

Ice Age Geology of the Great Barrier Reef

30-day Post Cruise Report

**Ship name**: Falkor

**Cruise Dates - Day Departed**: 11/22/2020 **Day Returned**: 12/22/2020

**Cruise Number**: FK201122

**Departure Port**: Brisbane, Australia **Arrival Port**: Brisbane, Australia

**Mid-Cruise Port Call (if any)**: Gladstone, Australia

**Participating Organizations, Institutions, Foundations, Government Agencies, etc.:** Queensland University of Technology, James Cook University, University of Sydney, University of Queensland, Geoscience Australia, AusSeabed.

**Funding Sources:** Participants salaries, including any data post-processing are funded internally by their respective institutions. There was no additional external funding sourced for this voyage. Since the voyage was short-notice and opportunistic, specific projects pertaining to post-cruise scientific outputs and publications are yet to be established by the participating organizations.

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**Name of Co - Chief Scientist**: Dr. Jody Webster (remote participate - did not sail)

**Organization**: University of Sydney

**Country**: Australia

**Geographical area(s) where the science occurred and why working in this location was important or impactful:**

The southern Swain Reefs region, the Capricorn-Bunker shelf edge, and Capricorn Channel areas of the southern Great Barrier Reef.

**Cruise Objectives**:

The Capricorn-Bunker and Swain Reefs comprise the southern-most extent of the modern Great Barrier Reef, and mark the transition from tropical to temperate ocean conditions. The shelf edge and upper slope in this area of the southern Great Barrier Reef (sGBR) are poorly mapped when compared to the north. Most existing multibeam datasets were collected opportunistically while in transit, and as a result very little systematic mapping has been done in the sGBR.
The original cruise objectives were to systematically map the southern extent of the shelf edge and upper continental slope at the Capricorn-Bunker Reefs, Capricorn Channel, and Swain Reefs. Based on our understanding from the northern GBR, the shelf edge at ~100 m should preserve a record of submerged (or drowned) reefs, pinnacles and terraces that represent Last Glacial Maximum (LGM) “ice-age” reefs and shorelines that formed between 12 to 20,000 years ago. The shelf edge also preserves remnant ancient river channels at ~50 m, such as the paleo-Fitzroy River and delta deposit. The Capricorn Channel has a ~40 m-high ‘cliff’ at ~250 m, which may represent the Miocene/Pleistocene boundary for GBR reef growth.
Additionally, the cruise supported a supplementary project for the Reef Restoration and Adaptation Program, to measure atmospheric aerosol particles for a cloud-seeding & cloud-brightening project. These data will contribute to a feasibility study for reef cooling & shading to mitigate coral bleaching, and feed in to atmospheric and hydrodynamic climate models.

**Impact of the Research:**
The cruise completed the most comprehensive systematic multibeam mapping of the southern extent of the Great Barrier Reef shelf-edge and upper slope.

Along more than 400 km of shoreline, we have systematically mapped the 50 to 120m depth range, revealing the targeted drowned reef terraces, pinnacles, beaches and shorelines, river channels and deltas. This depth range is significant because it contains geologically and ecologically significant submerged features that formed between 10 to 20,000 years ago when sea-level was 120m lower than today.

These results and the analytical data that will follow from the post-cruise science will inform new models of the growth and evolution of the southern GBR from 20,000 years ago to present.

Importantly, the bathymetry maps from this cruise will be leveraged to develop proposals for further geophysical surveys and extraction of geological samples (coral reef cores) that will be used for future analysis.

Future analyses of physical samples will inform revised sea-level curves for this region, and paleoclimate and paleoceanographic modelling.

The submerged coastal geomorphology and in particular the paleo-shorelines and beach ridges will be used to inform the timing and magnitude of past storm events.

The atmospheric aerosol data collected will be used to inform a feasibility study on cloud brightening for shading and cooling the reef as part of the Reef Restoration and Adaptation Program, and will also contribute to new efforts to link atmospheric models with hydrodynamic models to reduce uncertainty in IPCC climate modelling.

**Relevance to managers and the local communities**

Geoscience Australia, one of the cruise participating organisations, is the Australian Commonwealth Government agency tasked with managing all aspects of Australia's geoscience research, technical, and data including Australia's marine estate. As a cruise participant they will be directly involved in collaborating on all post-cruise science and outputs including publication of the bathymetry data to the AusSeabed public portal.

Additionally, the knowledge and information generated will be shared with the Great Barrier Reef Marine Park Authority through permitting obligations as well as contributions to the five-yearly Great Barrier Reef Marine Park Outlook Report.

The cruise and post-cruise findings will be shared formally and informally through academic and non-academic engagement activities such as conference and community presentations, blogs, and social media activity.

**Summary of Operations and Data Collection**

The expedition was primarily a multibeam mapping cruise. The main data product is multibeam bathymetry data and associated outputs such as bathymetry DEMs and backscatter mosaics. The cruise covered a ship track of 10,586 km and collected 13,045 km^2 of multibeam data.
12 soundspeed profiles and 1 CTD profile were collected (no CTD water collection).

The WH300 ADCP was run concurrently with the multibeam system for part of the cruise, and these data have been shared to UHDAS at the University of Hawaii.

**Did you collect Measurements or Samples, including biological specimens?** Yes

**Is there any suspected or confirmed new species discovered during the cruise?**  No

**Did you deploy and/or recover any Moorings, Bottom Mounted Gear, or Drifting Systems?** No

**Equipment Used**: N/A

**Total number of CTD casts completed during the cruise:** 1 CTD profile - no water collected

**Total number of AUV dives completed during the cruise:** 0

**Total number of ROV dives completed during the cruise:** 0

**Total number of ROV samples collected during the cruise:** 0

**Total number of Unmanned Aerial Vehicle (UAV) or other vehicle deployments during the cruise:** 0

**Total amount (TBs) of data collected during the cruise:** 5

**Other interesting things about the cruise**

Cruise participant and Artist-at-Sea Taloi Havini collected information that will inform her first solo international exhibition at the Ocean Space, TBA21 Academy in Venice, in March 2021.

The cruise was a hybrid in-person/remote telepresence enable cruise due to Covid-19 travel restrictions.