INFOMAR Integrated Mapping for the Sustainable Development of Ireland's Marine Resource
An Roinn Aeráide, Fuinnimh agus Comhshaoil Department of Climate, Energy and the Environment
Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann
Marine Institute Foras na Mara

Marine Geoscience Report 004

Old Head of Kinsale

Overview

The Old Head of Kinsale is a prominent peninsula located on the southern coast of County Cork, approximately 30 km to the southwest of Cork city. Extending nearly 5 km into the Atlantic Ocean, the Old Head features dramatic cliffs and rugged coastlines that showcase the transition between the Devonian and Carboniferous periods. The geology of the peninsula preserves evidence of ancient environments and the tectonic processes that shaped the region's development. As well as being recognised as a County Geological site by the Geological Heritage Project, the site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the Kittiwake and Guillemot (National Parks & Wildlife Service, 2014).

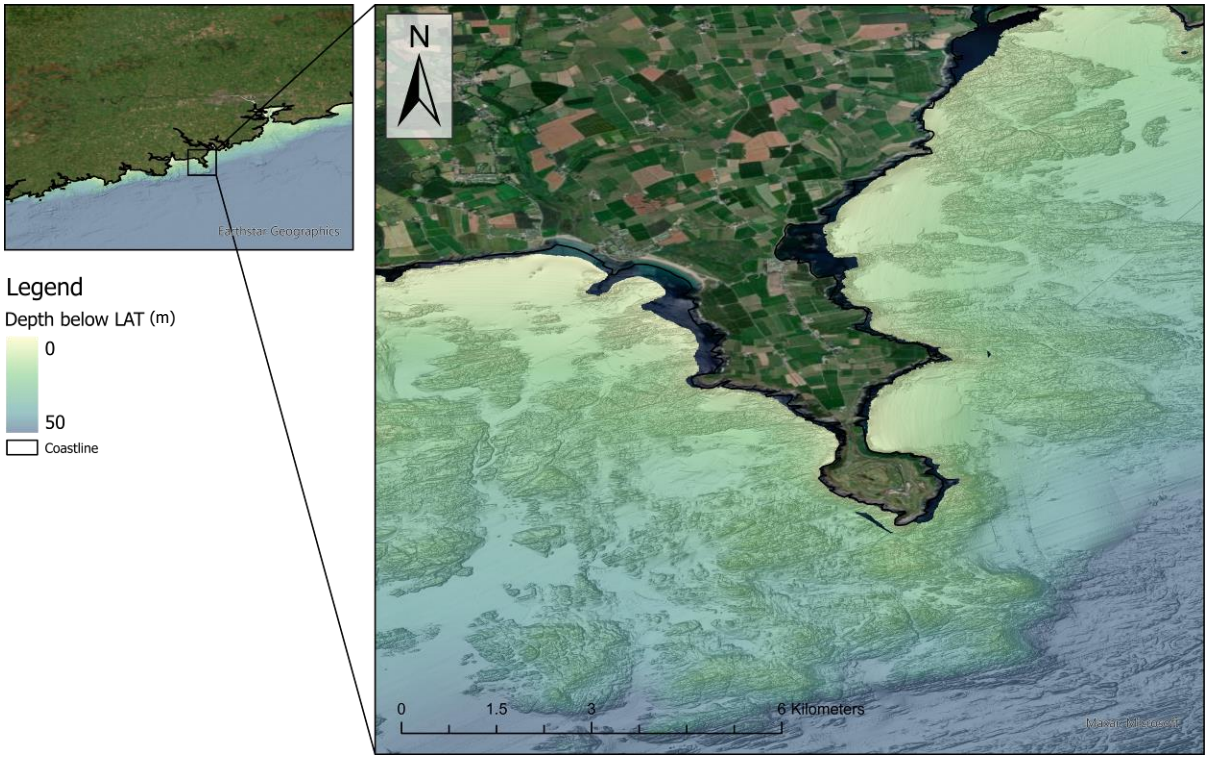

Figure 1: Overview of bathymetry around the Old Head of Kinsale. Depths are given referenced to Lowest Astronomical Tide (LAT).

Geology of Cork

The geology of County Cork is primarily composed of Devonian and Carboniferous sedimentary rocks, which were deposited between approximately 370 and 310 million years ago (Ma). These rocks reflect a transition from terrestrial to marine environments, with the Devonian representing a period of semi-desert conditions and the Carboniferous marking the onset of shallow marine environments in the South Munster Basin (Sleeman & Pracht, 1994).

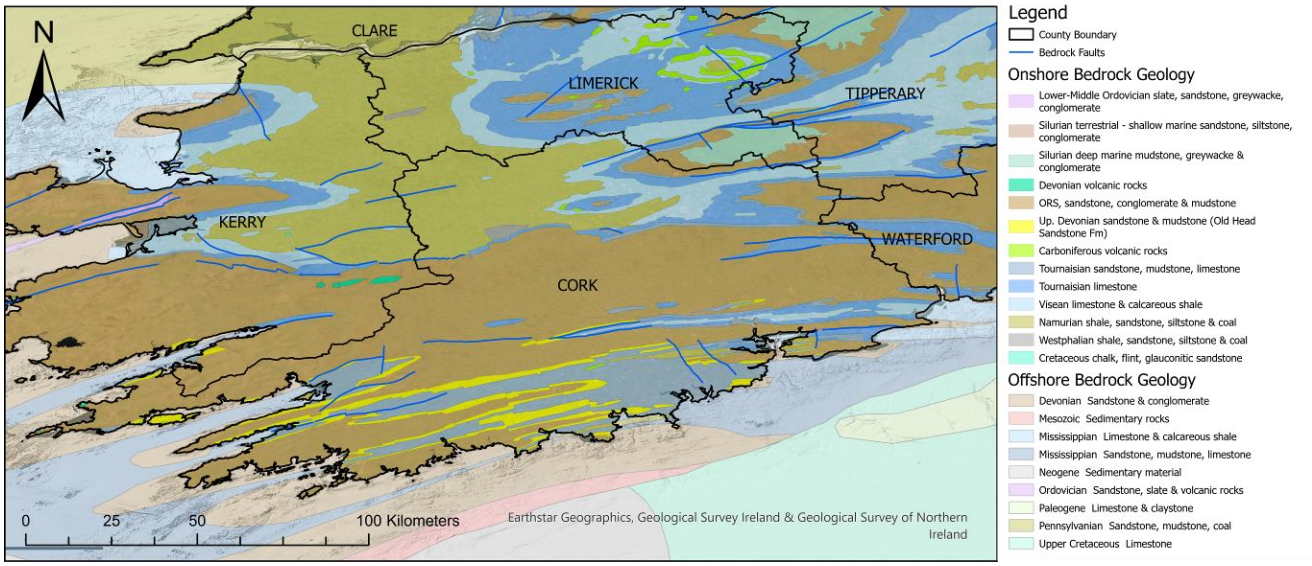

Figure 2: Geology of County Cork.

During the Devonian period, 420 to 358 Ma, Cork's landscape was shaped by semi-arid conditions. Sediments consisting of sandstones, conglomerates, and mudstones were deposited in river systems that were prone to flash floods. These rivers transported material from mountain ranges to the north, and the sediments accumulated in a large trough known as the Munster Basin (Sleeman & Pracht, 1994).

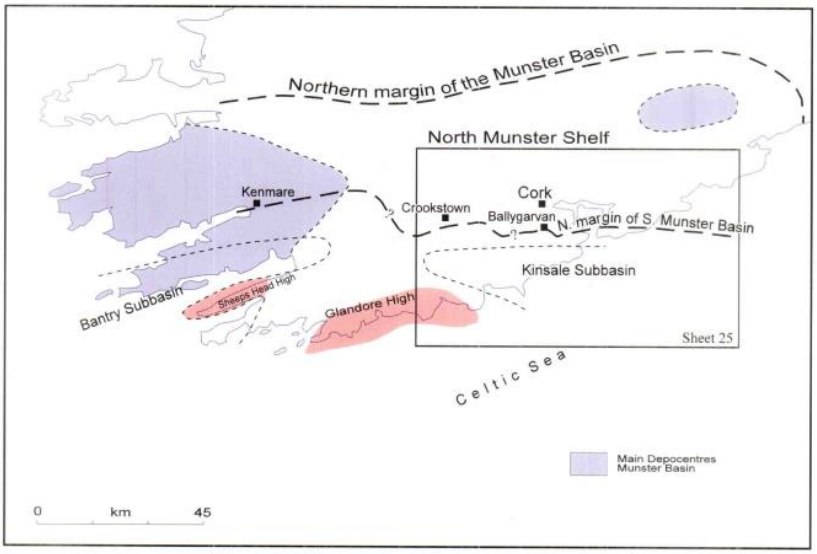

Figure 3: Structural framework of County Cork. Image from (Sleeman & Pracht, 1994).

The transition to the Carboniferous period saw the South Munster Basin gradually deepen, leading to the deposition of marine sandstones and mudstones. In contrast, limestones were deposited to the north on the North Munster Shelf, reflecting a shallow tropical sea. Towards the end of the Carboniferous period, 298 Ma, the region underwent significant tectonic activity during the Variscan Orogeny, a mountain-building event that caused the rocks to be uplifted, folded, and faulted (Sleeman & Pracht, 1994). This event produced SW – NE trending folds and faults, which are evident in the peninsulas of southwest Ireland. The more resistant Devonian Old Red Sandstone (ORS) forms the ridges and headlands, while the softer Carboniferous limestones, sandstones, and mudstones have been

eroded to form bays and valleys. The region also experienced faulting, with many NNW – SSE trending faulting. The faults with this trend are dominantly strike-slip faults with a dextral shear (Sleeman & Pracht, 1994). A strike-slip fault results in dominantly horizontal motion, and a dextral shear results in the rocks moving parallel to the fault, with the far block moving to the right, as illustrated in the image below (Panchuk, 2021).

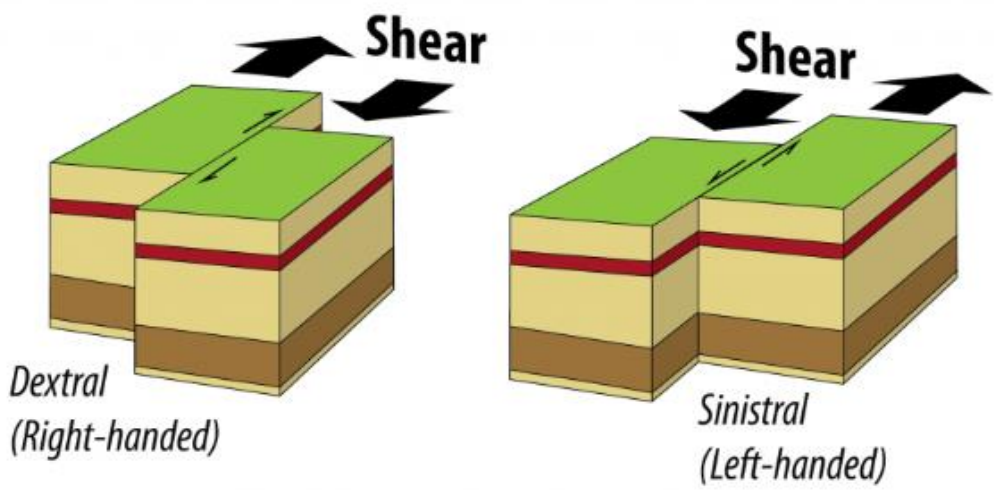

Figure 4: Block diagram of dextral and sinistral strike-slip faults. Image from (Panchuk, 2021).

INFOMAR bathymetry data can be used to map out the probable offshore extension of these faults, in the bedrock outcrop on the seabed, as can be seen in the figure below.

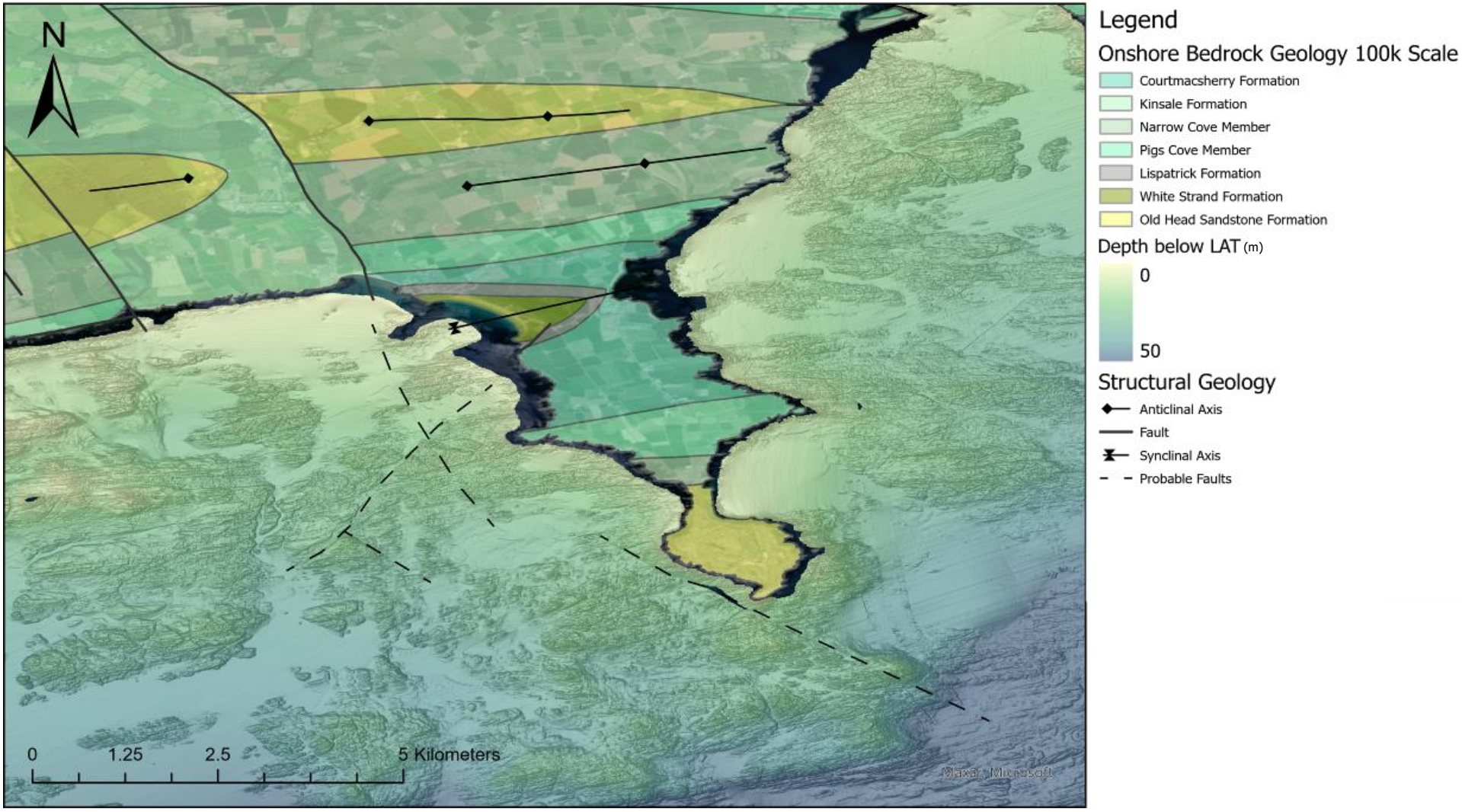

Figure 4: Probable expressions of faults evident in bedrock outcrop on the seabed.

Following the Variscan Orogeny, there is little geological evidence in South Cork from the end of the Carboniferous period until the Quaternary, around 2.58 million years ago. This gap in the geological record is largely due to prolonged uplift and erosion, which removed much of the deposited material from this time (Hennessy, et al., 2023). As a result, much of the evidence from this extended interval has been lost.

During the Quaternary, much of the region's bedrock was covered by glacial sediments, particularly in valleys and low-lying areas. These sediments were deposited either directly by glacier ice or through meltwater from retreating glaciers (Sleeman & Pracht, 1994). The glacial till is relatively fine-grained but contains angular blocks of sandstone (Corcoran, 1989).

Geology of Kinsale Head

The Old Head of Kinsale provides an exceptional cross-section of Upper Devonian to Lower Carboniferous rocks, exposing a sequence up to 2000 m thick of sedimentary deposits that record the environmental changes of the time (Hennessy, et al., 2023).

The southern tip of the Old Head is composed of the Old Head Sandstone Formation, which dates to the uppermost Devonian period, over 355 Ma. These sandstones are characterized by ripple marks, mud streaks, and layers of intertidal and subtidal deposits, indicating sediments were laid down in shallow coastal waters, likely influenced by tidal currents (Sleeman & Pracht, 1994).

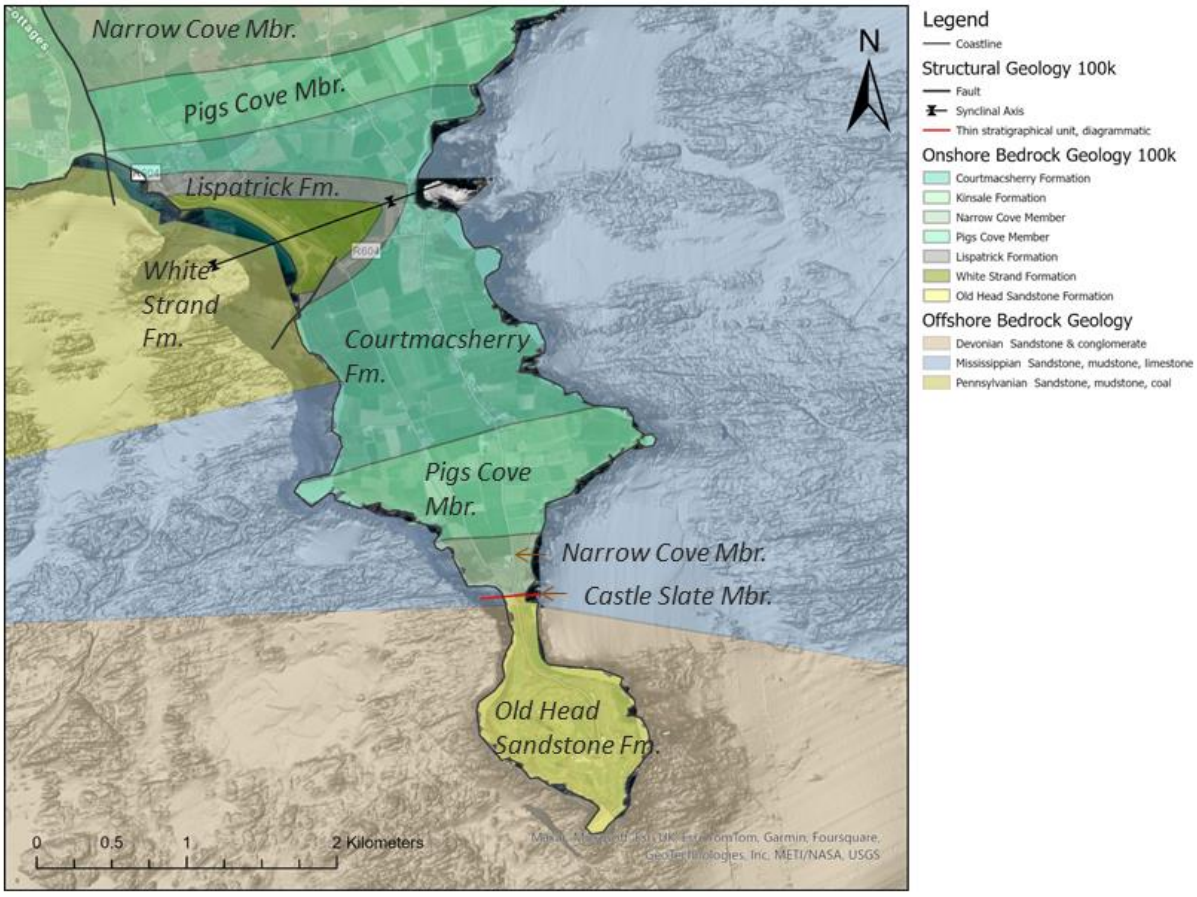

Figure 5: Onshore and offshore geology of the Old Head of Kinsale with formations and members labelled.

North of the Old Head Sandstone Formation, the Kinsale Formation becomes the dominant rock unit. The rocks within the Kinsale Formation are sub-divided into three members: The Castle Slate Member, the Narrow Cove Member and the Pigs Cove Member (Corcoran, 1989). This formation is significant as it marks the Devonian-Carboniferous boundary (Hennessy, et al., 2023). At the transition between the Old Head and Kinsale Formation, the peninsula narrows dramatically, exposing a sequence of easily eroded soft shales, comprising the Castle Slate Member. The Castle Slate member marks the start of the Carboniferous period (Sleeman & Pracht, 1994). The Kinsale Formation consists primarily of mudstones interspersed with sand lenses, deposited in a shallow marine shelf environment.

Figure 6: Old Head Sandstone formation (lighter rock to the right) and the Kinsale Formation (darker rock to the left) contact marking the Devonian-Carboniferous boundary. Image from Hennessy et al (2023).

The transition from the Kinsale Formation to the overlying White Strand Formation marks a shift in sedimentation environment. The White Strand Formation consists of interbedded sandstones and mudstones, with evidence of slumping, suggesting deposition on steep slopes in a deepening marine environment (Sleeman & Pracht, 1994).

The presence of synclines in this formation reflects the intense folding that occurred during the Variscan Orogeny (Sleeman & Pracht, 1994). The image below shows the Courtmacsherry syncline and its expression on the seabed. A syncline folds the rock strata in a concave upwards shape, resulting in younger rocks being flanked on both sides by older rocks. In the Courtmacsherry syncline, this results in the younger White Strand Formation being flanked to the north, south and east by the older Lispatrick and Courtmacsherry formations.

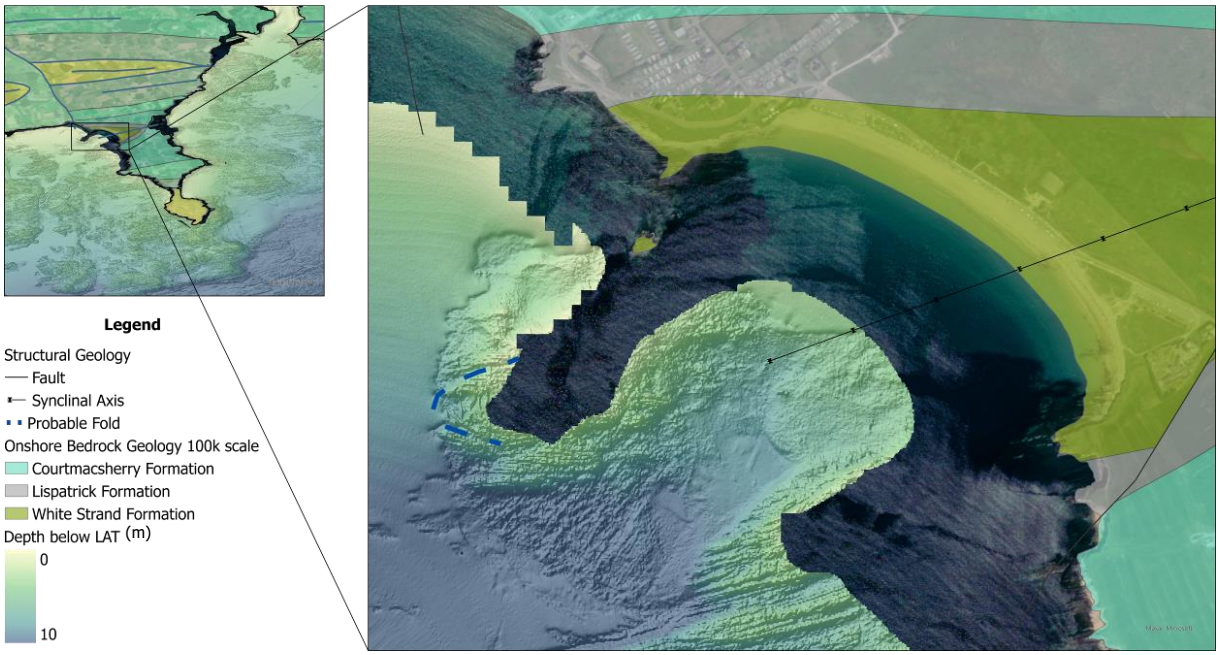

Figure 7: Expression of folded bedrock, part of the Courtmacsherry Syncline, evident in bedrock outcrop on the seafloor.

Conclusion

The Old Head of Kinsale is a geologically significant site that showcases the transition from the Devonian semi-desert environment to the Carboniferous marine environment. The peninsula's landscape is a direct product of the underlying bedrock geology, shaped by sedimentation processes and tectonic forces during the Variscan Orogeny. Understanding the geology of the Old Head of Kinsale is essential not only for academic study but also for appreciating how bedrock geology influences coastal landscapes and the shaping of Ireland's rugged coastline. The steeply inclined cliffs and folded rock formations are a testament to millions of years of geological evolution, providing a valuable record of Ireland's ancient past.

Bibliography

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