

Using cold-water coral mini-mounds as analogue for giant mound growth: assessment of environmental drivers and anthropogenic impact

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Abstract: The FWO MINIMOUND project (2013-2016) aims to investigate small fossil cold-water coral (CWC) mounds within the Bay of Biscay in order to determine the impact of: (1) palaeoceanographic changes related to glacial-interglacial climate change in the last 15ka, (2) hydrocarbon related processes (seepage) and (3) anthropogenic fishing activities on CWC habitats. A better understanding of these mini-mounds will provide insight in the mechanisms of mound initiation and build up to large CWC mounds (e.g. Challenger Mound). The project will target three mini-mound provinces: the Explorer and Dangeard Canyons on the Celtic Margin, the Guilvinec Canyon on the Armorican Margin and the Upper Ferrol Canyon on the Cantabrian Margin. In these provinces USBL guided cores will be acquired to allow for sedimentological, palaeoceanographic and biogeochemical analyses throughout the mini-mounds. In addition, video dropframe acquisition will allow for habitat mapping and predictive modelling of the CWC habitats.

Key words: Cold-water coral mounds, *Lophelia pertusa*, palaeoceanography, habitat mapping.

INTRODUCTION

Cold-water corals (CWC) are found along the entire north-eastern Atlantic Margin from Norway to the Gulf of Cadiz. These coral reefs are mainly formed by framework building scleratinians *Lophelia pertusa* and *Madrepora oculata* that baffle sediment and over time, have the potential to develop into large coral carbonate mounds of up to 300m high (Roberts *et al.*, 2006). These large mounds (e.g. Challenger mound in the Porcupine Seabight) have been well studied over the past two decades (Wheeler *et al.*, 2007). The detailed mechanisms of initiation and build-up of such large CWC mounds are however not yet fully understood (Huvenne *et al.*, 2009). It is therefore essential to study smaller mounds (often termed “mini-mounds”) that can be interpreted as earlier growth stages that haven’t had the time to coalesce and develop into larger mounds (De Mol *et al.*, 2005).

The FWO MINIMOUND project (2013-2016) aims to investigate the initiation, growth and demise of these small CWC mounds and to determine the role of climatic and hydrocarbon-seepage related processes as well as anthropogenic impact. This high-resolution multidisciplinary study will focus on three mini-mound provinces along the Biscay continental margin (Fig. 1): (1) the Explorer and Dangeard Canyons on the Celtic Margin (Stewart *et al.*, 2013), (2) the Guilvinec Canyon on the Armorican Margin (De Mol *et al.*, 2011) and (3) the Upper Ferrol Canyon on the Cantabrian Margin.

These mini-mounds are fossil (9.7ka BP) and occur at relative shallow depth on the interface between the Eastern North Atlantic Central Water (ENACW) and the Mediterranean Outflow Water (MOW).

Contrastingly, most present-day living CWC reef habitats dwell in the deeper MOW depth range, relying on the density and dynamics of this water mass for their food supply.

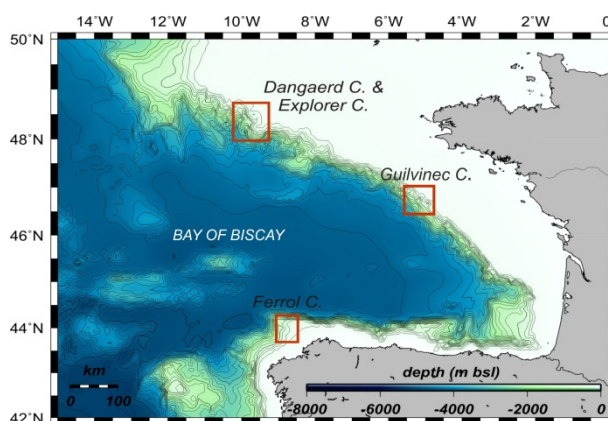


FIGURE 1. Bathymetry map (GEBCO) of the Bay of Biscay with indication of the three study areas of the FWO Minimound project.

OBJECTIVES

The objectives of the project are threefold: (1) the establishment of a chronostratigraphic framework and the reconstruction of palaeoceanographic changes over the last 15,000 years in order to determine the impact of glacial to interglacial climate change on the ENACW-MOW interface and the CWC habitats (Frank *et al.*, 2011); (2) the mini-mound province at the Upper Ferrol Canyon shows a close association with hydrocarbon-seepage (pockmarks) which allows to assess the role of hydrocarbon related processes in CWC mound

formation; (3) the potential impact of anthropogenic fisheries activities will be investigated.

PROJECT OUTLINE

These objectives will be tackled through a coupled geophysical, sedimentological and integrative approach, including the palaeoceanographic and biogeochemical core study in cooperation with the BGS (UK), LSCE (Gif-sur-Yvette, France), IFREMER (France), IGME (Spain) and IEO (Spain). Two sampling campaigns with the R/V Belgica will be undertaken of which the first is planned for June 2014. This campaign will target the mini-mounds, pockmarks and off mound sites on the upper slopes of the Ferrol Canyon and the Explorer and Dangeard Interflues. The targets were selected based on the analyses of multibeam bathymetry maps, high resolution seismic and groundtruthing of the CWC mounds using ROV (Fig. 2). Cores will be acquired with a USBL guided vibrocorer supplied by the BGS (UK). In addition to core collection, drop frame images will be acquired to allow habitat mapping and predictive modelling of the CWC habitats in cooperation with the Marine Institute of Plymouth University (UK). During the 2nd Deep Water Circulation Congress, the first preliminary results of the core analysis will be presented.

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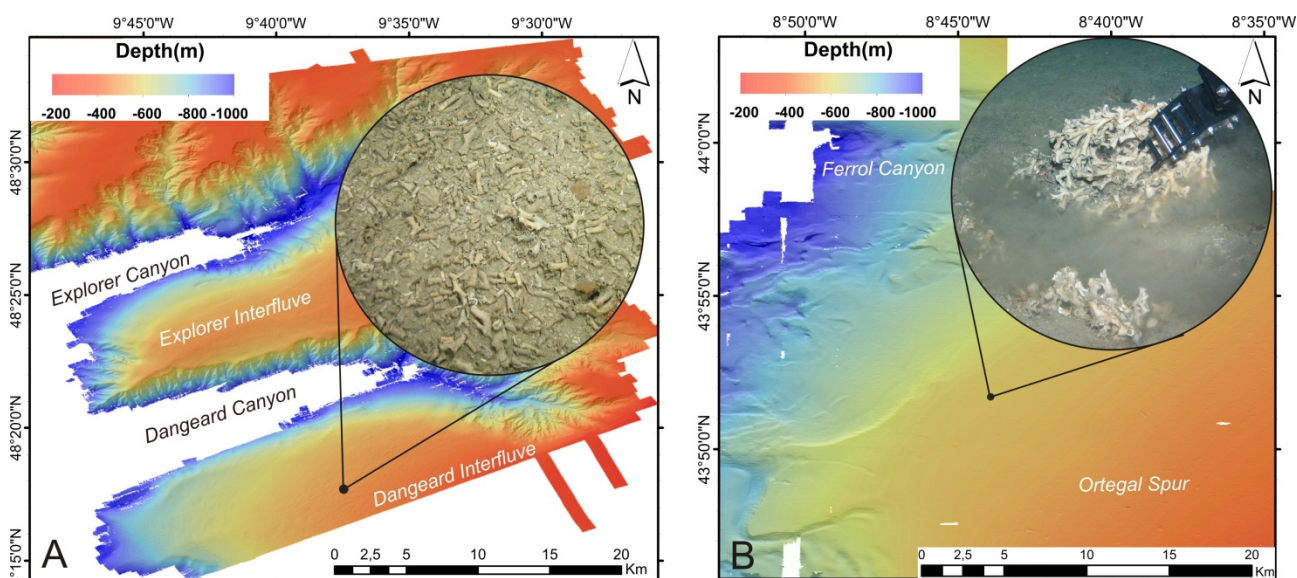


FIGURE 2. Bathymetry maps and ROV footage of the study areas targeted by the 2014 R/V Belgica campaign. A: The Explorer and Dangeard Canyons (data collected by MESH canyons cruise with the R/V Celtic Explorer, 2007). B: The upper Ferrol Canyon (data collected by the R/V Belgica GENESIS cruise, 2009).