



Marine Geoscience Report 031

Clew Bay

Overview

Clew Bay, County Mayo, is a west-facing embayment on Ireland's Atlantic coast, opening between Clare Island to the west and Achill to the north-west. It is renowned for its maze of small islands and submerged hills; local folklore speaks of 365 islands, one for each day of the year (Destination Westport, 2026). These islands are the tops of drumlins – streamlined glacial hills partly submerged by post-glacial sea-level rise. The result is a classic drowned drumlin landscape in which emergent mounds, tidal channels, spits and bars interlock to create the bay's intricate morphology. The inner coastline between Newport and Westport is especially dense with elongated, east-west trending ridges and peninsulas, many with west-facing cliffs flanked by beaches, shoals and trailing spits derived from erosion of drumlin faces. Together, these features form one of Ireland's clearest coastal drumlin landscapes.

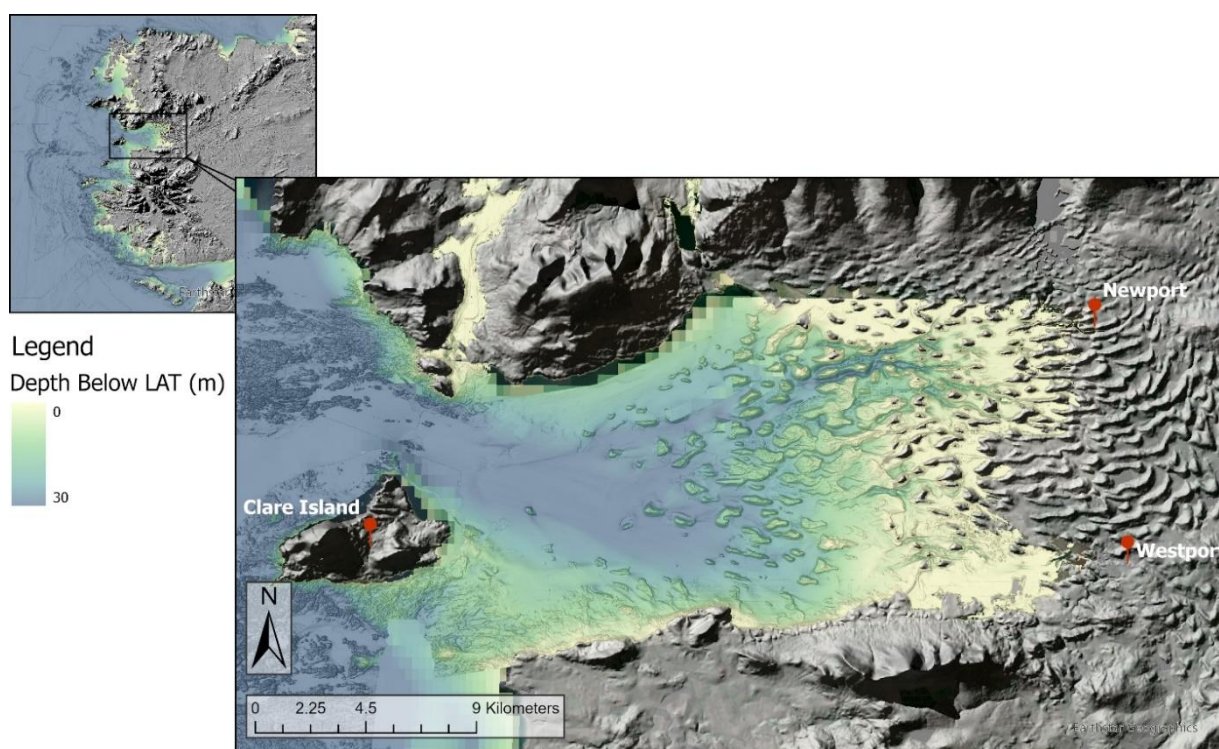


Figure 1: Bathymetry of Clew Bay, compiled from a combination of vessel based acoustic soundings and airborne elevation data (for the intertidal and adjacent land), allowing seamless mapping across the onshore and offshore transition. Depths are referenced to Lowest Astronomical Tide (LAT).

Geological history

Clew Bay sits at the junction of three bedrock belts: Carboniferous sandstones to the north, Lower Carboniferous limestones in the inner bay, and Silurian metasedimentary and meta-igneous rocks along the southern shores beneath Croagh Patrick and its foothills.

After deposition of Carboniferous limestones and sandstones (359 to 299 Ma), the local rock record is largely absent until the Quaternary (2.58 Ma). This gap reflects uplift and prolonged erosion that stripped away any younger cover, so Quaternary deposits now rest directly on older bedrock (Hennessy, et al., 2019).

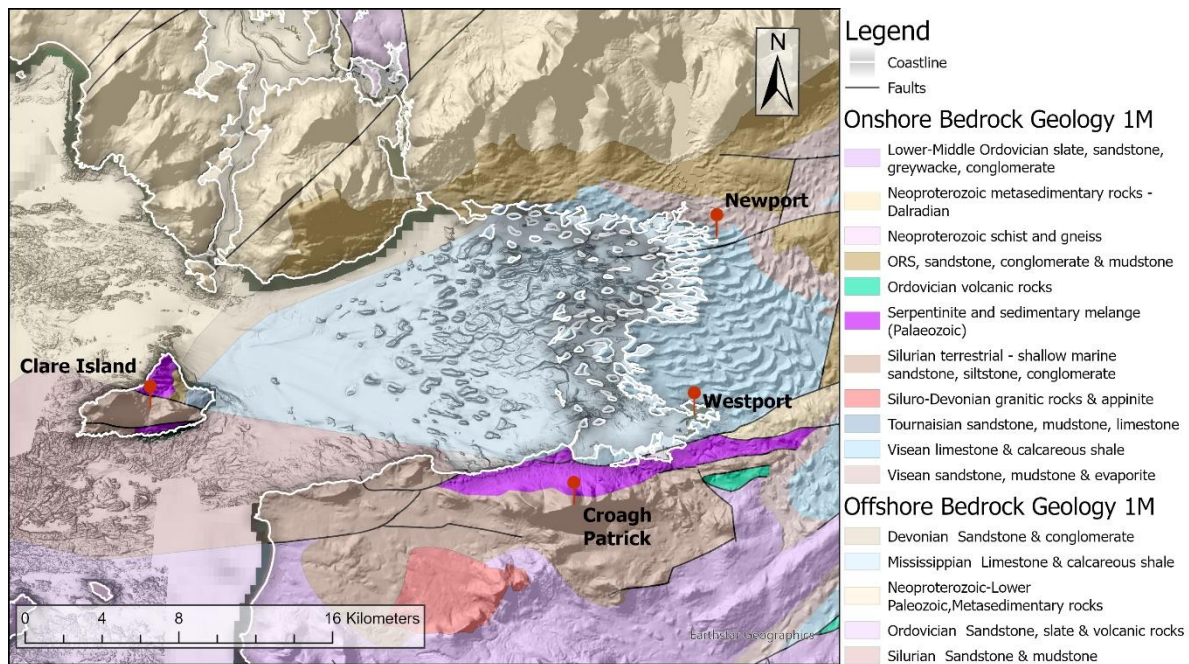


Figure 2: Geology of Clew Bay.

During the Quaternary, repeated glaciations sculpted the lowlands and left the tills, gravels and sands that blanket Clew Bay. At the Last Glacial Maximum, about 24 ka, the British-Irish Ice Sheet flowed mainly westwards across western Ireland, exiting through embayments such as Clew Bay and reaching terminal extent, marked by ice-marginal deposits on the Atlantic shelf, before retreating rapidly (Ó Cofaigh, et al., 2012).

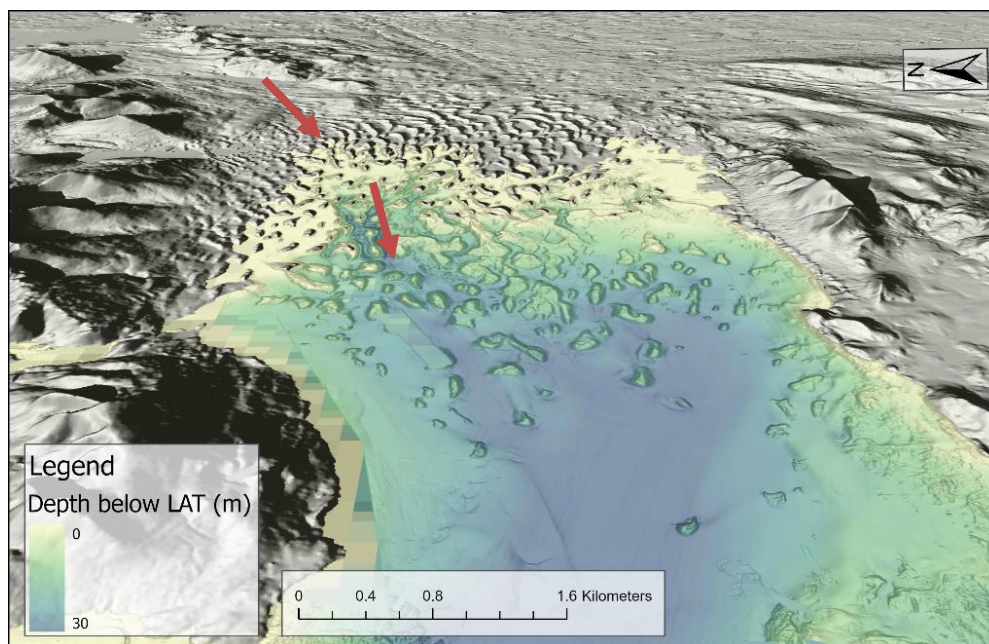


Figure 3: 3D bathymetry of Clew Bay, with arrows indicating ice flow direction.

Drumlin formation

A drumlin is an oval hill of glacial till formed at the bed of a moving ice sheet and aligned with the direction of ice flow. Till is the unsorted debris of glaciation, a mix of clay, sand, pebbles and boulders. In plan view, drumlins are usually oval with a long axis that records former flow; in profile the stoss side is typically blunter and steeper and the lee side more tapered (University of Sheffield, n.d.). The word comes from Irish *droimnín*, meaning a small ridge (Burren and Cliffs of Moher Geopark, 2013).

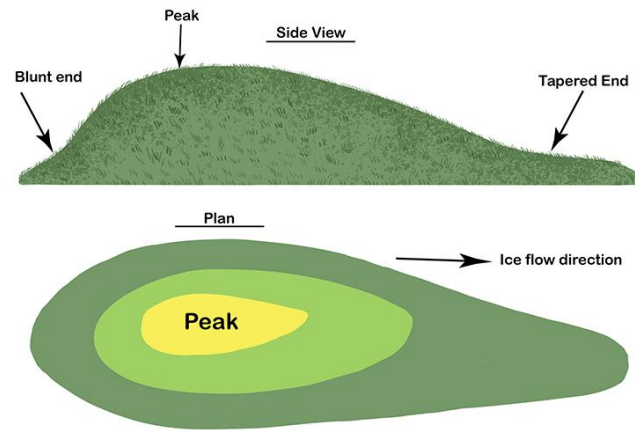


Figure 4: Diagram showing the geometry of a drumlin in plan and side view. Image from (Mammoth Memory, n.d.).

Drumlins are widely understood to form beneath ice sheets, commonly in zones of compressive flow, through a combination of subglacial erosion and deposition. Ongoing research is focused on refining the precise mechanisms and the relative importance of these processes, because individual drumlins can be predominantly erosional, predominantly depositional (sometimes initiated over a bedrock obstacle), or a mixture of both (Schomacker, et al., 2018).

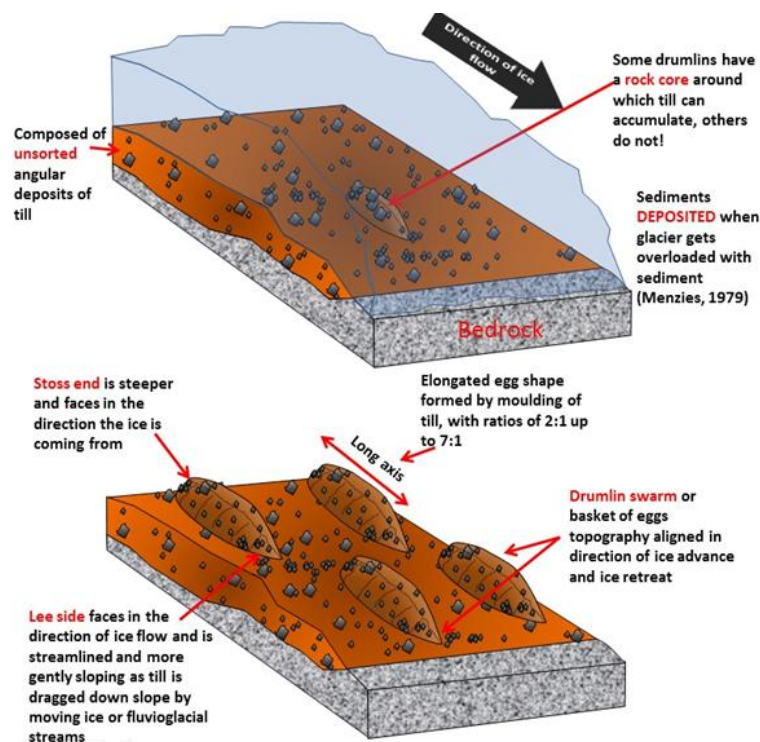


Figure 5: Diagram showing drumlin formation. Image from (Gamesby, 2012).

Drumlins of Clew Bay

Clew Bay hosts a dense swarm of drumlins and related ridges that continue seamlessly from the land into the shallow seabed. INFOMAR bathymetry data shows that the drumlins in the inner bay are up to 1 km in length and rise to 10 m above the surrounding seabed.

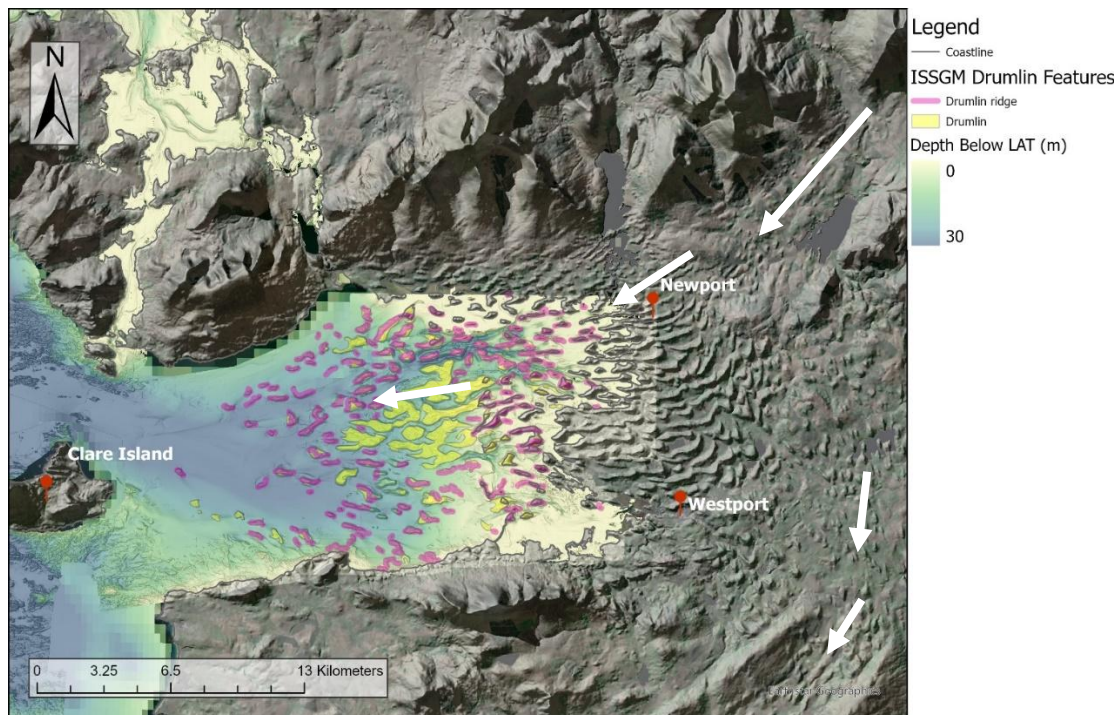


Figure 6: Mapped drumlins offshore, from (Arosio, et al., 2023), with white arrows indicating the direction of ice flow.

Many of the drumlins are aligned south-west to north-east, owing to an initial ice flow direction from the north-east and then westwards towards the offshore continental shelf (Hiemstra, et al., 2011). Later ice movement from the south-east results in the drumlins having north-west pointing ridge ends, such that many drumlins are now slightly bow-shaped (Hennessy, et al., 2019).

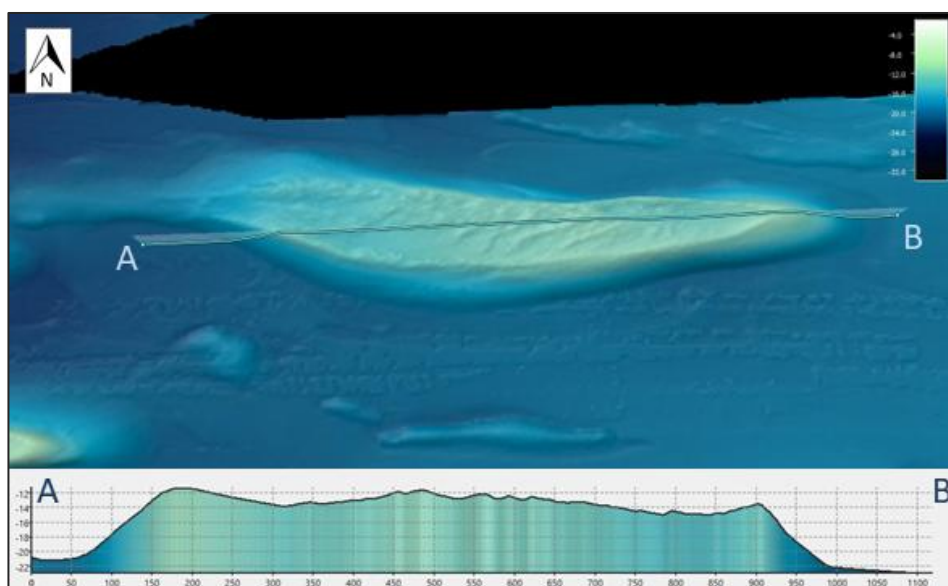


Figure 7: 3D bathymetry and profile of a bow-shaped drumlin.

Acoustic backscatter, which records the strength of the sonar echo, helps separate seabed types: compact, coarse materials such as till give stronger returns, while finer sands and muds return weaker signals. Sampling and backscatter mapping indicate that the drumlin crests are dominated by dense till and coarser sediments, while intervening lows often host finer sandy muds and muddy sands. The QuIMPeR II survey also mapped extensive concentrations of mobile sand caught between partly buried and buried drumlins, with sand packages locally up to about 20 m thick. These sediment stores are useful for understanding how beaches and nearshore bars around the bay are replenished and connected (Sheehan, 2019).

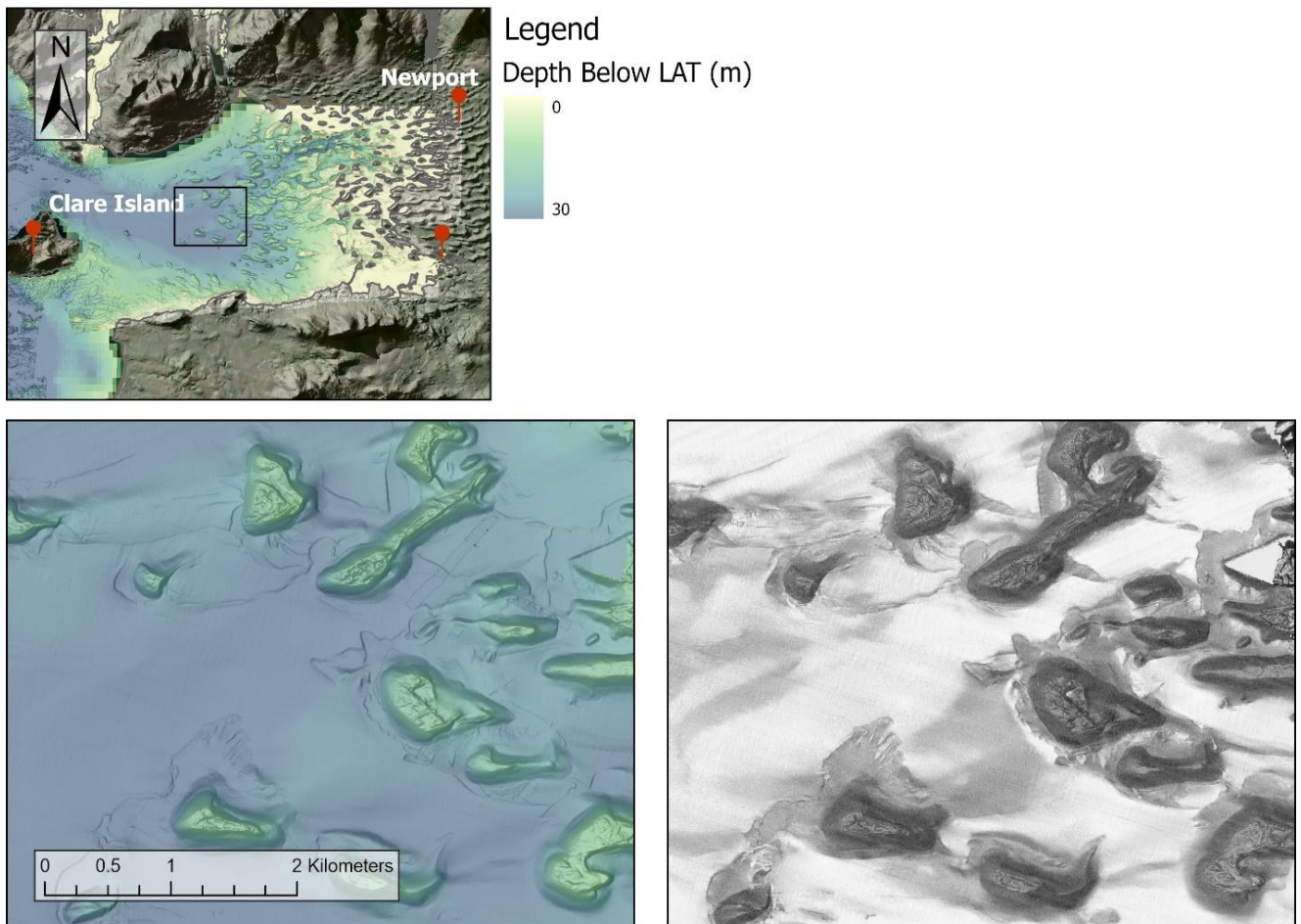


Figure 10: Bathymetry (left) and acoustic backscatter (right), with inset showing the survey location. In the backscatter image, darker tones indicate stronger returns from harder or coarser seabed (e.g. glacial till), while lighter tones indicate weaker returns from softer, finer-grained sediments (typically sand–mud and mud).

Biodiversity

Across the bay, islands, tidal channels and sheltered coves together create a mosaic of habitats. The Clew Bay Complex is designated as a Special Area of Conservation for extensive tidal flats, saltmarsh, reefs and the transitional waters around the drumlin fringes (National Parks & Wildlife Service, 2021). The variety in seabed substrates, with till-cored highs, sandy aprons and muddy lows, helps support diverse communities of algae, invertebrates and fish, while beaches and spits that trail from the drumlins provide roosting and feeding grounds for birds.



Figure 11: The drowned drumlin landscape of Clew Bay, viewed from the south. Image from (Hennessy, et al., 2019).

Conclusion

Clew Bay records the combined influence of bedrock geology, ice-sheet movement and coastal processes. Carboniferous limestones and sandstones, together with Silurian rocks along the southern shores, provide the underlying framework. During the last glaciation, ice moulded a dense field of till drumlins, and post-glacial sea-level rise later drowned the lowlands, leaving many of the mounds as islands with tidal corridors between them.

Seabed mapping shows that the drumlins continue offshore with the same streamlined forms, strong till signatures and locally gravelly caps seen on land. Finer sediment has accumulated in the intervening lows, while tidal currents continue to rework sand and maintain deeper channels between the drumlin highs.

Clew Bay remains one of Ireland's clearest examples of a drowned drumlin landscape. Its value lies in the scale and preservation of its glacial landforms, and in the way these features continue to shape seabed morphology, sediment movement, habitats and navigation within the bay.

Bibliography

- Arosio, R. et al., 2023. The geomorphology of Ireland's continental shelf. *Journal of Maps*.
- Burren and Cliffs of Moher Geopark, 2013. *Drumlins*, s.l.: s.n.
- Destination Westport, 2026. *Clew Bay and the Islands*. [Online]
Available at: <https://www.destinationwestport.com/directory/clew-bay-and-the-islands>
[Accessed 2026].
- Gamesby, R., 2012. *Glacial Landforms*. [Online]
Available at: <https://www.coolgeography.co.uk/A-level/AQA/Year%2012/Cold%20environs/Glacial%20Landforms/Landforms.htm>
- Hennessy, R., Feely, M., Parkes, M. & Gatley, S., 2019. *The Geological Heritage of County Mayo: An audit of County Geological Sites in County Mayo*, s.l.: Geological Survey Ireland.
- Hiemstra, J. F., Kulesa, B., King, E. C. & Ntarlagiannis, D., 2011. The use of integrated sedimentological and geophysical methods in drumlin research –a case study of Pigeon Point, Clew Bay, Northwest Ireland. *Earth Surface Processes and Landforms*, p. 1860–1871.
- Mammoth Memory, n.d. *Drumlin*. [Online]
Available at: <https://mammothmemory.net/geography/geography-vocabulary/glacial-landscapes/drumlin.html>
- National Parks & Wildlife Service, 2021. *Clew Bay Complex SAC*, s.l.: Department of Housing, Local Government and Heritage.
- Ó Cofaigh, C., Telfer, M., Bailey, R. & Evans, D., 2012. Late Pleistocene chronostratigraphy and ice sheet limits, southern Ireland. *Quaternary Science Reviews*, pp. 160-179.
- Schomacker, A., Johnson, M. D. & Möller, P., 2018. Drumlin formation: a mystery or not?. *GFF*, pp. 91-92.
- Sheehan, K., 2019. *Quantifying Irish Marine Placer Resources (QuIMPeR) II: Survey CV19011 - R.V. Celtic Voyager, Clew Bay*, s.l.: INFOMAR.
- University of Sheffield, n.d. *Drumlins*. [Online]
Available at: <https://sheffield.ac.uk/drumlins/definition>
[Accessed 2026].