

FINAL REPORT PROGRAM LEFE

Program LEFE/ IMAGO	Project Title HOLOCENE NORTH ATLANTIC MARINE RADIOCARBON RECONSTRUCTION AND COLD- WATER CORAL REEF DYNAMICS	Years 2015– 2016
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<p>Context: This research project was based on the study of a sediment core retrieved from a cold-water coral reef near the Wyville Thomson Ridge: a key region for paleoclimate studies as it is directly influenced by the surface limb of the AMOC. The initial dates acquired from downcore cold-water coral fragments cover the Holocene (2.1ka to 8.2ka) and the base of the sediment core was estimated to cover the last deglacial/glacial period. The aim of the study was to derive reservoir ages by coupling ^{14}C analyses with already available U-series ages performed on cold-water coral. An exploratory component of this project aimed to expand reservoir age reconstructions at this locality to the last deglacial/glacial period by using fossil bivalves. Such a record from a climatically sensitive region was key for both the calibration of samples containing marine carbon and reconstruction of sea surface hydrology.</p> <p>Objectives: Our research aimed to provide a chronological framework to on-going paleo-environmental reconstructions that sought to constrain the environmental parameters that account for the colonisation of <i>L. pertusa</i> on site and that have impacted reef growth during the Holocene.</p> <p>Main results: Results from a vibrocore collected on the northern edge of the Scottish continental shelf at around 300 m water depth, on the Wyville Thomson Ridge, enable to reconstruct the history of CWC reef growth and demise during the Holocene period. We report on significant age differences between U/Th and ^{14}C dates obtained on pristine well-preserved CWC (<i>Lophelia pertusa</i>), which may reflect a diagenetic process that standard quality tests have failed to highlight. Additional ^{14}C dates derived from bivalve fragments (<i>Venus</i> sp.) and foraminifera (<i>Cibicides refulgens</i>) samples show a gradual ageing with core depth but with significant age inversions in the lower section of the sediment core, which we consider reflects sedimentary mixing. We thus chose to derive an independent age model using planktonic foraminifera <i>Globigerina bulloides</i> stable isotope profiles. The vibrocore record is divided into 3 phases: 1- Mixed sediment deposits of glacial age corresponding to the base of the core with ages older than 13 cal ka BP, 2- The end of the deglacial/early Holocene between 13-9 cal ka BP and 3- Finally, the Holocene period from around 9 cal ka BP with abundant <i>Lophelia pertusa</i> fossils. Siliciclastic grain size and clay mineralogical composition show two significant shifts at around 13 and 9 cal ka BP indicating changes in sedimentary sources and transport associated with the dynamics and flow patterns of surface currents during the deglaciation and Holocene. Our results show that the onset of CWC reef growth on the Wyville Thomson Ridge occurred around 9 cal ka BP and was associated with a shift in flow patterns of surface currents in this area. This change of circulation patterns induced favourable sedimentological and hydrological conditions for corals to grow, and is associated with large scale modifications of North Atlantic circulation patterns at the end of the deglaciation.</p> <p>Future of the project: This project has enable us to build an age model for a sediment core which provides new information on the onset of cold water corals. We obtained unexpected result, ^{14}C ages and U/Th dates performed on the same fossil material are unexpectedly high. Similar results have been found in a site further south on the British continental platform in a similar setting. We aim to bring these data together to further our understanding of diagenetic effect that we were not able to detect using standard techniques. We anticipate that these findings will lead to new research projects.</p>		

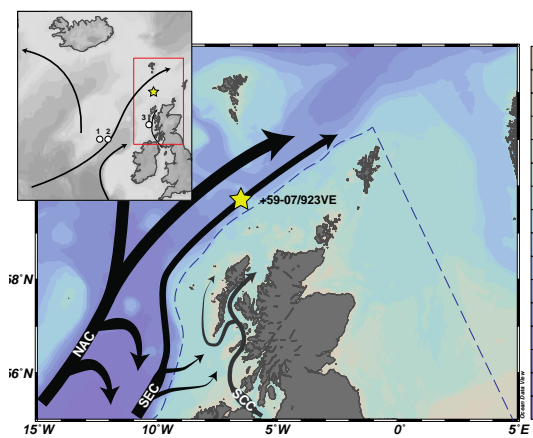
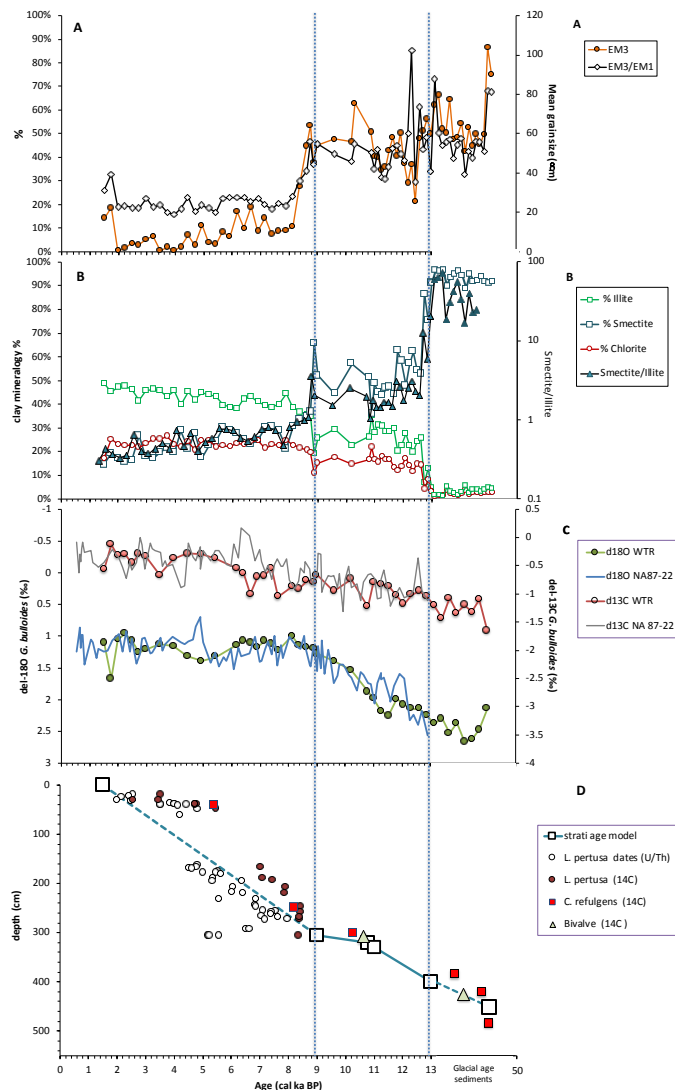


Fig1: above Map of the study area showing the location of vibrocore +59-07/923VE (yellow star). Arrows represent the main subsurface oceanographic currents. NAC: North Atlantic Current; SEC: Shelf Edge Current; SCC: Scottish Coastal Current. The position of the maximum extent on the BIS is show dashed line.

Fig2: Right panel: Vibrocore 59-07/293VE all data versus age. The blue shaded area highlights the glacial age deposits >13 cal ka BP with average mean sedimentation rate of 2cm/ka (the age scale is compressed for easier viewing). The red shaded area highlights the end of the deglacial/early Holocene with average mean sedimentation rates of 35-8cm/ka and the yellow shaded area highlights the period from 9 cal ka BP-modern when abundant CWC are found and mean sedimentation is the highest: 30-40cm/ka. A: grain-size data. B: clay mineralogy. C: $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ *G. bulloides* of core 59-07/293VE (green and red) and Na87-22 (blue and grey). D: Age depth relationship for the stratigraphic age model (blue line) and the distribution of U/Th (black open circles) and ^{14}C dates for *L. pertusa* (full brown circles) *C. refulgens* (red squares) and marine bivalves (green triangles). The tie points for the stratigraphic age model with (blue squares). Mean sediment rates are indicated for the stratigraphic age model. The glacial section (13-50ka) of this diagram has been compressed in order to facilitate viewing of the transitions at 9 and 13 cal ka BP.



Figures from Elliot et al., accepted for publication in Marine Geology

Nombre de publications et de communications

- Elliot M., C. Colin, M. Douarin, E. Pons-Branchu, N. Tisnérat-Laborde, F. Schmidt, E. Michel, Q. Dubois-Dauphin, A. Dapoigny, L. Foliot, S. Miska, D. Long, T. Francois, E. Douville. Onset and demise of coral reefs, relationship with regional ocean circulation on the Wyville Thomson Ridge accepted to Marine Geology
- Dubois-Dauphin, Q., Colin C., Elliot M., Dapoigny A., Douville E., Holocene shifts in sub-surface water circulation of the North-East Atlantic inferred from Nd isotopic composition in cold-water corals, Marine Geology, 410, 135-145, 2019
- Bonneau L., C. Colin, E. Pons-Branchu, F. Mienis, N. Tisnérat-Laborde, D. Blamart, M. Elliot, T. Collart, N. Frank, L. Foliot, E. Douville. Imprint of Holocene 1 climate variability on cold-water coral reef growth at the SW Rockall Trough margin, NE Atlantic. Geochemistry, Geophysics, Geosystems, DOI: 10.1029/2018GC007502. 2018
- Onset and demise of coral reefs, relationship with regional ocean circulation on the Wyville Tompson Ridge Mary Elliot, C. Colin, M. Douarin, E. Pons-Branchu, N. Tisnérat, D. Blamart, Q. Dubois-Dauphin, N. Frank, A Dapoigny, L Foliot, E Douville, EGU 2018, Vienne, Autriche.