



Marine Geology Report 029

Kilkieran Bay

Overview

Kilkieran Bay, or *Cill Chiaráin*, is a broad, island rich embayment on the south Connemara coast. It forms a highly indented, fjord-like inlet system shaped by numerous rocky outcrops and islands. Rather than a single open bay, it is a maze of shallow basins, narrow sounds and deeper channels that connect the inner waters to the Atlantic. The shoreline is threaded by channels between islands, rocky islets and low peninsulas. Kilkieran Bay and Islands SAC encompasses this island and channel seascape, including extensive open marine water as well as sheltered inner inlets and lagoon systems. The larger islands are linked into the road network by bridges and causeways across narrow intertidal channels, so land and sea routes interlock closely.

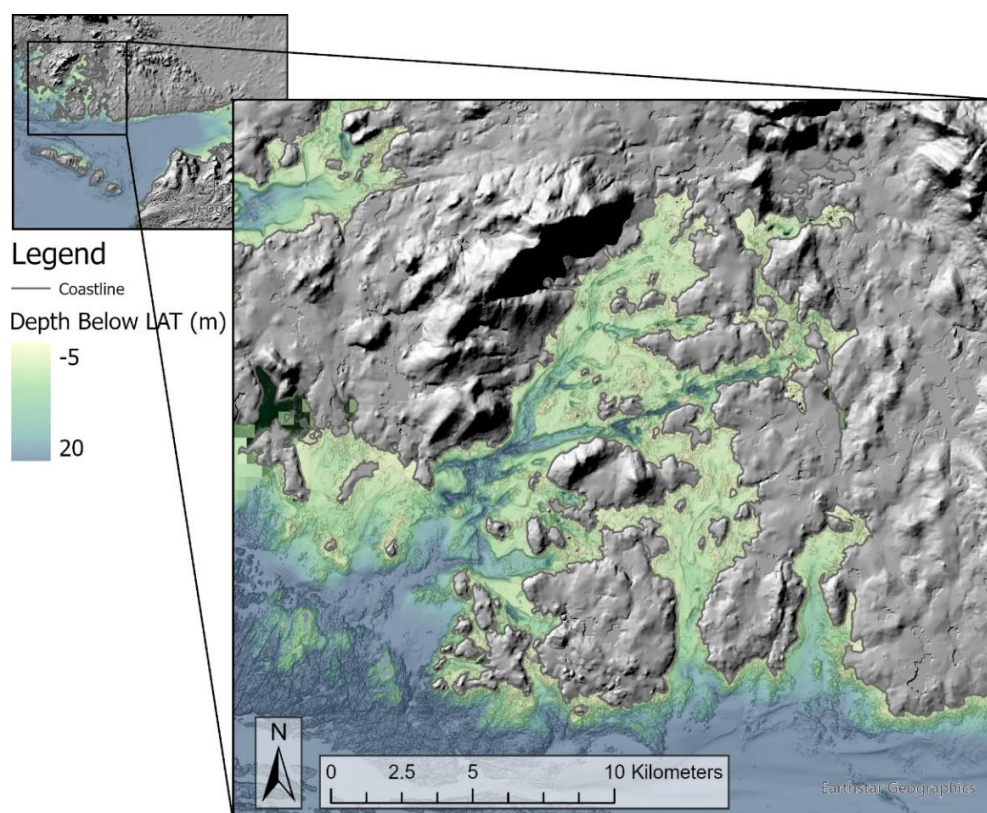


Figure 1: Bathymetry of Kilkieran Bay. Depths are referenced to Lowest Astronomical Tide (LAT).

Conditions vary sharply across the bay. The entrances face the prevailing south-westerly winds, so wave exposure can be high at the Atlantic approaches, while extremely sheltered waters occur towards the head of the bay within the lee of islands and headlands. Tidal exchange is repeatedly squeezed through narrow sounds and channels, generating strong tidal streams as water funnels between islands. In the inner bay, the main channels experience currents of up to about 2 knots and spring tidal ranges of about 4 m (Admiralty Chart 2096). These energetic currents help explain the bay's characteristic seabed pattern of rocky channel margins and locally steep submarine slopes alongside deeper passages.

This mix of exposed outer waters, tide-swept corridors and sheltered inner basins underpins the site's rich biodiversity, with a wide variety of habitats and many rare or conservation-important marine species recorded within the SAC.

Regional Geology

Kilkieran Bay lies on the south Connemara coast, within a landscape dominated by hard, intrusive igneous rocks, mainly granite. This resistant bedrock underpins the bay's rugged island topography and provides abundant rocky substrate offshore. The coastline is generally rocky, but in many places, this grades into mud in shallow water. Bedrock and boulder habitats remain common around islands and along channel margins, even where adjacent basins are mud dominated,

The oldest rocks in the region formed in the late Precambrian eon (800 to 541 Ma), when thick piles of sediment, with occasional volcanic layers, accumulated along the margin of the ancient continent Laurentia. These deposits became the Dalradian Supergroup, later altered by deep burial and mountain building into schists, quartzites and marbles that form much of the Connemara Massif (Pracht & Feely, 2004). As rifting progressed, the Iapetus Ocean opened between major crustal blocks. In this period, the landmasses that would later form Ireland lay on opposite sides of the ocean: the north-western half (including Connemara) on the Laurentian plate, and the south-eastern half on Avalonia, with oceanic crust between them (Pracht & Feely, 2004).

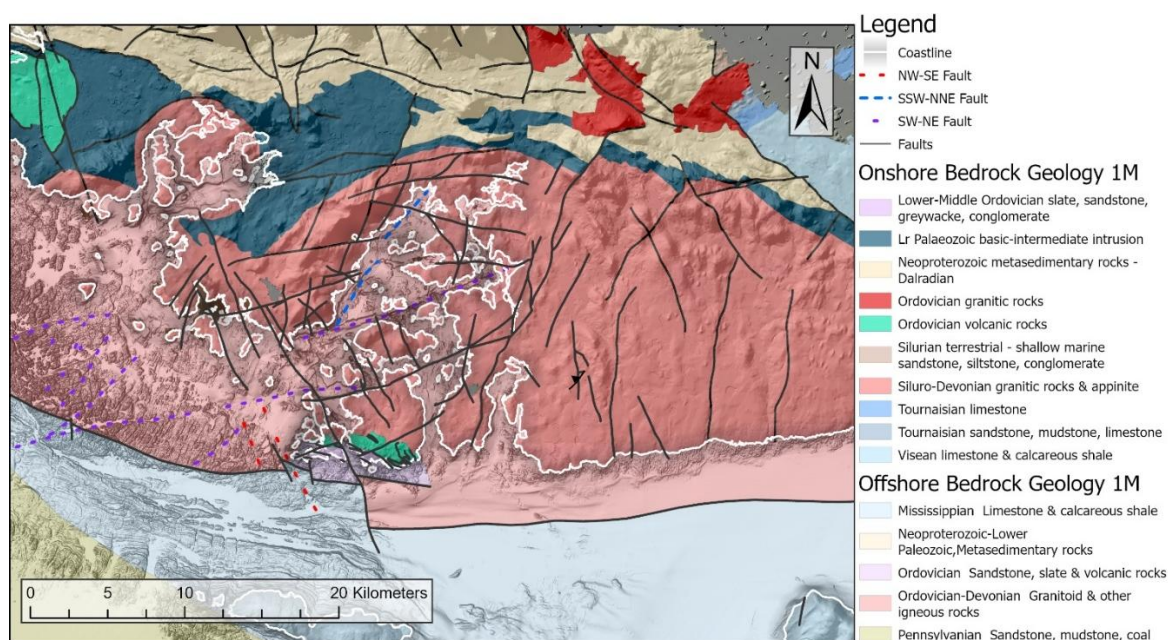


Figure 2: Geology of Connemara.

By the Ordovician (485 to 444 Ma), the tectonic setting had changed from rifting to convergence. Instead of the crust being pulled apart during rifting, the plates began to move towards each other and collide, and the Iapetus Ocean started to close. Oceanic crust was progressively consumed at subduction zones, narrowing the ocean basin and bringing the Laurentian margin (northwest Ireland, including Connemara) closer to Avalonia in the southeast. This marked the onset of the Caledonian Orogeny, a prolonged mountain building episode in which crust was compressed and thickened, causing intense folding and deformation and driving regional metamorphism in the Dalradian rocks. Over time, this convergence and collision welded the main Irish crustal blocks together (Morris, et al., 1995).

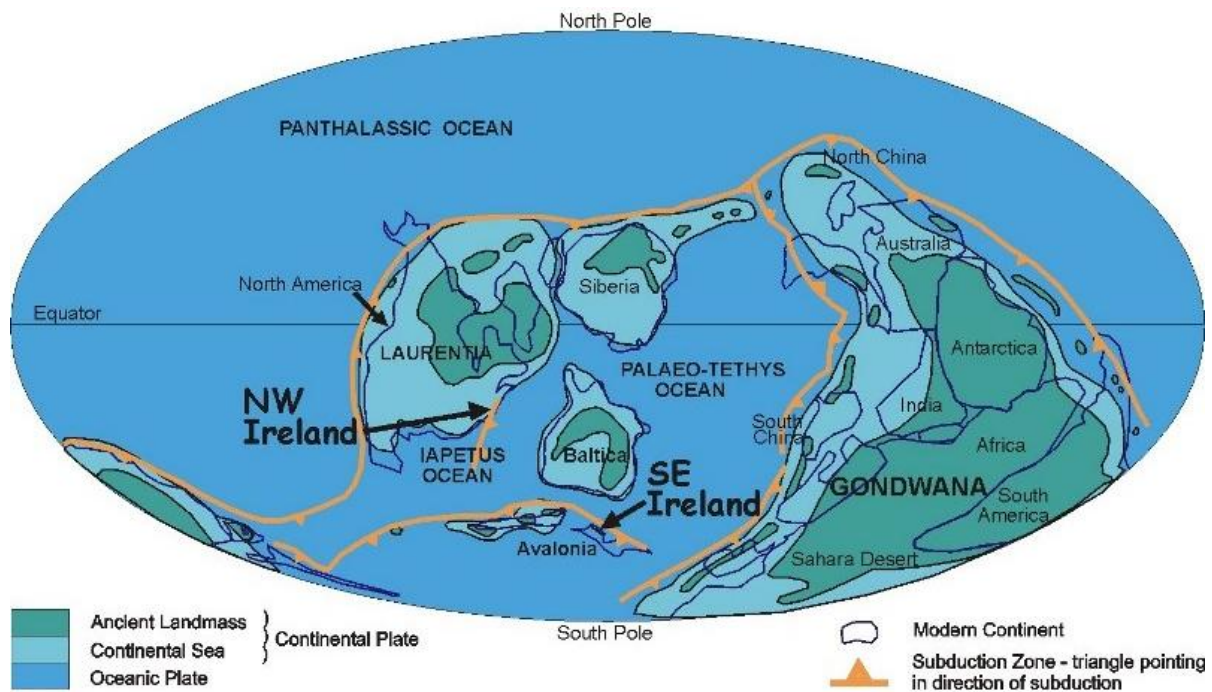


Figure 3: Palaeogeography of Ireland at the beginning of the Ordovician Period. Image from (Sleeman, et al., 2004).

South Connemara also preserves fragments of Ordovician ocean floor and volcanic environments that developed within the Iapetus Ocean. These rocks are grouped as the South Connemara Group and include deep-water cherts and shales, for example the Golam Formation, as well as volcanic rocks such as submarine basalts. Pillow basalts form when lava erupts underwater and chills into rounded “pillows”, a clear sign of submarine volcanism. Some of these volcanic rocks were later metamorphosed to amphibolite, and many were thermally altered where they were heated next to later intrusions (Morris, et al., 1995).

By the Late Silurian to Devonian (420 to 380 Ma), repeated pulses of magma intruded and crystallised at depth to form the Galway Granite Complex, a major composite batholith extending more than 80 km across Connemara (Pracht & Feely, 2004). A batholith is a very large body of intrusive igneous rock made up of many individual intrusions, or plutons, that coalesce at depth and are later exposed by uplift and erosion. Granite emplacement effectively “stitched” together the previously separate crustal blocks along the former Iapetus suture, uniting the Dalradian and South Connemara terranes into one landmass. Five different granites have been mapped within Kilkieran Bay: Lettermore granodiorites, Carna-type granite, Murvey Granite, Errisbeg Townland Granite and Callowfinish Granite (Pracht & Feely, 2004).

By the Carboniferous Period (359 to 299 Ma), Ireland lay in tropical latitudes, and shallow warm seas deposited thick limestones, mudstones and sandstones across much of the country. In the Connemara region, however, Carboniferous rocks are sparse and no Carboniferous cover is preserved in the Kilkieran Bay area. This absence is commonly attributed to non-deposition on locally elevated granite and metamorphic basement and/or later erosion that stripped any thin cover that may once have been present (Morris, et al., 1995).

Low-temperature thermochronology, including apatite fission-track and apatite (U-Th)/He analysis, helps reconstruct the timing of burial and uplift by showing how minerals record heating and cooling at relatively low crustal temperatures. Data from the onshore Irish Atlantic margin indicate significant Mesozoic to Cenozoic burial and exhumation, consistent with substantial post-Palaeozoic denudation that could have removed former cover, although it does not uniquely distinguish non-deposition from later stripping (Cogne, et al., 2014).

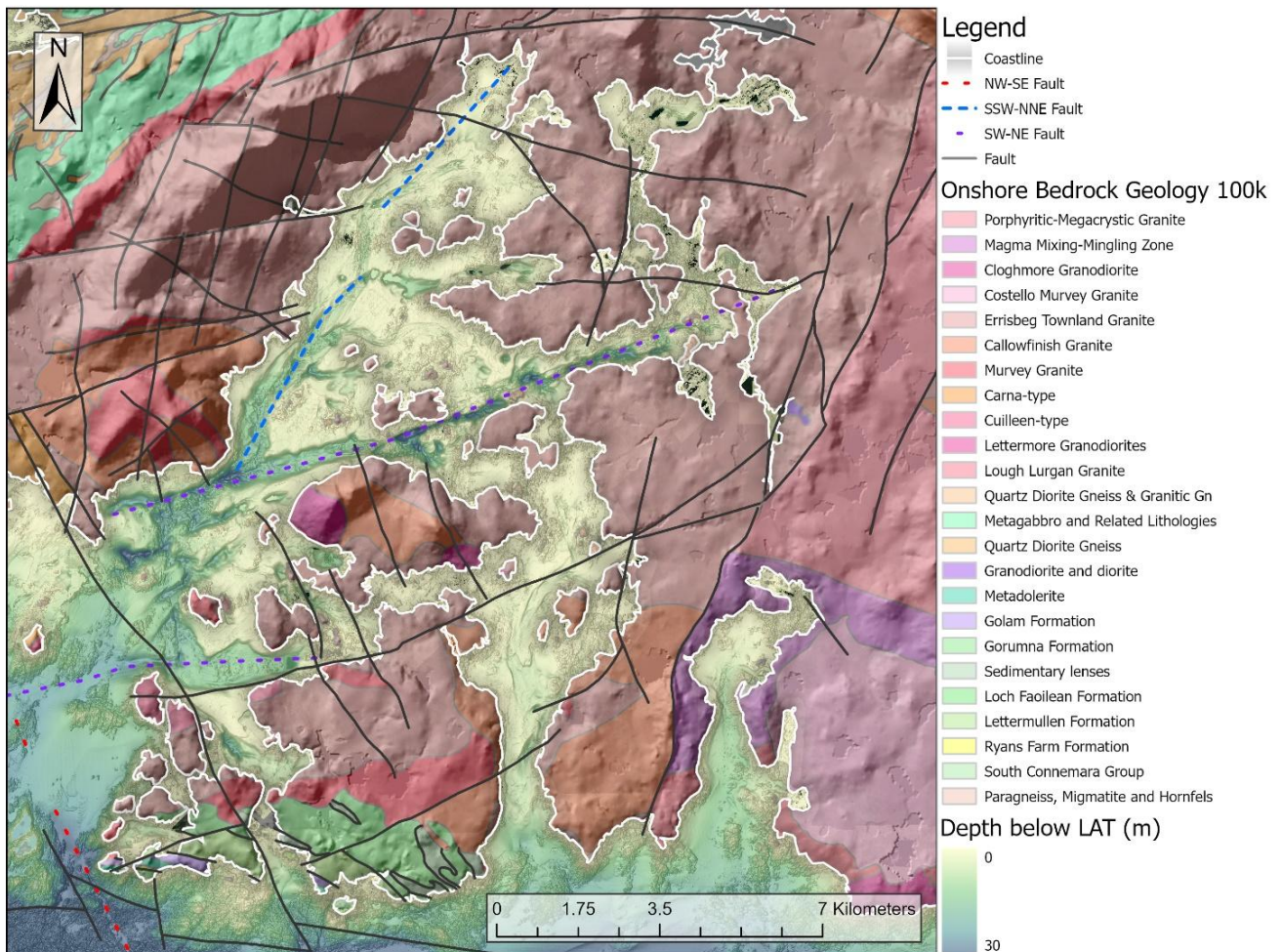


Figure 4: Detailed geology of Kilkieran Bay.

The most recent major shaping event was Quaternary glaciation. Large ice sheets repeatedly covered Ireland, and the last glaciation left especially strong signatures in Connemara: ice flowing south and south-west scoured and streamlined bedrock, carved grooves, and left drumlins, eskers, till and erratic boulders. Glacial deposits are patchy and often obscured by later peat cover, but the overall landscape, both onshore and beneath Kilkieran Bay, still bears the mark of ice erosion and meltwater incision (McCullagh, et al., 2020)

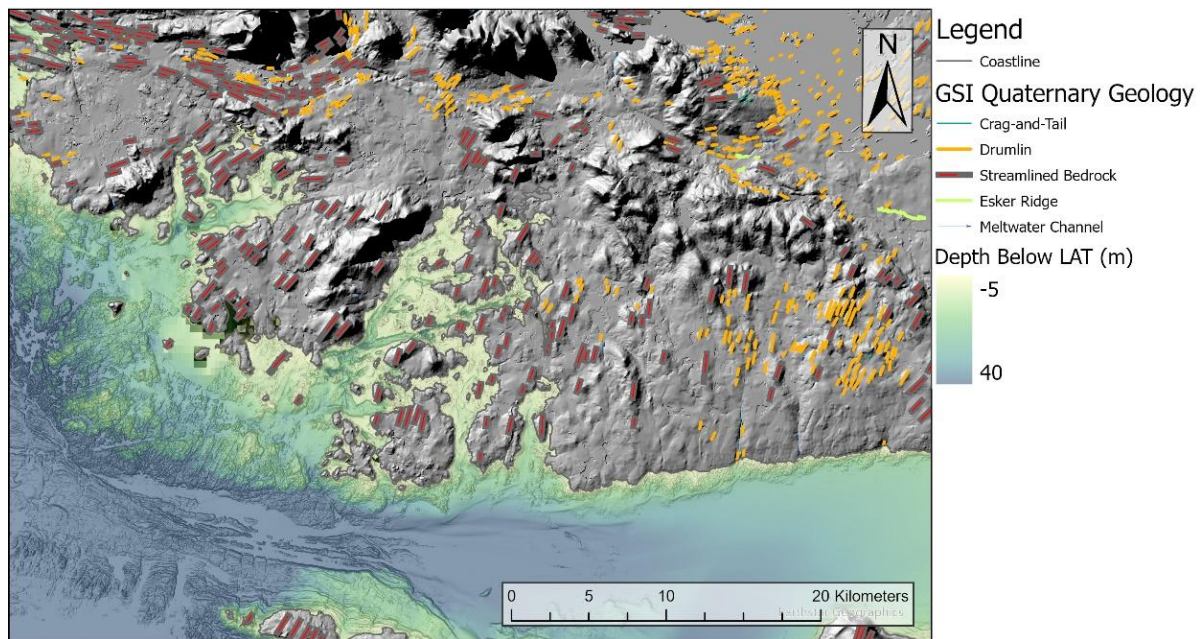


Figure 5: Terrestrial Quaternary geomorphology of South Connemara

Channels

Kilkieran Bay's seabed is dominated by channels and narrow sounds that separate islands and link the five main basins, providing the principal pathways for tidal exchange between the inner bay and the outer approaches. Strong tidal streams occur throughout the site as flow is funnelled through gaps between islands and along these narrow passages, with Admiralty Chart 2096 reporting currents of up to 2 knots.

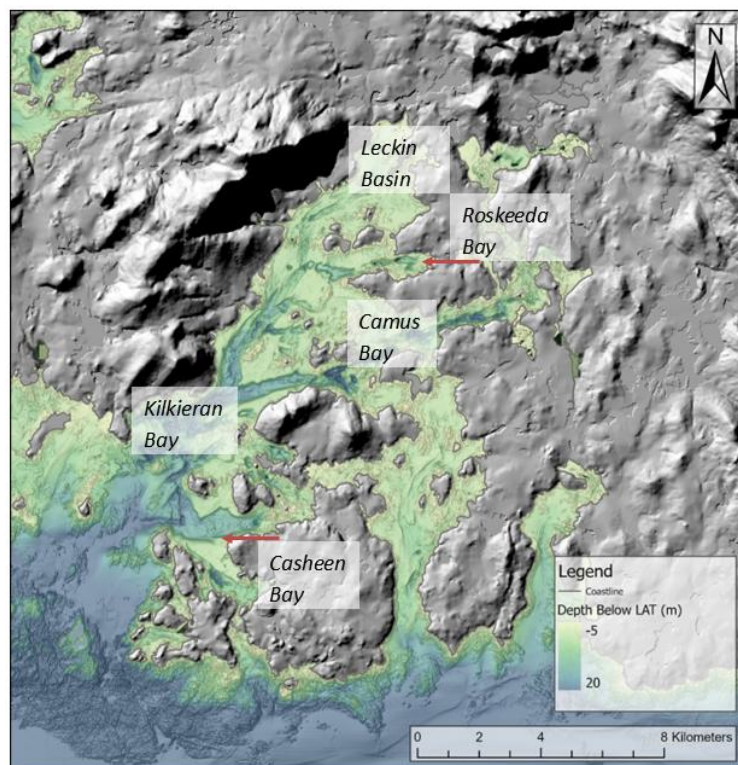


Figure 6: Bathymetry of Kilkieran Bay, with basins annotated.

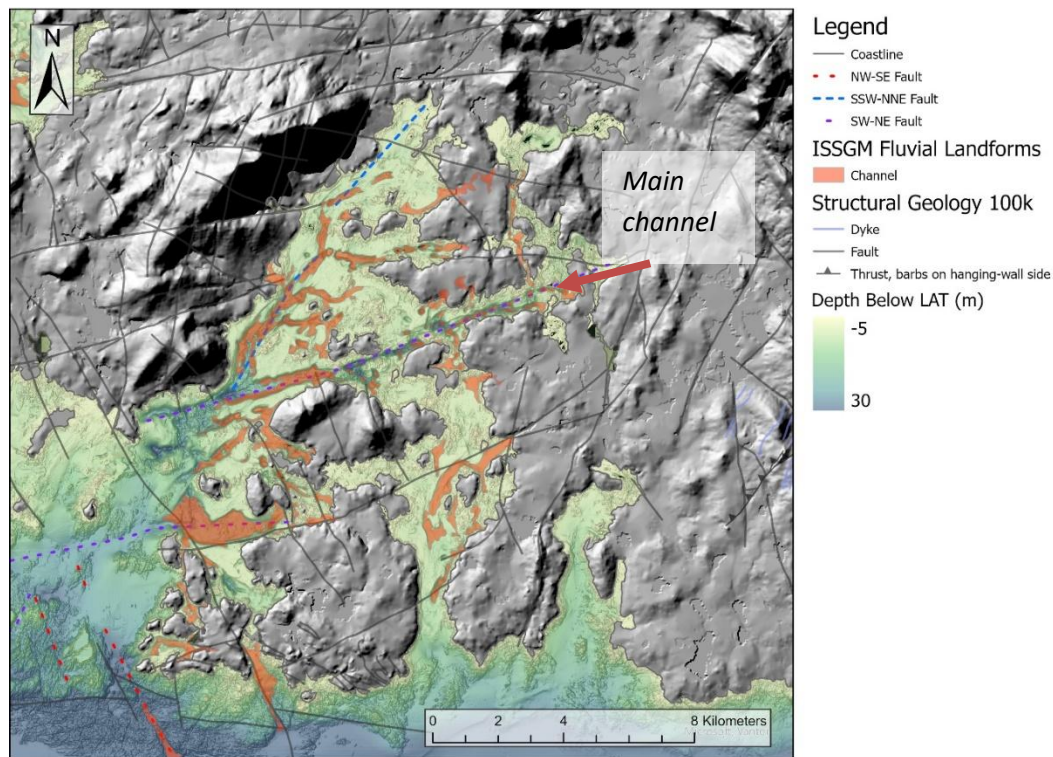


Figure 7: Bathymetry of Kilkieran Bay with structural geology and channel data overlain. Channel data from the Irish Shelf Geomorphological Map (Arosio, et al., 2023).

In hard, silica rich intrusive bedrock terrain, such as granite, channels commonly exploit pre-existing weaknesses such as faults and fracture zones, because broken rock is easier to erode than intact rock. The clear linearity and preferred orientations of the main passages in Kilkieran Bay are consistent with this type of structural guidance, with tidal currents then maintaining and sharpening the channel forms once established. Currents sweep sediment off rock highs and concentrate coarser material along channel margins.

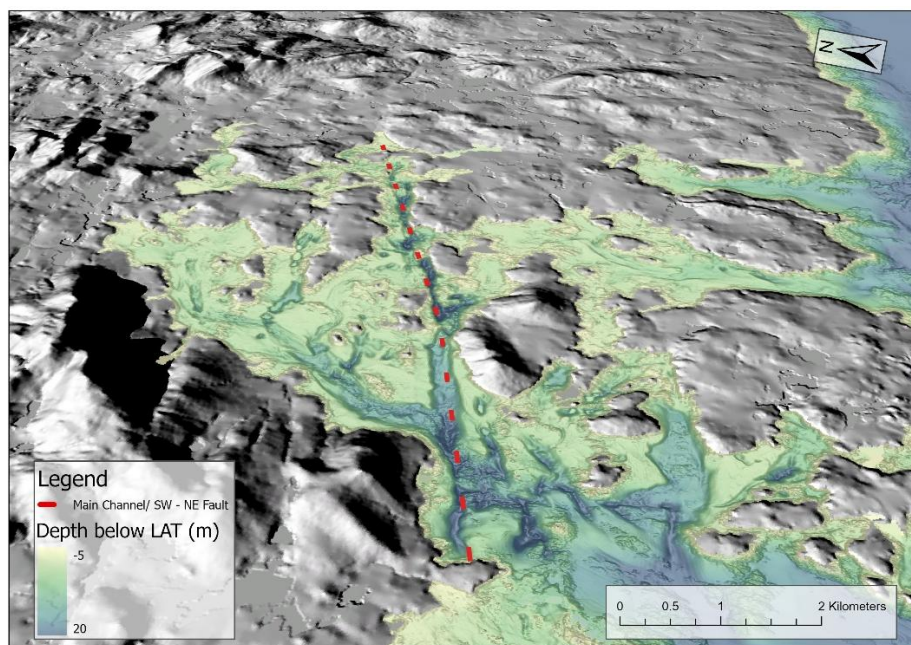


Figure 8: 3D imagery looking along the main channel.

Scour

Where tidal flow accelerates through constricted passages, the seabed shows clear signs of scour, meaning erosion driven by fast currents interacting with seabed obstacles and roughness. Scour tends to strip away finer sediment first, leaving exposed bedrock, boulders, and coarse lag deposits along channel margins and on rock highs.

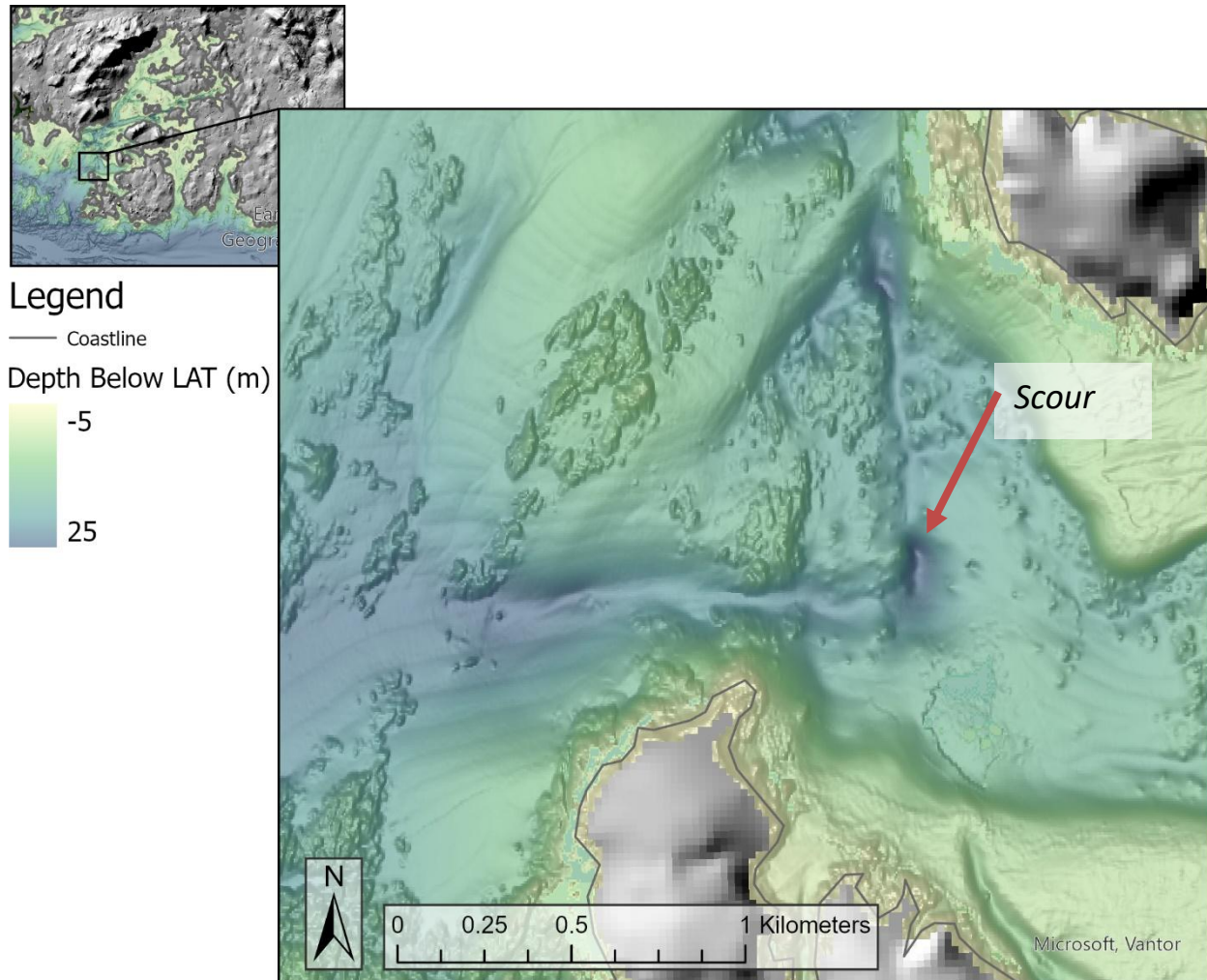


Figure 9: Evidence of tide driven scour where the channel narrows between bedrock outcrops, concentrating flow and erosion.

Adjacent to, and in places within, the main channel are multiple localised depressions, often referred to in survey descriptions as “deep holes” (Sides, et al., 1994). These occur within the main channel and in parts of the basins, including clusters around the head of the bay and between islands, and are described as exceeding 200 m across and around 10 to 15 m deep relative to surrounding seabed. The deepest of these features can reach water depths of several tens of metres in an otherwise shallow bay setting.

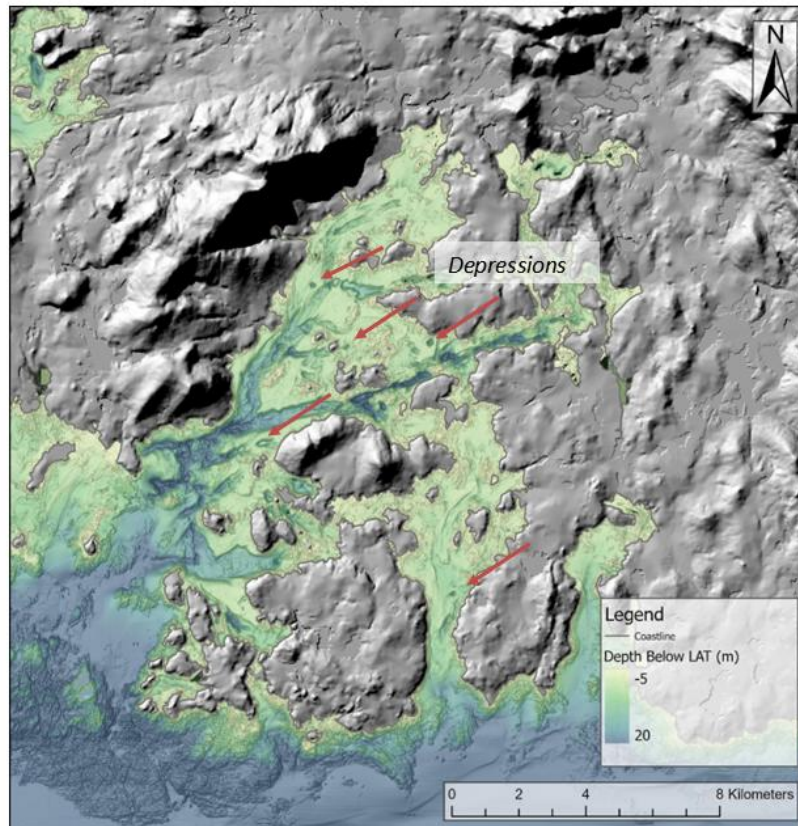


Figure 10: Location of larger depressions within Kilkieran Bay.

Their exact origin is not yet fully resolved from seabed form alone. Some may be scour hollows formed where high velocity flow interacts with bedrock steps or boulder fields, while others could reflect structurally controlled overdeepening along weaker rock zones, or localised glacial or meltwater incision later reworked by tidal currents. What is clear is that these depressions create distinct seabed habitats. Several of the depressions are noted for the very rare tube-dwelling anemone in fine mud (MERC Consultants Ltd, 2005).

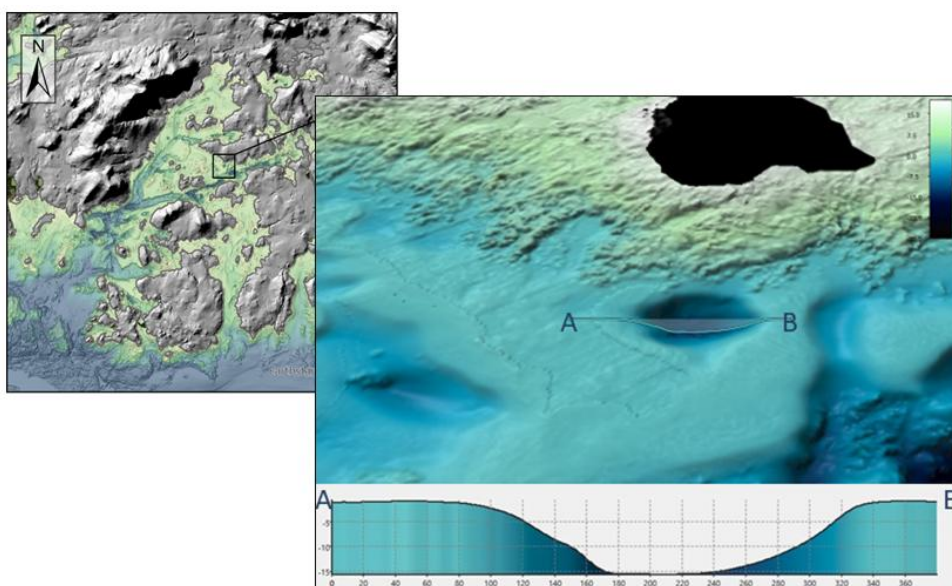


Figure 11: Elevation profile of a depression, with overview location to the left.

Biodiversity

Kilkieran Bay supports an diverse range of marine habitats and species because very different physical environments occur over short distances, from sheltered muddy basins to tide swept bedrock and boulder ground in narrow sounds and channels. Surveys recorded sublittoral sediments ranging from duned maërl through gravel and sand to fine mud, with maërl concentrated near strong current pathways and mud dominating the most sheltered inner bay settings (MERC Consultants Ltd, 2005).

Strong tidal flow along channel margins supports rich reef and boulder communities with abundant filter feeders such as sponges and sea squirts, while muddier basins support burrowing and emergent fauna including sea pens and large anemones. The SAC includes a range Annex I habitat types, including reefs, large shallow inlets and bays, mudflats and sandflats, coastal lagoons, saltmarsh, machair and lowland hay meadows, and it supports protected species including seals and otter (National Parks & Wildlife Service, 2024).

Conclusion

Kilkieran Bay is a structurally complex, island rich inlet where ancient bedrock and modern marine processes combine to create a highly varied seabed and coastline. The bay is underlain by resistant Connemara granites and related intrusions, assembled during closure of the Iapetus Ocean and Caledonian mountain building, and later modified by Quaternary glaciation. The overall bedrock geometry produces the rugged island and rocky islet topography, and the structural grain that controls the channel network through the bay.

Today, tidal exchange is repeatedly funnelled through narrow sounds and channels, producing strong currents that maintain rocky channel margins, strip away finer sediment in the most energetic corridors, and concentrate coarser gravel and boulder lag deposits along channel flanks. In contrast, the sheltered inner basins accumulate mud, creating sharp seabed and habitat transitions over short distances. The presence of multiple large circular depressions further emphasises how localised scour, structural weaknesses and inherited glacial forms can interact in a tide-dominated setting.

This combination of exposed Atlantic approaches, tide swept bedrock and boulder corridors, sheltered muddy basins, maërl-rich substrates and lagoon systems underpins the exceptional biodiversity for which the area is designated.

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