



Schmidt Ocean Institute Post Expedition Report

Seafloor to Seabirds in the Coral Sea

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1 Overview

SOI Expedition ID	FK210206
Vessel	R/V <i>Falkor</i>
Expedition Name	Seafloor to Seabirds in the Coral Sea
Expedition Dates	2021/02/06 - 2021/03/06
Departure Port	Brisbane, Australia
Termination Port	Brisbane, Australia
Ocean	South Pacific Ocean

1.0.0.1 Map of Expedition Location

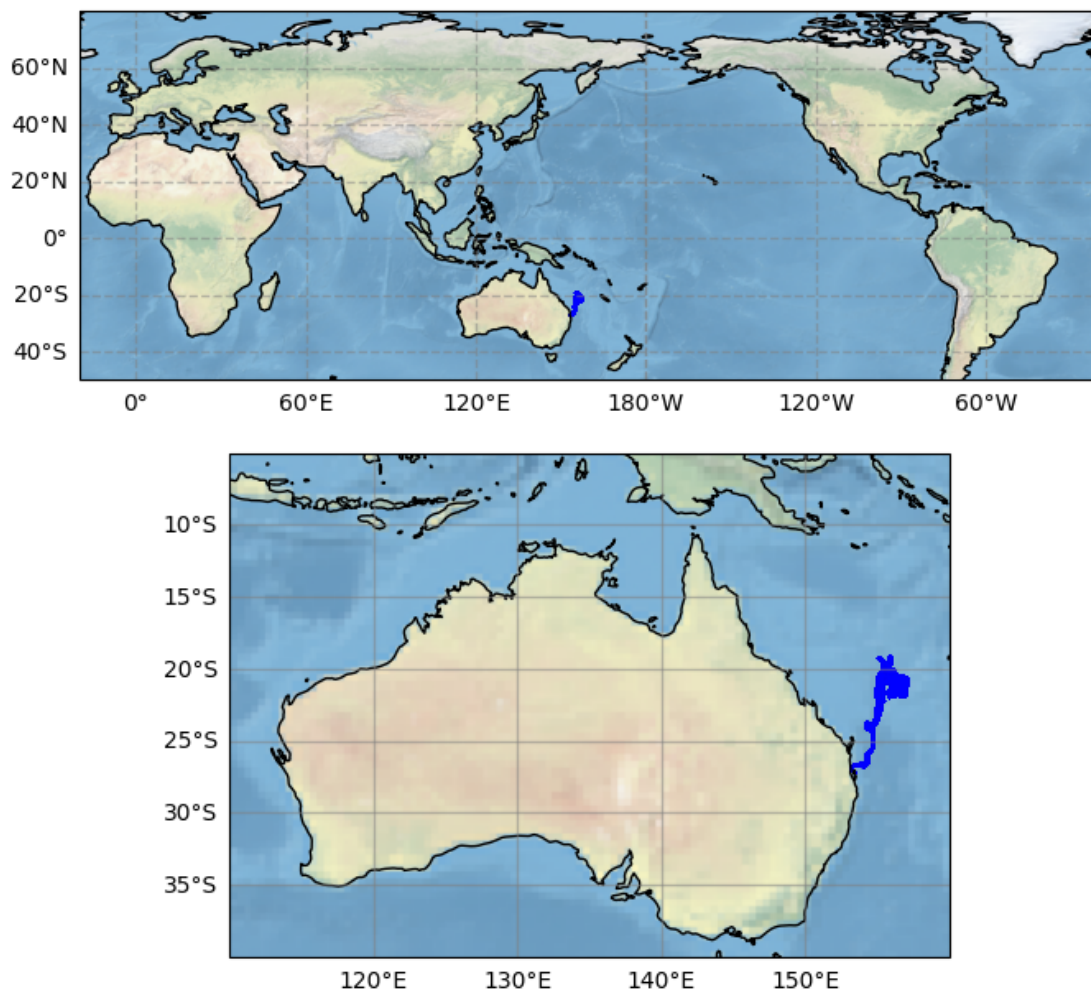


Figure 1. Map of Expedition Location.

1.1 Expedition Overview

The Coral Sea Marine Park is one of the largest marine protected areas in the world, and its seafloor is full of clues to better understand the complex geologic history of Australia and the submerged Zealandia continent. The expedition's focus was on mapping Kenn Plateau, a piece of continental crust (or a microcontinent) that was originally part of the Australian continent and separated and submerged during the break up of the supercontinent Gondwana.

Surveying the bathymetry and magnetic properties of the region led to a better understanding of the geological evolution of oceanic basins and continental fragments along the eastern Australian margin, which contributed to the separation of the submerged continent of Zealandia from the Australian landmass. Marine magnetic data was used to reconstruct the timing of the geologic events that shaped the region.

Alongside mapping the underwater landscape in the Coral Sea, the scientists also sought to measure ocean health by sampling for microplastics and studying the local seabird populations.

Collected data will help inform the future management of the Coral Sea Marine Park and other [International Union for Conservation of Nature \(IUCN\) Special Purpose Zones](#) and was added to the [Nippon Foundation-GEBCO Seabed 2030 Project](#).

1.2 Authorizations and Permitting

Permit Number	Permit Authority	Permit Focus
PA2019-00131-12 (variation PA2013-00131-13 and PA2013-00131-15)	Australian Government Director of National Parks - Australian Marine Park Activity Permit	MBES, SBES, ADCP, SVP, XBT, CTD, ROV, aerial drone, and magnetometer

1.3 Expedition Timeline

The expedition commenced on February 2, 2021, departing from Brisbane, Australia, and returned to Brisbane, Australia, on March 3, 2021.

1.4 Expedition Objectives

The expedition focused on three key data collection activities to advance management and understanding of the Coral Sea Marine Park: seafloor mapping, water sampling for microplastics, and sea bird surveys.

The mapping efforts for this expedition were focused on significant geomorphic features such as Cato Trough, Coriolis Ridge, Kenn Reef's bank, and Kenn and Chesterfield plateaus. Data from these areas were added to the high-definition seabed maps of the Coral Sea Marine Park created on R/V *Falkor*'s previous expeditions.

Moreover, the data collected will lead to a better understanding of the breakup and formation of the Australian continent and the region's complex tectonic history.

The team on board also sampled microplastics by utilizing and refining their techniques for collecting samples from both surface and deep waters using R/V *Falkor's* underway system and CTD rosette.

Local seabird populations were surveyed from the ship. The presence of many seabirds is recognized as an indicator of ocean health, contributing to the park's conservation efforts and understanding of these populations.

2 Expedition Accomplishments

2.1 At-sea Accomplishments

2.1.1 Science

Multibeam mapping

Multibeam mapping was conducted over the northern extent of the Tasman Sea and part of the Coral Sea as part of Schmidt Ocean Institute's contribution to the [Seabed 2030 Project](#) and marked the start of the [United Nations Decade of Ocean Science for Sustainable Development \(2021-2030\)](#). The mapping area was chosen based on the scientific objectives and included priority areas that had been identified for the Coral Sea Marine Park. As a result, 38,289 km² of the seafloor was surveyed (9,723 km of ship track), covering Cato Trough, Wreck Reef, Kenn Reef, Coriolis Ridge, and Selfridge Bank (Figure 2).

The new mapping data contributes to a greater understanding of the southern area of this extensive marine park. When combined with previous data collected, over 70,000 km² of seafloor has been mapped in the Coral and Tasman seas. The multibeam data were submitted to various data centers around the world to be made publicly available in the AusSeabed Marine Data Portal, Marine Geoscience Data System, and in the GEBCO database as a contribution to the Seabed 2030 Project.

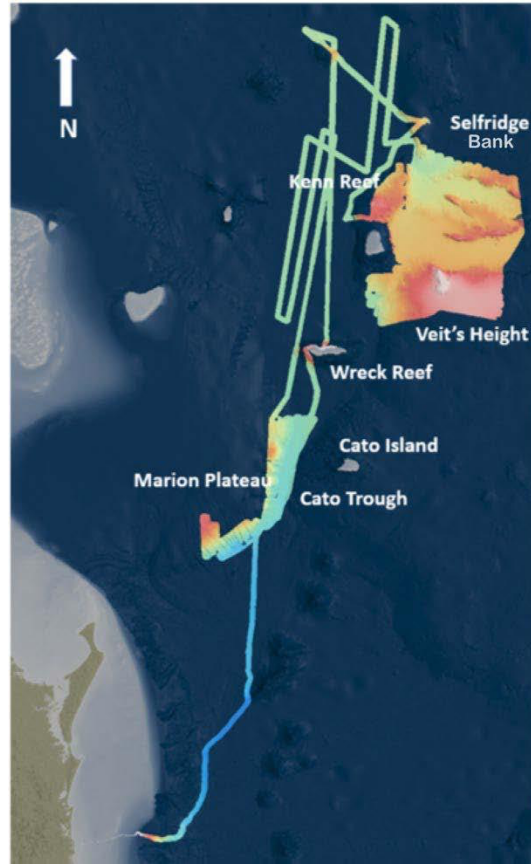


Figure 2. FK210206 Survey and geomorphic sites of interest.

The newly acquired data revealed submarine landslides, mass wasting, faults, channels, sand waves, scour marks, volcanic pinnacles (cinder cones), and pockmarks. The multibeam data was used by students studying these seamounts and using rock samples collected by other vessels (e.g. R/V *Investigator*) to understand the evolution of the Tasmania Seamounts and associated magmatic hotspots. The seafloor channels and sand waves provide new geomorphic information about the influence of deep water flows in the region, which have not been previously studied, and provide new information for regional ocean models.

Wreck Reef was the first geomorphic site of interest during the research expedition (Figure 2). A shallow northern section of the reef, close to where the reef breaches the sea surface, had not been mapped during previous *Falkor* voyages, so the aim was to complete the map of the reef.

Kenn Reef rises 3000 m above the seafloor and has a shallow coral reef with a large, extended deeper bank to the north. Faulting and cinder cones are present on the deeper bank, making it one of the most geomorphically complex areas surveyed during the expedition. Airborne lidar bathymetry data existed over the shallow reef and multibeam surveys had been conducted around the deeper flanks of Kenn Reef. This

expedition focused on filling the data gaps and mapping the northern extent of the Kenn Reef bank. The overall geology of the Kenn Reef bank was largely known, however, the detailed spatial extent of each rock group was unknown. New features of the Kenn Reef bank that were mapped include satellite vents and a significant fault scarp along its eastern side. This fault has a surface expression trace length of 20.5 km running on a northeast bearing and a scarp height of ~200m.

Coriolis Ridge was a priority for mapping by R/V *Falkor* because it is a commercial fishing area – designated as an IUCN V1 Special Purpose Zone (Trawl). While mapping the ridge, a new, relatively shallow feature was uncovered, a raised platform 400 m tall, 20 km long, and 13 km wide at its summit. The summit is 200 m below sea level. It is not large enough to be classified as a seamount or guyot, however, it does have a flat top, which could suggest a calcareous origin. The feature has significant evidence of mass wasting and slumping on the northern and western sides. Other significant features on the seafloor of Coriolis Ridge include large sediment waves, which give information on deep water flows across the region.

Selfridge Bank, lying to the east of Kenn Reef, was surveyed with the aim of characterizing steep-sided ridges that are oriented in an E-W direction. These features are tilted fault blocks, likely related to the opening of the north Tasman basin. Selfridge Bank is marked on marine charts with a shoal depth of 44 m, which was surveyed and disproven.

Cato Trough is significant in the region as it is the narrowest point between the submerged microcontinent of Zealandia and the Australian continent. Cato Trough also connects the Tasman Sea basin (to the south) with the Coral Sea basin (to the north). Much of this area had been surveyed with multibeam, however, this expedition filled in the data gaps of Cato Trough and the eastern margin of Marion Plateau, which forms one side of Cato Trough. Contour parallel slumping of sediments was observed off the eastern margin of the Marion Plateau into the Cato Trough.

Magnetic surveys

The onboard SeaSpy2 magnetometer was deployed for 2,487 km over 22 separate transects. The lines were collected in E-W and N-S directions (orthogonal to each other) to better understand the tectonic spreading history of the northern Tasman Sea basin. The connection between the Tasman and Coral Seas lies within the Cato Trough, which separates Australia's continental crust and the continent of Zealandia by only 15 km. Due to its position, it is an area of significant interest for bathymetric mapping and magnetometer deployment. All previous magnetic data from the Coral Sea basin have been collected in an E-W direction, which is not the optimum orientation for identifying the extinct spreading ridge. Prior to the expedition, the nature of the crust underlying Cato Trough was unknown, however, the magnetometer readings confirmed that it is comprised of oceanic crust. Post-cruise magnetic modeling and integration with

existing seismic data is underway to determine the age of the last spreading event in the northern Tasman Sea basin.

Oceanographic data (CTD/ADCP)

Four CTD rosette casts were deployed, and the Acoustic Doppler Current Profiler (ADCP) was operated continuously to determine current vectors and velocity down to 750 m depth. From the deployed rosette casts, water samples were collected just above the seafloor at 800 m, 50 m, and 5 m depth. The deepest depths obtained were: 3860 m (CTD01, south of Cato Trough), 2200 m (CTD02, Selfridge Rise), 3000 m (CTD03, northernmost Kenn Plateau), and 4000 m (CTD04, north of Cato Trough). The data were also used to confirm the water masses present and to ensure that the sound speed profiles used for the multibeam systems were accurate. The CTD data from the expedition (along with those collected from a previous *Falkor* expedition) were used as part of a student project on deep water flows by Megan Jeffers at the University of Queensland.

Microplastics

Forty (40) microplastic filter samples were collected using the ship's underway system and seawater recovered in the rosette casts. The sampling protocol developed on a previous *Falkor* expedition was significantly refined by implementing control samples for water and air samples. Filtering was done under the fume hood. Water samples were flushed with Milli-Q water to minimize contamination. Preliminary results suggest that there are visible microfibers present in all but one sample from the surface down to depths of 4,000 m.

Seabird observations

Continuous seabird and marine mammal observations were conducted from sunrise to sunset throughout the cruise. The data were integrated with underway physical and biological data to examine the relationships among seabirds and marine mammals with the marine environment. A total of 16 seabird taxa and one marine mammal species were observed. The most frequently-observed seabirds were Wedge-tailed Shearwater, Red-footed and Brown Boobies, and Bridled Terns, totaling more than 3,200 individuals. A total of 23 Bottle-nosed dolphins were recorded.

2.2 Post expedition Activities and Accomplishments

2.2.1 Overview

One of the main objectives was to map a continuous grid of seafloor to contribute data to the [Nippon Foundation-GEBCO Seabed 2030 Project](#). Moreover, the new geophysical data (magnetics) and the finding of the existence of oceanic crust, have implications for the understanding of the submerged portions of Zealandia.

Seabirds and marine mammals are top-order predators in marine ecosystems, and food availability and environmental conditions of the area are reflected in their distributions and abundance. The survey data collected provides a useful baseline for future surveys that could further examine the regional impacts associated with global ocean warming and the increased strength and persistence of the East Australia Current, whose origin is in the Coral Sea. The seabird observation data provide a snapshot of the distribution and relative abundance of the species observed during the cruise, which can provide baseline data for assessing current management frameworks and policies and inform the development and implementation of future management actions and policies. These data also provide insights into the relationships between the taxa observed and the marine environment.

2.2.2 Data

Datasets acquired during this expedition and those derived from the analysis of collected data and samples as of the date of this report’s publication.

Data Type	Curator	Completed
Raw environmental sensor data collected by <i>Falkor</i>	Rolling Deck to Repository	Yes
Bathymetry data	AusSeabed	Yes
Acoustic Backscatter, swath bathymetry, magnetics, and navigation data	MGDS	Yes
Seabird Observations	Commonwealth Scientific and Industrial Research Organisation (CSIRO) Ocean Biodiversity Information System (OBIS)	Yes
ADCP Data	University of Hawaii	Yes
Marine microplastic and microfibre analysis		No

Table 1. List of all publicly available data

2.2.3 Publications

Daudt, Nicholas W., Eric J. Woehler, Matthew R. Schofield, Robert O. Smith, Leandro Bugoni, and William J. Rayment. 2024. “Seabird Assemblages Are Linked to the Major Western Boundary Current Off Eastern Australia.” *Progress in Oceanography* 223 (April): 103215. <https://doi.org/10.1016/j.pocean.2024.103215>.

Johnson, Alysha. 2021. "Bathymetric Exploration of the Tasman and Coral Seas Aboard the R/V *Falkor*." *Quaternary Australasia* 38 (1): 11–13.
<https://doi.org/10.3316/informit.891792655549501>.

3 Appendix

3.1 Science Party Information

Scientist	Institution
Derya Gürer	The University of Queensland
Helen Bostock	The University of Queensland
Robin Beaman	James Cook University
Brendan Brooke	Geoscience Australia
Carmen Gaina	University of Oslo
Roi Granot	Ben Gurion University
Kim Picard	Geoscience Australia
Martin Russell	Coral Sea Marine Park
Maria Seton	University of Sydney
Jody Webster	University of Sydney
Eric Woehler	University of Tasmania
Emily Conn	The University of Queensland
Francisco Gelves Gomez	University of Tasmania
Lauren Huet	James Cook University
Alysha Johnson	University of Wollongong
Tara Jonnell	The University of Queensland
Bianca Keys	University of the Sunshine Coast
Kevin Mackay	National Institute of Water and Atmospheric Research (NIWA)
Luca Magri	University of Tasmania
Will White	Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Colin Woodroffe	University of Wollongong
Joseph Knafelc	Queensland University of Technology

Table 2. List of scientists and students aboard *Falkor*.

3.2 Conferences/Presentations/Posters

- Beaman, R.J., 2021. Schmidt Ocean Institute RV *Falkor* Australia campaign 2020-2021, Queensland– Smithsonian Fellowship Speaker Series. Oceans: life on the edge, 16 November 2021. Queensland Department of Environment and Science
- Smithsonian Institution, Remote conference, pp. 13. (Available at: <https://www.deepreef.org/2021/11/17/soi-rvFalkor-australia/>)
- Beaman, R.J., 2021. Schmidt Ocean Institute RV *Falkor* Australia campaign 2020-2021, Sub-Committee on Regional Undersea Mapping (SCRUM), GEBCO Week, 11-15 January 2021. General Bathymetric Chart of the Oceans (GEBCO) www.gebco.net, Virtually from Paris, France. (Available at: <https://www.deepreef.org/2021/01/13/soi-Falkor-campaign/>)
- Bradshaw, R., Seton, M., Webster, J., Carey, R., Whittaker, J. and Crundwell, M., 2022, Using New Bathymetry Data and Dredge Samples to Understand the Evolution of Kenn Seamount in the Tasmantid Seamount Chain, AGU Ocean Sciences Meeting
- Johnson, A., et al (2021, May 11). Preliminary Interpretation of Multibeam Bathymetry R/V *Falkor* The Tasman and Coral Seas 2021 [Specific Mapping Case Study]. 2021 GeoHab, Canberra, Australia. (Abstract submitted for the 2022 Ocean Science Forum).
- Johnson, A. (2021 April 20). Voyaging aboard the R/V *Falkor*. Guyots and reefs in the Tasmantid Seamount Chain. University of Queensland Centre for Marine Science Seminar Series. Brisbane, Australia.
- Johnson, A., et al., (2022, Feb) Geomorphology of the Tasmantid seamounts, guyots and carbonate reefs. AGU Ocean Sciences presentation.
- Jeffers M., et al., (2022) 'Intermediate and deepwater circulation in the Tasman and Coral seas offshore Eastern Australia using CTD and multibeam data from R/V *Falkor* voyages 2020-21' GEOHAB presentation May 2022

3.3 Student Projects, Thesis, and Dissertations

- Bradshaw (2021), The controls on the life cycle and evolution of the Kenn Seamount, Coral Sea, University of Sydney Honours Thesis.
- Megan Jeffers, The University of Queensland, Australia, Intermediate and deep-water circulation of the Tasman Sea and Cato Basin based on oceanographic and

seafloor bathymetric data. Unpublished undergraduate project using data from FK201228 and FK210206.

- Rebecca Bradshaw. The controls on the life cycle and evolution of the Kenn Seamount, Coral Sea. Unpublished undergraduate project using data from FK201228 and FK210206.

3.3.1 Cruise Records

- A series of [Cruise Log Videos](#) are available.

3.3.2 Media

There was a lot of media interest during the voyage. R/V *Falkor* was one of the first vessels to collect seabed mapping data at the start of the UN Decade of Ocean Science for Sustainable Development (2021- 2030).

3.3.3 Community Outreach

Public Presentations:

- Gürer (April 2021) UQ-Women in Science Research Networking Night, From microplates to microplastics.
- Bostock (June 2021) - UN Ocean Decade - talk for World Ocean Day.
- Gürer (June 2021) - *Falkor* voyages - talk for World Ocean Day.
- Gürer (July 2021) Fig Tree Pocket Kindergarten, Brisbane: What is at the bottom of the ocean?
- Bostock (July 2021) - Queensland Marine Teachers Professional Development.
- Bostock (Sept 2021) - Queensland Marine Teachers Association Annual Conference.
- Bostock (November 2021) Plastic pandemic - University of Queensland outreach program - Young Change Makers 2021.