2020-21 Supplementary Voyage Opportunities

To apply:

Applicants wishing to apply for any of these opportunities are requested to contact the MNF Science Operations Manager, Mr Matt Kimber on 03 6232 5186 to discuss the particular constraints that will apply to any proposals approved.

Primary Voyages

Click Voyage number for more information

IN2020_V05 – Dr Ruhi Humphries	**Depart Hobart (19 Aug) – Return Hobart (8 Sep)**
IN2020_V06 – Dr Rebecca Carey	**Depart Auckland (25 Sep) – Return Auckland (22 Oct)**
IN2020_V07 – Dr Martin Jutzeler	**Depart Auckland (27 Oct) – Return Hobart (24 Nov)**
IN2021_V02 – Prof Tom Trull	**Depart Hobart (18 Apr) – Return Hobart (2 May)**
IN2021_V03 – Dr Mark Meekan	**Depart Broome (26 May) – Return Broome (9 Jun)**

Transit Voyages

IN2020_T03 – Transit Voyage – Depart Cairns (1 July) – Arrive Hobart (11 July)

Supplementary Berths available – Up to 28
Station time available to supplementary projects – Up to 2 days

IN2020_T04 – Transit Voyage – Depart Hobart (11 Sep) – Arrive Auckland (20 Sep)

Supplementary Berths available – Up to 28
Station time available to supplementary projects – Up to 2 days

IN2021_T01 – Transit Voyage – Depart Hobart (7 May) – Arrive Broome (23 May)

Supplementary Berths available – Up to 28
Station time available to supplementary projects – Up to 3 days

IN2020_V05 – Dr Ruhi Humphries – Depart Hobart (19 Aug) – Return Hobart (8 Sep)

Supplementary Berths available – 20
Station time available to supplementary projects – None

Measuring the world's cleanest air – validating atmospheric measurements above the Southern Ocean.
The RV Investigator (RVI) was recently recognised as the world's first mobile platform in the World Meteorological Organization's (WMO) Global Atmosphere Watch (GAW) program. The Cape Grim Baseline Air Pollution Station (CGBAPS), on Tasmania's northwest coast, has been a GAW station for over 40 years, and as one of three premier global stations, is recognised as a world leader in atmospheric and climate observations. This project's first goal is to undertake a world first "station calibration" to validate the data coming from the nascent RVI. By collocating the RVI at the CGBAPS, and further utilising the mobile atmospheric facility (AIRBOX) as an independent check, the station calibration will be undertaken, validating measurements from the RVI against the world class measurements of the CGBAPS, increasing both the confidence and quality of the data for the variety of locations visited by the vessel, past and future.

The CGBAPS' main focus is sampling the pristine background marine air from the Southern Ocean. Extensive tracer and modelling studies have been undertaken to understand the true history of the air arriving at the CGBAPS under "baseline" conditions, but until now, experimental testing has not been possible. The second goal of this project is to experimentally validate the vital assumption of spatial representativeness of the CGBAPS using the unique mobility of the RVI station. By understanding the atmosphere's vertical structure and characterising its upwind composition, we will help to further refine the classification of its "baseline" conditions. Achieving these goals will significantly improve our understanding of Southern Ocean baseline concentrations of a range of trace atmospheric constituents. Results from this project will directly improve national and global air quality, climate, and smoke and pollen forecast models by validating and refining the pristine background chemical boundary conditions and atmospheric structure that are fundamental components of all atmospheric models.

Map of proposed voyage track

The location of the CGBAPS along with the proposed voyage research area (orange), overlayed on the CGBAPS baseline sector (yellow). A suggested voyage track is shown in red, but will depend on the prevailing wind directions at the time. The two preferred ports (Hobart and Melbourne) are also shown.

IN2020_V06 – Dr Rebecca Carey – Depart Auckland (25 Sep) – Return Auckland (22 Oct)

Supplementary Berths available – 6
Station time available to supplementary projects – None

Life after death: understanding the recovery of a submarine hydrothermal system and seafloor ecosystems post volcanic eruption

This project will address major outstanding questions related to biological and geological changes in deep-sea systems following a major seabed disturbance. The Havre volcanic eruption in 2012 occurred along the Kermadec Arc, north of New Zealand[3]. It produced a >36 km^2 blanket of pumice and ash that was dispersed onto biological communities in active hydrothermal vent and non-vent settings, and destroyed hydrothermal systems.

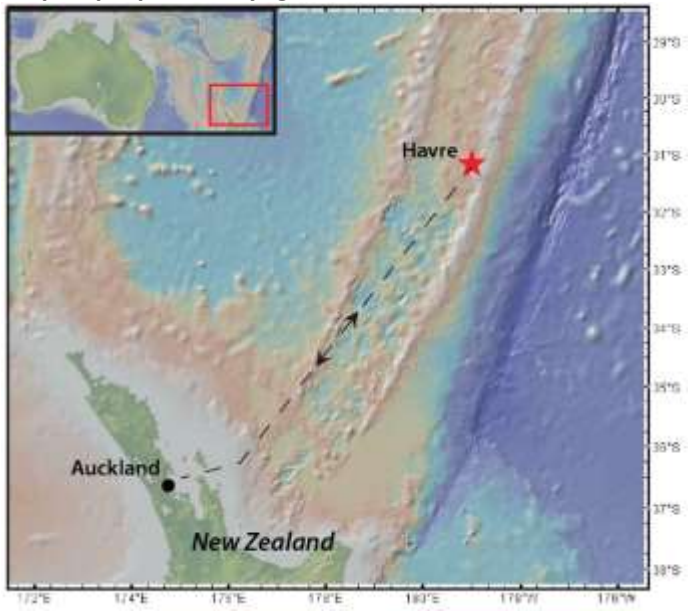
This project will measure the recovery of both geological and biological components at active vents and inactive sites, as well as their spatial patterns. We will determine the sources of colonising fauna, important in developing management options to balance any exploitation with conservation of the ecosystem's structure and function.

Scientific outputs will be of international significance and include distributional maps and quantitative analyses relating to a) hydrothermal venting, mineralisation and chemistry, b) benthic biological communities in multiple habitat types, and c) gene flow connectivity within, and between, Havre and the surrounding area. Outputs will be disseminated by research publications, conference and workshop presentations, and reports to end-users.

Outcomes of significance to National Benefit will be new frontier knowledge associated with the resilience of animal communities and hydrothermal systems after a major seafloor disturbance. This new knowledge and methods can be immediately applied to predicting the impacts of mining mineral deposits in the deep sea and will be delivered to end-users with regulatory roles at national (e.g., Environmental Protection Authorities) and international levels (Department of Foreign Affairs and Trade, International Seabed Authority) about how to monitor and manage the effects of seabed mining, and help to realise sustainable economic opportunities from seabed minerals for Australia.

This research value adds to a combined ~$5 million investment by the Australian Government (R.Carey ARC DECRA DE150101190), the US NSF (OCE1357443 (to PI Carey) & OCE1357216 (to PI Soule)), and the NZ Government (UOO1616).

Map of proposed voyage track



IN2020_V07 – Dr Martin Jutzeler – Depart Auckland (27 Oct) – Return Hobart (24 Nov)

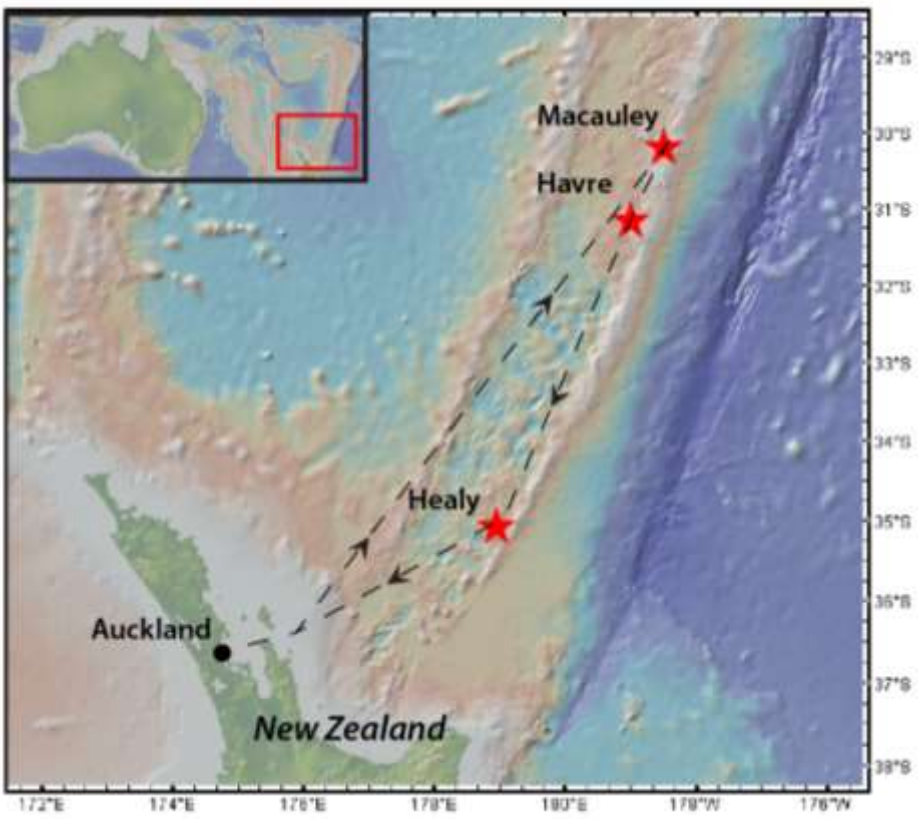
Supplementary Berths available – 5
Station time available to supplementary projects – None

Sedimentation at its extreme: how powerful are submarine caldera-forming eruptions (Kermadec arc)?
The *International Ocean Discovery Program* (IODP) is planning to have their main drilling ship (R/V *JOIDES Resolution*) in the southern Pacific by 2023. This is a major opportunity to solve one of the most frontier questions in submarine volcanism: what is the sub-seafloor structure of submarine caldera volcanoes and their sediment sheets, what is the intensity of underwater eruptions involving 10s km^3 of magma, and how does water depth influences their tsunamigenic potential?

The eruption style, eruption intensity, and sediment volumes produced during submarine arc volcanic events are largely unconstrained due to our inability to directly observe submarine eruptions and our limited knowledge of the deposits that reflect eruption properties. This project aims to quantify the magma flux of submarine eruptions by using 3D morphology of proximal sediment waves (dunes) deposited by eruption-fed sediment flows – a characteristic, but understudied feature of submarine arc volcanoes. We will carry out seismic reflection surveys, AUV and ship-based sub-bottom profiling, and collect sediment cores at three representative submarine silicic caldera volcanoes in the Kermadec arc.

Based on this data, sediment fluxes and eruption discharge rates will be scaled by numerical modelling. The morphology of sediment waves, water depth of the caldera, and rock composition at these three volcanoes will establish thresholds in intensity and style of eruptions in the context of deep-water caldera-forming silicic volcanism.
This threshold framework will provide a benchmark assessment of the tsunamigenic potential of submarine volcanism and raise awareness on the destructive ability of associated volcanogenic flows. Further, it will provide exceptional data on volcanic architecture that will improve ore exploration strategies at modern and ancient arc volcanoes. Importantly, collecting seismic data by 2020 will enable submission of a deep-sea drilling IODP proposal by 2020-2021, allowing access to the drilling ship while it is in our region (2023).

Map of proposed voyage track



IN2021_V02 – Prof Tom Trull – Depart Hobart (18 Apr) – Return Hobart (2 May)

Supplementary Berths available – 18
Station time available to supplementary projects – None

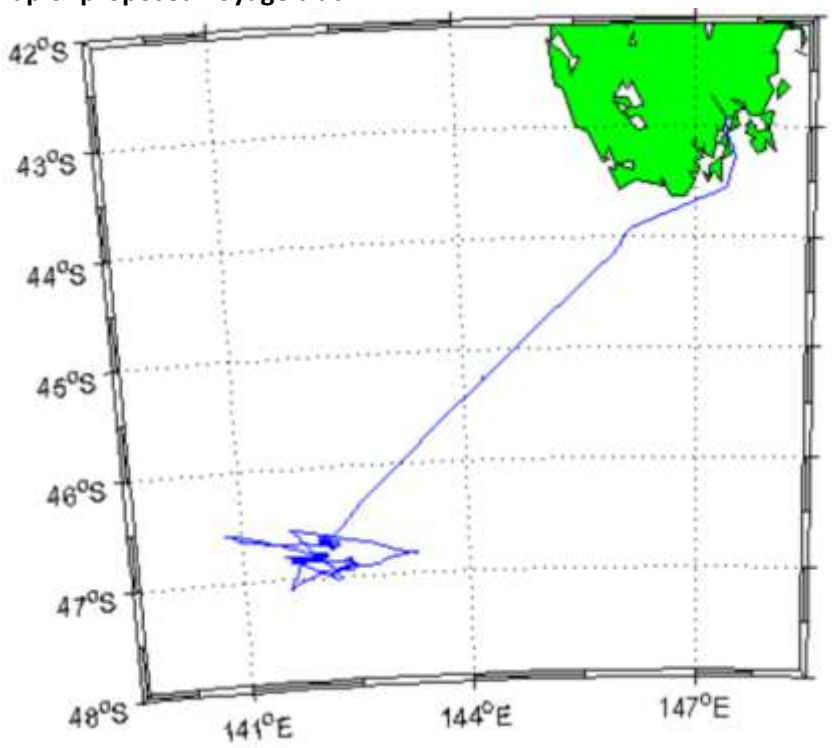
Integrated Marine Observing System Southern Ocean Times Series (IMOS-SOTS) for climate, carbon, and ocean health
Three voyages are requested to service the Southern Ocean Time Series (SOTS) moorings in the Subantarctic Zone (SAZ) southwest of Tasmania near 47°S, 141°E - a facility of the Australian Integrated Marine Observing System and a component of the OceanSITES global network.

The Southern Ocean Flux Station (SOFS) mooring focuses on heat, water, oxygen and CO_2 fluxes across the air- ocean interface, and the physical conditions and biological processes that modulate them, The SAZ sediment trap mooring focuses on quantifying the transfer of carbon and other nutrients to the ocean interior by sinking particles, i.e. the biological carbon pump. Both moorings also collect samples important to assessing ocean productivity and health, including limiting nutrients such as silicon and iron, phytoplankton functional groups, and microbial community structure via environmental DNA (eDNA).

The Southern Ocean plays a predominant role in the movement of heat and carbon into the ocean interior, thereby moderating Earth's average surface climate, variability, and rate of change. The oceanic uptake of excess anthropogenic heat and carbon drives changes in ocean ecosystems via warming, stratification, acidification, and ventilation - with an unknown mix of negative and positive consequences. SOTS acquires data that allows these processes to be quantified in a region where they are most intense and relatively poorly understood. The oceanic uptake of heat and CO2 varies with diel insolation cycles, weather events in the atmosphere, the evolution of eddies in the ocean, and seasonal and interannual dynamics. Thus, a complete understanding of these processes requires sustained high-frequency, and necessarily, automated observations.

SOTS focuses on Essential Climate Variables (ECV) and Essential Ocean Variables (EOV) as defined by the Global Climate Observing and Global Ocean Observing Systems (GCOS and GOOS), and also undertakes pilot efforts for Essential Biological Variables (EBV), as currently under development by GOOS.

Map of proposed voyage track



IN2021_V03 – Dr Mark Meekan – Depart Broome (26 May) – Return Broome (9 Jun)

Supplementary Berths available – 18
Station time available to supplementary projects – None

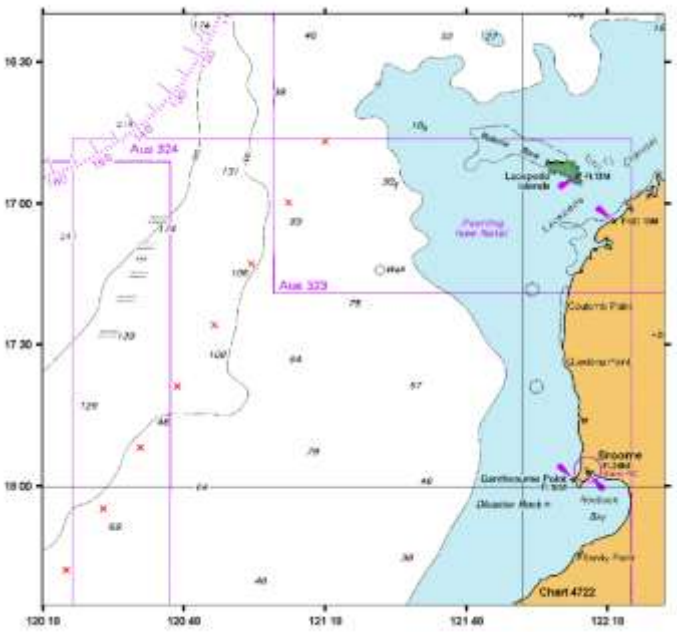
Evaluating the impact of seismic surveys on the zooplankton communities of the North West Shelf
This project addresses the question: Do the high energy impulse signals generated during seismic surveys for oil and gas in marine systems significantly impact zooplankton populations? Specific aims are to:

- Determine if the distribution, abundance, behaviour, biology and mortality of zooplankton in an area off the north-west coast of Western Australia are significantly altered by marine seismic survey operations
- Identify potential mechanisms for injury associated with any impacts generated by seismic survey operations.

The technique commonly used to locate marine petroleum deposits in the worlds' oceans relies on a high amplitude impulse sound signal (Anon, 2011) produced by an "air-gun". In recent, small-scale experiments, operation of a single air-gun resulted in substantially increased zooplankton mortality, decreased zooplankton abundance with impacts out to a range of one km in a coastal environment (McCauley et al., 2017).

These findings have caused considerable controversy among stakeholders including fisheries agencies, commercial fishermen, resource managers and the oil and gas industry. There is an urgent need to verify the results of McCauley et al (2017) and their applicability to real-world situations. This project will deploy a full-scale commercial seismic array on the *RV Investigator* and document the effect of seismic surveys on the plankton community on the shelf and offshore. The work will describe the distribution, abundance, behaviour and mortality of plankton using a variety of techniques including sonar surveys, plankton nets and pumps and light traps. Zooplankton exposed to surveys will be held in the laboratory onboard to examine behaviour, growth and reproduction rates. Using a combination of gene expression, immunological and histology studies we will seek to understand the mechanisms underlying any documented impacts on the zooplankton community

Map of proposed voyage track
Figure showing Broome Port and proposed sites (red crosses). These are spaced 15 n mile apart on a heading of 210° from the northern Point. The northern Point is 96 n mile from Broome wharf, the southern points 110 n mile. Sites locations (WGS 84 chart datum) and water depths are listed below:



#	Latitude	Longitude	Depth (m)
1	16° 46.883' S	121° 17.982' E	45
2	16° 59.862' S	121° 10.145' E	94
3	17° 12.841' S	121° 02.298' E	110
4	17° 25.820' S	120° 54.443' E	117
5	17° 38.799' S	120° 46.578' E	112
6	17° 51.778' S	120° 38.703' E	98
7	18° 04.757' S	120° 30.819' E	95
8	18° 17.736' S	120° 22.925' E	95