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Hydrodynamics and cold-water coral facies distribution related to recent sedimentary processes at Galway Mound west of Ireland

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Abstract

Cold-water coral carbonate mound development is the result of complex and interactive hydrographical, biological and geological processes that can result in morphostructures several hundred meters high. The case study presented here investigates one of these large mounds – Galway Mound – in the eastern Porcupine Seabight to build an understanding of mound forming processes and the driving factors. For the first time, bottom current data have been recorded at six locations over a mound thus allowing an interpretation of the local flow field to be made. In addition to the overall flow pattern in the Porcupine Seabight, the recorded data display distinct diurnal tides. Comparison of the local flow field, coral facies distributions, current induced seabed features and grain size distributions over the Galway Mound highlights a correlation between the abundance of living corals with areas of enhanced bottom currents. However, the interplay of contour currents, tidal currents and the local topography further influences the coral facies and results in a distinct asymmetry in the coral facies distribution at Galway Mound. By baffling sediment, the corals also affect sedimentation on the mound.

Keywords: cold-water coral carbonate mound; northeast Atlantic; hydrography; current meter; coral facies; grain size spectra

1. Introduction

Large cold-water coral carbonate mounds in the Porcupine Seabight (De Mol et al., 2002), south-west of Ireland, represent some of the most impressive biotherms in intermediate water depths in the world. As their name implies, these structures are closely linked to the ahermatypic (lack of symbionts) framework building cold-water corals *Lophelia pertusa* and *Madrepora oculata* that occur in European waters from northern Norway, where they form reef-like structures on moraines, to the Gulf of Cadiz, where they grow associated with mud volcanoes and carbonate crusts, and into the Mediterranean Sea (Wilson, 1979a,b; Freiwald and Wilson, 1998; Rogers, 1999; Freiwald, 2002; Freiwald and Roberts, 2005; Taviani et al., 2005; Roberts et al., 2006). However, it is only along the eastern and western Rockall Trough margin that these coral built-ups grow up to 350 m high, so-called giant carbonate mounds (Kenyon et al.,

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2003; van Weering et al., 2003; Mienis et al., 2006; Wheeler et al., 2007), and in the Porcupine Seabight where they grow up to 190 m high (De Mol et al., 2002).

In addition to these large mounds, smaller mounds are also common. Numerous buried mounds have also been reported on seismic profiles from the northern Porcupine Seabight (Huvenne et al., 2007; Huvenne et al., 2003). So far, in total several thousand buried and exposed mounds have been mapped in Irish and UK waters including the Porcupine Seabight, Rockall Trough and Hatton Trough (e.g. Croker and O'Loughlin, 1998) ranging from a few meters high to large composite mounds (De Mol et al., 2002; Huvenne et al., 2003; Kenyon et al., 2003; Wheeler et al., 2005a,b). In the Porcupine Seabight, carbonate mounds occur in clearly defined mound provinces located between 600 and 1200 m water depth (Fig. 1).

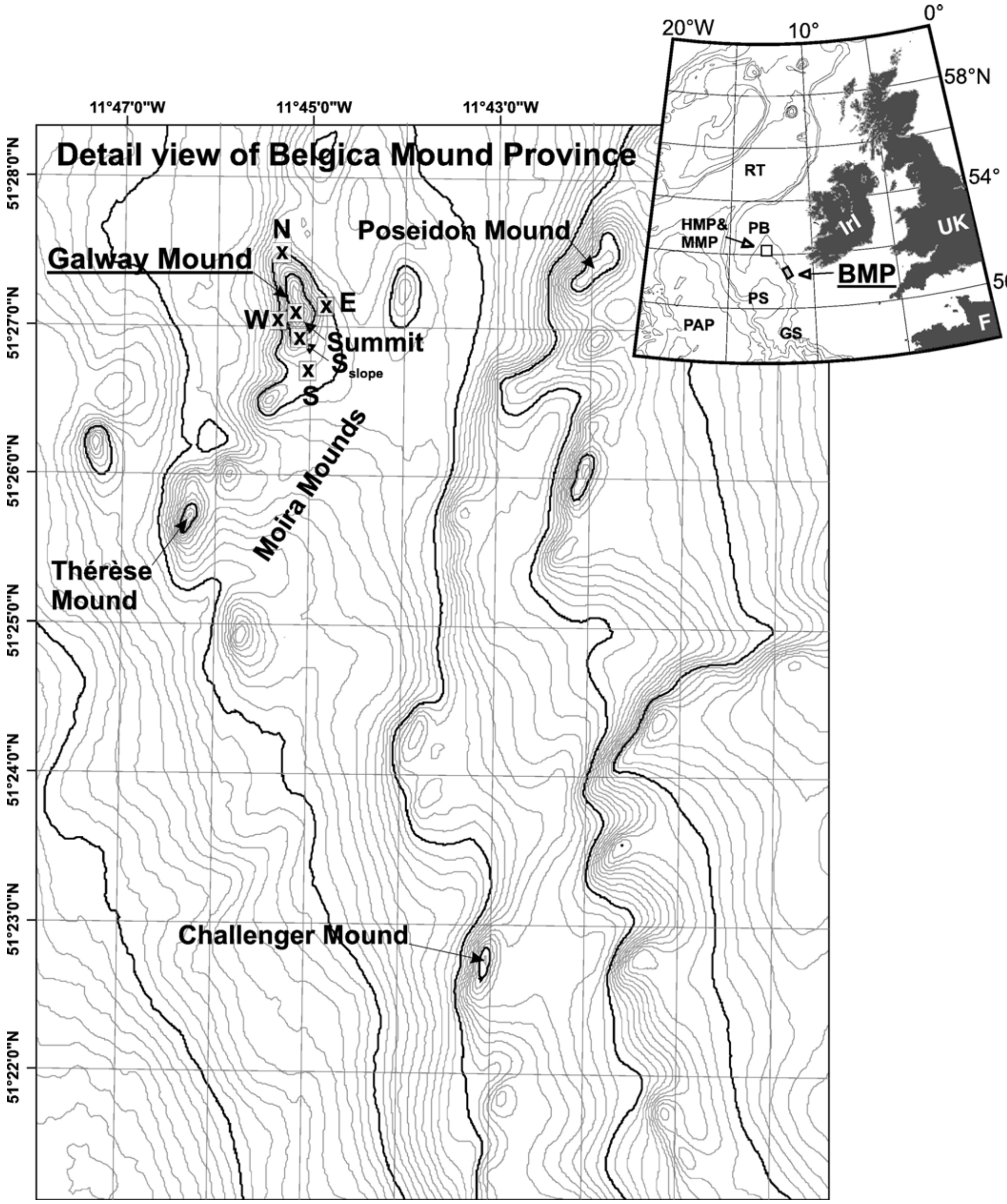

Fig. 1. Location and detailed map of the Belgica mound province (BMP) showing the locations of current meter moorings (X). RT: Rockall Trough; HMP: Hovland mound province; MMP: Magellan mound province; PB: Porcupine Bank, PS: Porcupine Seabight, GS: Goban Spur, PAP: Porcupine Abyssal Plain. Geographic data for the Belgica mound province after Beyer et al. (2003).