151.76574	3.67644	2150	-3.67644
71	46.1	1.0	492				772	289	8.65	17.52	2.00	11.85	2.88	0.84	3.64	0.543	3.50	0.878	2.55	0.396	2.37		1529	26	103	1274	3004	3	41.381	151	45.369	151.75615	3.68969	2193	-3.68969
72	6.3	0.8	446				788	247	10.14	20.59	3.12	14.15	3.61	1.09	3.86	0.668	3.82	1.010	2.89	0.424	2.59		484	23	102	1558	1299	3	42.701	151	43.818	151.73030	3.71168	2150	-3.71168
71	2.2	1.1	502				777	237	9.62	18.92	2.97	13.48	3.39	1.10	3.77	0.694	3.64	0.901	2.84	0.421	2.54		419	24	77	1186	1105	3	41.530	151	44.550	151.74250	3.69217	2205	-3.69217
75	0.8	3.0	100				1034	170	9.71	21.21	3.16	14.93	3.63	1.01	3.91	0.594	4.06	0.702	2.34	0.345	2.02			12		1538	1251	3	50.951	151	49.366	151.82276	3.84919	2109	-3.84919
88	19.8	1.1	268				899	211	9.10	21.10	2.93	12.62	3.11	0.87	3.19	0.526	3.20	0.787	2.31	0.335	2.18	<5	171	14	104	1474	1764	3	46.244	151	46.949	151.78249	3.77073	2170	-3.77073
67	5.2	2.0	378	103	512	261	1185	171	12.44	30.62	3.93	17.25	4.53	1.41	4.16	0.843	4.40	0.925	2.54	0.353	2.43		234	17	83	1720	1681	3	47.820	151	46.169	151.76948	3.79700	2169	-3.79700
80	1.6	0.8	392	120		247	1111	260	11.55	25.37	3.67	13.93	3.60	1.12	4.21	0.693	4.40	0.929	2.71	0.426	3.31		399	15	72	1191	761	3	47.820	151	46.169	151.76948	3.79700	2169	-3.79700
75	7.6	2.2	371	111		586	1172	183	11.93	28.21	3.86	13.05	3.22	1.00	3.59	0.548	3.32	0.688	1.97	0.294	2.37		412	12	73	1165	1337	3	49.140	151	44.076	151.73460	3.81900	2158	-3.81900
57	1.6	1.4	2142					243																				3	40.495	152	5.958	152.09930	3.67492	2118	-3.67492
66	5.6	1.0	21					293																				3	43.696	152	10.988	152.18279	3.72827	2098	-3.72827
58	3.6	1.7	304					283																				3	30.954	152	5.462	152.09103	3.66591	2121	-3.66591
68	2.7	1.6						333																				3	51.296	152	8.182	152.13637	3.85493	1709	-3.85493
63	20.2	1.7	844					331																				3	49.563	152	12.405	152.20675	3.82605	1775	-3.82605
61	0.7	1.1	75					290																				3	48.744	152	12.617	152.21028	3.81240	1778	-3.81240

VOLCANICLASTIC MUDLINE SEDIMENTS WITH CSIRO ANALYSES

CSIRO analysis #	Operation	Location	Sample description (onboard logbook)	Sample details (laboratory notes)	Lithol	Type
	Bugave					
132904	MD-80	SW Bugave Ridge	brown and black mud, "gradually mixed", one sediment trap		VOLC	A2
	Suzette					
132803	MD-76	SuSu Knolls, Suzette	mud from one sed trap	black, gritty	VOLC	B2
133028	MD-81	SuSu Knolls, Suzette	dark grey mud from one sed trap	dark grey	VOLC	B2
133782	MD-94	SuSu Knolls, Suzette	black-grey sulfidic mud from a sed trap (bag included "sloppy samples")		VOLC	B2
132786	MG-20	Suzette	Syringe, black-green mud (homogeneous grab)		VOLC	A4
133666	MG-24	Suzette	Grey sandy mud, surface of grab		VOLC	A4
133688	MG-26	Suzette	Dark grey surface of grab	black surficial layer	VOLC	A4
133098	MS-36	Suzette	Unit 2, 6.5-10 cm (Deduct 6.5 cm for reworked unit 1)		VOLC	A1
	Suzette vicinity					
133536	MD-86	NW of Suzette	brown to grey mud from variegated dredge bag	brown selected	VOLC	B3
133844	MG-27	East of Suzette	medium grey mud scraped from surface of grab	dark silty surface of grab	VOLC	A4
133850	MG-28	Ridge ENE of Suzette	dark grey gritty mud, typical whole grab	grey silty mud	VOLC	B4
	North Su					
132956	MD-83	SuSu Knolls, North Su crest	grey-green gritty mud from one sed trap (rock chips?)		VOLC	B2
133856	MD-96	SuSu Knolls, crest of North Su	sulfidic grit from sed trap		VOLC	B2
134323	MD-116	SuSu Knolls, Crest of North Su	black sulfidic mud from sed trap, some native S	black	VOLC	B2
132791	MG-21R	North Su crest	sand from grab		VOLC	C4
	South Su					
132311	MD-55	SuSu Knolls, SW slope South Su	mud from one sed trap	dark grey	VOLC	B2
133163	MD-77	South Su	mud from one sed trap	grey	VOLC	B2
132947	MD-82	SuSu Knolls, S flank of South Su	dark grey mud, bulk sample (i.e. must be dredge bag?)	dark grey	MIX	B3
133671	MD-91	SuSu Knolls, crest of South Su	black mud (there was brwn mud also in dredge)	black selected	VOLC	C3
133701	MD-92	SuSu Knolls, crest of South Su	black sulfidic mud, one sed trap	black	VOLC	C2
133759	MD-93	SuSu Knolls, crest of South Su	black silt from one sed trap	black	VOLC	B2
133831	MD-95	SuSu Knolls, crest of South Su	grey to dark grey silty mud from a sediment trap	dark grey silty mud selected	VOLC	B2
132935	MG-22	S foot of South Su, - under eye of plume	"pure brown mud" (there is black mud also in grab)	brown	VOLC	B4
133192	MG-22	S foot of South Su, - under eye of plume	dark silty mud	dark grey	VOLC	C4
	SuSu Vicinity					
132705	MD-72	SuSu Knolls, Cleavage Col	mud from one sed trap	dark grey	VOLC	B2
132852	MD-78	SuSu Knolls, col b/n North Su and Suzette	mud from one sed trap	dark grey, gritty	VOLC	B2
133901	MG-29	Enclosed basin E of SuSu Knolls	Top black slopy mud	topmost cm	VOLC	A4
133903	MG-29	Enclosed basin E of SuSu Knolls	Top 1/3 of black sulfidic mud	top 5-8 cm	VOLC	B4
133914	MG-30	East foot, North Su	Top 2 cm, fine volcanic sand	sandy	VOLC	A4
133932	MG-31	East of SuSu Knolls	Surface dark grey grit	top layer, dark grey	VOLC	A4
	Sediment Basins, SuSu vicinity					
132319	MS-26	Enclosed basin NE N Su, in SE Bugave trough	Black-dark green sandy sediment, small recovery		VOLC	B1
132725	MS-33	Enclosed basin in SE Bugave trough	Sediment drained from nosecone (only recovery)	sandy	VOLC	B1
134112	MS-44	Enclosed basin E of SuSu Knolls	residue in empty core liner	dark grey	VOLC	B1
133847	MS-45	Enclosed basin E of SuSu Knolls	black gritty sediment - entire sample	dark grey	VOLC	B1
	West Su Basin					
142067	MG-41	West Su Basin	Black layer , 1.5 - 2.0 cm		VOLC	C1
142349	MG-56	West Su Basin	Black "oily, gelatinous" layer, 0.6-1.8 mm		VOLC	C1
134107	MS-43	West Su Basin	brown mud, 0-4 cm	silty brown	VOLC	A1

CSIRO analysis #	SiO2	TiO2	Al2O3	FeO(t)	MnO	MgO	CaO	Na2O	K2O	P2O5	S	Total %
units / method(s)	% xrf	% aes	% aes	% aes	% aes	% aes	% aes	% aes	% aes	% aes	% aes	Majors
132904		0.55	14.95	7.00	0.15	2.12	4.05	4.31	0.94	0.41	1.38	35.85
132803		0.49	15.69	5.00	0.06	1.77	4.39	3.75	0.82	0.17	2.92	35.07
133028		0.47	15.00	6.86	0.07	1.73	4.80	3.80	0.78	0.58	2.41	36.50
133782		0.50	15.39	5.40	0.06	1.67	4.47	4.05	0.79	0.16	3.14	35.63
132786		0.48	15.08	5.47	0.07	1.92	4.74	3.97	0.70	0.15	3.27	35.85
133666		0.52	14.95	5.60	0.05	1.61	4.11	4.46	0.73	0.32	3.13	35.48
133688		0.51	14.93	5.48	0.05	1.66	4.30	4.42	0.72	0.25	3.01	35.33
133098		0.53	15.07	6.74	0.06	1.80	4.62	4.00	0.70	0.45	2.91	36.89
133536		0.51	15.79	6.04	0.07	1.96	4.15	4.15	0.87	0.42	1.89	35.86
133844		0.44	15.24	4.82	0.08	2.21	5.28	3.95	0.68	0.17	1.48	34.36
133850		0.50	15.23	5.63	0.08	2.16	4.67	4.03	0.79	0.21	2.55	35.83
132956		0.47	15.11	5.08	0.09	2.36	5.37	4.06	0.67	0.16	1.82	35.18
133856		0.45	14.53	5.22	0.10	2.66	5.53	3.72	0.70	0.13	1.90	34.93
134323		0.48	15.11	4.88	0.07	2.15	5.07	3.96	0.66	0.15	2.31	34.84
132791		0.44	15.21	4.58	0.09	2.37	5.57	3.42	0.67	0.13	1.09	33.57
132311		0.52	15.86	5.24	0.06	1.64	4.32	4.01	0.84	0.19	2.69	35.37
133163		0.52	15.62	5.49	0.07	1.86	4.67	3.94	0.91	0.29	2.03	35.39
132947		0.47	12.42	8.26	0.07	1.42	3.83	2.85	0.65	0.18	7.93	38.07
133671		0.52	16.02	4.22	0.07	2.08	4.96	4.05	0.80	0.18	1.47	34.39
133701		0.51	14.13	4.73	0.06	1.56	3.72	3.46	0.68	0.17	3.85	32.87
133759		0.46	15.79	5.39	0.10	2.52	5.87	4.19	0.81	0.15	1.15	36.42
133831	57.11	0.46	14.33	8.08	0.08	2.36	4.96	3.54	0.72	0.18	4.86	96.67
132935		0.50	15.25	5.61	0.07	1.83	4.31	4.23	0.82	0.31	2.61	35.54
133192		0.51	14.64	5.52	0.07	1.77	4.41	3.82	0.74	0.26	3.02	34.76
132705		0.48	14.95	5.22	0.11	2.28	5.68	3.84	0.76	0.15	0.50	33.96
132852		0.48	15.36	4.51	0.06	1.87	4.48	4.15	0.67	0.18	2.57	34.34
133901		0.54	14.92	5.34	0.05	1.49	3.70	4.01	0.82	0.22	3.56	34.65
133903		0.47	15.00	5.30	0.07	1.76	4.54	4.03	0.79	0.18	3.01	35.16
133914		0.43	14.92	4.74	0.08	2.33	5.27	3.96	0.70	0.13	1.34	33.90
133932		0.46	15.41	4.81	0.10	2.52	5.59	4.17	0.91	0.15	1.08	35.20
132319		0.47	15.04	5.25	0.05	1.58	4.16	3.98	0.68	0.14	3.65	35.00
132725		0.48	14.66	6.11	0.08	1.90	4.97	3.87	0.83	0.16	2.95	36.01
134112		0.47	15.04	4.81	0.07	1.80	4.84	4.10	0.78	0.17	2.37	34.46
133847		0.46	14.83	4.97	0.09	2.25	5.31	4.36	0.83	0.15	1.85	35.09
142067		0.55	15.39	6.83	0.07	1.73	4.37	3.28	0.70	0.24	3.08	36.24
142349		0.55	15.58	6.21	0.11	1.87	4.78	3.23	0.74	0.25	2.03	35.35
134107	52.49	0.53	14.38	6.39	0.98	2.34	4.34	4.55	0.96	0.39	1.26	88.62

CSIRO analysis #	Li	Be	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Rb	Sr	Y
units / method(s)	ppm aes	ppm aes	ppm aes	ppm aes	ppm aes	ppm aes & ms	ppm aes	ppm aes	ppm aes	ppm ms	ppm ms	ppm aes	ppm ms	ppm aes	ppm aes
132904	12	0.6	18	201	25	21	10	172	71			37		408	14.8
132803	5	0.6	17	180	18	20	7	292	75			25		491	11.2
133028	5	0.6	17	253	23	19	8	998	108			159		594	12.5
133782	4	0.7	16	174	15	24	10	363	227			29		440	10.3
132786	4	0.6	17	176	18	25	11	272	71			26		416	11.4
133666	4	0.7	17	202	18	23	9	274	69			21		400	10.8
133688	4	0.7	16	195	17	26	11	267	56	14.9	4.8	25	7.6	387	11.5
133098	4	0.6	16	176	19	22	7	1093	154	14.3	4.8	87	7.4	536	11.2
133536	9	0.6	17	192	20	18	7	351	71			42		505	12.2
133844	4	0.7	17	138	16	20	9	124	43	0.0	0.0	17		395	11.0
133850	6	0.6	18	186	25	22	12	188	62	15.6	4.8	20	9.3	405	12.8
132956	4	0.7	19	156	15	22	9	141	78			13		392	12.4
133856	5	0.6	19	130	28	22	16	287	97			102		417	12.2
134323	3	0.7	18	158	16	22	10	139	46			9		384	10.2
132791	4	0.7	18	127	16	20	8	113	66			7		389	12.8
132311	5	0.6	16	178	17	18	6	167	40			18		467	10.6
133163	5	0.6	16	183	16	17	6	294	33			36		491	10.4
132947	3	0.6	13	141	15	20	7	498	275			163		367	10.9
133671	6	0.7	18	183	17	17	7	198	58			21		447	12.3
133701	4	0.5	17	142	15	20	8	214	1683			18		477	8.6
133759	6	0.7	18	157	13	23	10	140	58			14		414	13.2
133831	5	0.6	18	172	23	18	12	1003	88			134		436	11.4
132935	5	0.6	16	189	18	20	6	184	44			25		451	11.6
133192	5	0.6	17	190	21	22	15	205	55	15.1	7.5	35	8.9	413	11.1
132705	4	0.7	20	157	18	23	10	90	61			6		367	15.3
132852	4	0.6	16	164	17	20	6	152	49			16		422	11.3
133901	5	0.7	16	202	20	23	10	232	46			20		397	11.8
133903	5	0.7	16	152	16	23	12	196	47	15.8	4.8	23	9.4	401	11.8
133914	4	0.7	17	133	14	20	10	110	48	15.4	5.0	20	9.0	390	12.3
133932	5	0.7	18	130	15	18	6	96	54			10		406	13.7
132319	3	0.6	16	150	29	24	17	259	41			22		420	8.1
132725	9	0.6	16	140	20	21	13	178	103			21		402	12.6
134112	5	0.7	15	131	14	19	6	155	51			17		398	12.0
133847	5	0.7	17	122	19	20	11	129	75			11		391	13.0
142067	6	0.6	17	187	21	19	16	210	53	17.3	3.1	32	8.7	402	10.7
142349	7	0.6	17	184	22	18	15	224	73	17.5	3.0	23	10.3	409	13.1
134107	15	0.7	17	196	24	25	21	484	174			62		452	15.5

NOTES

1. Sediment type - confidence it represents a mudline sample: A, definite; B, probable; C, uncertain; D, definitely not; X, contaminated
2. Sediment source: 1:, corer; 2, sediment trap on dredge; 3, dredge bag; 4, grab; 5, other.
3. Lithology code: HEMI, hemipelagic ooze; VOLC, colcaniclastic; MIX, mixture of hemipelagic and volcaniclastic; CONT, contaminated with sulfide or FeOxide particles
4. Analysis methods: xrf, x-ray fluorescence; aes, inductively coupled plasma atomic emission spectrometry; ms, inductively-coupled plasma mass spectrometry; naa, neutron activation.

Zr	Mo	Ag	Cd	In	Sb	Te	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Au	Tl	Pb	Bi	Th	U	Latitude		Longitude		Decimal	Decimal	Depth	LAT negative
ppm aes	ppm aes & ms	ppm aes	ppb aes & ms	ppb ms	ppb aes & ms	ppb ms	ppb ms	ppm aes	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppm ms	ppb naa	ppb ms	ppm aes & ms	ppb ms	ppb ms	ppb ms	deg	min	deg	min	Long	Lat	(m)	
54	2.4	1.4	1157					337															14		1				3	46.286	152	7.362	152.12270	3.77143	1700	-3.77143
53	2.6	1.9						771															66		13				3	47.418	152	5.653	152.09422	3.79030	1516	-3.79030
50	1.9	2.2	539					855																	122				3	47.277	152	5.587	152.09312	3.78796	1511	-3.78796
55	2.1	1.6						655															41						3	47.341	152	5.600	152.09333	3.78901	1524	-3.78901
51	3.7	1.6						438															36		9				3	47.400	152	5.662	152.09437	3.79000	1523	-3.79000
53	2.0	1.6	646					389															28						3	47.365	152	5.643	152.09405	3.78942	1521	-3.78942
54	2.7	1.6	521	98	552	721	440	318	5.00	12.53	1.74	8.09	2.10	0.78	2.20	0.351	2.20	0.419	1.23	0.160	1.27			416	11	116	473	386	3	47.372	152	5.848	152.09747	3.78953	1530	-3.78953
62	3.6	3.0	1185	110	4450	941	532	2112	5.49	12.13	1.75	7.67	2.08	1.01	2.22	0.346	2.13	0.451	1.29	0.199	1.34			2773	98	294	485	665	3	47.274	152	5.574	152.09290	3.78789	1515	-3.78789
																							201													
																																				0.00000
																																				0.00000
50	1.6	1.2	1946					528															50		17				3	47.032	152	5.447	152.09079	3.78387	1584	-3.78387
52	1.9	1.9						266																					3	47.386	152	6.050	152.10083	3.78977	1599	-3.78977
52	5.1	1.0	696	112	470	781	510	332	5.02	12.22	1.72	9.18	2.31	0.88	2.48	0.412	2.62	0.527	1.59	0.223	1.59			404	15	137	600	1133	3	46.885	152	6.483	152.10805	3.78142	1683	-3.78142
55	0.4	0.9	749					518																					3	47.972	152	6.068	152.10113	3.79953	1167	-3.79953
54	4.9	2.4	829					692															71		54				3	47.927	152	6.019	152.10032	3.79878	1176	-3.79878
53	5.3	0.5						262																					3	47.994	152	6.067	152.10111	3.79991	1173	-3.79991
56	0.1	1.8						298																					3	48.014	152	5.970	152.09950	3.80023	1183	-3.80023
54	1.4	1.0	322					337																					3	49.016	152	5.545	152.09242	3.81693	1660	-3.81693
56	1.6	2.1	1341					626																	4				3	48.515	152	6.238	152.10397	3.80858	1324	-3.80858
52	8.0	2.2	1203					335															257		154				3	48.640	152	6.319	152.10531	3.81067	1340	-3.81067
56	0.6	1.1						518															15		34				3	48.557	152	6.251	152.10418	3.80929	1326	-3.80929
49	10.3	1.8	6705					405															33		414				3	48.450	152	6.195	152.10325	3.80751	1335	-3.80751
55	3.3	3.2						242																					3	48.417	152	6.622	152.11037	3.80694	1472	-3.80694
51	5.8	4.7	2180					460															111		82				3	48.550	152	6.269	152.10449	3.80917	1329	-3.80917
54	0.8	1.7						393																					3	49.300	152	6.150	152.10250	3.82167	1647	-3.82167
60	3.1	1.2	369	55		773	459	351	5.10	11.88	1.91	8.55	2.12	0.76	2.26	0.369	2.11	0.448	1.35	0.200	1.40		21	404	13	127	461	498	3	49.300	152	6.150	152.10250	3.82167	1647	-3.82167
59	0.5	1.1	651					247																					3	48.320	152	6.132	152.10220	3.80533	1412	-3.80533
51	4.1	1.4	55					298																					3	47.666	152	5.878	152.09797	3.79443	1460	-3.79443
56	3.3	2.3	311					324															28						3	49.013	152	8.236	152.13727	3.81688	1737	-3.81688
54	3.2	1.9	349	79	531	1074	509	287	5.05	12.42	1.77	8.11	2.14	0.76	2.08	0.355	2.16	0.433	1.27	0.177	1.29			319	9	121	563	768	3	49.013	152	8.236	152.13727	3.81688	1737	-3.81688
53	2.2	0.6	129	57	395	195	500	260	4.64	11.33	1.57	7.98	1.95	0.85	2.36	0.344	2.35	0.478	1.42	0.199	1.36			199	5	53	520	606	3	47.836	152	6.523	152.10872	3.79727	1535	-3.79727
58	1.9	0.9						271																					3	48.450	152	7.130	152.11883	3.80750	1661	-3.80750
47	4.9	1.1	194					316																					3	46.877	152	7.135	152.11892	3.78128	1780	-3.78128
53	2.6	1.3						295																					3	45.793	152	8.212	152.13686	3.76322	1904	-3.76322
59	2.2	1.2						264																					3	48.976	152	8.227	152.13712	3.81626	1738	-3.81626
59	1.5	1.7						273																					3	48.971	152	8.283	152.13805	3.81619	1735	-3.81619
62	5.0	1.9	212	95	695	1048	509	429	5.52	12.00	1.72	6.82	1.87	0.70	1.85	0.337	1.84	0.460	1.23	0.215	1.24	0.215		329	13	159	571	527	3	46.997	152	3.001	152.05002	3.78328	2070	-3.78328
65	3.6	1.5	491	101	568	857	551	408	5.99	12.90	1.92	7.76	2.18	0.78	2.21	0.411	2.25	0.574	1.49	0.251	1.48	0.261		542	14	131	598	586	3	47.501	152	3.545	152.05908	3.79168	2059	-3.79168
55	3.9	1.6	1105					1627															119						3	48.135	152	1.941	152.03235	3.80224	2093	-3.80224

AVERAGE COMPOSITIONS

	units	SiO2 %	TiO2 %	Al2O3 %	FeO(t) %	MnO %	MgO %	CaO %	Na2O %	K2O %	P2O5 %	S %	Total % Majors	Li ppm	Be ppm	Sc ppm	V ppm	Cr ppm	Co ppm	Ni ppm	Cu ppm
Comparison of all mudline sediments																					
Average hemipelagic mudline sediment		40.5	0.60	12.7	7.8	1.29	2.7	6.5	4.8	1.18	0.44	0.37	78.9	26.5	0.83	19	217	37	21	27	331
	N	*17*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*		*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*
	Std Dev	*3.6*	*0.1*	*1.1*	*1.8*	*1.0*	*0.4*	*1.7*	*0.7*	*0.2*	*0.2*	*0.5*		*5.5*	*0.2*	*2*	*45*	*15*	*4*	*10*	*792*
Average volcaniclastic mudline sediment		54.8	0.50	15.0	5.6	0.10	2.0	4.7	3.9	0.77	0.22	2.53	90.2	6.0	0.64	17	170	19	21	10	336
	N	*2*	*40*	*40*	*40*	*40*	*40*	*40*	*40*	*40*	*40*	*40*		*40*	*40*	*40*	*40*	*40*	*40*	*40*	*40*
	Std Dev	*3.3*	*0.04*	*0.6*	*1.0*	*0.1*	*0.3*	*0.6*	*0.3*	*0.1*	*0.1*	*1.3*		*4.8*	*0.0*	*1*	*28*	*4*	*2*	*3*	*415*
Comparisons of background versus proximal hemipelagic sites																					
Average "background" hemipelagic mudline sediment from edifices, basins, and scarps		40.1	0.61	12.8	7.7	1.26	2.8	6.8	4.7	1.19	0.44	0.68	79.1	27.7	0.81	19	219	36	21	26	97
	N	*16*	*74*	*74*	*74*	*74*	*74*	*74*	*74*	*74*	*74*	*74*		*74*	*74*	*74*	*74*	*74*	*74*	*74*	*74*
	Std Dev	*3.3*	*0.06*	*1.0*	*1.2*	*1.0*	*0.4*	*1.5*	*0.6*	*0.2*	*0.2*	*0.2*		*5.4*	*0.2*	*2*	*45*	*14*	*4*	*8*	*23*
Average hemipelagic sediment from vicinity of hydrothermal activity (proximal and distal)		46.8	0.60	12.3	8.5	1.00	2.5	5.8	4.8	1.18	0.46	1.63	85.6	22.7	0.89	19	216	42	19	32	1186
	N	*1*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*		*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*
	Std Dev		*0.07*	*1.1*	*3.3*	*0.6*	*0.4*	*2.0*	*0.9*	*0.2*	*0.2*	*2.7*		*4.1*	*0.3*	*3*	*51*	*17*	*4*	*17*	*1440*
Average hemipelagic sediment at PACMANUS *hydrothermal sites*		46.8	0.59	12.2	8.3	0.89	2.5	5.4	4.9	1.16	0.46	2.6	85.7	22.33	0.95	19	211	49	18	36	2114
	N	*1*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*		*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*
	Std Dev		*0.05*	*0.9*	*2.2*	*0.59*	*0.4*	*1.9*	*1.1*	*0.09*	*0.21*	*3.5*		*2.7*	*0.3*	*4*	*49*	*20*	*3*	*20*	*1471*
Comparisons of background versus proximal volcaniclastic sites																					
Average "background" volcaniclastic sediment remote from hydrothermal activity			0.49	15.1	5.5	0.08	2.0	4.7	4.0	0.78	0.21	5.5	[38]	5.9	0.64	17	161	19	21	10	179
	N	*0*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*		*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*
	Std Dev		*0.04*	*0.3*	*0.8*	*0.0*	*0.3*	*0.6*	*0.3*	*0.1*	*0.1*	*2.3*		*2.4*	*0.0*	*1*	*28*	*4*	*2*	*3*	*68*
Average volcaniclastic sediment at Suzette hydrothermal site			0.51	15.1	5.7	0.06	1.7	4.5	4.0	0.74	0.27	7.6	[40]	4.1	0.64	17	190	18	23	9	453
	N	*0*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*		*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*
	Std Dev		*0.03*	*0.3*	*0.7*	*0.0*	*0.1*	*0.3*	*0.3*	*0.0*	*0.2*	*0.8*		*0.8*	*0.0*	*0*	*26*	*2*	*2*	*1*	*339*
Comparisons of background hemipelagic sediments from volcanic edifices, deep basins, and fault scarps																					
Average hemipelagic sediment on volcanic edifices remote from hydrothermal activity ("background")		41.7	0.59	12.3	7.9	0.91	2.9	7.5	4.8	1.17	0.44	0.25	80.5	26.3	0.86	19	231	37	20	26	103
	N	*8*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*		*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
	Std Dev	*3.3*	*0.06*	*0.7*	*1.0*	*0.7*	*0.4*	*1.4*	*0.6*	*0.2*	*0.2*	*0.1*		*4.9*	*0.2*	*2*	*41*	*15*	*4*	*6*	*20*
Average hemipelagic sediment from deep basins remote from hydrothermal activity ("background")		36.7	0.62	13.2	7.2	1.94	2.8	5.6	4.8	1.20	0.45	0.31	74.9	28.7	0.82	19	202	35	20	25	89
	N	*3*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*		*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*
	Std Dev	*3.2*	*0.06*	*1.2*	*1.4*	*1.4*	*0.4*	*1.4*	*0.7*	*0.2*	*0.2*	*0.1*		*6.2*	*0.2*	*2*	*49*	*15*	*5*	*9*	*26*
Average hemipelagic sediment at fault scarps remote from hydrothermal activity ("background")		39.6	0.62	13.3	8.0	1.07	2.8	6.6	4.5	1.22	0.40	0.28	78.5	29.7	0.67	19	212	35	24	29	96
	N	*5*	*13*	*13*	*13*	*13*	*13*	*13*	*13*	*13*	*13*	*13*		*13*	*13*	*13*	*13*	*13*	*13*	*13*	*13*
	Std Dev	*1.8*	*0.05*	*1.0*	*1.5*	*0.8*	*0.3*	*0.9*	*0.4*	*0.2*	*0.2*	*0.2*		*5.4*	*0.1*	*2*	*39*	*10*	*2*	*8*	*25*

	units	Zn ppm	Ga ppm	Ge ppm	As ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Mo ppm	Ag# ppm	Cd ppb	In ppb	Sb ppb	Te ppb	Cs ppb	Ba ppm
Comparison of all mudline sediments																	
Average hemipelagic mudline sediment		309	14.5	10.7	81	17.8	387	21	61	10.2	2.5	831	324	669	915	905	532
	N	*108*	*64*	*64*	*83*	*92*	*108*	*108*	*108*	*108*	*108*	*104*	*29*	*11*	*28*	*92*	*108*
	Std Dev	*945*	*1.9*	*8.1*	*173*	*3.7*	*64*	*2*	*13*	*22.5*	*2.1*	*2368*	*513*	*261*	*1288*	*565*	*1166*
Average volcaniclastic mudline sediment		129	14.0	4.2	36	8.8	433	12	55	3.1	1.6	1086	88	1094	799	501	620
	N	*40*	*9*	*9*	*40*	*8*	*40*	*40*	*40*	*39*	*40*	*26*	*8*	*7*	*8*	*8*	*40*
	Std Dev	*266*	*5.4*	*2.0*	*39*	*1.0*	*64*	*2*	*4*	*2.0*	*0.8*	*1360*	*22*	*1483*	*276*	*36*	*957*
Comparisons of background versus proximal hemipelagic sites																	
Average "background" hemipelagic mudline sediment from edifices, basins, and scarps		117	14.8	11.4	41	18.1	386	21	60	5.3	2.6	477	114	586	468	798	267
	N	*74*	*39*	*39*	*52*	*62*	*74*	*74*	*74*	*74*	*74*	*72*	*19*	*8*	*19*	*62*	*74*
	Std Dev	*54*	*1.8*	*8.5*	*21*	*4.1*	*57*	*2*	*12*	*6.7*	*2.3*	*300*	*13*	*117*	*160*	*195*	*49*
Average hemipelagic sediment from vicinity of hydrothermal activity (proximal and distal)		1023	14.0	11.7	194	16.9	392	22	60	24.6	2.8	2119	723	892	1858	1292	1511
	N	*23*	*18*	*18*	*22*	*21*	*23*	*23*	*23*	*23*	*23*	*22*	*10*	*3*	*9*	*21*	*23*
	Std Dev	*1913*	*2.2*	*8.1*	*312*	*2.4*	*89*	*2*	*18*	*43.9*	*2.0*	*4996*	*741*	*437*	*2017*	*1061*	*2309*
Average hemipelagic sediment at PACMANUS *hydrothermal sites*		1060	13.6	9.6	207	15.9	401	21	62	36	2.9	3259	1251	962	2968	1633	2522
	N	*12*	*11*	*11*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*5*	*1*	*5*	*12*	*12*
	Std Dev	*1160*	*2.2*	*6.7*	*186*	*2.2*	*100*	*2*	*15*	*56*	*2.3*	*6646*	*730*		*2148*	*1316*	*2877*
Comparisons of background versus proximal volcaniclastic sites																	
Average "background" volcaniclastic sediment remote from hydrothermal activity		59	13.6	3.4	21	9.4	407	12	55	2.9	1.4	563	89	532	791	516	321
	N	*16*	*6*	*6*	*16*	*5*	*16*	*16*	*16*	*16*	*16*	*11*	*5*	*5*	*5*	*5*	*16*
	Std Dev	*16*	*6.7*	*1.9*	*9*	*0.6*	*29*	*2*	*5*	*1.4*	*0.4*	*558*	*21*	*112*	*356*	*20*	*75*
Average volcaniclastic sediment at Suzette hydrothermal site		100	14.6	4.8	47	7.5	454	11	55	2.7	1.7	777	104	2501	831	486	701
	N	*9*	*2*	*2*	*9*	*2*	*9*	*9*	*9*	*9*	*9*	*5*	*2*	*2*	*2*	*2*	*9*
	Std Dev	*57*	*0.5*	*0.0*	*47*	*0.1*	*71*	*1*	*4*	*0.7*	*0.6*	*297*	*8*	*2757*	*155*	*65*	*563*
Comparisons of background hemipelagic sediments from volcanic edifices, deep basins, and fault scarps																	
Average hemipelagic sediment on volcanic edifices remote from hydrothermal activity ("background")		130	13.6	9.5	40	16.4	397	21	58	3.5	3.1	501	113	540	400	714	270
	N	*38*	*13*	*13*	*21*	*31*	*38*	*38*	*38*	*38*	*38*	*36*	*4*	*2*	*4*	*31*	*38*
	Std Dev	*70*	*1.0*	*7.4*	*16*	*3.9*	*58*	*2*	*9*	*3.4*	*2.3*	*258*	*13*	*40*	*68*	*155*	*48*
Average hemipelagic sediment from deep basins remote from hydrothermal activity ("background")		101	15.8	13.2	45	19.9	370	20	63	9.4	2.5	505	117	592	532	916	253
	N	*23*	*14*	*14*	*18*	*19*	*23*	*23*	*23*	*23*	*23*	*23*	*10*	*4*	*10*	*19*	*23*
	Std Dev	*22*	*2.1*	*10.0*	*26*	*3.8*	*57*	*1*	*14*	*9.7*	*2.5*	*381*	*13*	*133*	*185*	*211*	*49*
Average hemipelagic sediment at fault scarps remote from hydrothermal activity ("background")		109	14.8	11.3	37	19.7	384	22	63	3.4	1.3	361	107	619	395	827	281
	N	*13*	*12*	*12*	*13*	*12*	*13*	*13*	*13*	*13*	*13*	*13*	*5*	*2*	*5*	*12*	*13*
	Std Dev	*17*	*1.7*	*9.5*	*19*	*3.5*	*47*	*2*	*15*	*2.1*	*0.8*	*120*	*8*	*122*	*36*	*196*	*44*

	units	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Au ppb	Tl ppb	Pb ppm	Bi ppb	Th ppb	U ppb
Comparison of all mudline sediments																					
Average hemipelagic mudline sediment		9.7	17.6	2.7	12.0	3.2	1.1	3.6	0.63	3.9	0.89	2.6	0.38	2.5		77	1697	79	572	1048	1707
	N	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*92*	*0*	*12*	*78*	*96*	*65*	*92*	*91*
	Std Dev	*8.2*	*3.9*	*0.5*	*1.9*	*0.5*	*0.3*	*0.4*	*0.09*	*0.5*	*0.10*	*0.3*	*0.06*	*0.4*		*93*	*4330*	*154*	*1415*	*342*	*3230*
Average volcaniclastic mudline sediment		5.2	12.2	1.8	8.0	2.1	0.8	2.2	0.37	2.2	0.47	1.4	0.20	1.4	0.24	61	673	71	142	534	646
	N	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*2*	*11*	*8*	*20*	*8*	*8*	*8*
	Std Dev	*0.4*	*0.5*	*0.1*	*0.7*	*0.1*	*0.1*	*0.2*	*0.03*	*0.2*	*0.05*	*0.1*	*0.03*	*0.1*	*0.03*	*55*	*854*	*114*	*68*	*56*	*227*
Comparisons of background versus proximal hemipelagic sites																					
Average "background" hemipelagic mudline sediment from edifices, basins, and scarps		8.9	17.8	2.8	12.1	3.2	1.0	3.6	0.63	4.0	0.89	2.6	0.38	2.4		21	548	29	94	1045	1230
	N	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*62*	*0*	*6*	*48*	*65*	*39*	*62*	*62*
	Std Dev	*1.4*	*4.3*	*0.5*	*1.9*	*0.5*	*0.1*	*0.4*	*0.09*	*0.4*	*0.10*	*0.2*	*0.06*	*0.3*		*13*	*497*	*24*	*30*	*373*	*412*
Average hemipelagic sediment from vicinity of hydrothermal activity (proximal and distal)		12.2	17.1	2.6	11.4	3.1	1.3	3.5	0.63	3.9	0.90	2.6	0.38	2.66		197$	4615	248	1729	974	3186
	N	*21*	*21*	*21*	*21*	*21*	*21*	*21*	*21*	*21*	*21*	*21*	*21*	*21*		*4*	*21*	*22*	*19*	*21*	*20*
	Std Dev	*17.1*	*2.9*	*0.4*	*1.8*	*0.5*	*0.5*	*0.4*	*0.11*	*0.5*	*0.11*	*0.3*	*0.05*	*0.36*		*47*	*7696*	*259*	*2262*	*215*	*6756*
Average hemipelagic sediment at PACMANUS *hydrothermal sites*		8.2	16.5	2.5	10.7	2.9	1.4	3.5	0.60	3.7	0.89	2.6	0.38	2.7		197	7387	393	2622	1033	4908
	N	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*		*4*	*12*	*12*	*12*	*12*	*11*
	Std Dev	*1.2*	*2.7*	*0.4*	*1.6*	*0.4*	*0.5*	*0.5*	*0.10*	*0.5*	*0.12*	*0.4*	*0.06*	*0.4*		*47*	*9371*	*271*	*2450*	*257*	*8914*
Comparisons of background versus proximal volcaniclastic sites																					
Average "background" volcaniclastic sediment remote from hydrothermal activity		5.2	12.2	1.7	8.0	2.1	0.8	2.2	0.37	2.2	0.49	1.4	0.21	1.39	0.24	51	358	11	120	571	724
	N	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*2*	*6*	*5*	*7*	*5*	*5*	*5*
	Std Dev	*0.5*	*0.6*	*0.1*	*0.8*	*0.2*	*0.1*	*0.2*	*0.04*	*0.3*	*0.06*	*0.1*	*0.03*	*0.14*	*0.03*	*40*	*126*	*6*	*40*	*32*	*246*
Average volcaniclastic sediment at Suzette hydrothermal site		5.2	12.3	1.7	7.9	2.1	0.9	2.2	0.35	2.2	0.43	1.3	0.18	1.30		74	1595	51	205	479	525
	N	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*		*5*	*2*	*5*	*2*	*2*	*2*
	Std Dev	*0.4*	*0.3*	*0.0*	*0.3*	*0.0*	*0.2*	*0.0*	*0.00*	*0.1*	*0.02*	*0.0*	*0.03*	*0.05*		*72*	*1667*	*55*	*125*	*9*	*197*
Comparisons of background hemipelagic sediments from volcanic edifices, deep basins, and fault scarps																					
Average hemipelagic sediment on volcanic edifices remote from hydrothermal activity ("background")		8.1	15.6	2.6	11.5	3.1	1.0	3.5	0.62	4.0	0.88	2.6	0.39	2.3		25	452	35	101	884	1079
	N	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*31*	*0*	*5*	*20*	*34*	*13*	*31*	*31*
	Std Dev	*0.9*	*2.1*	*0.3*	*1.3*	*0.3*	*0.1*	*0.4*	*0.06*	*0.4*	*0.10*	*0.2*	*0.07*	*0.3*		*10*	*314*	*32*	*19*	*133*	*198*
Average hemipelagic sediment from deep basins remote from hydrothermal activity ("background")		9.8	20.8	3.1	13.1	3.4	1.1	3.7	0.65	4.0	0.86	2.5	0.36	2.5			805	22	87	1191	1466
	N	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*19*	*0*	*<5*	*16*	*19*	*14*	*19*	*19*
	Std Dev	*1.6*	*5.2*	*0.6*	*2.2*	*0.5*	*0.2*	*0.4*	*0.12*	*0.5*	*0.09*	*0.2*	*0.03*	*0.4*		*1*	*678*	*7*	*18*	*406*	*513*
Average hemipelagic sediment at fault scarps remote from hydrothermal activity ("background")		9.3	18.5	2.8	12.2	3.3	1.1	3.7	0.65	3.9	0.94	2.7	0.39	2.6		<5	366	22	95	1227	1248
	N	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*0*	*2*	*12*	*12*	*12*	*12*	*12*
	Std Dev	*1.6*	*4.8*	*0.6*	*2.2*	*0.6*	*0.2*	*0.5*	*0.11*	*0.5*	*0.11*	*0.3*	*0.05*	*0.3*			*208*	*10*	*47*	*544*	*528*

NOTES
Silver data are just below nominal detection limit, and thus unreliable
$ Gold data are all from PACMANUS sites