Gloria Knolls: A new coldwater coral habitat on the Great Barrier Reef margin

Robin J. Beaman[1] and Jody M. Webster[2]

Introduction

Coldwater coral habitats are usually associated with large geological features, such as deepwater seamounts and guyots, or found as smaller mounds on relatively steep continental slope and basin areas[1]. The genesis and initial control of the smaller mound settings on soft sediment is currently a point of debate[2,3].

For example various seabed features, such as hydrocarbon seeps, slumps and mud volcanoes, may provide the initial topographic relief, then is followed by phases of mound development due to favourable oceanographic conditions and the successive build-up of coldwater coral communities[2].

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We present new high-resolution multibeam bathymetry datasets from the Great Barrier Reef (GBR) margin[4]. Combined with seismic profiles and rock dredge samples, these data provides a fresh insight into the origin and spatial distribution of a new coldwater coral habitat discovered in the Queensland Trough.

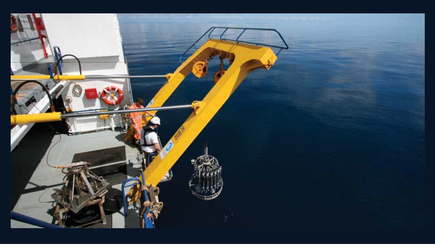
These findings suggest that large blocks may have broken off the GBR margin as catastrophic landslides, moving down the lower slope and coming to rest in the basin where they now form a preferential habitat for a deep, coldwater coral community. We have named these fascinating features the Gloria Knolls and they represent the first documented case of such a habitat adjacent to the GBR World Heritage Area (GBRWHA).

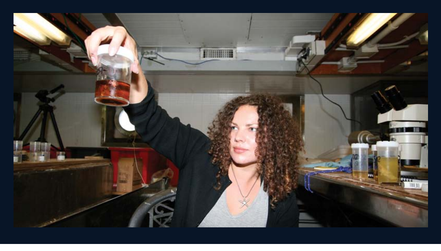
Objectives

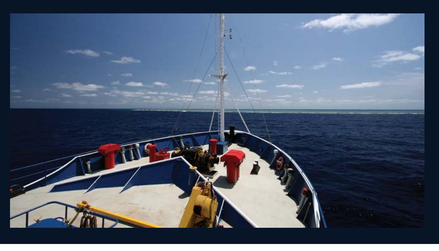
To find geophysical evidence that links the Gloria Knolls to a submarine landslide origin.
To understand the role of the landscape in defining the coldwater coral habitat boundaries using multibeam and seismic profile analyses.
To study the origin and biodiversity of the coldwater coral community using ^{14}C AMS dates, taxonomic and sediment analyses (to be completed in 2009).

Methods

The project utilised ArcGIS and Fledermaus visualisation software to analyse the geophysical spatial datasets. Destructive techniques and geochemical analyses were conducted on sediment. Taxonomic specialists provided information on the biogenic samples obtained in the dredge.

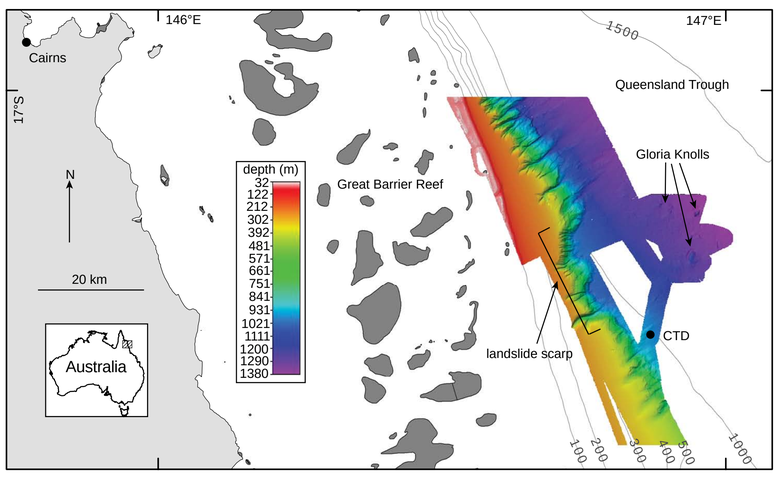


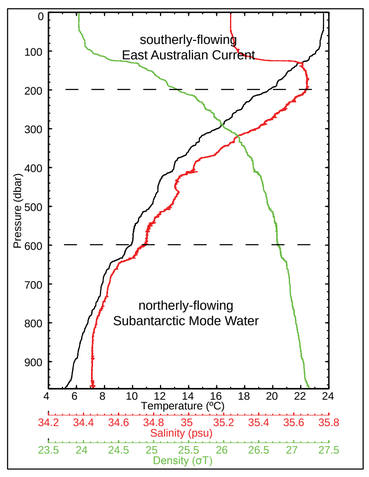




1. Setting

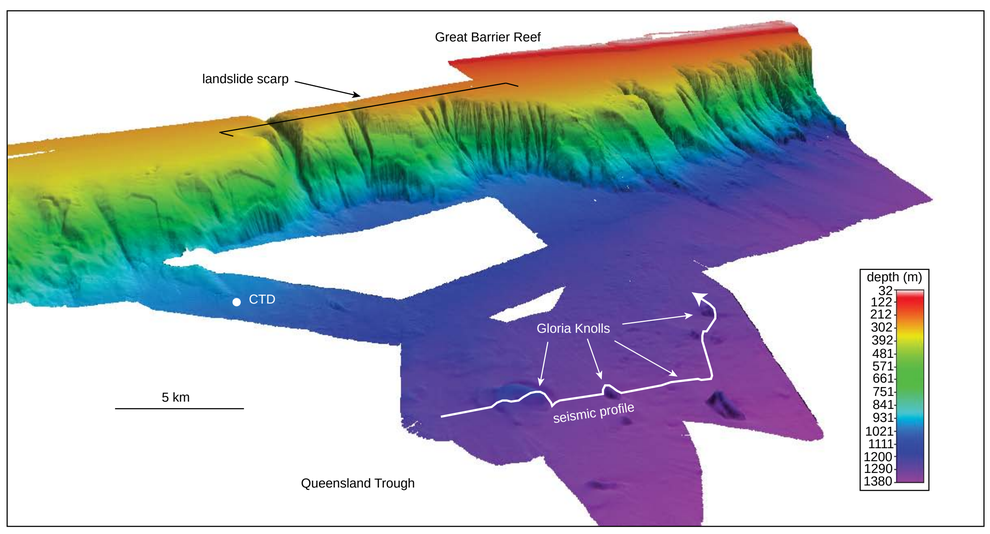
The survey of the GBR margin about 80 km east of Cairns revealed a spectacular network of submarine canyons, slump scars and landslide deposits on the continental slope and upper basin. The canyons often terminate in the Queensland Trough as slide scarps and debris fields where progressive upslope erosion has reduced the stability of the parent margin sediments.





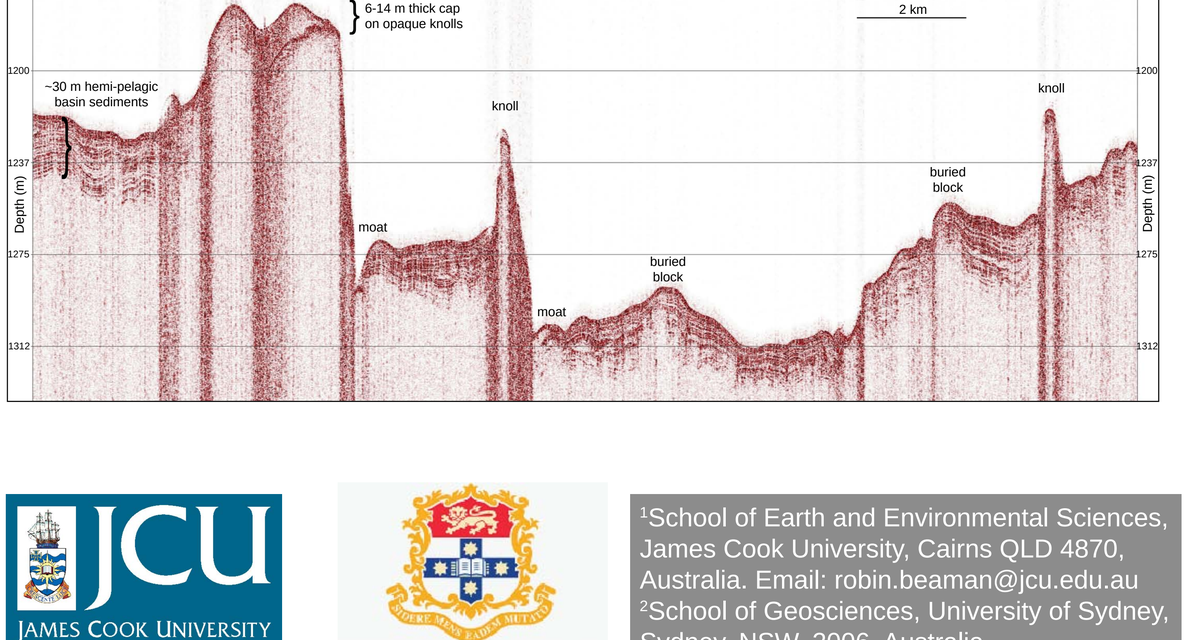
2. Multibeam, oceanography

Lying downslope of the canyons and slump scars, the multibeam maps show a cluster of eight knolls up to two km long and over 100 m high in depths of about 1100-1300 m. Moats or scours are prominent on the north-side of the larger knolls and are indicative of impinging bottom currents. A CTD profile in the vicinity confirmed the near-seabed temp. is ~4°C and a northerly-flowing Subantarctic Mode Water in the Queensland Trough.



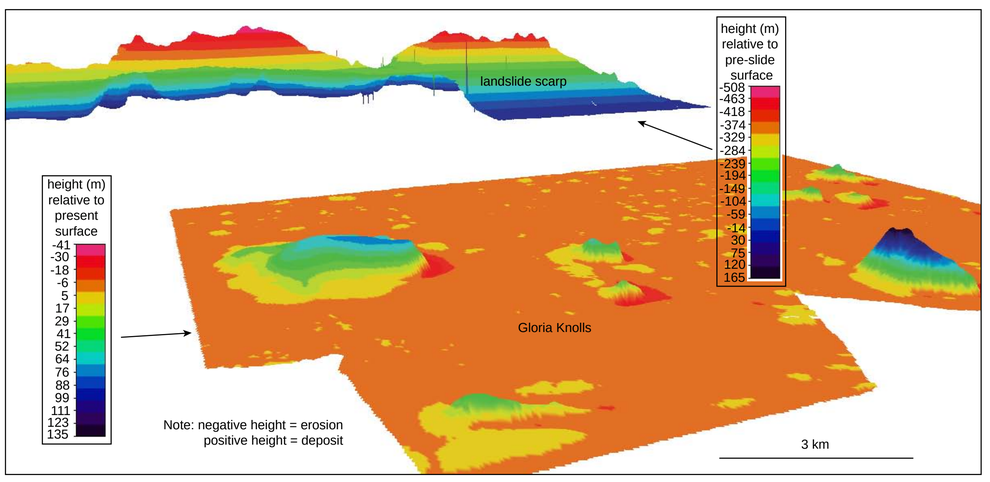
3. Seismics

Profiles reveal large, steep-sided blocks embedded within a matrix of low-relief Trough sediments ~30 m thick with 15-20 parallel sub-bottom reflectors. Moats lie north of the larger blocks up to 40 m deeper than the adjacent Trough seafloor. The largest blocks are opaque with caps of 6-14 m thick semi-opaque parallel reflectors. Smaller buried opaque blocks are covered by Trough sediments that preserves a higher seabed relief above the blocks.



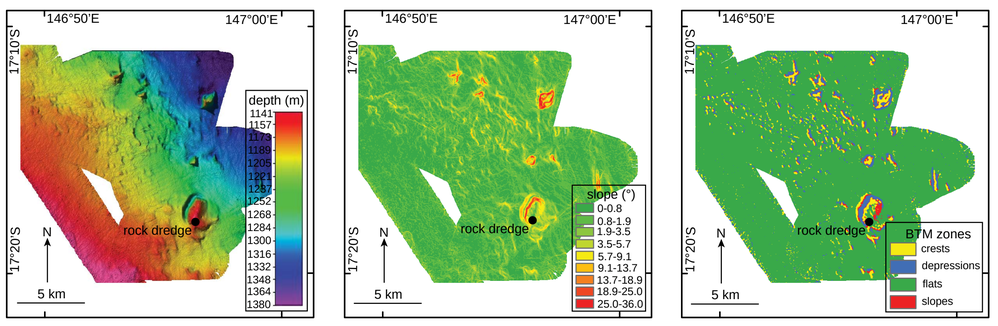
4. Surface difference

A huge landslide scarp lies 20 km upslope from the Gloria Knolls with dimensions about 20 km long, 5 km wide and 300-1000 m in depth. Small canyons have downcut into the scarp face. Fledermaus software was used to calculate the erosion volume of the scarp (32.6 km^3) relative to a pre-slide surface. The total Gloria Knolls volume is only 0.4 km^3 above the surrounding flat seabed. Most of the landslide debris now appears to be buried.



5. Landscapes

The Gloria Knolls multibeam data were analysed in ArcGIS for slope and Benthic Terrain Modeler[5] basic zones to highlight the physical landscape boundaries. In addition to the eight larger knolls, the results show numerous smaller-sized (less than 1 km long, 10-20 m high) features with east-side depressions, suggesting initial debris transport from the GBR margin.



6. Dredge sample

A rock dredge taken from the crest of the largest knoll in 1170 m recovered evidence of a coldwater coral community, including live gorgonians, dead scleractinian and bamboo corals, barnacle plates, gastropods and serpulid worms. The sediment matrix comprised a carbonate mud showing progressive calcification into hard nodules, which also provide hard attachment surfaces for the sessile fauna. Taxonomic analysis is preliminary but highlights similarities with Australian tropical province scleractinia and New Zealand Subantarctic cirripedia.

7. Conclusions

The Gloria Knolls are the remnants of a large debris flow transported into the Queensland Trough due to a catastrophic landslide on the GBR margin. Hemi-pelagic sediments have subsequently buried most of the debris blocks except for the largest knolls. Multiple sub-bottom reflectors from the surrounding Trough sediments and the small canyons downcut into the scarp, points to the landslide being an ancient event.
The knolls deflect northerly-flowing currents and provide a favourable habitat for a coldwater coral community on the crests. Numerous smaller knolls may provide additional positive relief habitats for corals. The limited taxonomic analysis shows similarities with other western Pacific coldwater fauna. Significantly, submarine landslides are common on the margin and there is potential that similar debris flow features can be used as proxies for coldwater coral distribution in the GBRWHA.

Acknowledgements

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[1]School of Earth and Environmental Sciences, James Cook University, Cairns QLD 4870, Australia. Email: robin.beaman@jcu.edu.au
[2]School of Geosciences, University of Sydney, Sydney, NSW, 2006, Australia