



NW Atlantic scleractinian cold-water coral occurrence through the last 250,000 years

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Introduction

Studies performed over the last decades show a see-saw pattern of the cold-water corals distribution in the NE Atlantic. On the northern margins (>50°N), corals flourished mainly during interglacial (warm) periods forming extended reefs and mound structures, while in the southern areas (<37°N), coral mounds developed predominantly during glacial (cold) periods (review by Frank et al., 2011, Geology). The extensive cold-water coral reef and mound development has been related to specific environmental conditions such as increased surface productivity or bottom water circulation. The environmental variability that may affect the vitality of the cold-water corals appears to be triggered by the glacial-interglacial climatic cycles. While substantial knowledge exists regarding the cold-water coral distribution in the NE Atlantic, hardly any information exists so far from the NW Atlantic.

Objective

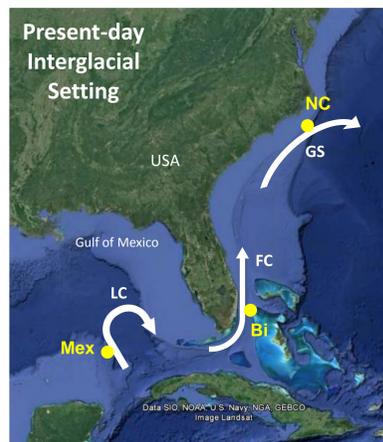
This study aims to be the first to unravel the occurrence pattern of NW Atlantic cold-water corals through the last glacial-interglacial cycles.

To reconstruct the development of cold-water corals in this region we present 66 cold-water coral U-Th ages from three areas: off Cape Lookout, North Carolina; off Bimini, Florida Strait; and at the Campeche Bank, Mexico.

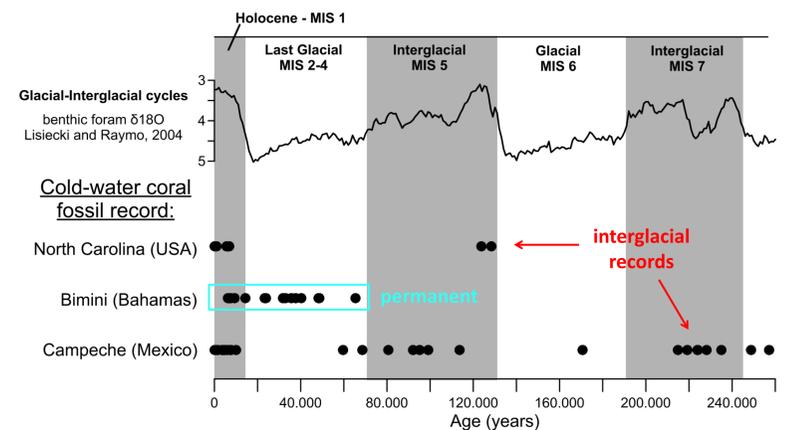
Results

Comparing the datings from the three studied cold-water corals sites, interpreted to reflect periods with enhanced cold-water coral proliferation, reveal different occurrence patterns:

- mostly interglacial coral growth along the North Carolina (NC) and Mexican (Mex) margins
- permanent coral presence in the Florida Strait off Bimini (Bi)



Map of the study areas: Cape Lookout, North Carolina (NC), Bimini (Bi), eastern margin of the Florida Strait, and Campeche Bank, Mexican margin (Mex). White arrows represent the present location of the most relevant currents: Gulf Stream (GS); Florida Current (FC) and the Loop Current.



Discussion

The results suggest that during the last glacial-interglacial cycles the environmental conditions have remained relatively constant at the Florida Strait, allowing an uninterrupted coral growth, but have changed in the North Carolina and Mexican margins, where the corals vanished during glacial times. Since the proliferation of the corals is usually related to the hydrographic setting, we suggest that:

- during the last glacial the Florida Current was relatively similar to the present interglacial
- during the last glacial (and until 7,500 years ago) the Gulf Stream influence was weaker in the North Carolina margin, which is likely related to an offshore dislocation of its main axis (Matos et al., 2015, DSRI)*
- during the glacial periods a less established Loop Current (Nürnberg et al., 2008, EPSL) might have imposed a weaker influence at the Campeche CWC Province, Mexican margin (Hebbeln et al., 2014, Biogeosciences)*

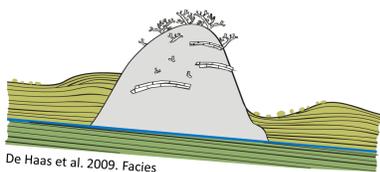
CWC and Paleoceanography

Scleractinian corals have rigid skeletons, therefore:

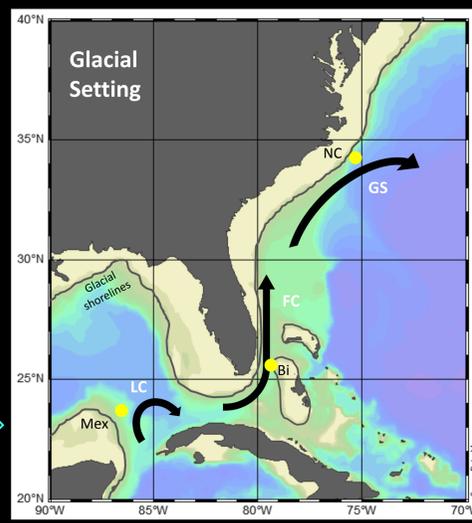
- May form reefs (e.g. *Lophelia pertusa*)
- Create good fossil records (carbonate mounds)
- Are easily datable (e.g. U/Th, ¹⁴C...)
- Chemically register the environmental conditions



Photograph (left) and CT-scan (right) of a sediment core collected on a carbonate mound. Note the structure made of fossil coral reef covered by fine sediment.



Stratigraphic representation of a carbonate mound with cemented CWC and exposed living colonies on top.



Map of suggested glacial hydrographic setting affecting the study sites: North Carolina (NC), Bimini (Bi), and Campeche Bank, Mexican margin (Mex). Black arrows represent the suggested location of the glacial Gulf Stream (GS); Florida (FC) and Loop Currents (LC).

Offshore location of the Gulf Stream

Similar Florida Current

Less established Loop Current



*Published papers related to the presenting author's PhD Thesis:

- Hebbeln, D., Wienberg, C., Wintersteller, P., Freiwald, A., Becker, M., Beuck, L., Dullo, C., Eberli, G. P., Glogowski, S., Matos, L., Forster, N., Reyes-Bonilla, H., and Taviani, M.: Environmental forcing of the Campeche cold-water coral province, southern Gulf of Mexico, Biogeosciences, 11, 1799-1815, doi:10.5194/bg-11-1799-2014, 2014.
- Matos, L., F. Mienis, C. Wienberg, N. Frank, C. Kwiatkowski, J. Groeneveld, F. Thil, F. Abrantes, M.R. Cunha, D. Hebbeln, Interglacial occurrence of cold-water corals off Cape Lookout (NW Atlantic): First evidence of the Gulf Stream influence, DSRI: Oceanographic Res. Papers, Volume 105, November 2015, Pages 158-170, ISSN 0967-0637, <http://dx.doi.org/10.1016/j.dsr.2015.09.003>.

FCT
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