RV *Investigator* Voyage Plan

VOYAGE #:	IN2022_V02
Version Number:	Final - 2.20
Voyage title:	Sedimentation at its extreme: how powerful are submarine caldera-forming eruptions (Kermadec arc)?
Depart:	Hobart: Tuesday, 15th March 2022
Return:	Hobart: Tuesday, 19th April 2022
Demobilisation:	Hobart: Wednesday, 20th April 2022 – Thursday, 21st April 2022
Chief Scientist:	Dr. Martin Jutzeler
Affiliation:	CODES/Earth Sciences, UTAS
Principal Investigators:	Rebecca Carey, Adam Soule, Geoffroy Lamarche, Richard Wysoczanski, Michael Manga, Steffen Kutterolf, Joanne Whittaker
Project name:	Sedimentation at its extreme: how powerful are submarine caldera-forming eruptions (Kermadec arc)?

- PLEASE NOTE -

Acknowledgement to Ngāti Kuri

Ngāti Kuri, the kaitiaki and mana whenua of Rangitāhua, the customary guardians of Rangitāhua, (Kermadec arc) agree to access to voyage data for educational, academic and non-commercial use.

For other proposed use of voyage data please seek the free, prior and informed consent of Ngāti Kuri [email: research@ngatikuri.iwi.nz].

Users of voyage data are asked to acknowledge Ngāti Kuri as kaitiaki and mana whenua of Rangitāhua in any analogue or digital publications resulting from the use of this data.

Scientific objectives

The aim of this project is to link the behaviour of deep submarine eruptions with the morphology of their deposits. Modelling calculations of sediment mass fluxes will permit the first-ever hazard mapping scheme for submarine volcanoes globally (tsunami and sediment flows) and provide new ore vectoring strategies for exploration in Australia.

This expedition will collect new information on volcanoes responsible for the largest types of volcanic eruptions, focusing on those located along the submarine Kermadec volcanic arc, northeast of New Zealand, as shown in Figure 1. The voyage will target three massive caldera volcanoes (Macauley, Havre and Healy), aiming to acquire their internal structure to infer eruption style and depositional processes.

The project revolves around four main objectives:

1. We will establish further that the dune-like bedforms on the flanks of the selected submarine volcanoes are eruption-fed sediment waves, not mass-wasting deposits. Geophysical data and sediment cores will be used to confirm the eruption-fed origin of the waveforms, as proposed recently.

1. We will model magma flux of deep submarine eruptions based on the internal morphology of sediment wave deposits. There is a direct relationship between magma discharge rate at the vent and sediment flux on the flank of volcanoes. Fluxes will be numerically modelled from the internal geometry of sediment waves acquired through marine geophysics and coring.

2. We will establish the tsunamigenic potential of submarine volcanism, based on magma flux, sediment flux, and water depth. Combination of these three factors at representative volcanoes will be assessed to infer risks and build hazards maps for modern submarine volcanism (tsunamis and seafloor sediment flows).

3. We will carry out seismic surveys to fulfil mandatory requirements for a future IODP drilling campaign.

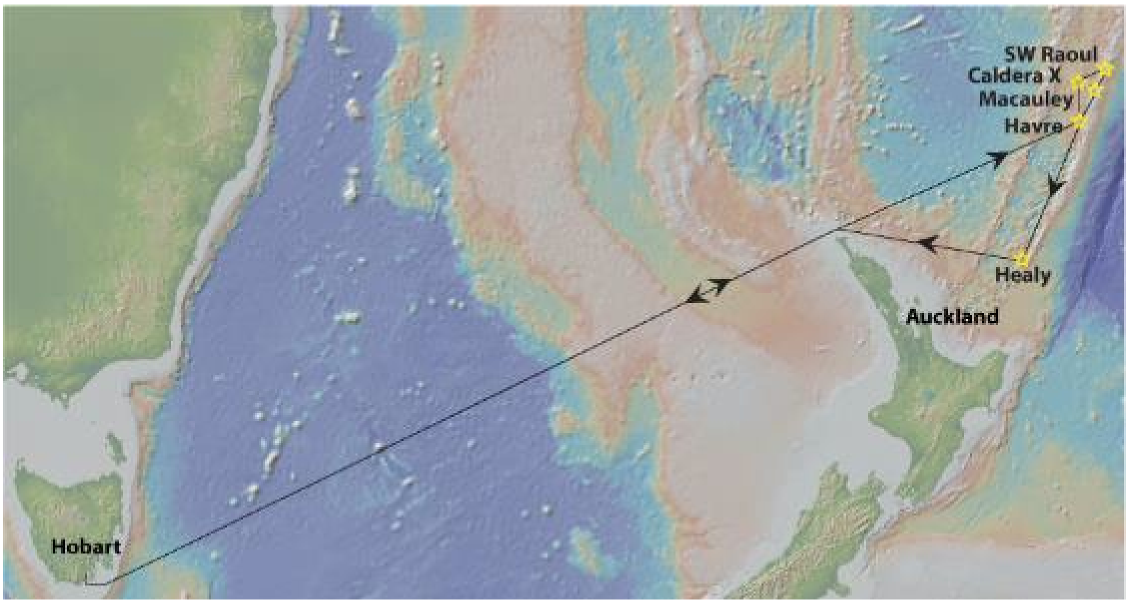

Figure 1: Map highlighting research area in the Kermadec arc, New Zealand

Voyage objectives

The aim of this project is to link the behaviour of deep submarine eruptions with the morphology of their deposits. Our main objective is to collect **bathymetry, seismic reflection, sub-bottom profiler data and sediment cores** to reconstruct the architecture of several submarine volcanoes. We target submarine volcanoes that comprise sediment waves, and/or calderas that represent large magnitude volcanism. As lower priority, we may target a few volcanoes or vents nearby to reconstruct their architecture as well. Our primary targets are Healy, Havre, Macauley; secondary targets are caldera X and SW Raoul. Seismic data will be used as site survey in a deep-sea drilling IODP pre-proposal. We will conduct a seismic survey at Havre to image the 2012 eruption products in detail.

1. Multibeam bathymetry/backscatter: we will acquire multibeam data at Healy, Havre, Macauley, SW Raoul and caldera X. Anticipated water depths range from <200 m to ~4500 m, thus we will use both EM122 (deep water) and EM710 in water depths less than ~1500 m. Transects will be perpendicular to sediment waves and elongated features, and surrounding volcanoes to acquire crossing transects. A few transects will be in deep-water areas with satellite bathymetry data only (e.g., NE of Havre). Transits will ideally have data acquisition.

2. Sub-bottom profiling: we will acquire SBP120 data continuously during multibeam data acquisition. These near-real-time data will contribute to identifying the best locations for coring. SBP120 will be acquired during seismic reflection profiles and during transit. Transects will include 1) pre-coring surveys for coring site-selection; 2) topical transects with targets of interest.

3. Seismic reflection: we will utilise the MNF seismic system consisting of a 40-channel (12.5m group spacing), 500-m-long streamer. To abide from environmental laws in the New Zealand EEZ, we will use a single 150 in^3 GI gun and carry out seismic reflection. We will acquire transects at Healy, Havre, Macauley, SW Raoul and Caldera X. Seismic reflection data acquisition will be undertaken at 4 kts, each deployment and retrieval of the system will take approximately 2 hours, and transits between the lines will be conducted at 11 kts (equipment onboard) or 5 kts (equipment left at sea for short transits).

4. Sediment coring: We will utilise the new MNF Giant Piston Corer (GPC) system. We will test various core liner length configurations depending on success rate and targeted sediment type (mud vs sand). Sediment cores are essential data to reconstruct volcanic stratigraphy and study geochemistry of the volcanic products. We will bring the Karsten corer as back-up system, as it can be used by night as well. This system is only 4 m long and thus of much less value than the up-to-24-m long piston coring system. Coring will be performed at Healy, Havre, Macauley; coring at SW Raoul and Caldera X is lower priority. The products of the 2012 Havre eruption will be cored to better understand raft-generated seafloor deposits.

We will employ the Geoscience Australia core splitter to allow preliminary stratigraphic, sedimentological and volcanological assessments. The *working* half will be sampled onboard and samples will be catalogued, while the *archive* half will remain untouched. The split corer will be of invaluable help to assist the scientific team on coring strategies.

5. Dredging: Time depending, we will dredge sites NW of Havre, or in absence of good core recovery. Dredging may recover large pumice clasts and other products of submarine volcanism. Utilizing the near-real-time multibeam, and sub-bottom profiling, we will select dredging sites in water depths as great as ~4500 m.

6. Single-beam and multi-beam water column echo-sounding: we will collect EK60 and ME70 data throughout the entire voyage. The near-real-time data will reveal any acoustic plumes emanating from the seafloor, providing invaluable information on the state of activity of the targeted volcanoes.

7. Gravity: gravity data will be acquired by the shipboard gravity meter during the entire voyage, complementing previous datasets.

8. Deep Tow Camera: We may decide capture videos of the seafloor NW of Havre volcano to document on seafloor habitat post-2012. Objectives include mapping of the seafloor deposits from the 2012 pumice raft, life recovery after the 2012 eruption, and survey of the substrate surrounding the various volcanoes. Transects will be conducted at 1-2 knots, and the total video recorded time will be discussed to match the RV Investigator's data storage capabilities. Drop camera could be used as a backup, but the towed camera is strongly preferred, especially for its ability to run distances and carry the eDNA sampler.

9. eDNA collection with the **Deep Tow Camera.** eDNA will be sampled during several Deep Tow Camera surveys. The seawater (ca. 2 litres) will be filtered for DNA and the concentrate refrigerated at –80C. A student has been assigned for processing the samples.

10. IMOS requested ship time to deploy two BGC **Argo floats** and **CTD** runs. A student will take care of the water samples (student will be trained by IMOS people). A student has been assigned for processing the samples. Five regular **Argo floats** will also be deployed

11. Andrew Bowie (IMAS) requested **aerosols** to be sampled with the same methods as planned for IN2022_V01. A student has been assigned for processing the samples.

Lost time

Lost time (equipment malfunction, whales, weather, etc.) will be dealt with by reducing the number of targets, depending on the quality of the already acquired data, and instrument capability. Priority volcanoes (Havre, Macauley, Healy) and priority surveys have been planned.

Overall activity plan including details for first 24 hours of voyage

The first 24h at sea will consist in the start of a 5-day transit to first target. Transit time will be used to organise shifts, set up the labs for splitting and study of sediment cores, and get familiarised with the seismic and bathymetry acquisition systems and process CTD samples taken for IMOS.

Waypoints and stations

No.	Site	DDM Lat	DDM Long	Distance (NM)	Total Distance (NM)
1	PW4	42°53.159'S	147°20.331'E	0.3	0
2	Battery Pt	42°53.159'S	147°20.874'E	2.3	0.3
3	Garrow	42°54.860'S	147°23.066'E	0.7	2.6
4	HBA PBG	42°55.411'S	147°22.974'E	3.2	3.3
5	White Rock	42°58.619'S	147°22.493'E	5.1	6.5
6	Iron Pot	43°03.771'S	147°23.456'E	13.2	11.6
7	BS Cal1 Start	43°11.899'S	147°37.508'E	6.8	24.8
8	BS Cal1 End	43°16.187'S	147°44.785'E	3.9	31.6
9	BS Cal4 Start	43°16.511'S	147°50.109'E	4.4	35.5
10	BS Cal4 End	43°16.630'S	147°56.108'E	5	39.9
11	Tasman Sea Crossing	43°16.200'S	148°03.001'E	1271.3	44.9
12	Reinga	34°18.345'S	172°39.999'E	461.6	1316.2
13	Havre	31°06.619'S	179°02.014'W	61.8	1777.8
14	Macauley	30°11.793'S	178°28.671'W	46.8	1839.6
15	SW Raoul	29°28.071'S	178°05.801'W	54.4	1886.4
16	Caldera-X	29°55.314'S	179°00.404'W	320.5	1940.8
17	Healy	35°00.000'S	178°59.813'E	292.5	2261.3
18	North Cape	34°18.322'S	173°08.995'E	24	2553.8
19	Reinga	34°18.346'S	172°39.999'E	1271.3	2577.7
20	Tasman Sea Crossing	43°16.200'S	148°03.001'E	13.8	3849
21	Raoul	43°17.325'S	147°44.142'E	20.4	3862.8
22	Iron Pot	43°03.674'S	147°23.438'E	5.2	3883.2
23	White Rock	42°58.583'S	147°22.499'E	3.2	3888.4
24	HBA PBG	42°55.411'S	147°22.974'E	0.4	3891.6
25	Garrow	42°54.860'S	147°23.066'E	2.6	3892
26	Battery Pt	42°53.027'S	147°20.701'E	0.2	3894.6
27	Sullivans Cove	42°53.026'S	147°20.356'E	0.2	3894.8
28	PW4	42°53.170'S	147°20.320'E		3895

****NOTE: project area crosses UTM zones, please take care with longitude sign convention****

****Site coordinates are provided for operational areas (Havre, Macauley, SW Raoul, Caldera X, Healy) – specific seismic transects and coring locations will be managed onboard****

Time estimates

DAYS	ACTIVITY
1 - 6	Transit to Kermadec region for priority coring/seismic at Havre. Deploy 2 x BGC ARGO floats (+CTD) & 5 x regular ARGO floats on transit
7 - 14	Havre site activity (4 days seismic, 4 days coring), High priority
15 - 20	Macauley site activity (3 days seismic, 2 days coring), High priority
21 - 22	SW Raoul site activity (1 day seismic, 1 day coring), Low priority
23 - 24	Caldera X site activity (1 say seismic, 1 day coring), Low priority
25 - 29	Healy site activity (1 day transit, 2 days seismic, 2 days coring), High priority
30 - 36	Transit back to Hobart

Please refer to IN2022_V02-Planning Timetable for more detailed breakdown at each site

Seismic Strategy & Parameters

The RVI seismic system will use all parameters previously tested in IN2021_E04. 6m streamer and source depth have been selected to reduce the impact of swell, while maintaining an appropriate bandwidth in the recorded data.

Seismic operations will nominally occur during the day; however, permit conditions will allow acquisition at night outside of the marine reserves. This may allow some seismic acquisition to continue after sunset, however, this will be at the discretion of the Master and VM and consider fatigue levels & operational safety.

Seismic transects are indicated on **Figure 3** to **Figure 8**, but will be finalised onboard.

Source Depth:	6m, Single Source Rail
Source Volume:	1 x 150cuin GI (Harmonic Mode)
Pressure:	140 bar (operational)
Shot point interval:	12.5m (6s, TBC with expected water depth on each transect)
Recording Length:	6s (TBC with expected water depth on each transect)
Streamer Length:	500m (40 channels)
Streamer Depth:	6m
Deployment Speed:	2kts – 4kts
Acquisition Speed:	4kts

Coring Strategy & Parameters

The recently commissioned Giant Piston Corer (GPC) and Core Pipe Handler (CPH) will be utilised. Coring sites will be determined from Sub-bottom Profiler data collected on the seismic transects, which will occur first.

Coring will be planned for daylight operations only and nominally 1 core per day, with additional sites selected should operational conditions allow this.

Coring sites are indicated on **Figure 3** to **Figure 8**, but will be finalised onboard.

Site	Lat	Long	WaterDepth (m)	Desired Coring Length (m)	Sediment Characterisation
Healy-1	-35 6.03	179 4.85	-2200	25.5	hemipelagic mud, sand, gravel
Healy-2	-35 3.78	178 52.97	-2450	17	hemipelagic mud, sand, gravel
Healy-3	-34 57.62	178 58.63	-1800	8.5	hemipelagic mud, sand, gravel
Havre-1	-31 12.29	-179 11.60	-2200	8.5	hemipelagic mud, sand, gravel
Havre-2	-31 0.15	-179 4.34	-1550	8.5	hemipelagic mud, sand, gravel
Havre-3	-30 58.76	-179 0.24	-1700	8.5	hemipelagic mud, sand, gravel
Havre-4	-30 52.78	-178 56.37	-1800	17	hemipelagic mud, sand, gravel
Havre-5	-30 55.11	-179 3.42	-1900	17	hemipelagic mud, sand, gravel

Havre-6	-30 58.21	-179 8.26	-1700	8.5	hemipelagic mud, sand, gravel
Havre-7	-31 16.83	-179 17.27	-2500	17	hemipelagic mud, sand, gravel
Havre-8	-31 9.03	-178 54.21	-1600	8.5	hemipelagic mud, sand, gravel
Havre-9	-31 22.76	-179 24.50	-2500	25.5	hemipelagic mud, sand, gravel
Havre-10	-30 51.42	-179 25.24	-2200	25.5	hemipelagic mud, sand, gravel
Havre-11	-31 6.56	-179 6.25	-1250	8.5	hemipelagic mud, sand, gravel
Havre-12	-31 6.94	-179 1.41	-1300	8.5	hemipelagic mud, sand, gravel
Macauley-1	-30 20.10	-178 49.45	-1800	8.5	hemipelagic mud, sand, gravel
Macauley-2	-30 20.98	-179 1.73	-2300	8.5	hemipelagic mud, sand, gravel
Macauley-3	-30 17.01	-178 38.46	-1300	17	hemipelagic mud, sand, gravel
Macauley-4	-29 46.13	-178 30.19	-2300	17	hemipelagic mud, sand, gravel
Macauley-5	-30 5.46	-178 31.03	-1300	17	hemipelagic mud, sand, gravel
Macauley-6	-29 53.44	-178 30.51	-1900	8.5	hemipelagic mud, sand, gravel
SW Raoul-1	-29 25.45	-178 4.23	-1000	8.5	hemipelagic mud, sand, gravel
SW Raoul-2	-29 33.86	-178 11.40	-700	8.5	hemipelagic mud, sand, gravel
SW Raoul-3	-29 44.76	-178 19.15	-1600	17	hemipelagic mud, sand, gravel
Caldera X-1	-29 58.6	-178 59.64	-1900	8.5	hemipelagic mud, sand, gravel
Caldera X-2	-29 51.64	-178 59.58	-2000	17	hemipelagic mud, sand, gravel

Voyage Risk Assessment (VRA)

This voyage has undergone a comprehensive risk assessment process. The full VRA is available in a separate document.

Permits

Foreign clearance permit (NZ EEZ): Consent to Conduct Marine Scientific Research in Areas Under National Jurisdiction of New Zealand.

This permit also contains our NZ conditions for conducting seismic acquisition.

This permit was granted on 22/12/2021 and all conditions should be reviewed in:

MFAT TPN in response to CSIRO MSR application.pdf

NZ permit on Maori consultation: Consultation with Maori (through iwis) has been initiated by NIWA and the CI in early 2021. We produced a prospectus to inform iwis on the voyage.

EPBC Cetacean Permit

As an Australian government entity and Australian flagged ship conducting the work, the Department of Agriculture, Water & Environment EPBC permit shall also apply in NZ waters.

Cetacean Permit CP2019.0003 & CP2019.0003 Permit variation -(issued 2022)

ARGO Float Permit

PA2020-00051-1 Permit - South East - signed 20200723

Media Activities

The MNF will seek to pursue opportunities that arise during the voyage to promote the science, scientists and ship, via conventional and social media channels, in consultation and/or collaboration with the relevant ship user.

ORGANISATION	ACTIVITIES	TIMING	RESPONSIBLE PERSON
UTAS	Chief Scientist undertaking interviews with networks to discuss science being undertaken	Pre-departure	Dr. Martin Jutzeler
UTAS	Live cross to network and a range of stories and blogs to be released.	Throughout voyage	Science team

Piggyback Projects

BGC & Standard Argo Floats Craig Hanstein (CSIRO), Peter Strutton (UTAS)

Biogeochemical-Argo is the extension of the Argo array of profiling floats to include floats that are equipped with biogeochemical sensors for pH, oxygen, nitrate, chlorophyll, suspended particles, and downwelling irradiance. Newly developed sensors now allow profiling floats to also observe biogeochemical properties with sufficient accuracy for climate studies. This extension of Argo will enable an observing system that can determine the seasonal to decadal-scale variability in biological productivity, the supply of essential plant nutrients from deep waters to the sunlit surface layer, ocean acidification, hypoxia, and ocean uptake of CO2. Biogeochemical-Argo will drive a transformative shift in our ability to observe and predict the effects of climate change on ocean metabolism, carbon uptake, and living marine resource management. The Australian contribution to global Biogeochemical-Argo is coordinated through the IMOS Argo-Australia facility.

We will use this voyage to deploy 2 floats in the Tasman Sea, with supporting CTD casts to 2,250m depth.

Deployment of the BGC-Argo float will be done in waters deeper than 2000 and preferably deeper than 2500m, following the Safe Working Instruction and associated procedures via the K75 Crane.

The CTD cast provides sensor comparisons between the CTD and the float, and for this reason we would like the following 3 sensors to be mounted on the CTD:

- MNF supplied Wetlabs FLBB sensor
- MNF supplied Wetlabs CStar transmissometer
- MNF supplied PAR sensor

The CTD also allows collection of samples for calibration and improved interpretation of the float sensor records, as follows.

Water samples to be analysed ashore for nutrients (for comparison to the float nitrate sensor)

Water samples to be collected for analysis onshore for dissolved inorganic carbon (DIC) and alkalinity (this pair allows pH to be calculated for comparison to the float sensor)

Filtered particle samples for analysis onshore for plant pigments (for comparison to the Chlorophyll fluorescence sensor) and particulate organic carbon (POC, for comparison to the BB optical backscatter sensors).

Typically, we decide on sample depths adjusted to local oceanographic features such as minima and maxima in T, S, O2, etc. The deepest sample is taken at 2000m depth, but the cast is taken to 2250m depth to provide sensor data below the deepest sample.

Following are *approximate* positions of ARGO Float deployments on the transit from Hobart to the Kermadec Islands. 5 regular plus 2 BGC ARGO floats will be deployed.

Deploy floats by Longitude if ships track is different.

ARGO FLOAT No.	Latitude	Longitude
Hull BGC*	43.0153 S	149.2640 E
Hull 1318<	42.45 S	151.03 E
Hull 11104<	42.45 S	151.03 E
Hull 1319	41.38 S	153.95 E
Hull BGC*	40.8414 S	155.4128 E
Hull 1320	40.30 S	156.87 E
Hull BGC*	39.7625 S	158.3349 E
Hull 1332	39.22 S	159.79 E
Hull 1333>	38.14 S	162.72 E
Hull 11158>	38.14 S	162.72 E

BGC ARGO Floats.
* Precise locations will be at nearby CTD locations when they have been determined by the Chief Scientist and BGC ARGO Team.
Note: There are two BGC ARGO Floats, but three locations have been chosen. TBA.

Buddy Float Deployment < & >
There will two sets of deployments with two ARGO floats being deployed together, one after the other. The buddy deployment will be done to compare a Seabird CTD with a RBR CTD.

Cardboard Box Deployments.
Follow SWI for cardboard box deployment method. This is for the standard ARGO Floats.
Rope Deployments.
Follow SWI for rope deployment method. This is for BGC ARGO Floats.

After Successful deployment:
Email: ArgoDeployments@csiro.au
Include Hull No. Deployment Latitude, Longitude, Date, Time & Water Depth. Plus CTD Cast Number if applicable.
If you have any problems:
Contact: Email: ArgoDeployments@csiro.au
Craig Hanstein Ph.Mob +61 467 718 754
Pat McMahon Ph.Mob +61 428 258 025

Natural iron fertilization of oceans around Australia: linking terrestrial dust and bushfires to marine biogeochemistry Andrew Bowie, Scott Meyerink, (UTAS)

This project will facilitate an integrated ship-based atmospheric observational program for trace elements in oceans around Australia. We will sample atmospheric particles containing terrestrial dust, bushfire smoke and anthropogenic emissions that are transported from Australia to its surrounding oceans. We will install an atmospheric sampling system for the clean collection of particles in the ship's aerosol lab. This system consists of vacuum pumps (Thomas Sheboygan 2107CD18), flow meters (DiTGM ML-2500) and filtration systems (Savillex PFA). The manifold is connected to air intake lines fed from the sampling nozzle located ~10 m above sea level on the foremast at the bow of the vessel. Samples will be collected on filters housed in 47 mm filtration holders located within a laminar flow hood (AirClean Systems) to avoid contamination. The system is controlled by automated sector control switch (pump controller) to ensure the system only samples 'clean' air from the forward sector (nominally between 270° port and 90° starboard), avoiding air impacted by the ship's exhaust. The system can run up to 4 flow lines in parallel, to enable replicate sampling or to sample for different parameters using different filters on different lines. Sampled filters will be stored frozen and returned to the shore-based laboratory for further experiments and analyses.

We will also opportunistically collect event-based clean rainwater samples using a polyethylene funnel and collection bottle (when conditions allow) located on deck 5, to quantify the trace metal deposition in the 'bulk' and 'precipitate-only' fractions. Ideally samples would be collected on upper and forward decks, either above the bridge or at the bow when heading into the wind. Rain samples will be acidified on board with a small amount of distilled concentrated acid (1-2uL/mL) and will be stored in the ship's freezer (in the hallway, (non-walk-in) freezer between laboratories). This project has been successfully completed on more than 10 previous RV Investigator voyages.

Signature

Your name	Martin Jutzeler
Title	Chief Scientist
Signature	
Date:	12 March 2022

List of additional figures and documents

Seismic transects are indicated by a numbered line

Coring sites are indicated by a numbered point

Marine Reserves are indicated by a red-dashed line

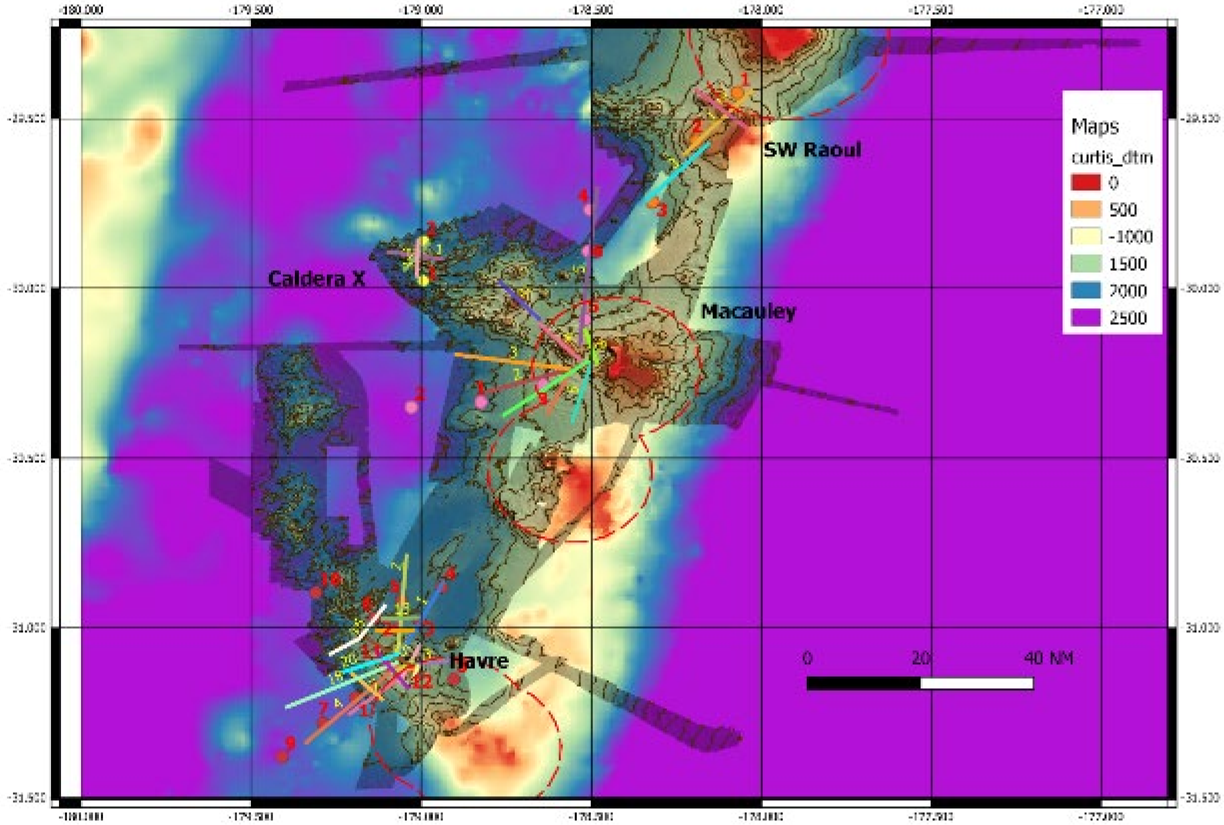

Figure 2: Regional Map (all targets except Healy)

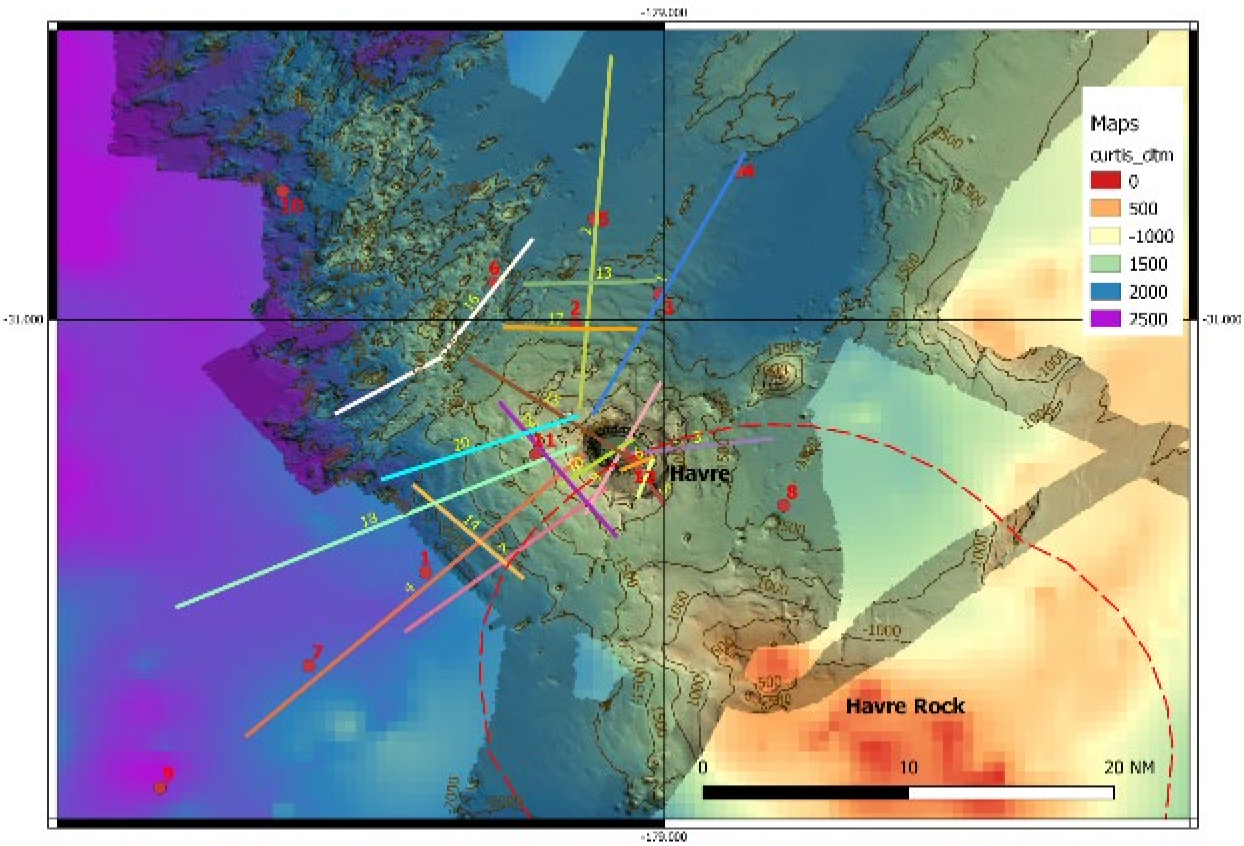

Figure 3: Havre

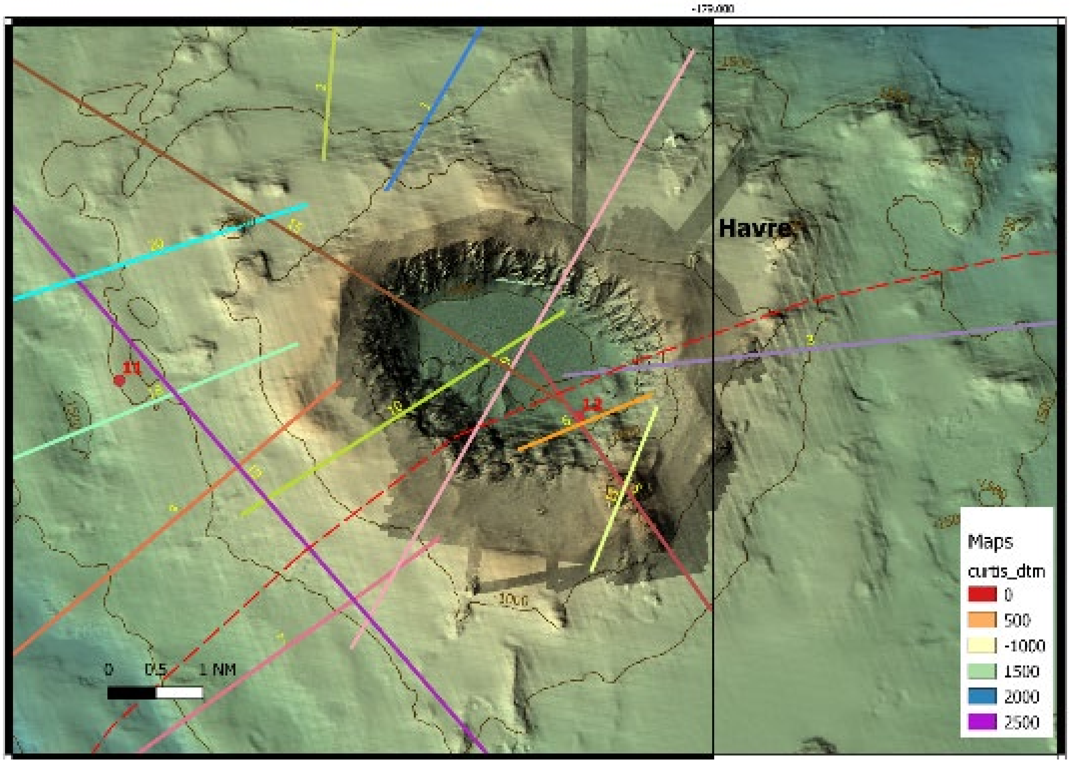

Figure 4: Havre (zoomed)

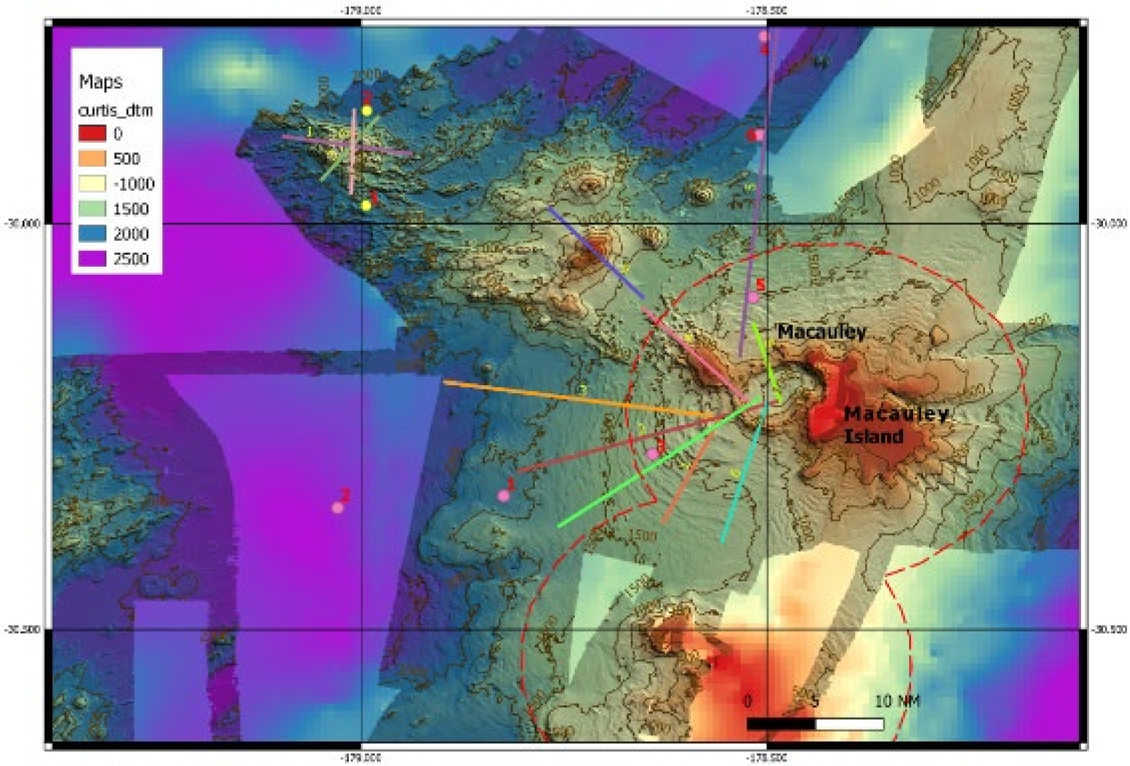

Figure 5: Macauley

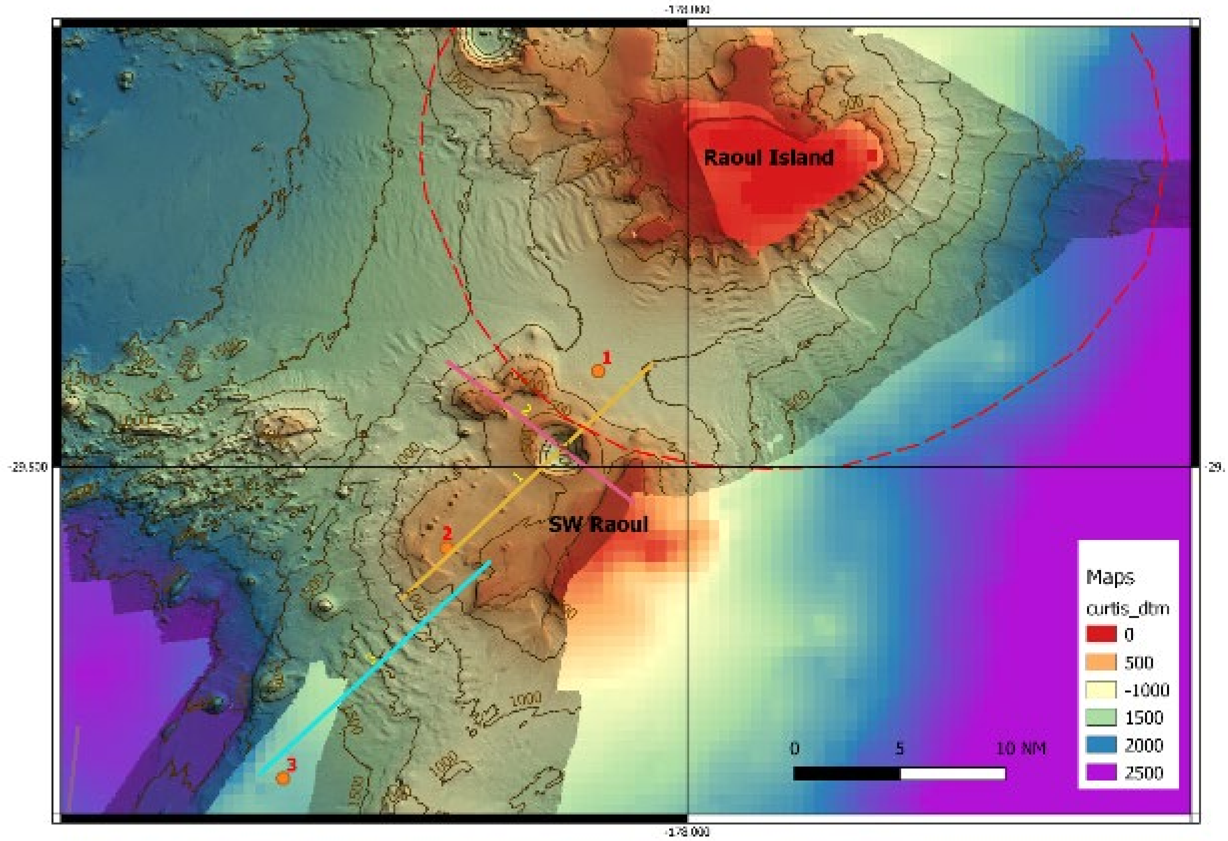

Figure 6: SW Raoul

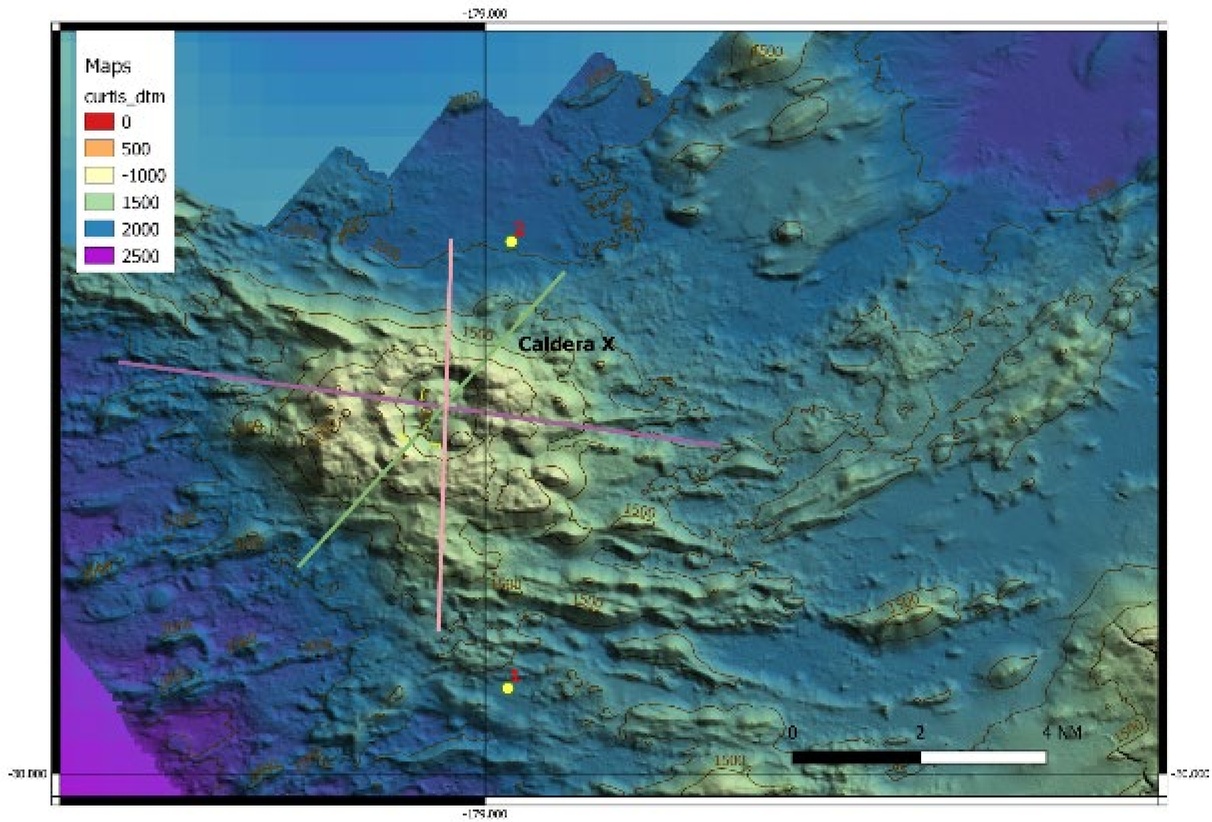

Figure 7: Caldera X

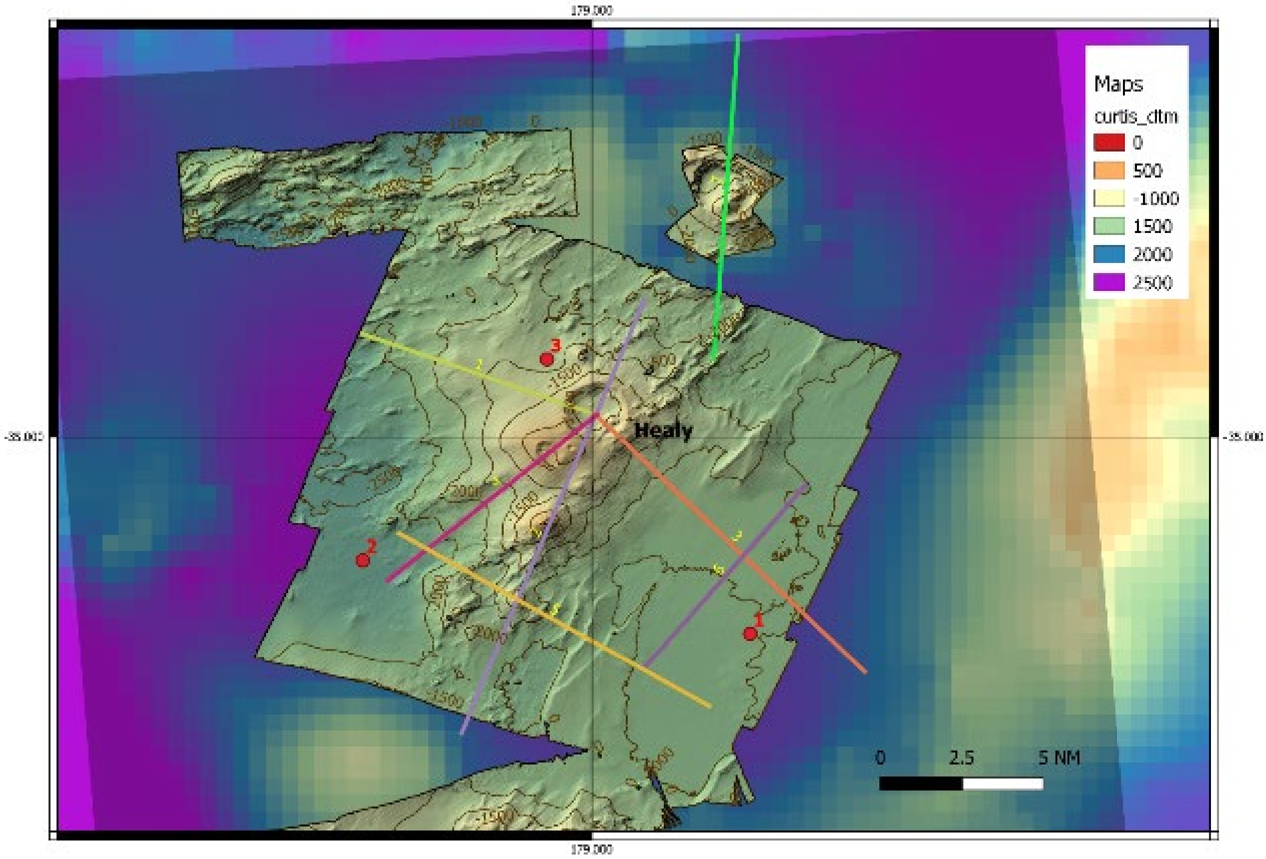

Figure 8: Healy

a.

Appendix A

Scientific equipment and facilities provided by the Marine National Facility

Some equipment items on the list may not be available at the time of sailing. Applicants will be notified directly of any changes. Indicate what equipment and facilities you require from the Marine National Facility by placing an **X** in the relevant box.

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Aerosol Sampling Lab		
Air Chemistry Lab		
Preservation Lab		
Constant Temperature Lab (Min temp: 2°C / Max temp 35°C)	X	Core storage 4°C
Underway Seawater Analysis Laboratory		
GP Wet Lab (Dirty)	X	Cut/study/sample cores and dredges
GP Wet Lab (Clean)	X	Sample bagging and storage area.
GP Dry Lab (Clean)	X	Field Ops and Science Party sharing space for working
Sheltered Science Area	X	Rock saws, temporary sample storage
Observation Deck 07 Level	X	Whale watching
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3	X	Temporary core storage 0°C
Clean Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C)		

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Volume: >2.5m^3 Co-located within the Internal freezer and separated by a door		
Blast Freezer (Dirty Wet lab) (Min temp -30^{o}C / Max temp 0^{o}C) Internal volume >1.5m^3 Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.		
Cool Room (Dirty Wet lab) (Min temp 0^{o}C / Max temp 10^{o}C)	X	Temporary core storage 4^{o}C
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80^{o}C / Max temp -80^{o}C)	X	For eDNA samples.
YODA Freezers (x2) (Clean Dry lab) (Min temp -20^{o}C / Max temp 10^{o}C)		

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Isotope Laboratory			
Trace Metal Niskin Sampling Container (TM1-blue - 20ft)			
Trace Metal Seawater Analysis Laboratory (TM2-white - 20ft)			
Trace Metal Rosette and Niskin Storage Container			

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Hazchem Locker			
Stabilised Platform Container			
Clothing Container			

STANDARD SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
CTD - Seabird 911 with 36 Bottle Rosette			
CTD - Seabird 911 with 24 Bottle Rosette	x		Only for IMOS with the ARGO floats – science staff will sample
Lowered ADCP			
Continuous Plankton Recorder (CPR)			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
TRIAXUS – Underway Profiling CTD			
Piston Coring System	X		
Multi Corer			
Kasten Corer	X		Onboard as back-up to GPC
Smith Mac Grab			
Rock Dredges		X	2x, with teeth

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Rock Saw			
Seaspy Magnetometer			
Portable Pot Hauler			
Equipment to measure seawater sound velocity/CTD:			
XBT System			
Valeport Rapid SV	X		Velocity profiles with RapidCast for seismic & GSM
Valeport Rapid CTD			
Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			
Deep Towed Camera	X		
Drop Camera			
Sherman Epibenthic Sled			
Brenke Sled			
EZ Net (Multiple net system, 1m x 1m)			
Hydro-Bios MultiNet (1m x 1m)			
Surface Net (1m x 1m)			

SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
Bongo Net 485mm diameter			
Beam Trawl			
MIDOC			
Pelagic Trawl System (net, doors)			
Demersal Trawl System (net, doors)			
RMT-8 (Rectangular Midwater Trawl)			
RMT-16 (Rectangular Midwater Trawl)			
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			
Stern ramp		INSTALLED	Dancefloor IN

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Salt Water Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			
Milli-Q System	X		eDNA sampling
Sonardyne USBL System			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				NOTES/COMMENTS
BRAND / MODEL	TYPE	ESSENTIAL	DESIRABLE	Refer to the “MNF microscopes procedure” for more information
Leica / M80	Dissecting	X		
Leica / M80	Dissecting	X		
Leica /MZ6	Dissecting	X		
Olympus / CH	Compound	X		
Olympus /CH	Compound	X		
Leica / MTU282	Camera tube	X		
Adapters for tube / Nikon	Pentax	X		
Ring Light *2 / MEB121	LED	X		
Heavy Duty Electronic Balance (80kg)			X	
Medium Duty Electronic Balance (15kg/5g resolution)		X		
Light Duty Electronic Balance (3kg/1g resolution)		X		

ACOUSTIC UNDERWAY SYSTEMS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
75kHz ADCP	X		
150kHz ADCP	X		
Multi Beam Echo Sounder EM122 12kHz (100m to full ocean depth)	X		
Multi Beam Echo Sounder EM710 70-100kHz (0-1000m approx.)	X		

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS			
MICROSCOPES:			**NOTES/COMMENTS**
Sub-Bottom Profiler SBP120	X		
Scientific Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)		X	
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)		X	
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)		X	
Gravity Meter	X		

ATMOSPHERIC UNDERWAY SENSORS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Nephelometer			
Multi Angle Absorption Photometer (MAAP)			
Scanning Mobility Particle Sizer (SMPS)			
Radon Detector			
Ozone Detector			
Condensation Particle Counter (CPC)			
Picarro Spectrometer (analysis of CO_2/CH_4/H_2O)			
Aerodyne Spectrometer (analysis of N_2O/CO/H_2O)			
Cloud Condensation Nuclei (CCN)			

ATMOSPHERIC UNDERWAY SENSORS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Polarimetric Weather Radar			

UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Thermosalinograph			
Fluorometer			
Optode			
pCO2			

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories			
Raw seawater available on deck and in laboratories	X		

EQUIPMENT AND SAMPLING GEAR REQUIRING EXTERNAL SUPPORT (MAY REQUIRE ADDITIONAL SUPPORT FROM APPLICANTS)			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Seismic Compressors	X		
Seismic Acquisition System	X		

CTD Configuration

Fundamentals:	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	24
Likely total number of casts:	2
Likely maximum depth of deepest cast:	2250m
Lowered ADCP required:	No
Instrumentation (maximum 6 auxiliary channels in addition to 2x DO):	
2x pumped Temperature, Conductivity, Dissolved Oxygen circuits:	(Standard)
Altimeter (required if operating anywhere near the sea floor):	
PAR Sensor (Biospherical QCP-2300):	Yes
Transmissometer (Wetlabs C-Star 25cm):	Yes
Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):	
Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	
Nephelometer (Seapoint Turbidity Meter)	
ECO-Triplet (Chlorophyll-a, CDOM & backscatter – maximum depth 2000m)	
Wetlabs FLBB sensor	Yes

***Sampling will be conducted by a pre-trained science participant as there are no Hydrochemists onboard

Appendix B

User Supplied Equipment

The table below will include information provided by the Chief Scientist / Principal Investigators in the '*Equipment Manifest-user supplied voyage specific*' document. The Chief Scientist will co-ordinate the completion of this Manifest with all PIs and forward the completed document to the Voyage Operations Manager.

NOTE: User supplied equipment will remain the responsibility of the science party throughout the voyage. The MNF technicians and ship's crew endeavour to assist wherever possible, however the MNF take no responsibility for the pre-deployment checks or repairs and maintenance of this equipment

This information will also be used for the mobilisation list and deck plan for the voyage.

Owner	Item Name	Weight	Dimensions	Location on Vessel
Geoscience Australia (Martin Jutzeler)	Core Splitter and its crate	200 kg	2600x750x500 on double width pallet	Dirty Wet Lab
Martin Jutzeler	Flat-packed timber 3x	heavy	3 pallets, 2 are very tall	Clean wet lab
Martin Jutzeler	plastic rolls	50kg	1 pallet	Preservation lab
Martin Jutzeler	foam roll	15 kg	1500x800x800	Clean wet lab
Martin Jutzeler	Foam noodles	10 kg	2000x500x500	Preservation lab
Martin Jutzeler	6-10 boxes (FRAGILE)	<50 kg	6-10 times 800x600x600	Clean wet lab
Martin Jutzeler	microscope (FRAGILE)	10 kg	600x300x400 in box	clean dry lab
Martin Jutzeler	Drill and screw/drill bits, incl. charger and batteries	3 kg	40x30x50	dirty Wet Lab
Martin Jutzeler	Hydrochloric acid, 10% conc.	1 kg	10x10x10	Dirty Wet lab
Martin Jutzeler	Acetone	1 kg	10x10x10	clean wet and clean dry lab
Martin Jutzeler	Empty buckets (10x)	6kg	1200x30x70	dirty dry lab

Appendix C

Hazardous Materials Manifest

Responsible Person	Hazardous Material Name	UN#	Poison Schedule #	Class	Concentration	Quantity: Total	Quantity: Units	Container Size	Location of Use
Martin Jutzeler	Hydrochloric Acid (10%)	1789	S6	Class 8 - Corrosives	10%	0.7	0.5 and 5x 0.05	0.5 and 5x 0.05	GP Wet Laboratory - Dirty
Martin Jutzeler	Acetone	1090	S5	Class 3 - Flammable Liquid	100%	0.7	0.5 and 5x 0.05	0.5 and 5x 0.05	GP Dry Laboratory – Clean
Martin Jutzeler	Ethanol	1170	S5	Class 3 - Flammable Liquid	100%	0.7	0.5 and 5x 0.05	0.5 and 5x 0.05	GP Dry Laboratory – Clean
Craig Neill	Mercuric Chloride	2024	S7	Class 6 - Toxic	7.4%	120	mL	2 x 60 mL plastic bottles	CTD sample space
Martin Jutzeler	Epoxy resin	3082	S5	N/A	100%	4	L	4L Container	GP Wet Laboratory – Dirty
Martin Jutzeler	Slow hardener for epoxy	2735	S5	N/A	100%	1	L	1L Container	GP Wet Laboratory – Dirty
Aaron Tyndall	Sodium Hypochlorite (bleach)	N/A	S5	N/A	4.9%	2.5	L	2.5L Container	GP Wet Laboratory - Clean
Aaron Tyndall	Lithium Metal Primary (Non rechargable Battery	N/A				8	8	Carton - 40cm x 25cm x 22cm	Main Deck (stored in Electronics Workshop)