RV *Investigator* Voyage Summary

Voyage #:	**IN2016_E01**		
Voyage title:	East Tasman Plateau: key to unravelling the onset of the Antarctic Circumpolar Current MNF Equipment Sea Trials		
Mobilisation:	As compatible with port period activities		
Depart:	Hobart: 1800 Wednesday 17 August, 2016		
Return:	Hobart: 0800 Monday 22 August, 2016		
Demobilisation:	Monday 22 August, 2016		
Voyage Manager:	Doug Thost	Contact details:	Matt.kimber@csiro.au
Chief Scientist:	Joanne Whittaker		
Affiliation:	Institute for Marine & Antarctic Studies, University of Tasmania	Contact details:	Jo.whittaker@utas.edu.au

Objectives and brief narrative of voyage

Scientific objectives

1) Dredge volcanic and sedimentary rocks to obtain new, rigorous age and paleo-depth constraints for the Cascade Guyot. Underway bathymetric data will be used to refine dredge targets.
2) Collect sediment cores across a depth transect to enable work investigating paleo-oceanographic conditions using proxies. Preferably at least a multicore proximal to IODP site 1172, and piston cores at the mid- and shallow-depth sites.
3) Collect high resolution swath bathymetry and sub-bottom profile data to see how far recent sediment flows extend from the Cascade Guyot towards IODP site 1172, to test the hypothesis that downslope transport resulted in the observed sediment patterns in core 1172. Existing coverage and resolution of bathymetry across the East Tasman Plateau is insufficient to resolve this question.
4) CTD to complement the sediment core data if possible. Alternative is for clean underway surface supply samples to be taken where CTD not possible.

Voyage objectives

Aspects of the MNF equipment testing tie in with the objectives of the supplementary science program. The voyage objectives of both the science and the equipment testing share equal priority and therefore determined to share as the primary objective.

Voyage objectives listed in order of priority

1. Deploy and test/calibrate a range of key MNF equipment utilised on science voyages and retrieve samples to be utilised by supplementary program:
    I. Seagoing Instrumentation/Supplementary Voyage
        - Test following equipment:
            - Rock dredge: Test gallows modification and develop procedure for use at target locations as identified under science objectives.
            - CTD System Testing and deployment
                1. Automatic Pay out / Pay-in to pressure values rather than wire-out values (this used to work, but got broken somewhere with one of their upgrades).
                2. Heave compensation review – make sure that this can be selected and works.
                3. Spooling review in deep water – at the moment the crew have to keep adjusting the spooling manually.
                4. Constant Tension mode during the boom movement during deployment and retrieval (as the crew have lost confidence in this and don’t use it, since the CTD wire was broken).
                5. Min of 2 x casts at up to 4000m (~4 hours per cast for 8 hours total)
            - Sediment Coring System testing and deployment:
                1. Multicorer: 3 possible target sites ranging from 2500-700m with the 2500m site at location 1172 the priority. Minimal use on previous voyages and some changes to the system requires testing. Listed for IN2017_V01. NOTE: deep site with multicorer will only be possible in calm sea state.
                    - Whole cores to be stored in CT Lab at 3-5 degrees Celsius

- Samples will be sectioned into bags using core extruder and frozen.

2. Piston corer (long corer): Test of system in preparation for IN2017_V01
3. Kasten corer: Test of recent modifications
    - Whole-core sample taken with U-channel and stored in CT Lab at 3-5 degrees Celsius
    - Sub samples to be taken and stored in freezer

- GP Towing Winch Spooling Test
- Other
    1. Stabilised platform: Test stabilisation range, mechanical strength, motor drive and water tightness. Testing in rough conditions or deliberate course deviations/accentuating pitch and roll of vessel is required.
    2. Calibration of ships compass: Will be conducted upon leaving the wharf prior to reaching the Echo sounding calibration site.

II. Geophysical Survey and Mapping (GSM)
- Calibrate EK-60 Echo sounder in Storm Bay
- Seabed mapping at designated locations

III. Supplementary Voyage
- Bathymetry of the seafloor south of drill site 1172

IV. Other
1. Sonardyne USBL Beacons: Test range of beacons by deploying trawling winch opportunistically
2. ADCP bottom track collection in approx. 150-200m depth of water, where opportunity presents.

2. Data Acquisition and Processing (DAP)
    - Commence seagoing training for 3 new recruits.
    - Testing port period updates as follows. The tests will mostly involve monitoring normal operations and attending to any issues that surface:
        - Netequalizer Bandwidth Management device
        - New Investigator domain & server OS upgrade
        - Commbox upgrade
        - New firewalls & server switches
        - SAN expansion & virtual server storage
        - Visage
        - Polarion/Resources sync & intranet linkage

3. Provide vessel familiarisation and training opportunities to new MNF personnel.

Results

<u>Science Objective 1</u>. Dredge volcanic and sedimentary rocks to obtain new, rigorous age and paleo-depth constraints for the Cascade Guyot. Underway bathymetric data will be used to refine dredge targets.

The dredging was definitely a success. We dredged volcanic and sedimentary rocks at all 6 attempted dredge sites (Figure 1). In total we collected 713 kg of rock samples, including basalts, conglomerates, sandstones, limestones and tuffs. A full list of recovered samples is included in Appendix A. Samples were collected at key depth intervals (Fig. 2), which will enable detailed analysis of the age and subsidence history of the Cascade Guyot.

Dredge locations other than Dredge Site 1 were different to the planned dredge locations. This was due to the prevailing wind direction, which meant that we couldn't dredge towards the east. Dredge targets were adjusted to target south-facing slopes so we could dredge into the wind. Originally, 2 additional deeper sites were planned, but with significant volumes of rock recovered at dredges 1 and 2, a decision was taken to use the remaining dredges to focus on the terraces on the top of the Cascade Guyot in order to have a better chance of developing a detailed subsidence history. We do not know yet if can develop a detailed subsidence history, but the cruise component of this voyage has exceeded our expectations.

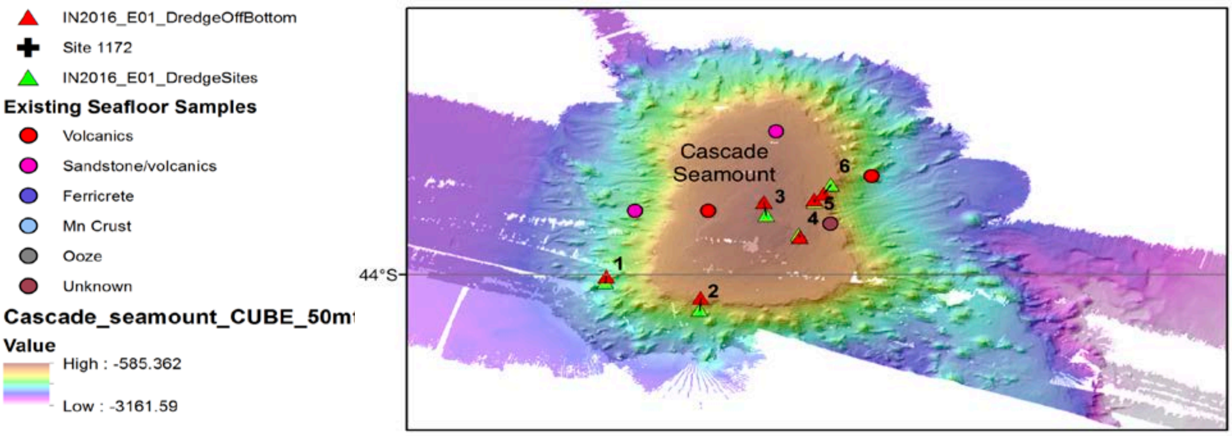


Figure 1. Location of existing dredge sites and the 6 successful dredge locations from this voyage.

<u>Science Objective 2.</u> Collect sediment cores across a depth transect to enable work investigating paleo-oceanographic conditions using proxies. Preferably at least a multicore proximal to IODP site 1172, and piston cores at the mid- and shallow-depth sites.

This scientific was partially successful. A full depth transect could not be obtained due to unfavourable sedimentary conditions on the top and flank of the Cascade Guyot (too sandy). A Smith-Mac Grab (SMG1) was successful on the NE flank of the Cascade Guyot, although a Kasten core was unsuccessful due to the sandy substrate.

To the west of the Cascade Guyot in ~2,500 m of water, we were successful in recovering a Kasten Core (2.15 m), and Gravity Core (10.18 m) proximal to IODP drill site 1172. A successful piston core (13 m) was obtained immediately offshore the Tasmanian continental shelf, and a Smith-Mac grab at the head of the Derwent sampling a hypothesized Last Glacial Maximum beach deposit. A multi-core at this site was unsuccessful due to the sandy substrate.

Science Objective 3. Collect high resolution swath bathymetry and sub-bottom profile data to see how far recent sediment flows extend from the Cascade Guyot towards IODP site 1172, to test the hypothesis that downslope transport resulted in the observed sediment patterns in core 1172. Existing coverage and resolution of bathymetry across the East Tasman Plateau is insufficient to resolve this question.

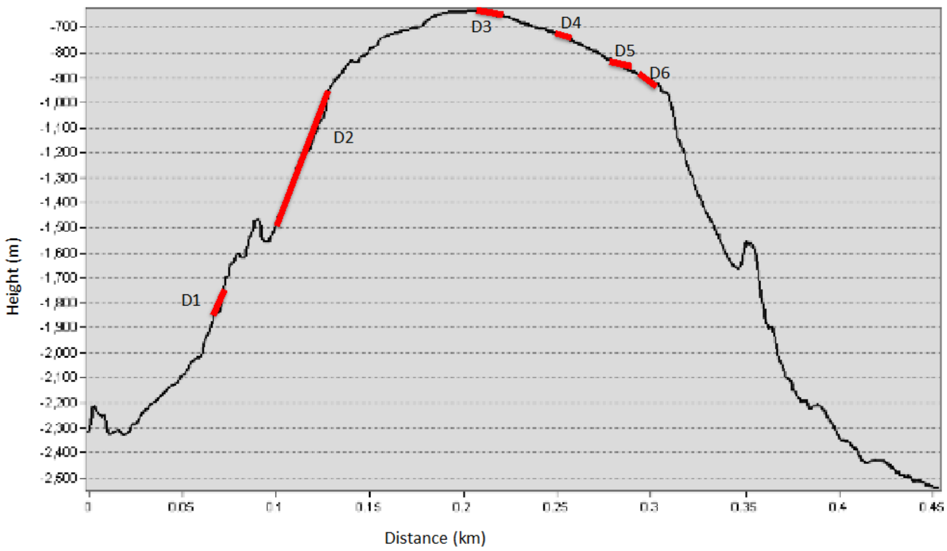


Figure 2. Cross section view of the Cascade Guyot, with dredge locations shown in red.

During the voyage, swath bathymetry (including backscatter), sub-bottom profiler and gravity data were collected continuously. Most useful was the swath bathymetry and sub-bottom profile data, which allowed us to image large regions of previously unmapped seafloor fabric to the south of Site 1172 (bathymetric coverage shown in Figure 3). Further analysis needed to determine the presence of sediment lobes, which, if present will indicate downslope sediment transport. Backscatter data will be able to be processed after the voyage and may help us map regions of volcanic basement and sediment lobes on the guyot and extending across the East Tasman Plateau.

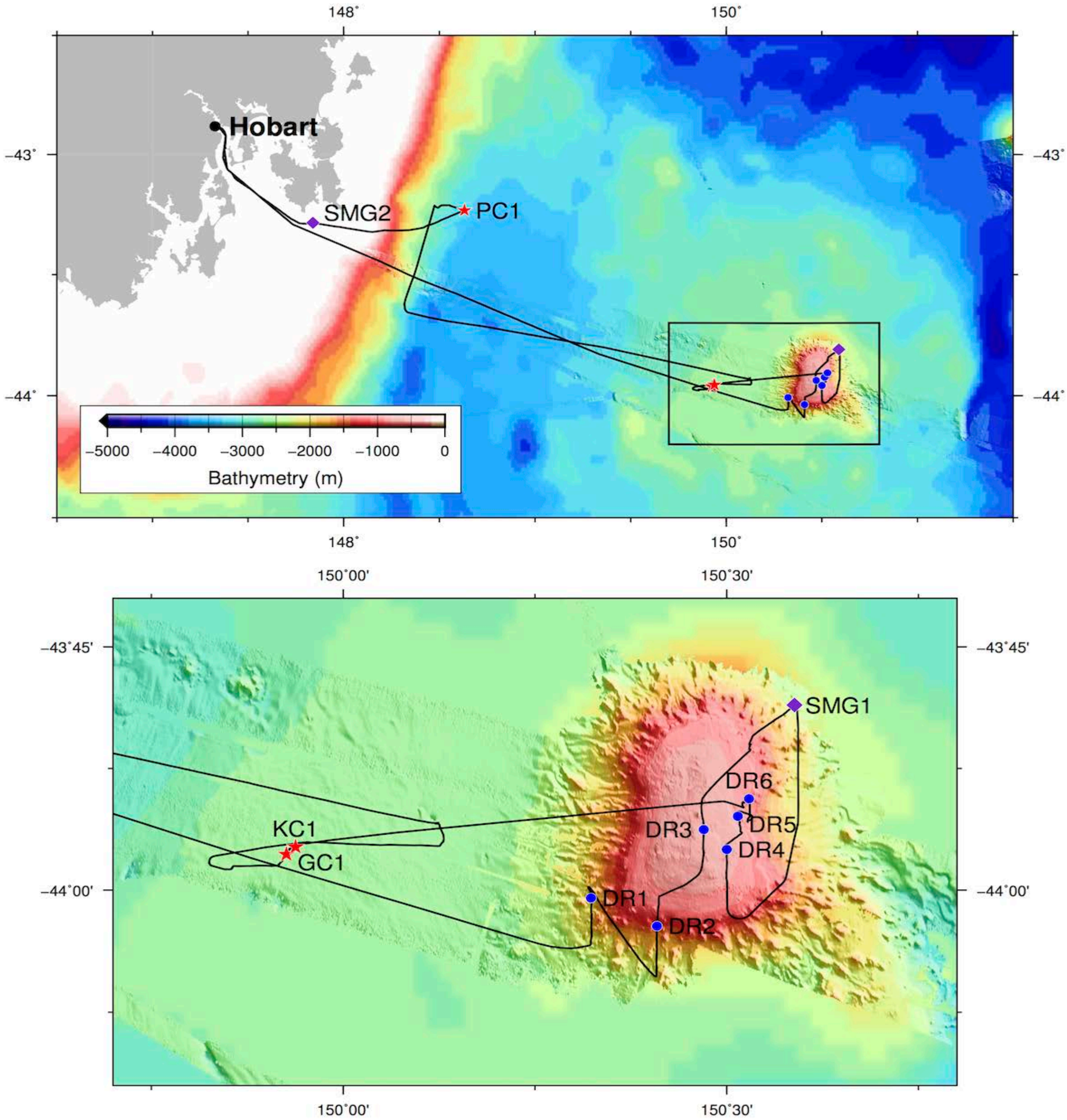


Figure 3. Top. Full shiptrack (black line) Locations of successful sediment sampling are shown as red stars (PC – piston core, KC – Kasten core, GC – gravity core) and SMG – Smith-Mac Grab show as purple diamonds. Bottom – zoom-in on Cascade Guyot (DR – dredge, blue squares).

<u>**Science Objective 4.**</u> CTD to complement the sediment core data if possible. Alternative is for clean underway surface supply samples to be taken where CTD not possible.

This objective was successful, with water samples obtained from the CTD cast proximal to site 1172 to a depth of 1000m. Heave compensation testing was carried out followed by firing of the bottles at depth to collect water for calibration laboratory.

MNF Equipment Testing Voyage Objectives

MNF science equipment and ship systems, which had undergone recent modifications were successfully tested. At the completion of IN2016_E01 there was further testing and modification required to some of the winch systems and this will be on-going over the coming months. Full reports of all activities conducted are included in Appendix 3 (SIT), Appendix 4 (GSM) and Appendix 5 (DAP).

Voyage Narrative

Overall, the voyage can be separated into two main components:

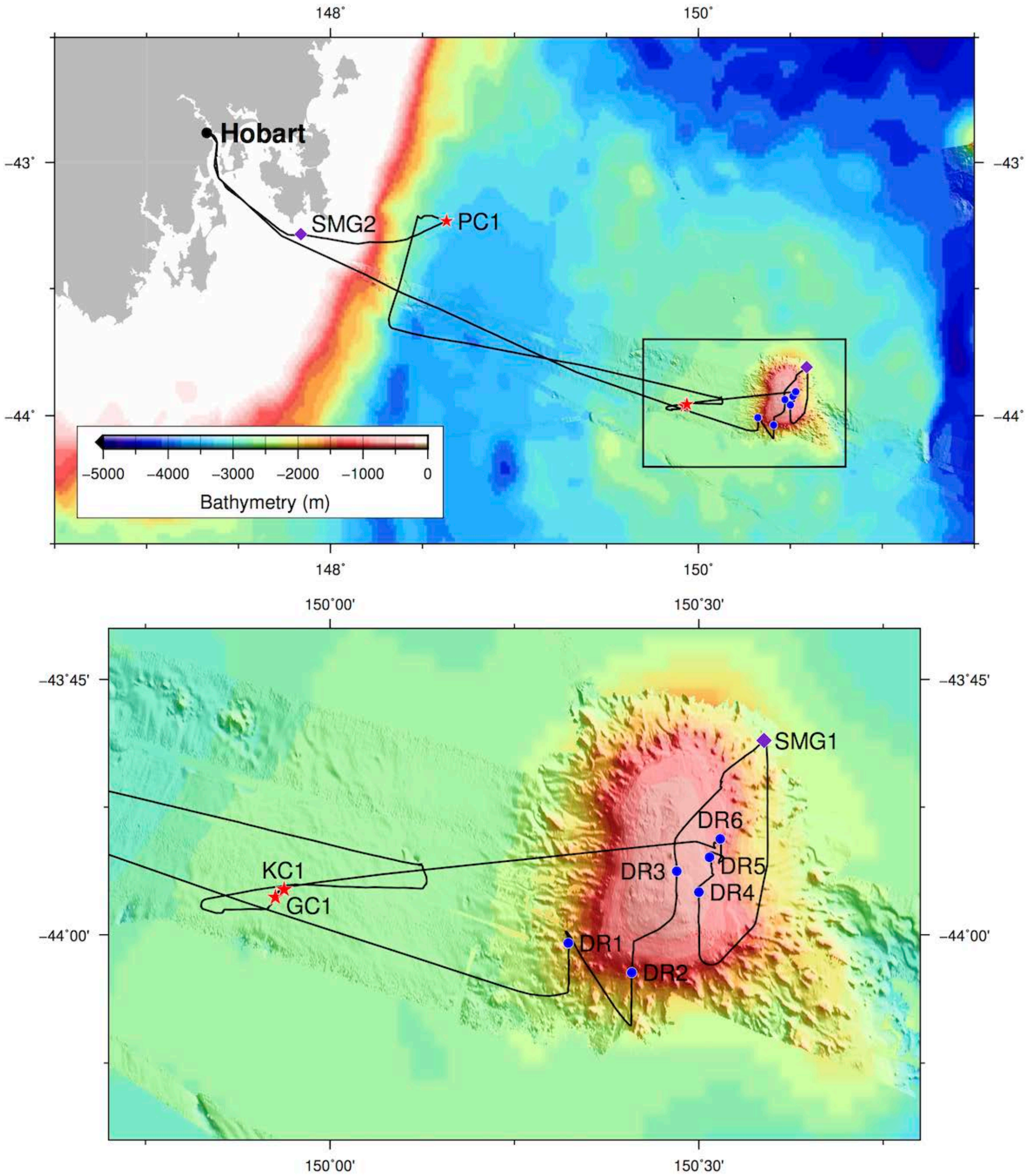
- Scientific dredging and sediment sampling
  - **Dredging.** Six dredges were completed using the rock dredge, during the evenings of Thursday 18th and Friday 19th August, 2016. Dredge targets were selected using existing swath bathymetry coverage. We targeted slopes and terraces of different depths (see Figure 2) to obtain rocks at discrete intervals, which will enable us to build a subsidence history through time for the Cascade Guyot. Once recovered dredged material were washed, sorted, labelled and catalogued, before being stored in the cool room.
  - **Coring.** There were five coring options available to us on this voyage – Smith-Mac grab, multi-corer, Kasten corer, gravity corer, and piston corer. These options have strengths and weaknesses related to the type and amount of sedimentary material they can recover. We aimed to core the summit of the Cascade Guyot but Dredge 3 during the evening of Thursday 18th showed that this site was unsuitable for coring. Instead we moved to the NE flank of the Cascade Guyot and obtained a successful Smith-Mac grab sample during Friday 19th. A Kasten core at the same site was unsuccessful. On Saturday 20th following completion of dredging we moved to Site 1172 and successfully recovered a Kasten core and a gravity core.
- MNF equipment testing and training.

Summary

The voyage was very successful. We achieved far more than expected with respect to the amount and variety of rocks recovered through dredging. Swath and sub-bottom profile coverage was exactly what we wanted and we are hopeful that further analysis will provide indications of downslope transport from the Cascade Guyot towards site 1172. The sediment coring wasn't completely successful in obtaining a complete depth transect, but was successful in collecting sediment data proximal to Site 1172, which was a key priority. Water samples from the CTD complement this sampling and will be very valuable.

Overall the combination of an MNF equipment trial and science voyage presented some challenges, however the results were positive with almost all major objectives completed and some very efficient use of ship time.

Voyage Track

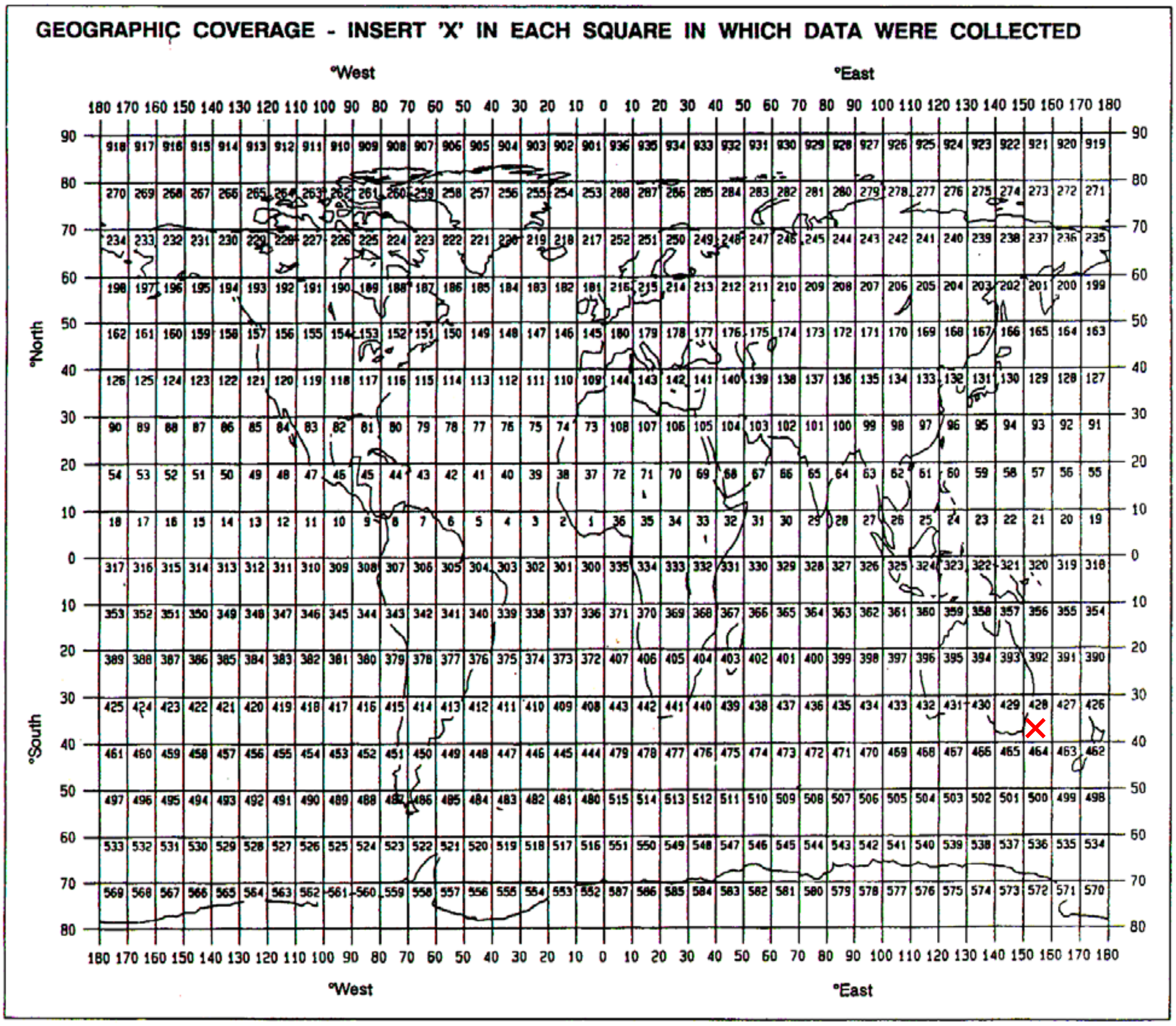


Top. Full shiptrack (black line) Locations of successful sediment sampling are shown as red stars (PC – piston core, KC – Kasten core, GC – gravity core) and SMG – Smith-Mac Grab show as purple diamonds. Bottom – zoom-in on Cascade Guyot (DR – dredge, blue squares).

Marsden Squares

Move a red “x” into squares in which data was collected

× × × × ×



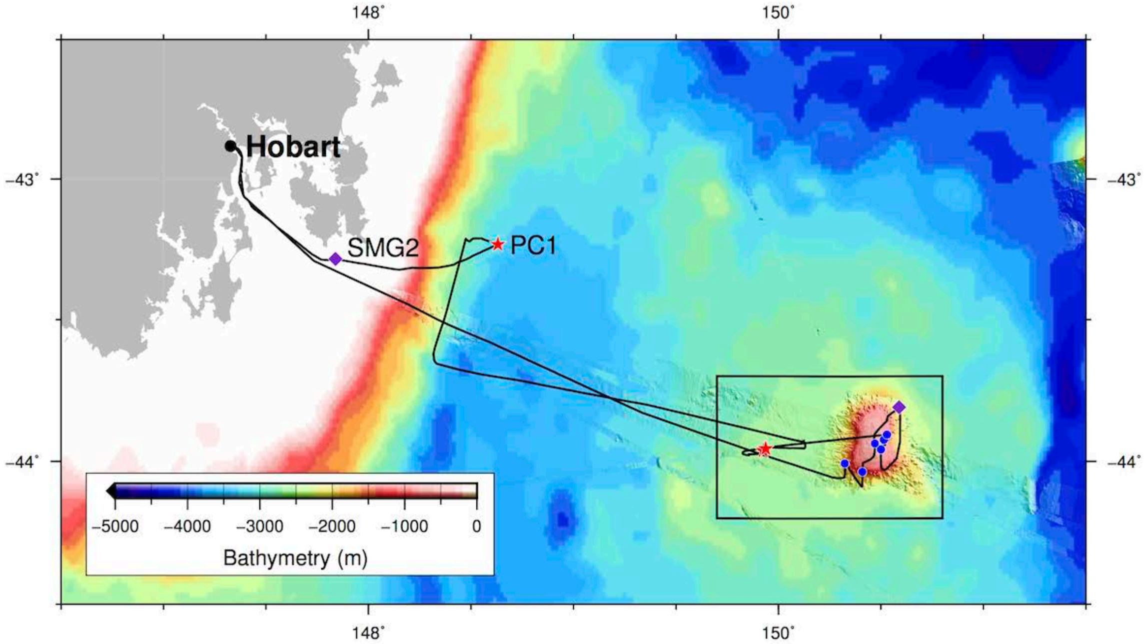
Summary of Measurements and samples taken

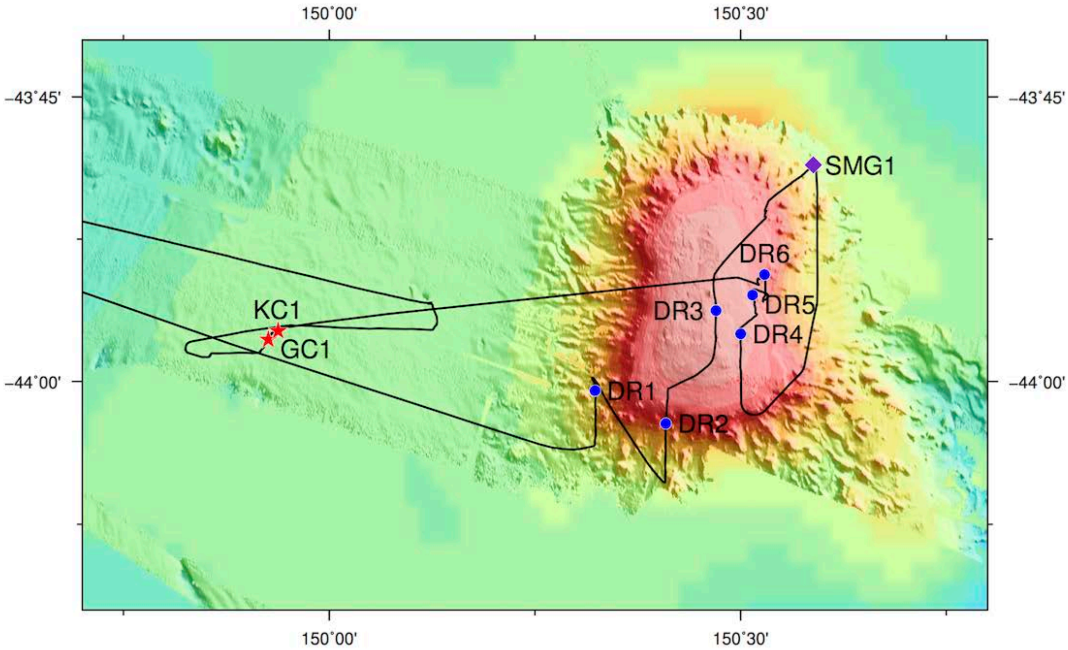
Item No.	PI see page above	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on last page	DESCRIPTION Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e. g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
1	Whittaker	6	Sites	G01	Dredge samples from 6 sites. A full listing is given in Appendix A. Samples taken ashore for geochemical and geochronological sampling.
2	Whittaker	2	Sites	G04	Sediment cores – 1 Kasten ; 1 gravity
3	Whittaker	1	Sites	G02	Sediment grab – 1 Smith-Mac grab
4	Whittaker	863,228	km	G74	Swath Bathymetry (including backscatter) - continuous collection of data. Preliminary data used for dredge site planning. Data to be fully processed and analysed onshore.
5	Whittaker	610,461	km	G75	Sub-bottom Profiler – continuous collection of data, to be fully processed and analysed onshore.

Curation Report

Item No.	DESCRIPTION
1.	**Rock samples** from the dredges were sent to two institutions for further work and/or archiving: - The University of Tasmania, Australia (contact Jo Whittaker, Sean Johnson, Rebecca Carey): main repository for all dredge samples - Macquarie University, Sydney (contact Nathan Daczko) for descriptions and thin sections. The logbook of the cruise is kept with the repository at the University of Tasmania.
2.	**Sediment cores** were sent to the University of Tasmania for further work. Archiving of these samples at this location is only possible during the analysis period.
3.	**Sediment grabs** were sent to the University of Tasmania for further work. Archiving of these samples at this location is only possible during the analysis period.

Track Chart


148˚
150˚
Hobart
SMG2
PC1
–43˚
–44˚
–5000
–4000
–3000
–2000
–1000
0
Bathymetry (m)


150˚00'
150˚30'
–43˚45'
–44˚00'
SMG1
DR6
DR3
DR5
DR4
KC1
GC1
DR1
DR2

Personnel List

	Surname name	First name	Organisation	Role
1.	Thost	Doug	CSIRO MNF	Voyage Manager
2.	Whittaker	Joanne	Utas	Chief Scientist
3.	Buchanan	Pearse	Utas	PhD student geochemistry
4.	Ding	Xuesong	Sydney	PhD Student geophysics
5.	Duggan	Brian	Uni South Carolina	Geologist
6.	Farmer	Michael	Macquarie	Masters student geology
7.	Fox	Jody	Utas	PhD student volcanology
8.	Johnson	Sean	Utas	PhD student geology
9.	Mundana	Rhiannan	Utas	Student volcanology
10.	Perez-Tribouillier	Habacuc	Utas	Sedimentologist
11.	Rhodes	Andrew	Utas	Communications
12.	Sauermilch	Isabel	Utas	PhD student geophys
13.	Scher	Howie	Uni South Carolina	Geologist
14.	Watson	Sally	Utas	PhD student geophys
15.	West	Harry	Macquarie	PhD student geology
16.	Wild	Toban	Monash	PhD student Palaeontology
17.	Williams	Simon	Sydney	Alternative Chief Scientist
18.	Wright	Nicky	Sydney	PhD student geophys
19.	McKenzie	Don	CSIRO MNF	Deputy Voyage Manager
20.	McGuire	Max	CSIRO MNF	IN2017_01 VOM
21.	Lewis	Mark	CSIRO MNF	SIT
22.	Fazey	Jason	CSIRO MNF	SIT
23.	Muir	Brett	CSIRO MNF	SIT
24.	McRobert	Ian	CSIRO MNF	SIT
25.	Filisetti	Andrew	CSIRO	SIT
26.	Ponsonby	Will	CSIRO MNF	SIT
27.	Nau	Amy	CSIRO MNF	GSM
28.	Cooke	Frances	CSIRO MNF	GSM
29.	Boyd	Matt	CSIRO MNF	GSM
30.	Hawkes	Ian	CSIRO MNF	DAP
31.	Barker	Hugh	CSIRO MNF	DAP
32.	Chui	Francis	CSIRO MNF	DAP
33.	Shanks	Peter	CSIRO MNF	DAP
34.	Malakoff	Karl	CSIRO MNF	DAP
35.	Groneng	Kim-Arne	Rapp Marine	Technician
36.	Pedersen	Bard Morten	Nordkontakt	Technician
37.	Opdyke	Bradley	Macquarie Uni	Sedimentologist
38.	Kimber	Matt	CSIRO MNF	Support and familiarisation
39.	Scanlon	Mark	CSIRO MNF	Support and familiarisation

Marine Crew

Role	Surname	First Name
Master	Nagra	Gurmukh
Ch Off	Quinn	Roderick
2nd Off	Koolhof	Adrian
3rd Off	Watson	Thomas
C/Engr	Minness	Chris
1st Engr	Benson	Sam
2nd Engr	Mcdonald	Ian
3rd Engr	Wright	Damian
E/Engr	Kromcamp	Shane
CIR	Lumb	Jonathan
IR 1	Hingston	Dean
IR 2	Capon	Darren
IR 3	Lord	Murray
IR 4	Ellis	Jarod
IR 5	Lewis	Kel
IR 6	Drennan	Ryan
COOK	Gardiner	Matt
C/COOK	Lee	Rebecca
C/Stwd	Martin	Alan
1/Stwd	Hall	Gary
Trainee/Cadet	Edwards	Sam

Acknowledgements

We are grateful to the MNF and ASP for ship access prior to the mobilization day, and for excellent support at sea.

Signature

Your name	Joanne Whittaker
Title	Chief Scientist
Signature	
Date:	16/09/2016

List of additional figures and documents

Appendix 1 Summary of Dredged material

Appendix 2 GSM Activities Report

Appendix 1 Summary of dredged material

SAMPLE ID	WEIGHT (kg)	DESCRIPTION
D1_A_01	0.999	Tuff? Fine grained bedded, light cream
D1_A_02	0.009	Black fragments 1-2mm
D1_B_01	25.000	Large rock, roughly 1m initially, broken smaller pieces mm scale glass fragments. Pervasively clay altered basalt vesicular
D1_C_01	0.336	Porous chunk, brown
D1_C_02	0.273	Porous brown chunk, large vesicles
D1_C_03	0.187	Porous brown chunk, less vesicular than 02
D1_D_01	2.444	Botryoidal surface, brown
D1_D_02	3.704	Large rock, oxide coated, small vesicles
D1_D_03	16.300	Massive botryoidal surface, vesicular rock
D1_E_01	0.059	Coral chunk
D1_E_02	0.029	Coral
D1_E_03	0.003	Coral
D1_F_01	11.100	Massive oxide covered basalt with coral
D1_F_02	13.900	Botryoidal surface, brown
D1_F_03	1.064	Oxidised rock (Basalt)
D1_F_04	18.700	Botryoidal surface, brown
D1_F_05	14.300	Botryoidal basalt
D1_F_06	5.185	Weathered basalt covered in oxide
D1_F_07	2.314	Weathered basalt covered in oxide
D1_F_08	2.387	Weathered basalt covered in oxide
D1_F_09	8.505	Weathered basalt covered in oxide
D1_F_10	1.568	Weathered basalt covered in oxide
D1_F_11	1.065	Weathered basalt covered in oxide
D1_F_12	14.300	Weathered basalt covered in oxide
D1_F_13	25.800	Botryoidal surface, weathered basalt covered in oxide
D1_G_01	3.044	Heavily weathered basalt
D1_G_02	0.754	Heavily weathered basalt
D1_G_03	0.512	Half of the rock is weathered, remainder is vesicular basalt
D1_G_04	2.506	Weathered basalt
D1_G_05	1.508	Weathered basalt, pyroxene crystals
D1_G_06	1.126	Weathered basalt, pyroxene crystals
D1_G_07	4.034	Weathered basalt
D1_G_08	5.183	Weathered basalt
D1_H_01	1.696	Weathered basalt with a little botryoidalism
D1_H_02	1.367	Weathered basalt with oxide coating
D1_H_03	1.457	Weathered basalt with vesicles
D1_H_04	1.322	Weathered basalt with oxide coating
D1_H_05	1.041	Weathered basalt with vesicles
D1_I_01	1.870	Fresh basalt, has vesicles
D1_I_02	11.800	Fresh basalt, high vesicularity
D1_I_03	2.141	Fresh basalt, vesicular
D1_I_04	6.050	Basalt, some alteration
D1_I_05	7.065	Basalt, moderately altered

SAMPLE ID	WEIGHT (kg)	DESCRIPTION
D1_J_01	13.280	Basaltic breccia
D1_J_02	29.700	Basaltic breccia with coral on top
D2_A_01	2.955	Sediment catcher - Whole sample representative (sand and rocks)
D2_A_02	4.092	Sediment catcher - Sand (same as D2_A_01) but with rocks removed
D2_B_01	4.584	Cemented carbonate sandstone
D2_B_02	1.880	Manganese crusted cemented carbonate sandstone
D2_B_03	10.000	Cemented carbonate sandstone with basaltic fragments
D2_B_04	0.670	Manganese crusted cemented carbonate sandstone w basaltic fragments
D2_B_05	0.255	Predominantly manganese oxide carbonate sandstone w basaltic fragments
D2_B_06	0.791	Finer grained cemented carbonate sandstone with basaltic fragments
D2_B_07	0.152	Fine grained cemented carbonate sandstone with basaltic fragments
D2_B_08	1.296	Small amount of sandstone cemented mainly manganese oxide
D2_C_01	1.121	Basaltic breccia with carbonate cement
D2_D_01	12.200	Weathered vesicular basalt
D2_D_02	2.420	Strongly altered and manganese coated basalt
D2_D_03	3.510	Altered manganese coated basalt
D2_D_04	1.196	Altered manganese coated basalt
D2_D_06	3.766	Altered vesicular basalt
D2_E_01	8.650	Basalt
D2_E_02	11.070	Basalt with coral
D2_E_03	4.880	Weathered basalt
D2_E_04	12.400	Weathered basalt w cemented basaltic clasts on side
D2_E_05	2.175	Weathered basalt
D2_F_01	0.004	Fine grained sandstone
D2_G_01	6.065	Breccia at the bottom with manganese
D2_H_01	12.720	Graded, Sandstone and coarse clastic, deeply cemented by Fe Mn oxide
D3_A_01	4.260	Mixed coarse sand/sediment
D3_B_01	1.550	Brown clastic
D3_B_02	0.560	Brown clastic
D3_B_03	3.556	Brown clastic
D3_B_04	0.349	Brown clastic
D3_C_01	2.065	Weathered basalt, vesicular
D3_C_02	1.433	Vesicular weathered basalt
D3_C_03	2.258	Weathered basalt, vesicular
D3_C_04	0.495	Vesicular basalt
D3_C_05	5.654	Vesicular basalt with coral on it
D3_C_06	2.578	Altered basalt
D3_D_01	2.603	Cemented basalt breccia
D3_D_02	0.798	Cemented basalt breccia
D3_D_03	8.050	Cemented basalt breccia

SAMPLE ID	WEIGHT (kg)	DESCRIPTION
D3_E_01	0.748	Limestone, heavily altered
D3_E_02	0.426	Limestone, heavily altered
D3_E_03	0.464	Limestone, heavily altered
D3_E_04	0.488	Limestone, heavily altered
D3_E_05	0.979	Limestone, heavily altered
D3_F_01	4.032	Fine-grained basaltic rock
D3_F_02	3.692	Fine-grained basaltic rock
D3_F_03	0.327	Fine-grained basaltic rock with black phenocrysts
D3_F_04	3.984	Fine-grained basaltic rock
D3_F_05	1.235	Weathered fine grained basalt
D3_G_01	1.670	Medium-grained sandstone
D3_H_01	2.112	Fine-grained, crystal-rich tuff
D3_H_02	1.243	Fine-grained, crystal-rich tuff
D3_H_03	3.972	Fine-grained, larger crystals (?) 2mm tuff
D3_H_04	6.290	Fine-grained, few crystals, tuff
D3_H_05	0.791	Fine-grained, tuff
D3_H_06	0.526	
D3_H_07	0.546	
D3_I_01	2.729	Altered polymictic breccia
D3_J_01	2.410	Weathered basalt with cemented sides, infilled with carbonate and fragments
D3_J_02	2.503	Weathered basalt with cemented sides, infilled with carbonate and fragments
D3_J_03	8.380	Weathered basalt with cemented sides, infilled with carbonate and fragments
D3_K_01	4.912	V. fine grained black rock with weathered phenocrysts
D3_K_02	5.090	V. fine grained black rock with slightly weathered phenocrysts/clasts
D3_K_03	11.010	Fresh basalt with olivine phenocrysts
D3_L_01	9.375	Cobble to pebble beach cemented with carbonate
D3_L_02	8.375	Cobble to pebble beach cemented with carbonate
D3_L_03	2.916	Cobble beach cemented
D3_L_04	3.636	Cobbly beach stone with >5cm clasts, also has angular gravel sized clasts in cement
D3_L_05	2.568	Cobble beach rock with limestone growing on top of it, has benthic forams
D3_L_06	2.863	Carbonate/limestone with dolomite also has basalt clast and iron oxide phenocrysts
D3_L_07	3.276	Polymictic limestone, dolomite and basalt clasts
D4 - Sediment Bucket - archive	1.520	Med - fine grained forams, 1mm translucent stems, $CaCO_3$, < 1mm shell fragments, Nautiloid corals colonial ? Qtz grains
D4-W-Sediment Bucket - Pebbles (1/3)	0.623	6 x grains > 2cm, <10cm lithified sed. Shell fragments and Mn
D4-W-Sediment Bucket - Coarse fraction - >8050um (2/3)	0.989	Shell Fragments mm, Stems brown and clear coral fragments Limestone fragments

SAMPLE ID	WEIGHT (kg)	DESCRIPTION
D4-W-Sediment Bucket - Fine fraction >600um (3/3)	0.973	<1mm $CaCO_3$ clast sub-rounded, Shell and Coral debris 15%, Clear $CaCO_3$ forams
D4-A-01	7.550	Lithified $CaCO_3$ Sediment/Shell fragments-biopackstone? With angular - sub-rounded clast and weathered crust (upper) brownish-red crust
D4-A-02	4.982	Lithified Shell fragments with oxide weathered crust
D4-A-03	2.642	Coral/Shell rich sediment lithified with oxide crust
D4-A-04	0.055	mm Scale rock fragments in $CaCO_3$ matrix + coral fragments, packstone?
D4-A-05	6.630	Lithified shell fragments with weathered oxide crust
D4-A-06	2.422	Lithified shell fragments with oxide crust
D4-A-07	3.972	Lithified shell fragments with weathered oxide crust
D4-A-08	1.122	Iron pan layer
D4-A-09	0.573	Iron oxide crust with 1-3mm shell fragments + pyroxene fragments
D4-A-10	2.995	Lithified shell fragments with weathered iron oxide crust
D4-B-01	17.160	Large basaltic? Grains - subrounded cobble conglomerate matrix of mm to sub-mm shell fragments
D4-B-02	1.550	Polymictic cobble conglomerate
D4-B-03	1.047	Iron pan layer with 1 - 2 mm sized shell fragments + large basaltic? clasts
D4-B-04	1.593	large basaltic clasts - sub-rounded cobble conglomerate - matrix of mm to sub-mm shell fragments
D4-B-05	3.318	Polymictic cobble conglomerate
D4-B-06	15.440	Polymictic cobble conglomerate
D4-C-01	0.503	Iron oxide crust with lithified shell fragments
D4-D-01	1.989	grain supported polymictic breccia
D4-D-02	0.884	grain supported polymictic breccia
D5-A-01	1.967	Polymictic bio grainstone
D5-A-02	0.727	Polymictic bio grainstone
D5-A-03	2.350	Polymictic bio grainstone
D5-A-04	0.199	Polymictic bio grainstone
D5-B-01	1.328	Coral
D5-B-02	0.058	Coral
D5-B-03	0.092	Coral
D5-B-04	0.052	Coral
D5-B-05	0.055	Coral
D5-B-06	0.036	Coral
D5-C-01	0.555	Fine grained matrix supported breccia
D5-C-02	0.332	Fine grained matrix supported breccia
D5-C-03	0.126	Fine grained matrix supported breccia
D5-C-04	1.514	Fine grained matrix supported breccia
D5-D-01	0.940	Polymictic conglomerate with sub angular to sub rounded centimetre scale clast wit shell fragments + grain supported matrix

SAMPLE ID	WEIGHT (kg)	DESCRIPTION
D5-D-02	0.714	Polymictic conglomerate with sub angular to sub rounded centimetre scale clast wit shell fragments + grain supported matrix
D5-D-03	0.438	Polymictic conglomerate with sub angular to sub rounded centimetre scale clast wit shell fragments + grain supported matrix with basaltic clast
D5-D-04	0.539	Polymictic conglomerate with sub angular to sub rounded centimetre scale clast wit shell fragments + grain supported matrix but with fewer clasts that are maximum 1 -2 cm
D5-D-05	0.597	Polymictic conglomerate with sub angular to sub rounded centimetre scale clast wit shell fragments + grain supported matrix
D5-D-06	0.408	Polymictic breccia grain supported with shell fragments + mm scale fragments of basaltic glass of cm scale clasts
D5-D-07	0.228	Polymictic fine grained breccia with abundant coral fragments + mm - cm scale clasts
D5-E-01	0.883	Phosphatic? Bio grainstone to packstone, shell fragments on mm scale + Colonial Coral Fragments to 5mm
D5-E-02	0.376	Phosphatic? Bio grainstone to packstone, shell fragments on mm scale + Colonial Coral Fragments to 5mm
D5-E-03	1.563	Phosphatic? Bio grainstone to packstone, shell fragments on mm scale + Colonial Coral Fragments to 5mm with more abundant coral + calcareous tube structures
D5-E-04	0.793	Phosphatic? Bio grainstone to packstone, shell fragments on mm scale + Colonial Coral Fragments to 5mm
D5-E-05	0.510	Phosphatic? Bio grainstone to packstone, shell fragments on mm scale + Colonial Coral Fragments to 5mm
D5-E-06	0.981	Sandstone with biology - bioclastic, coarse - grained
D5-E-07	1.690	Sandstone, coarse grained, bioclastic
D5-E-08	0.714	Sandstone, g coarse grained
D5-E-09	1.057	sandstone (coarse) with biology
D5-E-10	8.185	Sandstone, coarse grained, bioclastic
D5-E-11	0.283	Sandstone with biology - bioclastic, coarse - grained
D5-F-01	4.152	Conglomerate
D5-F-02	0.947	Heavily weathered conglomerate
D5-F-03	0.893	weathered conglomerate
D5-F-04	1.043	weathered conglomerate
D5-F-05	4.178	weathered conglomerate
D5-F-06	0.812	weathered conglomerate
D5-G-01	45.500	Conglomerate with carbonate and bioclastic 5 pieces
D6-A-01	4.474	Med/coarse grained grained biogenic send
D6-B-01	2.227	weathered aphyric basalt

SAMPLE ID	WEIGHT (kg)	DESCRIPTION
D6-B-02	1.220	fine-grained basalt with small <1mm olivine phenocrysts
D6-B-03	8.995	fine-grained basalt with small <2mm olivine phenocrysts (rock cut in two)
D6-C-01	1.283	weathered basaltic conglomerate
D6-C-02	1.931	Basaltic conglomerate with thick Mn oxide crust
D6-C-03	3.052	Basaltic conglomerate with thin Mn oxide crust
Total	707.145	

Appendix 2 Geophysical Survey Mapping Activities

Calibration of EK-60 Echo Sounder: Calibration was undertaken in storm Bay over a period of approx. 10 hours. Calibration was carried out using the "sphere method", whereby solid spheres of tungsten carbide steel and another of electrical grade copper are placed in the beam of the echo sounder, and moved around to measure the variation in the return echo from the sphere.

Six full calibrations of the six transducers (18, 38, 70, 120, 200, and 333 kHz) were completed at 0515, the gear packed up by 0610 and ship back underway at 0615. The system operated with no problems throughout the voyage.

Swath Bathymetry: 863,228 km mapped.

Sub Bottom Profiling: XXXXX km mapped