Topographic and Morphologic Variations in Bathymetry Between and Galway Bay Bertraughboy Bay

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ABSTRACT

The continental shelf surrounding Ireland has been vigorously surveyed within the last decade by the Marine Institute of Ireland and the Geological Survey of Ireland as part of the INFOMAR program. Bertraughboy Bay, a bay on Ireland’s western coast just north of Galway Bay was surveyed from July into early August in 2014 using a Kongshavn EM2040 Multibeam echosounder aboard the R/V Celtic Voyager. The bay’s nearby terrestrial geology in Galway County (Fig. 1) indicates a transition in the seafloor geology from Bertraughboy Bay which is primarily comprised of granites and igneous intrusive rocks, ranging to Inishmore Island (one of the Aran Islands) which is comprised of weathered limestone. The hard bathymetric features may be fractured and eroded from layers of softer substrate of unconsolidated sediments similar to the Galway Bay area giving way to complex geomorphological features. Sonar data were post-processed using CARIS HIPS and SIPS 9.1 in order to create bathymetric maps, and backscatter intensity surfaces in both 2D and 3D. The purpose of this study is to interpret and characterize the geomorphology and possible underlying geology of Bertraughboy Bay.

BACKGROUND

Galway Bay is an INFOMAR priority bay, and has been extensively researched. The bay area has been a point of geologic bewilderment for some time due to its complex geomorphological features. Numerous Devonian granite outcrops have been identified in Galway Bay, particularly in the northern sectors where fractures generated granite intrusions (Fig. 5) (Burke, 2009). Northwest of the Aran Islands (Figs. 1a,b) lies Bertraughboy Bay. This bay’s offshore geology is particularly interesting as it displays granite bedrock outcrops (Fig. 2), composed of errisberg limestone, granite, and dolerite.

Examples from the Galway Granite

Changes in morphology between the Galway Granite and Limestone were observed using successive transect profiles (Figs. 3, 4). Our sonar surveys have identified numerous fracture zones within the Galway Granite outcrop that are not associated with all mounds (Figs. 5, 7), are likely of igneous origin and inferred to be the Galway Granite. In contrast, areas of tilted and isolated terraced features are likely the limestone units found on Inishmore as well as in the Burren on the west coast of Ireland. Boundaries chosen for the exposed bedrock mound features were based on characteristics of igneous rocks which are more dense and harder than limestone, resulting in higher backscatter intensities. These mounds also contain numerous fractures (Fig. 5) Burke et al. (2002) suggested that these fractures allowed for the intrusion of igneous granites, but also stated that not all of the mounds exhibit fractures. The fractures associated with the mounds are due to ancient arc-continent collisions which created numerous fault zones, as well as isostatic rebound of the earth with glacial retreat in the Pleistocene Epoch, 18 Ka (Brown et al. 2011; Burke 1957).

RESULTS

Profile A shows significant geomorphological changes from Bertraughboy Bay southeastwards towards Galway Bay (Fig. 3). The geomorphology ranges from mounds of hard exposed bedrock near Bertraughboy Bay to tilted terrace features near Galway Bay (Fig. 4). Backscatter intensity images show different intensity returns for observed hard substrates (Fig. 6) as well as a trend in intensity return relative to trends in geomorphology (Fig. 4). The slope map (Fig. 7) illustrates different slope patterns associated with different morphologic features. Fractures associated with some of the mounds (Figs. 5, 7) are not associated with all mounds and/or local faults (Fig. 5). The mounds near Bertraughboy Bay consist of harder material (based on backscatter intensity) which is likely exposed bedrock, whereas the tilted terrace features are likely the limestone beds proximal to Inishmore Island (Fig. 7).

DISCUSSION

The purpose of this study was to map the transition between the limestone beds found on Inishmore and igneous bedrock known as Galway Granite found in Bertraughboy Bay. This lithology transition was identified using backscatter return intensities and differences in morphology and slope. Hard-substrate mounds with fractures (Fig. 5) are likely of igneous origin and inferred to be the Galway Granite. In contrast, areas of tilted and isolated terraced features are likely the limestone units found on Inishmore as well as Inishmore in the Burren on the west coast of Ireland. Boundaries chosen for the exposed bedrock mound features were based on characteristics of igneous rocks which are more dense and harder than limestone, resulting in higher backscatter intensities. These mounds also contain numerous fractures (Fig. 5). Burke et al. (2002) suggested that these fractures allowed for the intrusion of igneous granites, but also stated that not all of the mounds exhibit fractures. The fractures associated with the mounds are due to ancient arc-continent collisions which created numerous fault zones, as well as isostatic rebound of the earth with glacial retreat in the Pleistocene Epoch, 18 Ka (Brown et al. 2011; Burke 1957).

Changes in morphology between the granites and limestones were observed using successive transect profiles (Figs. 3, 4). Slope data were used to highlight more subtle changes in morphology and to accentuate the terraced features associated with limestone beds (Fig. 7). All these sonar-derived data were then combined to create a seafloor lithology surface (Fig. 8), showing the contact between the major units of the Galway Granite and Limestone. Galway Granite is likely exposed in areas that have experienced significant erosion since the Devonian 410 Ma, whereas the Carboniferous limestone was sheared and smoothed 330 Ma ago. Inishmore Island shows a significant geologic transition between Devonian granite and Carboniferous limestone.

REFERENCES