Quantitative analysis of mini-mounds from the Explorer and Dangeard canyons area: an automated approach

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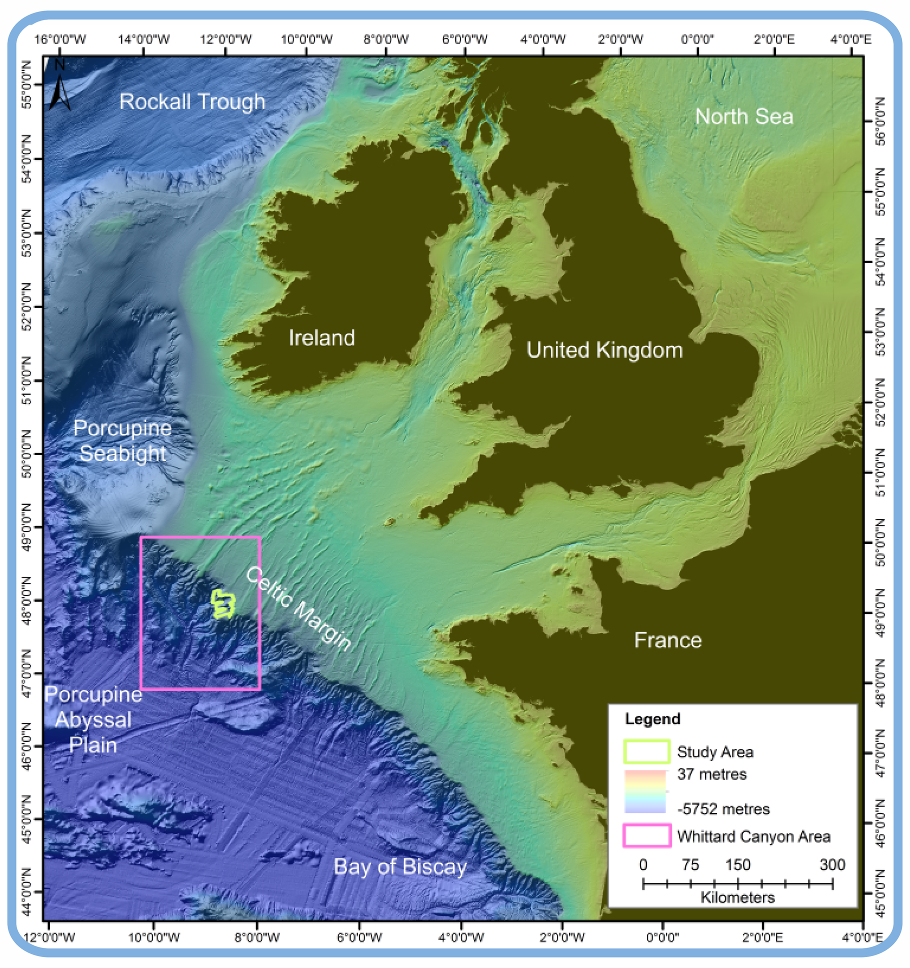


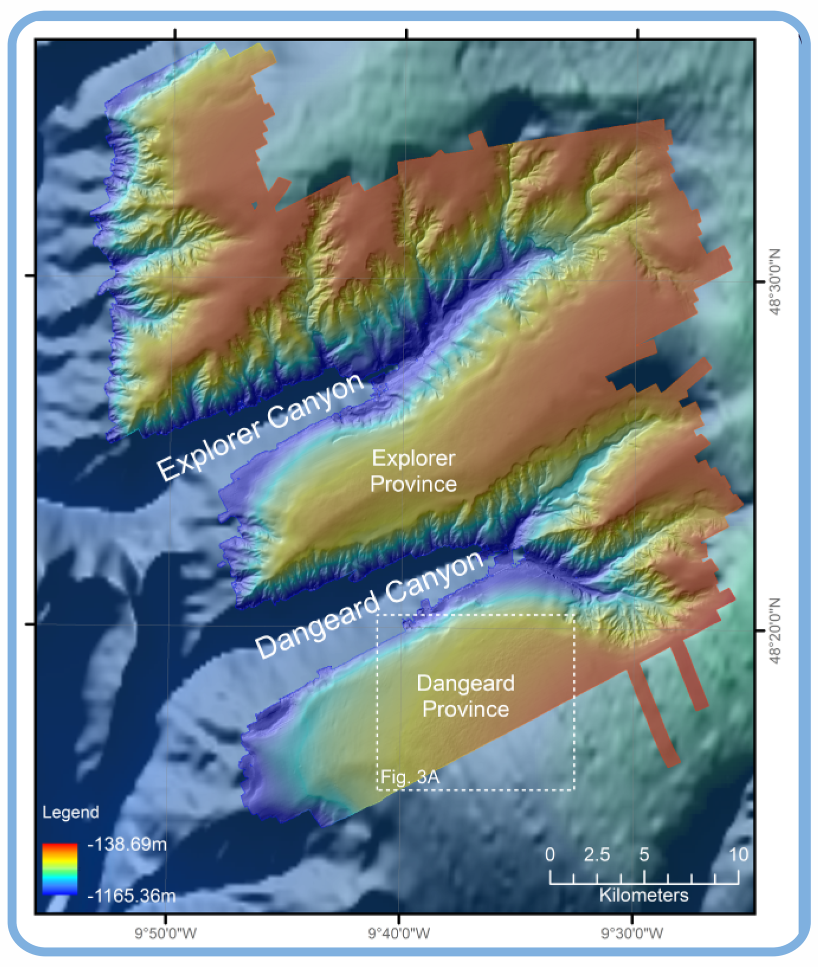
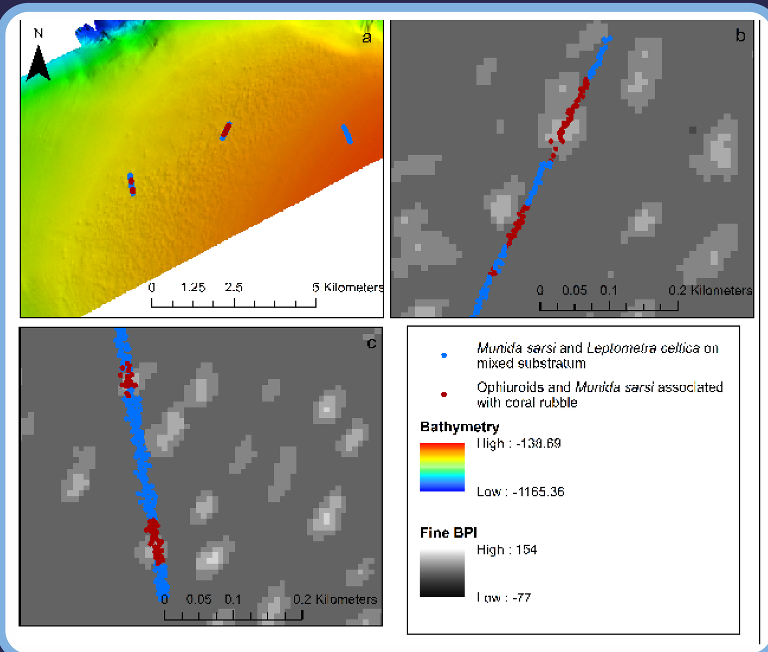


Fig. 1 (above). Regional bathymetry map showing the location of the study area. Digital Terrain Model for European Seas from EMODnet (www.emodnet-hydrography.eu/).

Fig. 2 (above right). Shaded relief map of the high resolution bathymetric data acquired in the Dangeard and Explorer canyons area. The shaded relief image reveals the morphology of the canyons and the flank of a third canyon in Irish territorial waters.

Fig. 3 (right). Distribution of observed fauna from the Dangeard cold-water coral mini-mound province as seen in camera transects C-3-2b (b) and C-3-7 (c). (a) Overview of multibeam bathymetry and camera data acquired over the Dangeard cold-water coral mini-mound province. For location see Fig. 1. (b and c) The change in observed fauna mapped from video footage, for location see (a). Areas of high fine-scale Bathymetric Position Index correspond to individual mounds. After Stewart et al., 2014.

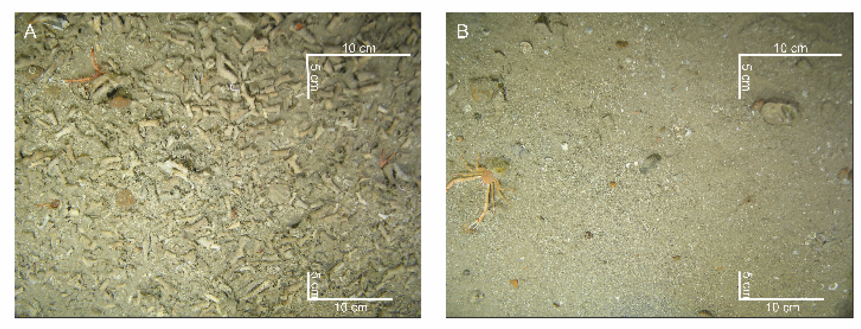


A time-efficient approach providing an unbiased and accurate mapping technique. Morphometric analysis enables quantitative analyses of potentially large numbers of sea-bed features.

Introduction

The Dangeard and Explorer canyons are located on the Celtic Margin, offshore UK, and are tributaries to the Celtic deep-sea fan via the Whittard Canyon (Fig. 1). The heads of the Dangeard and Explorer canyons were surveyed during the MESH canyons cruise in 2007 (Fig. 2). Two previously unknown provinces of cold-water coral mini-mounds were discovered on the interfluves of these canyons (Fig. 3) (Stewart *et al.*, 2014) and observed to comprise coral rubble and associated fauna including ophiuroids and the squat lobster Munida sarsi (Fig.4) (Davies *et al.*, 2014). In this poster we show results from the application of an automated mapping method to morphologically characterise these mini-mounds.

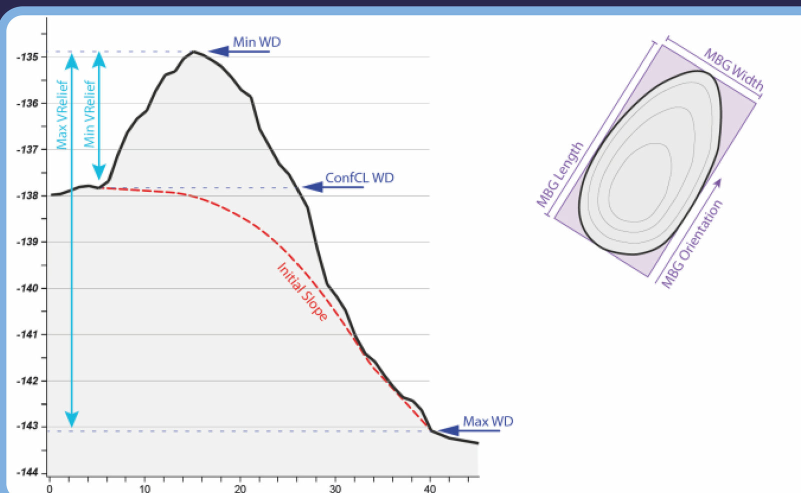
Fig. 4. (A) Example photograph of coral rubble associated fauna (including squat lobsters and ophiuroids) representing on-mound observed fauna. (B) Example photograph of between-mound associated fauna (including squat lobsters, ophiuroids and crinoids). After Stewart et al., 2014.



Methodology

The method employed was initially developed to map and characterise fluid-escape pockmarks at seabed (Gafeira *et al.*, 2012), and was subsequently tailored to delineate positive topographic features such as mounds and compiled into an ArcGIS Toolbox (*BGS Seabed Mapping Tool*). This toolbox includes two scripts that allow the systematic application of a sequence of tools available in ArcGIS and can be used to recognise, spatially delineate and characterise morphometrically seabed mounds using a Bathymetric Positioning Index (BPI) raster derived from the multibeam echosounder data.

Multibeam bathymetry data were gridded at 5 m cell size to generate a fine-scale BPI raster using the Benthic Terrain Modeler extension for ArcGIS (Wright et al., 2005). The first script generates an output polygon shapefile delineating the mini-mounds. The second script captures the morphological characteristics of each mound and populates the attribute table of the delineated polygons. Along with the extensive list of morphological attributes for each feature, where available properties extracted from supplementary datasets (e.g. backscatter intensity data) are also used to populate the geodatabase (Fig. 5). Two other point shapefiles are also generated: 1) showing the centroid, and 2) marking the shallowest point, of each delineated mound.



Fields listed on the table of attributes:

Area (sq m)	Minimum vertical relief
Perimeter (m)	Water depth of 1st confined contour line
Maximum BPI	Maximum slope
MBG_Width	Mean slope
MBG_Length	Minimum rugosity value
MBG_Orient	Maximum rugosity value
MBG_Width / MBG_Length	Mean rugosity value
Minimum water depth	Minimum backscatter value
Maximum water depth	Maximum backscatter value
Mean water depth	Mean backscatter value
Maximum vertical relief	Mean slope of the initial seabed surface

Fig. 5. Schematic of a sea floor mound showing example measurements. Table listing morphological attributes derived, and where available properties from other datasets, that populate the geodatabase.

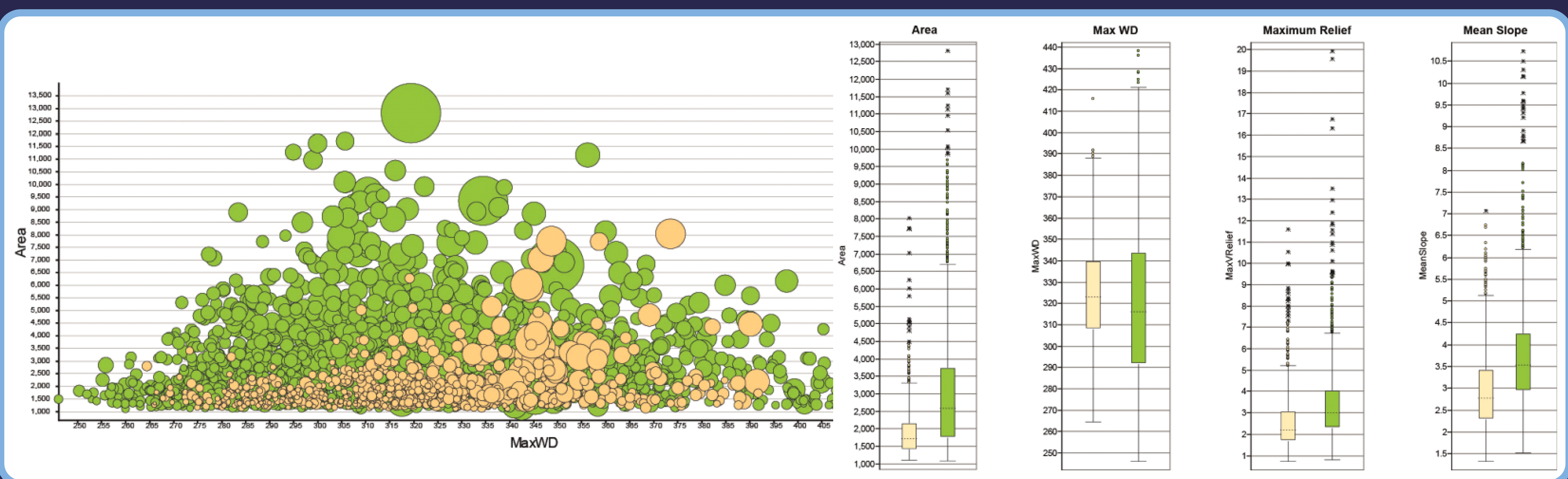


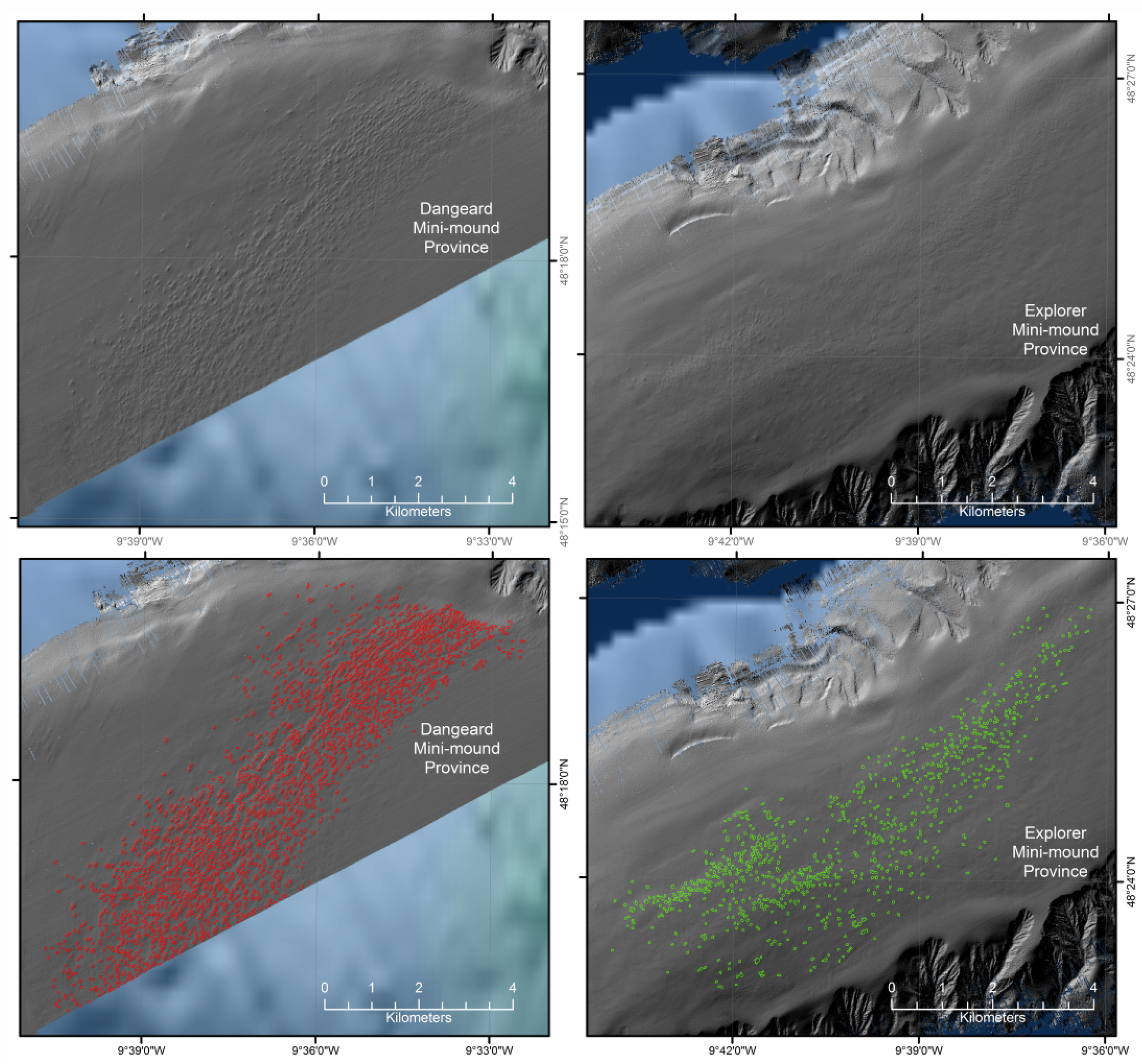
Fig. 7. Graph (on left) showing the relationship between area and water depth from the two provinces (Dangeard in green). Diagrams (on right) showing other morphometric data describing the mini-mound provinces.

Results

The outputs from the automated process reveal more than 2000 mini-mounds present in the Dangeard mini-mound province and more than 800 in the Explorer mini-mound province, representing a significant increase on previous estimates of mini-mounds in the area (Fig. 6) (Stewart *et al.*, 2014).

Morphometric data show that the mini-mounds of the Dangeard province are larger (3-4 m high and up to 3 .5 km^2 in area) than those observed in the Explorer province (2.5-3.5 m high and up to 2 km^2 in area) (Fig. 7). While further work will be required to explain this phenomenon, it may reflect trawling damage or a change in environmental conditions related to oceanographic currents within the Explorer province. The morphometric data also reveal that the mounds are elongated along slope, likely due to the influence of contour currents.

Fig. 6 (below). Overview (A) showing the results of running the Seabed Mapping Toolbox on the Dangeard (B) and Explorer (C) canyons dataset.



References:
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Stewart *et al.* 2014. Deep-Sea Research II, 104, 230-244
Wright *et al.* 2005. https://coast.noaa.gov/digitalcoast/tools/btm

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