RV *Investigator* Voyage Plan

Voyage #:	**IN2019_04**		
Voyage title:	**Hotspot dynamics in the Coral Sea: connections between the Australian plate and deep Earth**		
Mobilisation:	6th August, 2019		
Depart:	0700 7th August 2019, Trinity Wharf 1&2, Cairns		
Return:	0800 3rd September 2019, Hamilton Wharf 4, Brisbane		
Demobilisation:	3rd September, 2019		
Voyage Manager:	John Hooper	Contact details:	john.hooper@csiro.au
Chief Scientist:	Joanne Whittaker		
Affiliation:	University of Tasmania	Contact details:	Jo.whittaker@utas.edu.au 0404 143 394
Primary Project :	**Hotspot dynamics in the Coral Sea: connections between the Australian plate and deep Earth**		
Principle Investigators	Maria Seton (shore), Simon Williams, Karin Orth, Robin Beaman, Ben Cohen, Lara Kalnins (shore)		
Supplementary Project 1:	**Understanding the spatial links between geomorphology and biodiversity in the Coral Sea Australian Marine Park.**		
Principle Investigator	Vanessa Lucieer (University of Tasmania)		
Supplementary Project 2:	**Spatial and temporal variability in the distribution and abundance of seabirds.**		
Principle Investigator	Eric Woehler (Birdlife Australia)		

Primary Scientific objectives

One of the world's most extensive intraplate volcanic regions is located in Eastern Australia, including the world's longest continental hotspot trail and two parallel trails offshore (Tasmantid and Lord Howe Seamount chains). Hotspot trails are thought to arise from deep mantle plumes, whose episodic eruptions affecting the world's atmosphere (release of gas and aerosols), biosphere (mass extinctions) and hydrosphere (altering ocean circulation and chemistry)

We will use this offshore region as a natural laboratory to test competing hypotheses for how deep mantle plumes have influenced the evolution of the Australian plate. Using a combination of geophysical characterisation and geological sampling, we will determine the spatial and temporal extent of mantle plume activity in the Tasman and Coral Seas to test the following hypotheses:

1. The Louisiade Plateau is the birthplace of Eastern Australian intraplate volcanism and predominantly composed of volcanic material.
2. This volcanism formed within a short (1-2 Ma) timeframe shortly before the oldest Tasmantid seamounts.
3. The initiation of plume activity predates a major plate-mantle reorganisation affecting the southwest Pacific, and plume products provide a detailed record of Australian plate motion before, during, and after this reorganisation.
4. Fragments of rifted continental crust underlie the volcanic carapace.

Identifying the sites of mantle plume eruptions allows us to make connections between the surface and deep Earth with global scientific significance for understanding our planet's geodynamic and climatic history and biotic evolution. The results from this project will help inform government and industry on the effect of magmatism on distal continental margins and basins, and help constrain the extent of Australian continental crust into the Coral Sea.

Primary Voyage objectives

The key to answering these questions lies in the rocks of the Louisiade Plateau, Tasmantid seamount chain and Lord Howe Rise seamount chain that both run roughly parallel with the East coast of Australia.

Objective 1. Collect seafloor and subseafloor geophysical data. This data will be used:

a. To identify seafloor fabric, which will help refine plate reconstructions in areas difficult to constrain from magnetic anomaly lineations alone.
b. To collect magnetic anomaly profiles, which will help understand the seafloor spreading history of the area and be combined with other geophysical datasets particularly gravity and bathymetry to understand the subseafloor nature of the crust.
c. To obtain comprehensive multibeam and backscatter coverage of the Louisiade plateau and seamounts and their morphology to understand tectonic setting, eruptive style, palaeo-water-depth and sedimentation patterns;
d. To assist in dredge site targeting by identifying sediment-free scarps and slopes;
e. Sub-bottom profile data will be collected to provide additional context for the nature of the near-surface sediment and geological structure.

Objective 2. Dredge volcanic samples from seamounts from the Louisiade Plateau, Tasmantid seamount chain and Lord Howe Rise seamount chain. Ashore, samples will be:

a. Ar/Ar Dated to determine the age and duration of seamount formation;
b. Volcanic coherent rocks will be described macroscopically, petrographically and mineralogically to classify and characterise the type volcanism on the seamounts. Comparing the nature and origin of volcanism at different sites may reveal multiple episodes of volcanism or variations in volcanic activity in time and space.
c. Volcaniclastic rocks will be described macroscopically, petrographically, mineralogically and include ash morphology descriptions. This work will constrain submarine/subaerial eruption/emplacement and style of transport
d. Sedimentary rocks will be described macroscopically, microscopically and petrographically. Additional U-Pb geochronology will be undertaken as will micro- and macro-fossil palaeontology. These analyses can constrain depth, environment, and time of deposition, important for constraining the timing and rate of subsidence.

The objectives are linked and so have equal priority. If time is lost to weather etc we will dredge fewer locations. Swath mapping will be prioritised if weather conditions are too poor to dredge.

Supplementary Projects

1. Understanding the spatial links between geomorphology and biodiversity in the Coral Sea Australian Marine Park.
Principal Investigator: Dr Vanessa Lucieer

Scientific and voyage objectives:
This project will reveal how deep-water benthic habitats are related to geomorphic features on the seafloor. Using advance marine sonar we will examine how different habitats are distributed across a variety of geomorphic structures within the Coral Sea Marine Park. The seafloor habitats in this marine park are poorly understood and given the recent release of the Australian Marine Park (AMP) rezoning it is particularly important to understand the variability of these habitats. We can use this data to compare to seamount habitats in temperate locations such as the Huon AMP.

How the project fits into the time estimates:
Opportunistic sampling of the seafloor will be completed using a Smith-Mac grab as a tool to calibrate and perform QAQC of the underway sonar systems (Sub-Bottom Profiler). Its anticipated that this will mostly be performed at dredge sites during dredge sample assessment and decision to make-way to the next station.

2. Spatial and temporal variability in the distribution and abundance of seabirds.
Principal Investigator: Dr Eric Woehler

Scientific and voyage objectives:
The project will collect data to quantify the variability in the distribution and abundance of seabirds in the marine environment around Australia. The project will examine the relationships between physical oceanographic features and their use as seabird feeding areas. The study also seeks to identify species

assemblages, or associations, in the species of seabirds observed that are persistent over time. The project will use standard survey methods to ensure compatibility with existing data sets for the same species in other areas (eg Southern Ocean and south-eastern Australia).

Observations of marine mammals will be shared with researchers to facilitate greater understanding of the role of oceanographic processes in the spatial and temporal distribution of marine mammals at sea around Australia. The project will also provide a context to current research efforts tracking seabirds and marine mammals, which are often constrained to a relatively low number of instrumented individuals relative to the population as a whole.

Seabird at sea data will be collected by three seabird observers according to the method described by the BIOMASS Working Party on Bird Ecology. This method has been used by Australian Antarctic Division (AAD) personnel since 1980/81 and reflects the standard protocol for obtaining seabird at sea data. Observations will be made continuously while the vessel is underway during daylight hours from the specifically designed monkey bridge on board Investigator.

Briefly, all seabirds within a 300m forward quadrant will be recorded, with details of their ages (where identifiable) and behaviours (such as feeding, sitting on water, etc). By using standard methods, the data collected on these voyages will be able to be integrated with other data sets collected adjacent with, or in overlapping areas (eg Australian Antarctic Division surveys 1980/81 onwards). Observations of marine mammals are also included (in the absence of dedicated marine mammal observers) using standard protocols. Observation of marine debris are also recorded.

Data will be entered in real time on laptops connected to the ships oceanographic and GPS system to automatically record abiotic and biotic data along-side seabird observational records. Standardised methods of data collection ensure continuity and compatibility with extant data for the same species elsewhere and with similar studies of other species.

How the project fits into the time estimates:
This Supplementary project does not require extra voyage time or require instruments to deployed during the voyage.

Other Projects

1. Transit over likely wreck sites of the USS Lexington and USS Neosho

Principle Investigator: Dr Robin Beaman

Between proposed primary project dredge sites 11 and 12 the RV Investigator will detour around 41nm (4-5 hours) to the likely locations of the Lexington and Neosho wreck sites. While the locations have recently been discovered and an ROV got some images, neither of these wrecks have any swath bathymetry coverage. A slow transit over the sites (maximum 8 knots) would enable collection of this valuable, albeit low resolution data. The collection of the data is to aid in any future development of a management plan for the specific and greater areas. We also wish to hold a memorial service for those lost on these vessels. There is strong support from the Navy and community to hold a memorial service for those lost at sea, with wreaths to be provided for the ceremony.

The survey has been endorsed by the following organisations:

- The US Naval History and Heritage Command
- Parks Australia
- Acting Director of Historic Heritage Section, Department of Environment and Energy
- Australian National Maritime Museum.

2. **Argo Floats**.

Four ARGO floats will be activated and deployed during the voyage at sites within the CSAMP on behalf of Argo Australia operated by CSIRO Oceans and Atmosphere. Argo Australia is part of international ARGO program whose mission is to maintain a global ocean array of autonomous profiling floats.

Deployment sites will be in regions of table below subject to the ARGO array distribution within the Coral Sea at the time of sailing from Cairns. Notional deployment co-ordinates are tabulated.

ARGO Float No.	Latitude	Longitude
1087	17° 15’ S	155° 30’ E
1092	16° 15’ S	155° 45’ E
1093	15° 30’ S	156° 00’ E
1096	14° 30’ S	156° 15’ E

3. Collection of dead Invertebrates dredged with geological samples (Jeremy Horowitz, Rob Beaman)

PhD student Jeremy Horowitz will be opportunistically collecting and preserving dead coral skeleton and tissue retrieved as by-catch during the dredging process within the Australian EEZ. Specimens will be photographed and preserved with sub-samples collected for DNA and polyp preservations.

4. **CSIRO Educator on Board**

CSIRO Educator on Board is a professional development program for Australian STEM (science, technology, engineering and mathematics) school teachers which aims to support teacher professional development and provide students with a window on the real word application of STEM. Educator on Board puts teachers on voyages to assist with scientific operations and share their on-board experience with students across Australia through live ship-to-shore video broadcasts. Teachers will also develop curriculum-linked resources based on the ship and underway science to create a pool of lessons to share in schools across Australia.

Operational Risk Management

Risk	Activities impacted	Contingency management
Using the rock dredge – rock dredge caught on bottom, loss of rock dredge, wire under tension, fouling of ship rudder/props, injury	Science Objective, Ship Underway,	RISK MANAGEMENT -Set dredge break-pin appropriately (~10 tonnes). -Dredge site selection -Work within appropriate weather conditions. -Undertaking dredging slowly and as per ASP procedure and past best practice. -Manoeuvre to release dredge -Monitor calibrated tension gauges on trawl winch -Personnel exclusion zone from Main Deck whilst dredging. -R.O.V CONTINGENCY -Second Trawl winch -Spare dredges
Conducting Research and Foreign nations EEZ- Third Party Note – Access denied	Science Objective	Re-allocate Science Time to alternative secondary targets in other waters.
Cyclone Activity	All	-Very unlikely- unseasonal -Follow ASP procedure- divert

Overall activity plan including details for first 48 hours of voyage

6th August- Mobilisation Day
Equipment Mobilisation
STR Hire Winch rigged to rear deck
STR Hire Winch made live for testing.
1500 Science Team Seagoing Induction

7th August- Departure
Depart Cairns 0700- Approximately 51 hours transit to Dredge Station 1 (~566 nm @ 11 knots)
0930 -Voyage Briefing Presentation Meeting (VM)
1100 - Laboratory Inductions
1400 - Muster followed by Science Objective Discussion

8th August

Rear Deck and Dredge SWI Toolbox

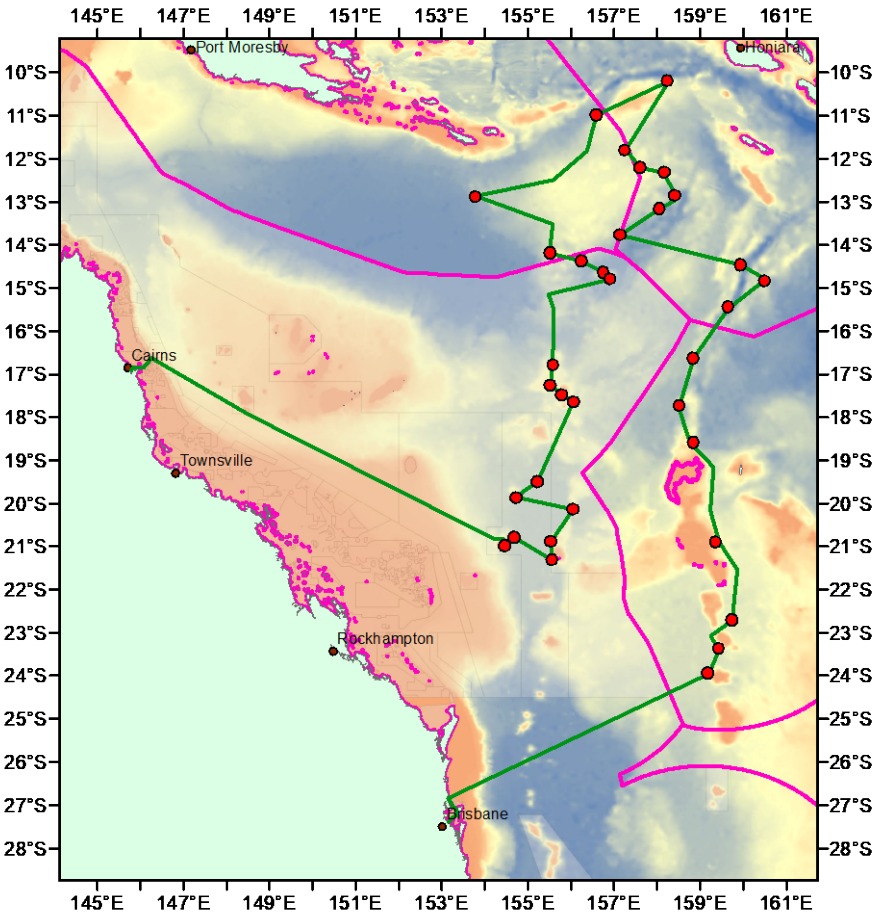
JSA followed by STR hire winch and SeaSpy2 Magnetometer test deployments

Communications and Media

Educators on Board program: Live crosses may be required at some stage during the voyage.

Media: Some publicity may be generated if a wreck is resolved as part of the Robin Beaman Supplementary. A media release has been drafted in the event of this occurrence and a communications plan has been established.

Voyage track proposed



Waypoints, stations and time estimates

At each dredge the magnetometer will be retrieved for dredging then returned to the water at the commencement of the next transit.

Location	Latitude	Longitude	Speed (nM)	Time for activity (hrs)	Total time (hrs)	Date	Time
Cairns	16° 54.72 S	145° 47.10 E	11	0.00	0.00	7/08/2019	7:00
Waypoint 1	16° 49.67 S	145° 50.04 E	11	0.52	0.52	7/08/2019	7:31
Waypoint 2	16° 50.57 S	146° 04.38 E	11	1.25	1.78	7/08/2019	8:46
Waypoint 3	16° 37.55 S	146° 15.24 E	11	1.51	3.29	7/08/2019	10:17
Waypoint 4	17° 56.15 S	148° 30.42 E	11	13.74	17.03	8/08/2019	0:01
Waypoint 5 Deploy magnetometer	20° 49.70 S	154° 13.74 E	11	33.40	50.43	9/08/2019	9:25
Waypoint 6	20° 49.79 S	154° 26.10 E	11	1.05	51.48	9/08/2019	10:28
To Dredge Site 1	20° 58.74 S	154° 27.78 E	11	0.76	52.24	9/08/2019	11:14
Time on Station				10.08	62.32	9/08/2019	21:18
To Dredge Site2	20° 47.34 S	154° 40.92 E	11	1.52	63.84	9/08/2019	22:50
Time on Station				10.08	73.92	10/08/2019	8:55
To Dredge Site 3	21° 18.66 S	155° 33.84 E	11	5.32	79.23	10/08/2019	14:13
Time on Station				10.08	89.31	11/08/2019	0:18
To Dredge Site 4	20° 52.80 S	155° 31.80 E	11	2.51	91.82	11/08/2019	2:49
Time on Station				10.08	101.90	11/08/2019	12:54
To Dredge Site 5	20° 07.83 S	156° 03.06 E	11	4.86	106.77	11/08/2019	17:46
Time on Station				10.08	116.85	12/08/2019	3:50
To Dredge Site 6	19° 51.06 S	154° 43.02 E	11	7.01	123.86	12/08/2019	10:51
Time on Station				10.08	133.94	12/08/2019	20:56
To Dredge Site 7	19° 28.78 S	155° 13.32 E	11	3.29	137.23	13/08/2019	0:13
Time on Station				10.08	147.31	13/08/2019	10:18
To Dredge Site 8	17° 38.92 S	156° 02.94 E	11	10.83	158.13	13/08/2019	21:08
Time on Station				10.08	168.21	14/08/2019	7:12
To Dredge Site 9	17° 28.40 S	155° 47.46 E	11	1.65	169.86	14/08/2019	8:51
Time on Station				10.08	179.94	14/08/2019	18:56
To Dredge Site10 Argo 1	17° 15.27 S	155° 30.84 E	11	2.03	181.98	14/08/2019	20:58
Time on Station				10.08	192.06	15/08/2019	7:03
To Dredge Site 11	16° 46.70 S	155° 34.20 E	11	2.60	194.66	15/08/2019	9:39
Time on Station				10.08	204.74	15/08/2019	19:44
Argo 2	16° 16.39 S	155° 34.98 E	11	2.86	207.59	15/08/2019	22:35
To site 11A	15° 34.99 S	155° 36.00 E	8	5.14	212.73	16/08/2019	3:43
To site 11B	15° 13.78 S	155° 27.54 E	8	2.78	215.51	16/08/2019	6:30
Argo 3	15° 01.02 S	156° 10.14 E	11	3.91	219.42	16/08/2019	10:25
To Dredge Site 12	14° 47.52 S	156° 54.18 E	11	4.06	223.49	16/08/2019	14:29

Location	Latitude	Longitude	Speed (nM)	Time for activity (hrs)	Total time (hrs)	Date	Time
Time on Station				10.08	233.57	17/08/2019	0:34
To Dredge Site 13	14° 38.40 S	156° 44.82 E	11	1.17	234.73	17/08/2019	1:44
Time on Station				10.08	244.81	17/08/2019	11:48
To Dredge Site 14 Argo 4	14° 22.20 S	156° 13.98 E	11	3.09	247.90	17/08/2019	14:54
Enter PNG EEZ							
Time on Station				10.08	257.98	18/08/2019	0:58
To Dredge Site 15	14° 11.29 S	155° 29.40 E	11	4.07	262.05	18/08/2019	5:02
Time on Station				10.08	272.13	18/08/2019	15:07
Waypoint 7	13° 30.53 S	155° 34.50 E	11	3.71	275.84	18/08/2019	18:50
To Dredge Site 16	12° 51.88 S	153° 47.10 E	11	10.25	286.10	19/08/2019	5:05
Time on Station				10.08	296.18	19/08/2019	15:10
Waypoint 8	12° 29.42 S	155° 35.04 E	11	9.80	305.98	20/08/2019	0:58
Waypoint 9	11° 48.88 S	156° 21.90 E	11	5.55	311.53	20/08/2019	6:31
To Dredge Site 17	10° 58.86 S	156° 35.22 E	11	4.69	316.21	20/08/2019	11:12
Enter Solomon Isl. EEZ							
Time on Station				10.08	326.29	20/08/2019	21:17
To Dredge Site 18	10° 11.96 S	158° 16.14 E	11	9.93	336.22	21/08/2019	7:13
Time on Station				10.08	346.30	21/08/2019	17:18
To Dredge Site 19	11° 47.01 S	157° 16.20 E	11	10.13	356.43	22/08/2019	3:25
Time on Station				10.08	366.51	22/08/2019	13:30
To Dredge Site 20	12° 12.18 S	157° 35.94 E	11	2.87	369.38	22/08/2019	16:22
Time on Station				10.08	379.46	23/08/2019	2:27
To Dredge Site 21	12° 19.76 S	158° 08.28 E	11	2.76	382.22	23/08/2019	5:13
Time on Station				10.08	392.30	23/08/2019	15:17
To Dredge Site 22	12° 55.24 S	158° 29.10 E	11	3.70	396.00	23/08/2019	19:00
Time on Station				10.08	406.08	24/08/2019	5:04
To Dredge Site 23	13° 10.75 S	158° 00.96 E	11	2.86	408.94	24/08/2019	7:56
Time on Station				10.08	419.02	24/08/2019	18:01
To Dredge Site 24	13° 45.84 S	157° 08.04 E	11	5.66	424.68	24/08/2019	23:40
Time on Station				10.08	434.76	25/08/2019	9:45
To Dredge Site 25	14° 27.42 S	159° 56.16 E	11	15.31	450.07	26/08/2019	1:04
Time on Station				10.08	460.15	26/08/2019	11:09
To Dredge Site 26	14° 47.46 S	160° 31.14 E	11	3.44	463.59	26/08/2019	14:35
Time on Station				10.08	473.67	27/08/2019	0:40
To Dredge Site 27	15° 28.79 S	159° 39.06 E	11	5.91	479.58	27/08/2019	6:34
Enter New Cal. EEZ							
Time on Station				10.08	489.66	27/08/2019	16:39
To Dredge Site 28	16° 37.48 S	158° 50.82 E	11	7.51	497.17	28/08/2019	0:10
Time on Station				10.08	507.25	28/08/2019	10:15
To Dredge Site 29	17° 46.41 S	158° 30.54 E	11	6.48	513.74	28/08/2019	16:44
Time on Station				10.08	523.82	29/08/2019	2:48
To Dredge Site 30	18° 35.00 S	158° 45.60 E	11	4.59	528.40	29/08/2019	7:24
Time on Station				10.08	538.48	29/08/2019	17:28

Location	Latitude	Longitude	Speed (nM)	Time for activity (hrs)	Total time (hrs)	Date	Time
Waypoint 10	19° 09.41 S	159° 18.24 E	11	4.19	542.68	29/08/2019	21:40
Waypoint 11	20° 09.08 S	159° 13.98 E	11	5.33	548.00	30/08/2019	3:00
To Dredge Site 31	20° 53.65 S	159° 26.10 E	11	4.19	552.19	30/08/2019	7:11
Time on Station				10.08	562.27	30/08/2019	17:16
Waypoint 12	21° 31.75 S	159° 51.78 E	11	3.95	566.23	30/08/2019	21:13
To Dredge Site 32	22° 42.96 S	159° 44.04 E	11	6.48	572.70	31/08/2019	3:42
Time on Station				10.08	582.78	31/08/2019	13:47
Waypoint 13	23° 03.89 S	159° 14.58 E	11	3.11	585.90	31/08/2019	16:53
To Dredge Site 33	23° 24.08 S	159° 25.98 E	11	2.06	587.96	31/08/2019	18:57
Time on Station				10.08	598.04	1/09/2019	5:02
To Dredge Site 34	23° 56.53 S	159° 12.06 E	11	3.16	601.20	1/09/2019	8:11
Time on Station				10.08	611.28	1/09/2019	18:16
Re-enter Australian Waters							
Waypoint 14	26° 49.73 S	153° 08.88 E	11	33.72	645.00	3/09/2019	3:59
Waypoint 15	26° 51.46 S	153° 09.18 E	11	0.17	645.17	3/09/2019	4:10
Waypoint 16	26° 57.86 S	153° 13.50 E	11	0.68	645.85	3/09/2019	4:50
Waypoint 17	27° 02.38 S	153° 15.42 E	11	0.41	646.25	3/09/2019	5:15
Waypoint 18	27° 03.34 S	153° 17.94 E	11	0.22	646.48	3/09/2019	5:28
Waypoint 19	27° 05.18 S	153° 18.60 E	11	0.18	646.65	3/09/2019	5:39
Waypoint 20	27° 08.26 S	153° 21.00 E	11	0.34	646.99	3/09/2019	5:59
Waypoint 21	27° 10.93 S	153° 20.70 E	11	0.23	647.22	3/09/2019	6:13
Waypoint 22	27° 14.24 S	153° 19.98 E	11	0.30	647.52	3/09/2019	6:31
Waypoint 23	27° 17.61 S	153° 13.26 E	11	0.62	648.14	3/09/2019	7:08
Brisbane	27° 23.08 S	153° 09.54 E	11	0.58	648.73	3/09/2019	7:43

Permits

- Permits to conduct Research in Coral Sea Australian Marine Park – PA2019-00047
- Permit for Access to Commonwealth biological resources (part 8a)- linked to PA2019-00047
- MNF non-invasive Marine Parks Australia research permit- PA2018-00005-001
- Third Party Note to conduct Research in Foreign EEZs (PNG, Solomon Islands, New Caledonia)
- Import Permit/Declaration required for rock samples from outside the Australian Economic Exclusion Zone.

Personnel List

Removed from website version

Signature

Your name	Joanne Whittaker
Title	Chief Scientist
Signature	
Date:	23 July, 2019

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.

(i) Standard laboratories and facilities

Name	Essential	Desirable	Notes/Comments
Aerosol Sampling Lab			
Air Chemistry Lab			
Preservation Lab			
Constant Temperature Lab			
Underway Seawater Analysis Laboratory			
GP Wet Lab (Dirty)	X		
GP Wet Lab (Clean)		X	
GP Dry Lab (Clean)		X	
Sheltered Science Area		X	
Observation deck 07 level	X		
Walk in Freezer			
Blast Freezer			
Ultra-Low Temperature Freezer (-80^{0}C)			
Walk in Cool Room		X	
Salt water ice machine			

(ii) Specialised laboratory and facilities

(May require additional support)

Name	Essential	Desirable	Notes/Comments
Modular Radiation Laboratory			
Modular Trace Metal Laboratory (TM1-blue)			• For determination of trace metal concentrations • Clean laboratory containing laminar flow cabinets
Modular Trace Metal Laboratory (TM2-white)			• Wet sampling of trace metal clean Niskins • Cannot be overstacked
Modular Hazchem Locker			
Deck incubators			
Stabilised Platform Container			
Clothing container			The use of this container will be identified by MNF

(iii) Standard laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments
CTD - Seabird 911 with 36 Bottle Rosette			
CTD -Seabird 911 with 24 Bottle Rosette			
Total number of Casts:			
Maximum depth:			
Analyses required for each deployment: (indicate which are required and the number of samples per deployment)			
Salinity			
Dissolved oxygen			
Nutrients:			Note: analytical throughput based on 2 hydrochemists/24hours: - Nutrients, dissolved oxygen, salinity. Sampling ration 1:1:1 equates to 48:48:48 - Nutrients, dissolved oxygen, salinity. Sampling ratio 2:1:1 equates to 72:36:36 - Nutrients only collection from every depth 160 maximum analytical output
Nitrate			
Phospate			
Silicate			
Nitrite			

Name	Essential	Desirable	Notes/Comments
Ammonia (special request after discussion with hydrochemistry			
Lowered ADCP			
MNF Auxiliary Instrumentation for CTD Rosette (please indicate which you require. Note 6 auxiliary sensor channels are generally available:			
Dissolved oxygen sensor			
Altimeter (required if operating anywhere near the sea floor)			
PAR Sensor (Biospherical QCP-2300)			
Transmissometer (Wetlabs C-Star 25cm)			
Fluorometer- Chlorophyll-a (Chelsea Aquatracka 111 – 430/685nm			
Flurometer – CDOM (Wetlabs)			
Nephelometer (Seapoint Turbidity Meter)			
ECO-Triplet (2,000m max depth, chlorophyll, CDOM & backscatter)			
Sonardyne USBL System			
Milli -Q System			
Laboratory Incubators			
Heavy Duty Electronic Balance (80kg)			
Medium Duty Electronic Balance (15kg/5g resolution)			
Light Duty Electronic Balance (3kg/1g resolution)			
Surface Net (mouth area 1m^2) 335 micron, 500 micron, 1,000 micron mesh available – please specify			
Bongo Net (500 micron mesh only, not instrumented) ring diameter 485mm 0.018m^2			

Name	Essential	Desirable	Notes/Comments
Smith Mac grab		X	
Dissecting Microscopes (x4, please specify number required.			

(iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments *(These items may require additional MNF support staff)*
TRIAXUS – Underway Profiling CTD			Notes: Triaxus is a pilotable towed vehicle capable of carrying a variety of instrumentation. Constant depth towing or undulating profiles (e.g. cyclic depth pattern from 10m to 200m) are possible. Towing speed depends on the tow profile, instrumentation payload and prevailing conditions. Typically, undulations from the surface to 200m are possible at 8knt, with slower speeds for deeper profiles and faster for constant-depth towing. Maximum achievable depth typically 300m Usual instrumentation: SBE9plus (pressure sensor and communication hub) and dual pumped temperature/conductivity/dissolved oxygen circuits. Usual auxiliary instrumentation includes an ECO-Triplet (Chl, CDOM, backscatter), transmissometer, PAR sensor, and Laser Optical Plankton Counter.
Desired towing profile:			
Additional instrumentation: (Please supply, make and model and datasheets. Also a contact person for discussion on integration.			
Continuous Plankton Recorder (CPR)			Note: indicate deployed location and support if required
Deep towed camera			
Piston Coring System			
Gravity Coring System			
Multi Corer			
Kasten Corer			
XBT System			
Trace Metal Rosette and Bottles			
Sherman epibenthic sled			
Trace- metal in-situ pumps (x4)			See *"Non-MNF owned equipment"* section below for additional 2 units
Rock Dredges	X		

Name	Essential	Desirable	Notes/Comments *(These items may require additional MNF support staff)*
EZ Net (maximum of 10 nets for depth stratified sampling. Mouth area of 1m^2 Indicate mesh size required:			
335 micron			
500 micron			
1,000 micron			
Rock saw (requires a trained science personnel)	X		
Portable pot hauler			
Beam Trawl			
Trawl doors (pelagic or demersal)			
Seaspy Magnetometer	X		
MIDOC (multiple opening/closing codend system for pelagic trawl			
Stern Ramp (tick to have the ramp exposed, or leave blank for deck covers installed			
Trawl monitoring instrumentation (ITI) (2,000m depth limit)			
Trawl nets: Mid water research trawl Wing end spread usually 21m Average headline height 8.97m Mouth area (on average) 188.37m^2 Mesh size 200mm in mouth area grading to 10mm in cod end.			
Radiosonde Receiver System			

(v) Equipment and sampling gear requiring external support

(May require additional support from applicants)

Name	Essential	Desirable	**Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with Voyage Operations Manager as required. Additional staff may be required for these activities.**
Seismic compressors			

Name	Essential	Desirable	Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with Voyage Operations Manager as required. Additional staff may be required for these activities.
Seismic acquisition system			

(vi) Underway systems

Atmospheric Underway Systems

Name	Essential	Desirable	Notes/Comments
75kHz ADCP			
150kHz ADCP			
Multibeam echo sounder EM122 12kHz (100m to full ocean depth)	X		
Multibeam echo sounder EM170 70-100kHz (0-1000m approx.)	X		
Sub-Bottom Profiler SBP120	X		
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)	X		
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)	X		
Omnidirectional Echo Sounder SH90			
Gravity Meter	X		

Atmospheric Underway Sensors

Name	Essential	Desirable	Notes/Comments
Nephelometer			
MAAP (multi angle absorption photometer)			
SMPS (scanning mobility particle sizer)			
Radon detector			
Ozone detector			
CPC (Condensation Particle Counter)			
Picarro spectrometer (analysis of CO_2/CH_4/H_2O)			
Aerodyne spectrometer (analysis of N_2O/CO/H_2O)			
CCN (Cloud Condensation Nuclei)			

Name	Essential	Desirable	Notes/Comments
Polarimetric Weather Radar			

Underway Seawater Instrumentation

Name	Essential	Desirable	Notes/Comments
Thermosalinograph			
Fluorometer			
Optode			
pCO2			

Seawater systems

Name	Essential	Desirable	Notes/Comments
Trace metal			
Scientific clean			
Raw			

Non MNF owned equipment which may be accessed

Name	Essential	Desirable	Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with Voyage Operations Manager as required.
D & N Francis winch			
Box Corer			
University of Tasmania (UTAS) in-situ pumps (x2)			
EM2040			