Coral Carbonate Mound Archives for Submarine Canyon Exchange Processes

Lim, A[1, 4], Power, K.[1, 4], Crowley, Q.[2, 4], Georgiopoulou, A [3, 4], Wheeler, A.J.[1, 4]

1) School of Biological, Earth & Environmental Science, University College Cork | 2) School of Natural Sciences, Trinity College Dublin | 3) School of Earth Sciences, University College Dublin | 4) iCRAG (Irish Centre for Research in Applied Geosciences)

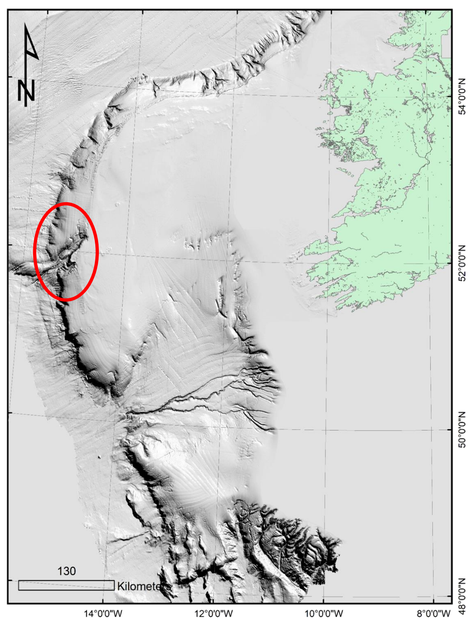
1. Introduction

The Porcupine Bank Canyon, Ireland's largest submarine canyon, is located at the centre of the Irish-Atlantic margin on the Porcupine Bank. Although designated as an SAC (Special Area of Conservation) until recently, it has largely been unexplored.

Three ROV research cruises (2015, 2016 and 2017) reveal a wealth cold water coral-dominated habitats in the form of individual colonies, coral gardens, mounds and vertical cliff faces. Corals are proven palaeoenvironmental archives. This, coupled with the novel nature of the project (high-resolution mapping and geochemistry), has the potential to reconstruct fine–scale spatial and temporal events (industrial activities, anthropogenic impacts and higher resolution natural variabilities). This presentation shows work completed on this iCRAG research project.

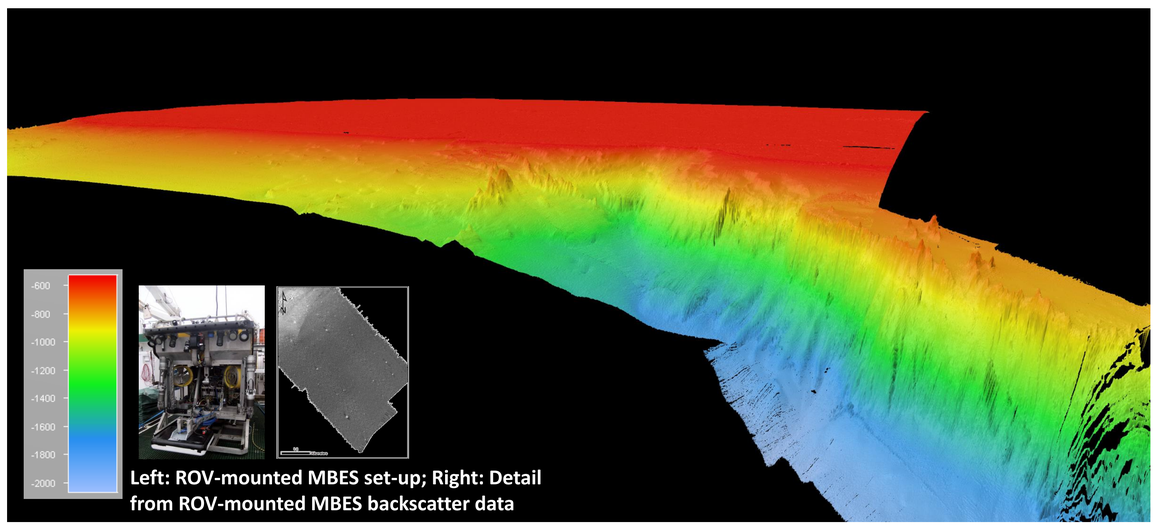
Aims

- To determine facies distribution within the canyon system
- To link high-resolution patterns of distribution to governing processes
- To use detailed understanding of canyon processes as a baseline against which high-resolution coral archives can be put into context
- To assess the fidelity of corals as decadal-scale palaeoarchives

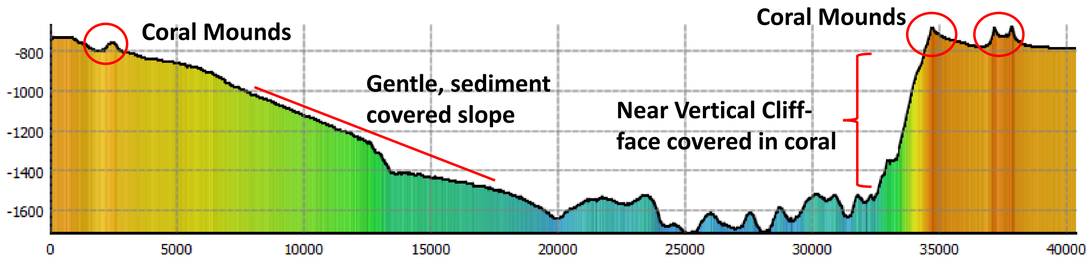


Map showing the location of the Porcupine Bank Canyon

2. Geomorphology

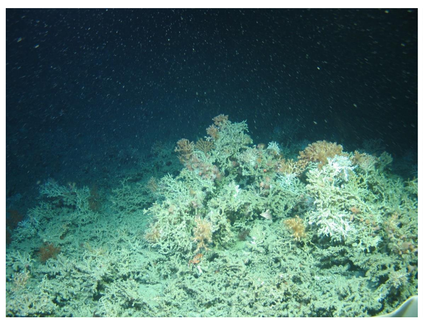
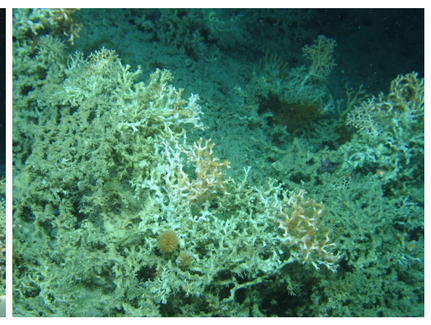
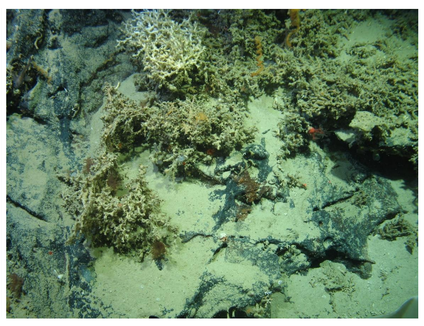


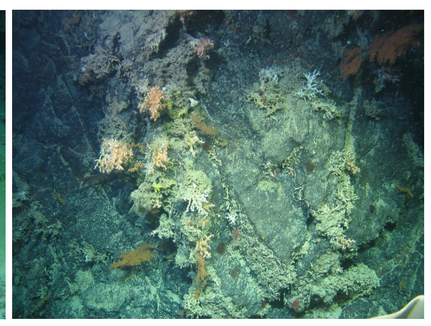
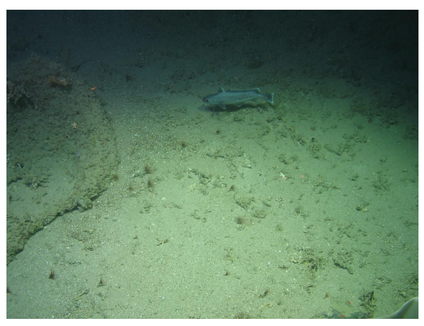
Left: ROV-mounted MBES set-up; Right: Detail from ROV-mounted MBES backscatter data



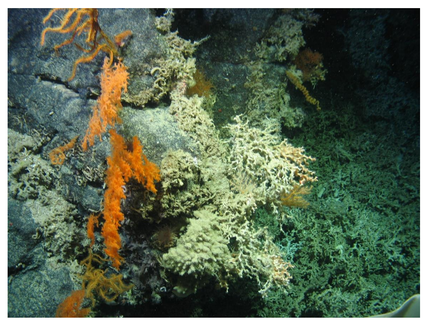
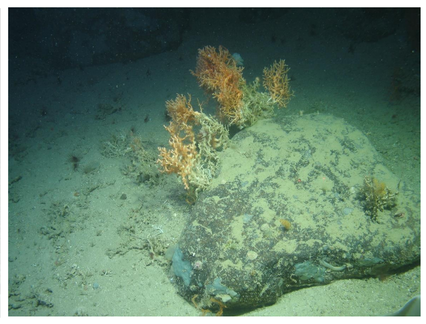
- The bathymetry was collected by with a Hull-mounted EM302 and ROV-mounted EM2040 using beam-steering where the canyon topography is near vertical
- The SE canyon margin has a near vertical, bedrock exposed, cliff-face approx. 700 m high while the NW margin has a sediment-dominated, gentle slope, extending into the canyon base
- Cold water coral mounds form on the cliff top and cliff lip where coral gardens extend along the lip between mounds
- A dense coverage of cold water corals (hard and soft) colonise the cliff-face up to 100 m in vertical extent

3. Canyon Facies

- Cold water corals have generated mound habitats at the cliff top and lip through extensive, long-term recolonization.
- Coral gardens connect mound features at the lip of the canyon. Coral gardens represent favourable environs for corals. Presumably, at the cliff lip, the corals benefits from nutrient-rich water flushing in and out of the canyon.
- On the cliff face (soft and hard) colonise exposed bedrock. Desmophyllum reflects the optimum conditions here in its large-sized polyps (~10 cm and; optimal for geochemical analyses).

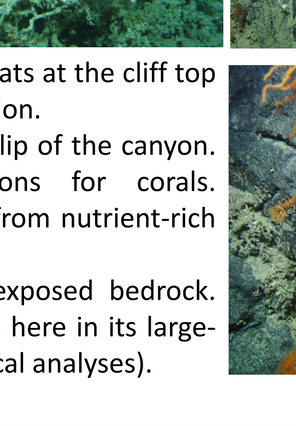
- Dropstones and large boulders occur within the canyon and on the cliff top, providing suitable substrate away from the cliff faces.
- Bedrock is heavily exposed on the steep SE canyon face (~45^{o}).
- Sediment (sorted sands) occurs at the canyon base, on canyon flats and canyon top. They are typically rippled with wavelengths increasing towards the NW.
- Coral rubble is common within the canyon (sourced from upper canyon coral), while hardgrounds appear to slide into the canyon.
- There is a heavy anthropogenic impact within the canyon (litter, fishing gear etc.).

4. Facies Suitability Mapping

- Oceanographic data (e.g. 4a), bathymetric (4b) and slope occurrence (4c) for each facies were isolated into a georeferenced format

- Occurrence of each facies can then be plotted within a facies suitability model (e.g. 4d: bedrock occurrence and; 4e: live coral, coral rubble and sediment)

- Within the canyon, coral preferentially colonise exposed bedrock where its rubble generates sizable deposits at the base. On the canyon top, corals form mounds



Potential bedrock occurrence

Habitat suitability of sediment (red), coral (blue) and rubble (yellow)

5. Conclusions and future work

- The Porcupine Bank Canyon is dynamic system, hosting a wide range of habitat types.

- Traditional (downward-facing, ship-based) mapping does not accurately resolve vertical seabed features. Given the occurrence of these potential, bedrock-exposing cliff faces along the Irish continental shelf, it seems likely, even at this early stage, that these new vertical habitats can provide km's of unmarked habitat.

- The project now focusses on the geochemistry (Li/Mg ratios) of the corals linking real-time temperature measurements with palaeo-temperature proxies to develop seasonal-scale fluctuations.

This publication has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) under Grant Number 13/RC/2092 and co-funded under the European Regional Development Fund and by PIPCO RSG and its member companies.

Ireland's European Structural and Investment Funds Programmes 2014-2020
Co-funded by the Irish Government and the European Union
European Union
European Regional Development Fund
Science Foundation Ireland sfi For what's next
PIP Petroleum Infrastructure Programme