# Bathymetric and Geomorphological Analysis of Inishmore Island, Ireland

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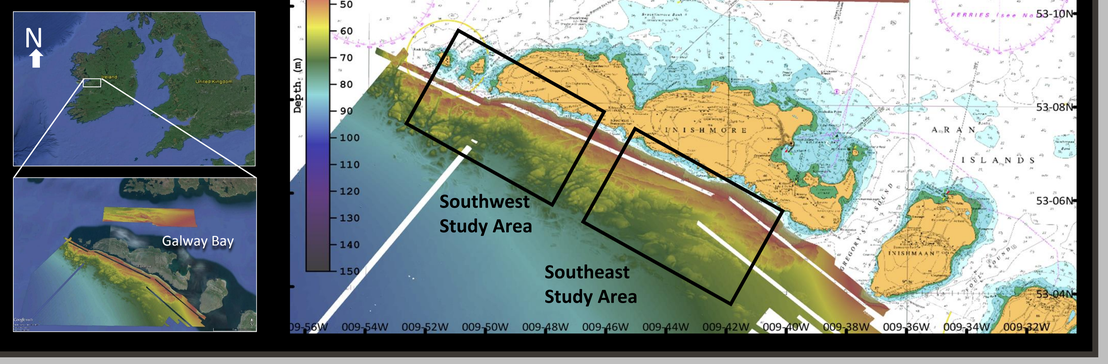
**Figure 1.** Location of Inishmore Island, Ireland. 2D BASE surfaces of the study areas are overlain on an Admiralty Chart of the Aran Island region off the central west coast.




## ABSTRACT

Bathymetric surveys were conducted just offshore of Inis Mór Island on Ireland's west-central coast, by the Marine Institute R/V *Celtic Voyager*. Data were post-processed using CARIS HIPS and SIPS 9.1 to create both 2D and 3D bathymetric surfaces. The study site is a glacio-karstic limestone landscape. Analysis of the bathymetry supports the interpretation of lithified marine sediment exposure above sea level, followed by erosion, and weathering since the Neogene Epoch, 23 Ma. Glaciers smoothed the exposed surfaces from 2 Ma to 18 Ka. Faulting and fracturing along the continental shelf showcases the limestone, highlighting its glacio-karstic characteristics. The purpose of this study is to use bathymetric analysis to map and characterize the submerged limestone strata that are seen exposed subaerially on Inishmore. of Ireland and Geological Survey of Ireland as part of the INFOMAR project. Data were collected from May to June 2014 using a Kongsberg EM2040 multibeam echosounder aboard the R/V *Celtic Voyager*.

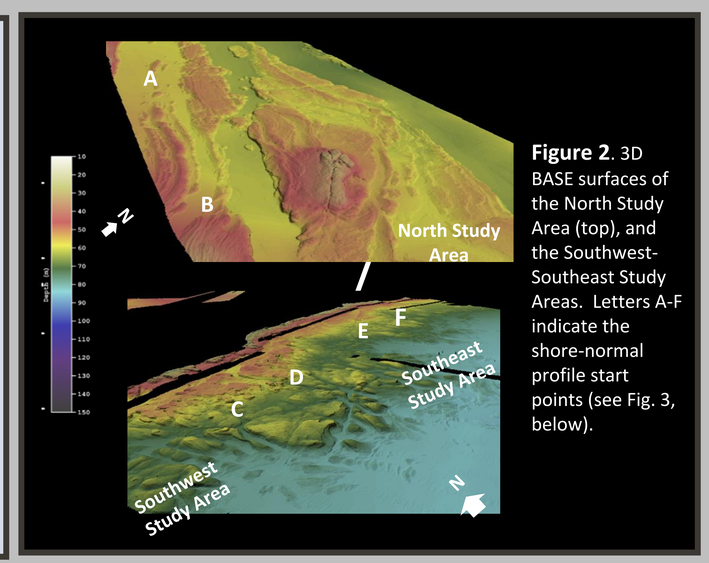
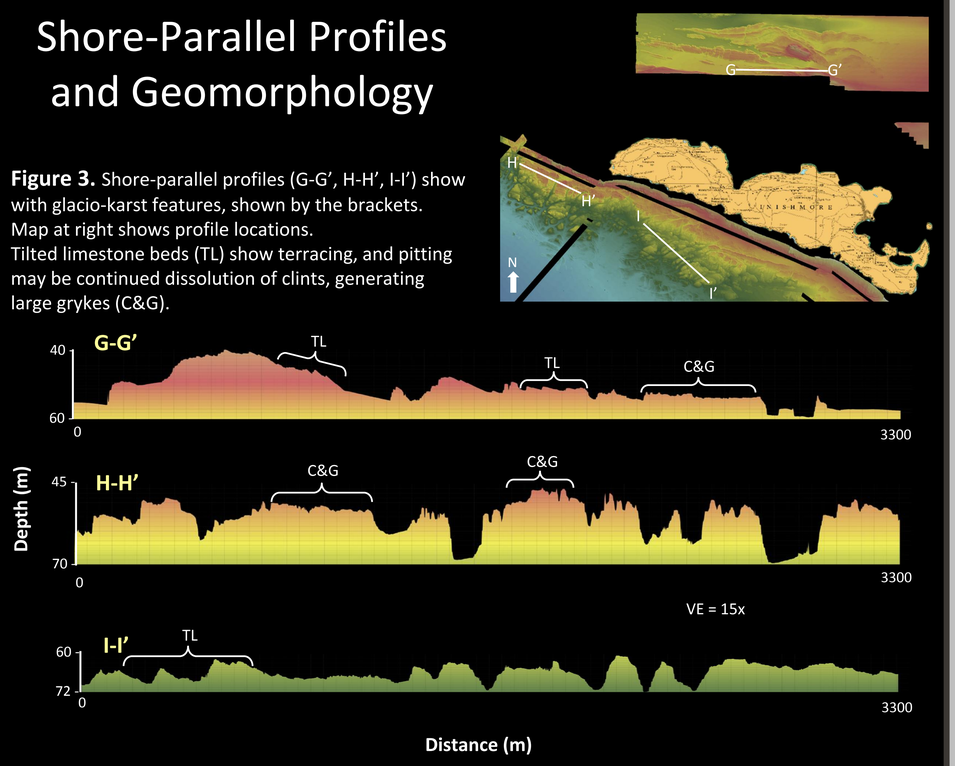



**Figure 2**. 3D BASE surfaces of the North Study Area (top), and the Southwest-Southeast Study Areas. Letters A-F indicate the shore-normal profile start points (see Fig. 3, below).

## Shore-Parallel Profiles and Geomorphology

**Figure 3.** Shore-parallel profiles (G-G', H-H', I-I') show with glacio-karst features, shown by the brackets. Map at right shows profile locations. Tilted limestone beds (TL) show terracing, and pitting may be continued dissolution of clints, generating large grykes (C&G).




## BACKGROUND

Inishmore Island sits at the mouth of Galway Bay in Western Ireland, and is the largest of the Aran Islands. The formation of a shallow marine environment during the Carbonifereous Period (358.9 Ma) resulted in the deposition of biogenic carbonate sediments which eventually would form what is now known as the Boireann (Burren) – the roughly 360 km$^2$ limestone area extending from Kilnaboy and Corranroo Bay in the east to the Aran Islands in the west (Geology of the Aran Islands)(Fig. 7). During the Pleistocene Epoch, decreased global temperatures caused eustatic sea level drop and glaciation to the islands, which resulted in the smoothing of the exposed limestone (Fig. 5) (McNamara, 2009). The landscape of the islands are raked in appearance, as erosion from rain water has formed fractured pavement slabs of smooth limestone ("clints") with deep cracks and trenches that separate them ("grykes") (Fig. 5). The island has a terraced nature from erosion and weathering which gives it a 'stair-step' terraced structure from tilting tectonism and erosion by glacial smoothing. The Aran islands are unique in their glacio-karstic deformation as the major processes of erosion and geomorphological evolution are dissolution based from rain water runoff, with glacial deformation less prevalent than karstic deformation.

The purpose of this study is to further characterize the geomorphology of the submerged limestone adjacent to the Aran Islands.

## Shore-Normal Profiles and Geomorphology

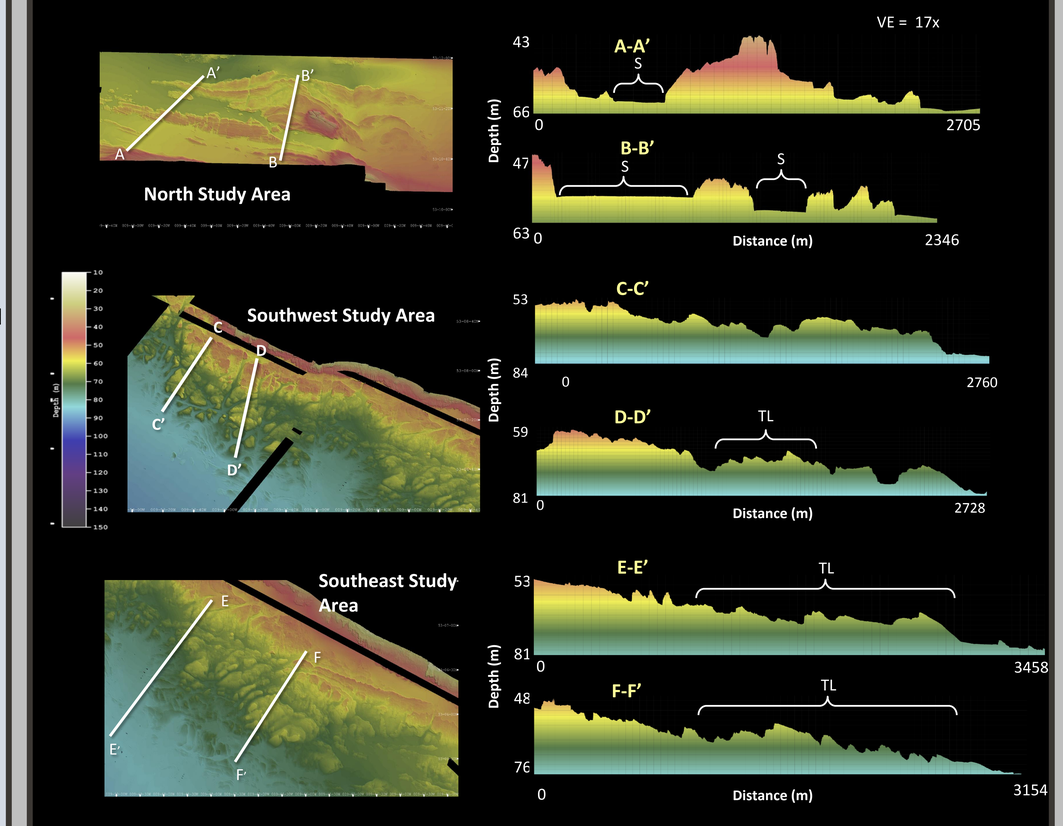



**Figure 4.** Shore-Normal profiles of Inishmore Island bathymetry in the North (A-A', B-B') show sediment-filled channels (S), whereas Southwest (C-C', D-D') and Southeast Study Areas (E-E', -FF') exhibit terraced, tilted limestone beds (TL). Profile locations are shown at left.

## METHODS

- Data for this research were collected using a Kongsberg EM2040 multibeam sonar aboard the R/V *Celtic Voyager*, from 05/26/14 to 06/07/14.
- Sonar data were post-processed and analyzed using CARIS HIPS & SIPS 9.1.
- A 2m resolution CUBE BASE surface and profiles of the major geomorphological features were made for analysis.
- Limestone deformation consistent with this region's geologic past was observed using the tools in HIPS and SIPS 9.1

## RESULTS

**Shore-Parallel Profiles:**

- Shore-Parallel profiles showcase the grykes and clints formed from weathering and erosion (Fig. 3, G-G').

**Shore-Normal Profiles:**

- Shore-Normal profiles exhibit similar bathymetric "stair-step" characteristics as those seen on land (Fig. 3, F-F').
- The weathering of the limestone along fault planes from subaerial exposure supports the previous literature on the rise and fall of sea level during this time leading to the deposition and subsequent erosion of the limestone.

**Inishmore Cross-Island Profile:**

- A cross-island profile (Fig. 8, J-J') showed a relatively flatter topography to the bathymetric profile (F-F') which we attribute to long-term subaerial exposure and erosion of Inishmore since well before the Pleistocene.

## DISCUSSION

The results of this study reinforce the pre-existing geomorphological literature of the area based on profiles and bathymetric data (Fig. 3, 4, 6). The bathymetry of the site was similar to the topography of the island in the systems of clints and grykes found in the limestone from various weathering events that have occurred since the Pleistocene. Overall, the offshore bathymetry appears to be a continuation of the landscape of the islands.

Ultimately, the results of research on the Aran Islands could be beneficial in understanding the characteristics of glacio-karstic limestones across the globe.

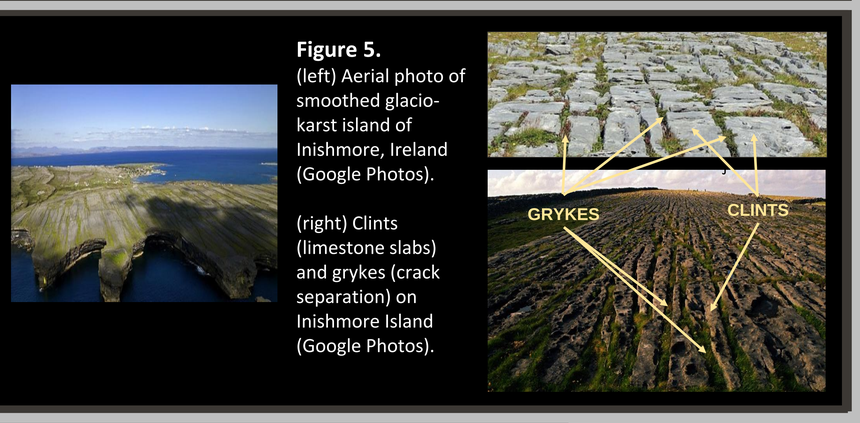



**Figure 5.** (left) Aerial photo of smoothed glacio-karst island of Inishmore, Ireland (Google Photos).

(right) Clints (limestone slabs) and grykes (crack separation) on Inishmore Island (Google Photos).

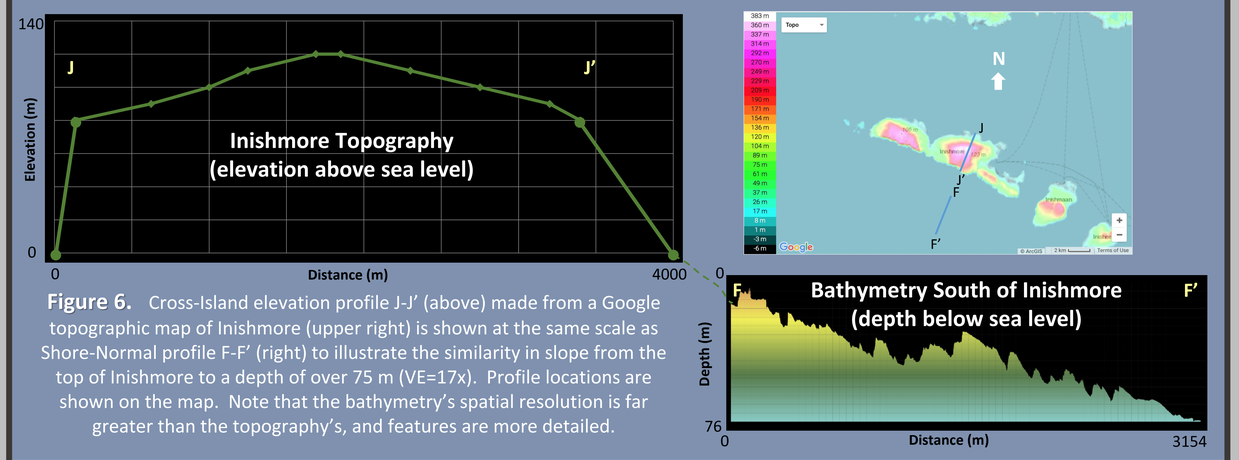



**Figure 6.** Cross-Island elevation profile J-J' (above) made from a Google topographic map of Inishmore (upper right) is shown at the same scale as Shore-Normal profile F-F' (right) to illustrate the similarity in slope from the top of Inishmore to a depth of over 75 m (VE=17x). Profile locations are shown on the map. Note that the bathymetry's spatial resolution is far greater than the topography's, and features are more detailed.

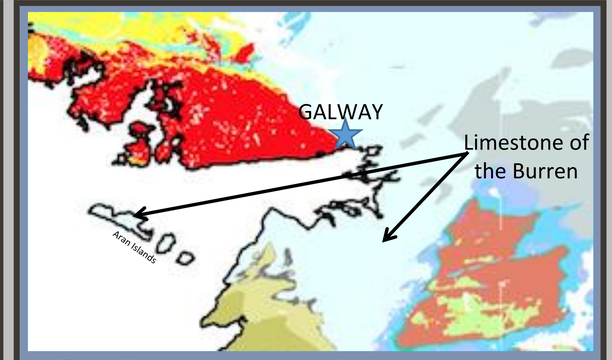



**Figure 7.** Geologic map of the Boireann (Burren) region of western Ireland near to Galway, highlighting the Limestone substrate of the area (light blue). Map courtesy of the Geological Society of Ireland.

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