MNF Voyage Highlights and Summary

Voyage #:	IN2024_T01
Voyage title:	Transit across the Great Australian Bight, from Fremantle to Hobart
Mobilisation:	Fremantle
Depart:	0900 Saturday 9th March, 2024
Return:	Hobart, 0800 20th March, 2024
Demobilisation:	Hobart, Thursday 21 March, 2024
Voyage Manager:	Ben Arthur
Chief Scientist:	Jo Whittaker
Affiliation:	University of Tasmania
Principal Investigators:	1. Jo Whittaker: jo.whittaker@utas.edu.au, UTAS 2. Elise Tuuri: elise.tuuri@flinders.edu.au, Flinders Uni 3. Peter Strutton: peter.strutton@utas.edu.au, UTAS
Project name:	1. Australia's Southern Tectonic Margin: Understanding how Australia and Antarctica broke up. 2. Microplastics in the food chain: impact on planktonic organisms and understanding microplastic distributions. 3. Characterization of data quality from a 6000m CTD: the RBRargo³|deep6k in the Great Australian Bight.

Voyage Highlights

The Chief Scientist

Professor Jo Whittaker works at the Institute for Marine and Antarctic Science at the University of Tasmania. Jo is an academic in the field of marine geoscience, specifically looking at the formation and evolution of continental margins and oceanic crust, with a focus on understanding the evolution of Australia, Antarctica, the Southern Ocean, and the Eastern Indian Ocean. She uses marine geophysical and geological datasets to understand how the interaction of upper mantle convection patterns and surface plate tectonics shape the formation of the seafloor and ocean basins.

Title

Australia's Southern Tectonic Margin: Understanding how Australia and Antarctica broke-up

Purpose

The voyage consisted of three main projects with the following objectives:

- Recover rocks from identified basement ridges in the Great Australian to understand the lithospheric nature of the transition from continental to oceanic crust
- Expand the spatial sampling distribution of microplastic pollution around Australia, to comprehensively quantify microplastic abundances, vertical and spatial distributions, and explore the potential associations with zooplankton communities
- Collect CTD profiles down to 6000 m to characterize instrument performance in the framework of the Argo program

There were additionally five piggy-back projects with the following objectives:

- Minderoo OceanOmics scientists to collect environmental DNA (eDNA) samples from underway water system and CTD casts to bolster marine eDNA sampling in Australian waters and hadal zones. This work is in partnership with Parks Australia under the Ocean Discovery and Restoration Program which aims to provide a proof-of-concept that genomic tools, like eDNA, can be an effective way to monitor biodiversity in Australia's large and remote marine parks.
- Selected atmospheric sampling to continue from preceding voyage IN2024_V01
- Deploy up to 3 'SOCCOM' style BGC-Argo floats during the transit between Fremantle and Hobart
- Collect underway bathymetry en route to Hobart offshore South-West Tasmania to map identified geological features of interest
- Have a NOAA surveyor/technician join voyage and share knowledge with the GSM team and assist with mapping responsibilities

During this voyage we were able to bring 11 undergraduate students from the University of Tasmania aboard to experience first-hand sea-going science.

Contribution to the nation

Understanding the formation, structure, and physical state of the Australian rifted margin, including the transition from continental to oceanic crust is important for its resource endowment and recovery, and lowers “the risk to sedimentary basins and marine environments due to resource extraction”. Our swath mapping program aligns with national and international efforts to map the oceans by 2030.

Education of marine scientists and communication of science to the public is critical for Australia. We were able to provide a unique experience for 11 undergraduate students to participate in the voyage and learn about marine science. We were incredibly fortunate to have science communicator Olly Dove onboard to communicate our research via the award-winning podcast “That’s What I Call Science”.

Australia is a key contributor to the Argo program, through all three Core, Deep, and BGC Argo programs. Diversifying the availability of sensors capable of delivering high-quality data for Argo is one of the priorities of the program: to avoid single point of failure, to drive sensor innovation, and to bring sensor prices down through competition. To this end, Argo Australia partnered with an instrumentation company, RBR, to provide a platform for field testing of CTDs, oxygen optodes, fluorometer, and backscattering sensors.

The microplastics research conducted during this voyage plays a crucial role in addressing Australia's significant environmental concerns regarding microplastic pollution in our marine ecosystems. With Australia's marine industry contributing over $80 billion annually to the national economy, understanding the impact of microplastic intrusion on marine ecosystems is imperative for understanding the impacts we may cause to this. While previous studies have mainly focused on marine surface waters, the vertical distribution of microplastic pollution is a growing concern. Our investigation into the vertical and spatial distribution of microplastics, alongside their potential associations with zooplankton communities, will provide valuable insights into understanding the dynamics of microplastic pollution at marine locations around the nation. This knowledge is crucial for informing policy decisions and management strategies aimed at mitigating the adverse effects of microplastics on marine life and human health. By comparing methodologies and supplementing existing datasets, our research will benefit various stakeholders, including government agencies, industries, researchers, and the wider community, by providing evidence-based information to guide actions aimed at preserving the health and integrity of our marine environment for present and future generations. Furthermore, the data collected will enhance our understanding of planktonic communities and microplastic ingestion by zooplankton, aiding in predicting the transfer of microplastics up the food chain and potential ingestion by fish. These insights, coupled with the development of a comprehensive model of plastic movement in ocean features, will help identify hotspots of plastic intrusion and aggregations along our coastlines, facilitating effective policy and pollution management strategies.

As a result of this voyage

- We have a better understanding of the geological nature of Australia's southern rifted margin.
- We have characterized the performance of a series of instruments capable of reaching 6000 dbar (approximately 6000 m depth)
- We have a better understanding of the spatial and vertical distribution, abundances, and characteristics of microplastic (5 mm > 20 µm) pollution in Australian waters.
- We have a better understanding of the zooplankton communities found in the oceans of Australia.
- We have new information on which methods are the most suitable and appropriate for the quantification of microplastics from marine samples.
- We have new knowledge about the oceanographic conditions of the Great Australian Bight

Next steps

Rocks collected during this voyage will be taken back to the University of Tasmania for extensive lab work, including rock and mineral descriptions, and geochemical and geochronological analyses.

Samples taken from the 4 deep CTDs will be analysed in the lab (phytoplankton pigments, particulate carbon, dissolved inorganic carbon and total alkalinity) and will improve calibrations for the BGC-Argo floats that were deployed.

The CTD data collected on this voyage will be analysed and compared to gold standard measurements from water samples to assess the accuracy of the instruments in situ.

eDNA samples collected from underway system and CTDs will be processed at the OceanOmics Centre at the University of Western Australia. Initial processing will involve DNA extraction and metabarcoding of 16S and 12S rRNA gene regions with a focus on marine fishes to characterize fish biodiversity and changes in assemblages across open water transects and in deep-sea hadal zones.

The collected microplastics samples will undergo processing at Flinders University. The samples collected from the niskin bottles will undergo enumeration for microplastic abundances, characteristics, and chemical composition. Samples from the net tows will be divided into two categories: (i) analysis of zooplankton communities using standard identification methods and (ii) assessment of environmental microplastic abundances and associations with zooplankton. The latter will involve laboratory procedures such as density separation of environmental plastics from the planktonic community and chemical digestion of biological material to release ingested and associated plastics, followed by microplastic enumeration and validation. Future outputs from this research will be published, and the relevant data will be made publicly available for stakeholders interested in accessing the findings.

Voyage Summary

Objectives and brief narrative of voyage

Scientific objectives

Australian-Antarctic Tectonics: Recover rocks from identified basement ridges in the Great Australian to understand the lithospheric nature of the transition from continental to oceanic crust

Microplastics: The collected samples will be added to a growing data set that aims to achieve various project goals, including: i) determining microplastic abundances and characteristics in Australian oceans, ii) assessing their vertical and spatial distributions across Australian waters, iii) identifying optimal collection methods for accurate microplastic quantification, and iv) investigating potential associations between microplastics and zooplankton communities, which are bioindicators of environmental change.

Deep CTDs: Complete 3 profiles to 6000 dbar collecting data from instruments, and water samples over the water column to provide a robust reference

Minderoo: Collect, filter, and preserve samples for eDNA analyses from the underway line and CTD. Sample collection spread out evenly along the transect from Fremantle to Hobart

Atmospheric sampling: Continue selected sampling from previous voyage IN2024_V01

ARGO: Deploy up to 3 'SOCCOM' style ARGO floats during the transit between Fremantle and Hobart

Opportunistic Seafloor mapping: Collect underway bathymetry en route to Hobart offshore South-West Tasmania to map identified geological features of interest

Strategic Partnership NOAA: NOAA surveyor/technician to join RV Investigator and share knowledge with the GSM team and assist with mapping responsibilities

Ship works and RotorLift Helicopter Winch Drill: Calibrate CTD winch drum spooling onboard and at end of voyage perform a live drill of helicopter winch operations

Voyage objectives

The primary objective of voyage IN2024_T01 is the safe and timely transit of RV *Investigator* from Fremantle to Hobart in preparation for future voyages leaving the port of Hobart. Up to 88 hours of operational time (weather dependent) within the transit voyage was allocated to conduct scientific operations for Supplementary Projects. Any remaining time would be available for Piggyback Projects, along with opportunistic seafloor mapping – while keeping "Expected Time of Arrival" in Hobart on track as the primary objective.

Results

Australian-Antarctic Tectonics: Rocks were recovered from 2 of the 3 dredge locations. Rocks recovered were mafic and a number are very fresh, unusually volcanic glass was present in some samples from dredge 2. These rocks will enable a suite of onshore analysis, including rock and

mineral descriptions, geochemistry, and geochronology. These data will enable a revised assessment of rifting models for the Australian-Antarctic break-up around 83 million years ago.

Microplastics: The voyage objective for this project is to expand the spatial distribution of sampling sites around Australia, employing a comprehensive approach that includes collecting samples using a CTD with a niskin bottle rosette with a paired hydro-bios net tow at three depths in the water column of each station (sub-surface, deep chlorophyll maximum, sub-bottom). Data will be collected from the Acoustic Doppler Current Profiler (ADCP) at each station, to allow us to understand the water profiles to develop particle tracking models of the microplastics collected.

Deep CTDs: All 3 planned deep profiles were collected, with successful water sampling and analysis by the hydrochemist. Early analysis demonstrated the performance of all additional sensors down to their maximum depth rating (6000 dbar). Water samples analysed so far already proved to be instrumental in the analysis, providing a high-quality reference. The final results of the analysis will allow the international Argo program to assess the instruments' performance and start installing them on profiling floats.

Minderoo: Underway water samples were collected, filtered, and preserved for eDNA analysis from 30 locations evenly spread between Fremantle and Hobart. Water samples were also successfully filtered and preserved from 6 CTD casts, at depths where complementary analyses will also be conducted. These samples will enable downstream genomic analyses, including metabarcoding analysis for fish biodiversity assessment. In total 250 eDNA samples, including negative controls, were collected from 6.5m to 5900 m depth.

Atmospheric sampling: Selected sampling continued from the previous voyage IN2024_V01

ARGO: 3 'SOCCOM' style ARGO floats were successfully deployed during the transit between Fremantle and Hobart. Each float was deployed following a CTD (CTDs 4, 5, and 7).

Opportunistic Seafloor mapping: High quality bathymetric data was collected of the seafloor geological features of interest.

Strategic Partnership NOAA: Amanda Finn joined the GSM team as the inaugural NOAA GSM exchange. The goals of knowledge sharing with the GSM team and assisting with mapping responsibilities were achieved.

Ship works and RotorLift Helicopter Winch Drill: Cancelled.

Voyage narrative

RV Investigator departed from Fremantle on 9 March 2024. The ship headed southward and around the southwest corner following the West Australian continental shelf collecting underway acoustic data and water. Thee shallow (<~200m) CTDs and accompanying hydrabios net deployments were undertaken along the section of the voyage. After the second station, the magnetometer was deployed when transiting. After the third station the ship left the continental shelf and headed more southeastward to deep waters to conduct a deep (~5,900m) CTD. Transiting eastward, the seafloor was mapped across known bathymetric ridges looking for suitable dredge sites, and three dredges were undertaken in water depths of ~5,300m. While the first dredge recovered only sediments, the following two dredges recovered significant hauls of seafloor rock samples. Farther to the east, two further deep CTD deployments were undertaken at sites carefully selected where the seafloor was deeper than 6,000m. Both CTDs successful reached depths greater than 6,000m (new records for

CTDs deployed from Investigator) and recovered water samples. One final CTD was undertaken at ~135°E to a depth of 2,200m. Very pleasant weather conditions were experienced for most of the voyage, with no weather delays to the science program. Return transit commenced on Sunday 17 March, and the ship returned to Hobart on 20 March 2024.

Outreach, education, and communications activities

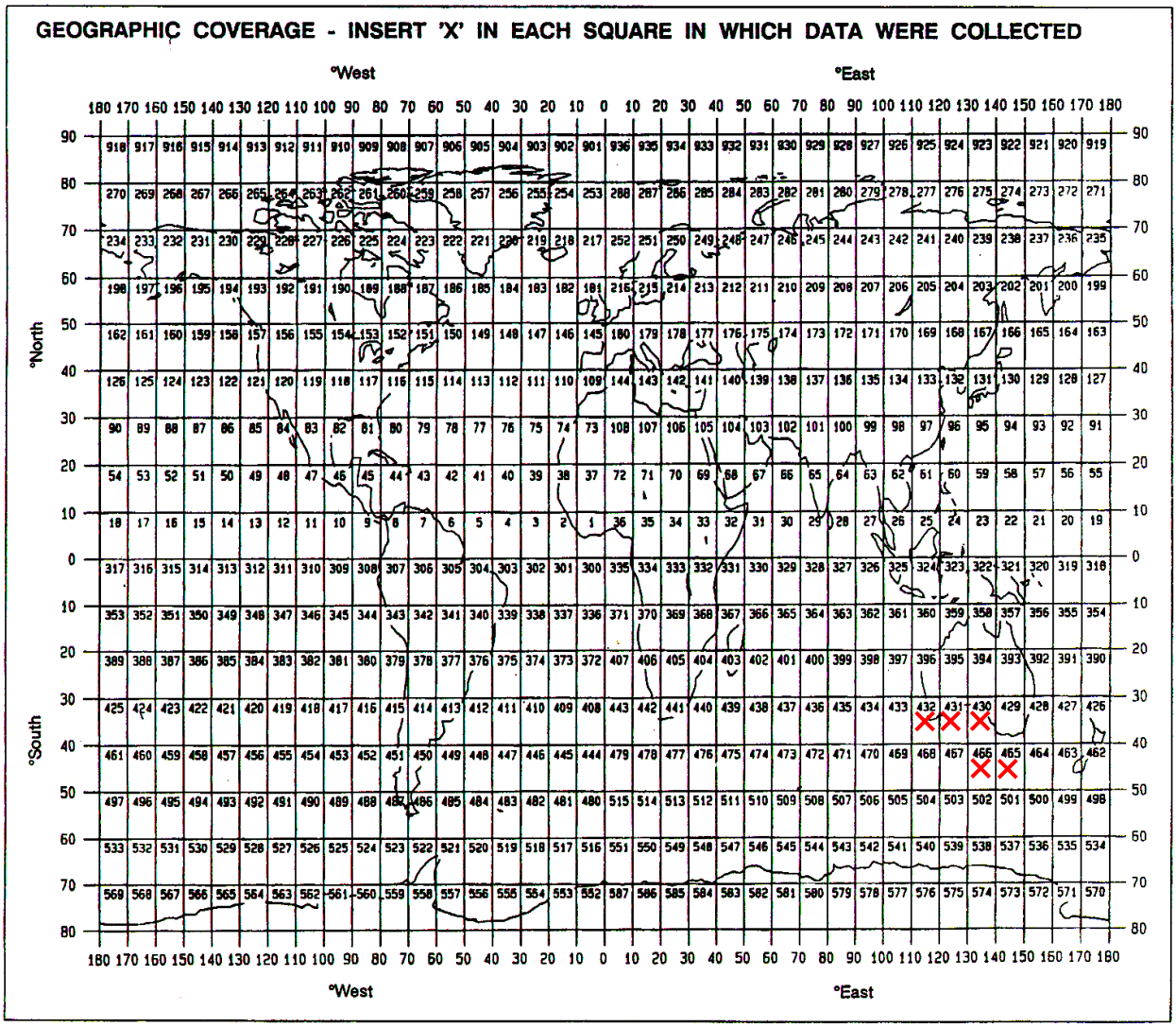
That's What I Call Science host Olly Dove was on board the IN2024_T01 to record both audio and visual content. As *That's What I Call Science* is a weekly radio and podcast show, Olly's main aim was to collect content for a mini-series focusing on all aspects of the voyage. What started off as a 3-part mini-series bloomed into a 5-part mini-series as she had over 25 of the scientists, staff, students, and crew on board excited to share their story. The episodes are due for release in June 2024 across the Australian community radio network (including Hobart-based Edge Radio) and internationally on all main podcasting platforms. For the visual side of Olly's trip, she visited all science streams aboard the ship (often alongside the students) and captured over 5 hours of footage which will be edited into a 30-60 minute video. This will potentially be shown at a local science festival in Hobart later in 2024.

During IN2024_T01, a group of 11 students from the University of Tasmania were on board as part of their Institute of Marine and Antarctic Science (IMAS) unit called "Oceanographic Methods". Their involvement was made possible via generous logistical support of the MNF after chief scientist and IMAS researcher, Jo Whittaker included the unit into her application for sea time. During the voyage, the students gained valuable at-sea training on the CSIRO research vessel, RV Investigator during a 12-day transit voyage from Fremantle, WA to Hobart, TAS. The goal of the unit is to introduce students to research at sea and provide hands-on exposure to standard methods for the collection and analysis of data in physical, chemical, and biological oceanography and marine mapping. Students performed a range of daily activities including underway sampling and extractions for Chlorophyll, macro nutrients analysis, aerosol sampling and CTD deployment and sampling. The data collected will be worked up during the semester after the voyage, forming the basis of their assessment. Students will also be introduced to other scientists onboard and be able to shadow some of their science activities in addition to experiencing what life is like sailing the high seas on Australia's premier research vessel. IMAS researcher and senior lecturer, Dr Pier van der Merwe supervised the students onboard.

Summary

This was an ambitious and multidisciplinary transit voyage along Australia's Southern margin. Despite there only being a relatively short window available for science during this trip, which had the primary objective of returning the vessel to Hobart, a great deal of excellent science, education and communication was achieved by the numerous different groups on board. Valuable and informative data were collected against all three of our principal objectives, and all the piggy-back projects achieved their aims except for the helicopter drill, which was cancelled. The highest scientific risks on this voyage were associated with the depth of the dredges and deep CTDs, with both gear failure (primarily CTD) and failure to collect samples (primarily dredges) a possibility. However, all deployments were 100% successful except for one dredge that did not recover rocks. This voyage was successful because of the skills and experience of the ship's crew, MNF staff, the science teams, and their ability to work together in any conditions.

Marsden Squares



Moorings, bottom-mounted gear and drifting systems

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	APPROXIMATE POSITION (as degrees, decimal minutes)						DATA TYPE enter code(s) from list in Appendix A	DESCRIPTION
		LATITUDE			LONGITUDE				Identify, as appropriate, the nature of the instrumentation, the parameters measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any site identifiers.
		deg	min	N/S	deg	min	E/W		
BGC ARGO float 6990588	Schallenberg	-37	28.7	S	122	44.3	E	D90	1 deployed BGC ARGO float. Parameters measured: salinity, temperature, depth, oxygen, nitrate, pH, chlorophyll fluorescence, optical backscatter, downwelling irradiance. Deployed 2024-03-12 09:47:43.768190+00:00
BGC ARGO float 7901107	Schallenberg	-38	55.6	S	126	58.7	E	D90	Details as above. Deployed 2024-03-15 04:00:09.707588+00:00
BGC ARGO float 7901108	Schallenberg	-41	56.6	S	135	0.48	E	D90	Details as above. Deployed 2024-03-16 22:05:02.364248+00:00

Summary of data and samples collected

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	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.
Dredges	Whittaker	3	Rock hauls	G01	Dredged rocks and sediments using rock dredge with attached mesh and solid bottom sediment buckets. Planned onshore science: Hand samples descriptions, thin section analysis, geochemical analysis (major, minor and trace elements), rock dating.
Underway Chl a analysis	Pier van der Merwe	44	Underway samples in duplicate	B02	Underway seawater analysis of Chl a pigments in seawater during the transit.
Aerosol samples for trace metal analysis	Andrew Bowie	3	Duplicate filters loaded with aerosols	H30	Underway trace metal aerosol sampling during the transit. Filters were collected on board, however, further processing at the home lab (UTAS) is needed before data are available.
Underway nutrient analysis	Pier van der Merwe	36	Underway samples in duplicate	H22 H24 H25 H76 H26	Underway seawater analysis of macronutrients in seawater during the transit.
Phytoplankton pigments, particulate organic matter, dissolved inorganic carbon,	Christina Schallenberg	19 POC and pigments,	samples	B02, B71, H90, H28	Samples on vertical profiles to aid interpretation of CTD sensors as well SOCCOM float calibrations; the usual hydrochemistry samples

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	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.
total alkalinity on the 4 deep CTDs (CTD 4-7)		39 carbon system			(oxygen, salinity, nutrients) were also analyzed on these CTDs (see next item)
Dissolved oxygen, salinity, nutrients on CTDs	Mathieu Dever	84	samples	H21, H22, H24, H25, H76, H90	Samples on vertical profiles to aid interpretation of CTD sensors as well SOCCOM float calibrations
Underway eDNA	Eric Raes	181	samples	B14/B90	eDNA collected from the underway line
CTD eDNA	Eric raes	69	samples	B14/B90	Samples on vertical CTD profiles. eDNA collected at various depths.
CTD profiles	Mathieu Dever	3	6000 m profiles	H10	Three CTD profiles to 600 m were completed. Besides the common setup on the rosette, 11 RBRargo|deep6k CTDs, 5 RBRcoda T.ODO oxygen optodes, and 1 fluorometer and backscatter sensor were installed on the rosette. Planned onshore science: Careful quantitative characterization of the instruments' performance.
Dissolved oxygen, salinity, on CTDs	Elise Tuuri	27	Bottles	H10	CTD data, as well as DO, and salinity through three different depth profiles.
Water collection from Niskin Bottles.	Elise Tuuri	36	Bottles	H10	3 x Niskin bottles at 3 x depths for each station. With the equivalent number of samples taken for later onshore analysis.
Zooplankton communities collected from Hydrobios net tows.	Elise Tuuri	9	Net tows	B09	1 x hydrobios tow at 3 x depths for each station. With the equivalent number of samples taken for later onshore analysis.
Zooplankton and microplastic samples collected from Hydrobios net tows.	Elise Tuuri	9	Net tows	B09	1 x hydrobios tow at 3 x depths for each station. With the equivalent number of samples taken for later onshore analysis.

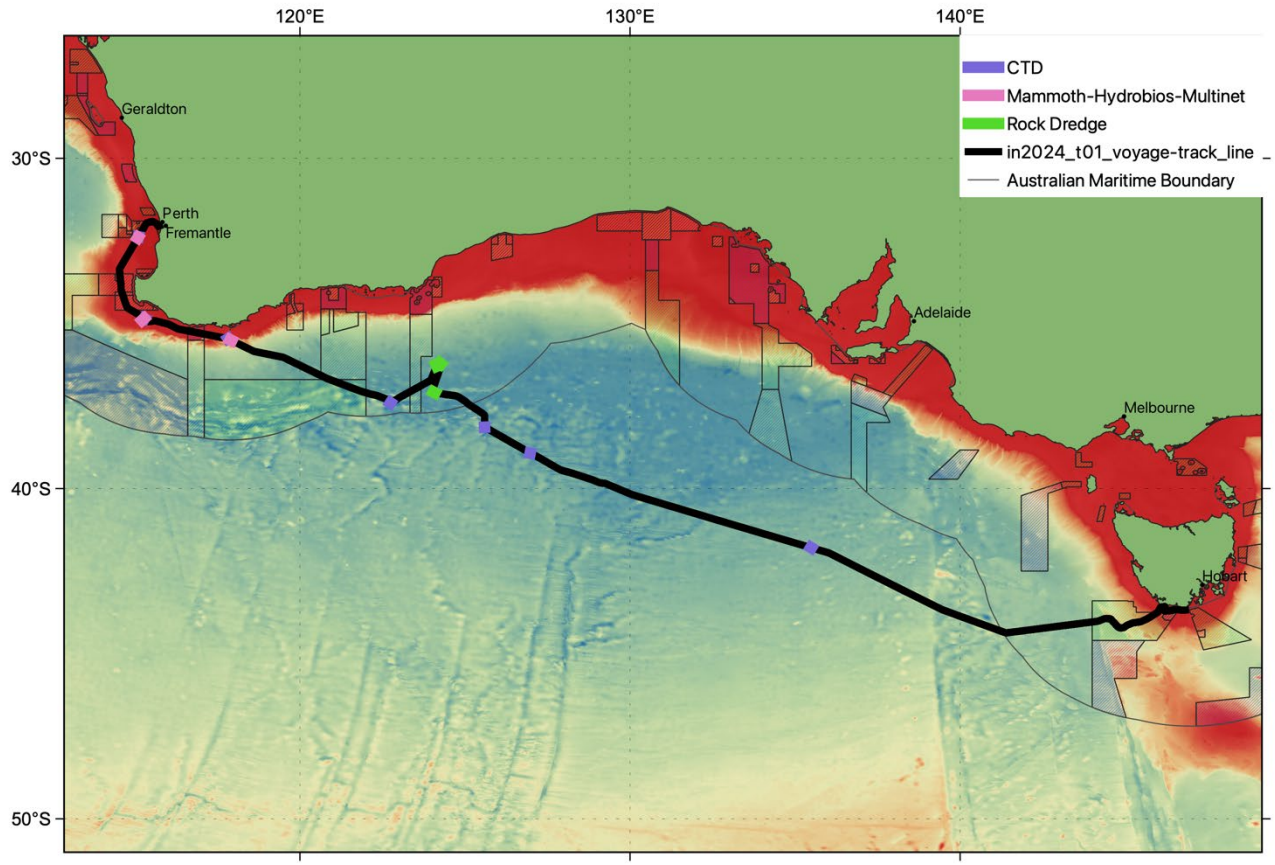
Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	DESCRIPTION Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include 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.
ADCP data	Elise Tuuri	4	Data	D71	Open access data collected and saved for later analysis with post stream samples.

Curation Report

Delete section if not applicable. Describe the storage location for all data/samples collected during the voyage, with each data/sample type included on a separate row. Details should include where the data/samples are being archived/curated, who is responsible for their curation, how the data/samples will be made accessible and to whom, and any further analyses that are underway/will commence.

Item #	Description	Storage	Access	Custodian
1	Dredged rocks and sediments	University of Tasmania	Emailed request	Jo Whittaker
2	eDNA	Minderoo/University of Western Australia	Emailed request	Eric Raes
3	Zooplankton communities	Flinders University	Emailed request	Elise Tuuri & Sophie Leterme
4	Post processed microplastic from biological material	Flinders University	Emailed request & CSIRO data portal once processing complete	Elise Tuuri & Sophie Leterme
5	Filters with microplastics from Niskin bottle samples	Flinders University	Emailed request & CSIRO data portal once processing complete	Elise Tuuri & Sophie Leterme
6	Controls from Niskin Bottles, HB nets, and other environmental contaminants (i.e. atmospheric, workers, vessel).	Flinders University	Emailed request & CSIRO data portal once processing complete	Elise Tuuri & Sophie Leterme

Track Chart


120°E
130°E
140°E
30°S
40°S
50°S
Geraldton
Perth
Fremantle
Adelaide
Melbourne
Hobart
CTD
Mammoth-Hydrobios-Multinet
Rock Dredge
in2024_t01_voyage-track_line
Australian Maritime Boundary

Acknowledgements

Please insert acknowledgements to organisations, teams or individuals that have supported your project(s).

Signature

Your name:	Jo Whittaker
Title:	Chief Scientist
Signature:	
Date:	20.03.2024

Appendix A – CSR/ROSCOP Parameter Codes

	METEOROLOGY
M01	Upper air observations
M02	Incident radiation
M05	Occasional standard measurements
M06	Routine standard measurements
M71	Atmospheric chemistry
M90	Other meteorological measurements

	PHYSICAL OCEANOGRAPHY
H71	Surface measurements underway (T,S)
H13	Bathythermograph
H09	Water bottle stations
H10	CTD stations
H11	Subsurface measurements underway (T,S)
H72	Thermistor chain
H16	Transparency (eg transmissometer)
H17	Optics (eg underwater light levels)
H73	Geochemical tracers (eg freons)
D01	Current meters
D71	Current profiler (eg ADCP)
D03	Currents measured from ship drift
D04	GEK
D05	Surface drifters/drifting buoys
D06	Neutrally buoyant floats
D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

	CHEMICAL OCEANOGRAPHY
H21	Oxygen
H74	Carbon dioxide
H33	Other dissolved gases
H22	Phosphate
H23	Total - P
H24	Nitrate

	MARINE BIOLOGY/FISHERIES
B01	Primary productivity
B02	Phytoplankton pigments (eg chlorophyll, fluorescence)
B71	Particulate organic matter (inc POC, PON)
B06	Dissolved organic matter (inc DOC)
B72	Biochemical measurements (eg lipids, amino acids)
B73	Sediment traps
B08	Phytoplankton
B09	Zooplankton
B03	Seston
B10	Neuston
B11	Nekton
B13	Eggs & larvae
B07	Pelagic bacteria/micro-organisms
B16	Benthic bacteria/micro-organisms
B17	Phytobenthos
B18	Zoobenthos
B25	Birds
B26	Mammals & reptiles
B14	Pelagic fish
B19	Demersal fish
B20	Molluscs
B21	Crustaceans
B28	Acoustic reflection on marine organisms
B37	Taggings
B64	Gear research
B65	Exploratory fishing
B90	Other biological/fisheries measurements

	MARINE GEOLOGY/GEOPHYSICS
G01	Dredge
G02	Grab
G03	Core - rock
G04	Core - soft bottom
G08	Bottom photography

H25	Nitrite
H75	Total - N
H76	Ammonia
H26	Silicate
H27	Alkalinity
H28	PH
H30	Trace elements
H31	Radioactivity
H32	Isotopes
H90	Other chemical oceanographic measurements

	MARINE CONTAMINANTS/POLLUTION
P01	Suspended matter
P02	Trace metals
P03	Petroleum residues
P04	Chlorinated hydrocarbons
P05	Other dissolved substances
P12	Bottom deposits
P13	Contaminants in organisms
P90	Other contaminant measurements

G71	In-situ seafloor measurement/sampling
G72	Geophysical measurements made at depth
G73	Single-beam echosounding
G74	Multi-beam echosounding
G24	Long/short range side scan sonar
G75	Single channel seismic reflection
G76	Multichannel seismic reflection
G26	Seismic refraction
G27	Gravity measurements
G28	Magnetic measurements
G90	Other geological/geophysical measurements

Appendix B – Photographs

Photos from voyages are valuable for communication opportunities and promotional materials. Voyage photos may be published in the MNF Annual Report and the voyage gallery on the MNF website. Please provide high resolution photos (a maximum of 10-20 per voyage) as .jpg, .png or .tif files and include a short caption and an image credit with each. For the latter, this should be a person or an organisation.

If referring to significant equipment items in the text, supply a photo or diagram so that readers can gain a sense of what has been done. Where possible, we encourage you to include people (particularly students) in photos, however only with permission from the subject.

View recent Annual Reports for ideas on what type of photos to supply.

Appendix C – [Insert Title]

Please supply any additional material you would like to attach here (as Appendix C, Appendix D etc.). Delete if not applicable.