

Identifying important coastal geological sites

The Irish Geological Heritage (IGH) Programme of the Geological Survey of Ireland is conducting the identification and documentation of Ireland's geological and geomorphological heritage sites of importance. The sixteen different themes include one on Coastal Geomorphology, although the work for this theme has progressed only as far as an indicative list of sites to be considered.

The IGH Programme makes recommendations to the National Parks and Wildlife Service on geological sites that should be designated as Natural Heritage Areas (NHA) under the Wildlife (Amendment) Act 2000 which specifically includes geology, complementing Special Areas of Conservation (SAC) designated under the European Habitats Directive.

Listing of County Geological Sites (CGS) provides a second tier of recognition through inclusion in County Development Plans. Some counties including Sligo, Clare, Meath and Fingal have commissioned the IGH Programme to conduct audits of geological heritage sites within their counties. Heritage Council funding has supported these projects and heritage officers are able to use these reports to both ensure protection of sites within the planning system, and the local promotion of geological heritage.



Streedagh Point, Co. Sligo. Each bed of rock represents a former sea floor - of a tropical sea full of corals.

In practice, many geological heritage sites are found to overlap or be within areas designated as SACs or identified as NHA. The geodiversity identified in many of the sites is the foundation of the biodiversity which already has protection or recognition. However, for many geological sites, and especially those on the coast, there is very little required other than not obscuring the scientific interest by coastal protection works. Geology should of course be considered in any project affecting a coastal area.

How to get involved

Find out more about the IGH Programme through the GSI website [www.gsi.ie](http://www.gsi.ie) Earth Science 2000 is a group raising awareness of geology throughout Ireland. Check the website <http://www.habitas.org.uk/es2k/> and read the magazine *Earth Science Ireland*. Get out and about with geologists in a friendly, informal way on field trips with the Irish Geological Association ([www.geology.ie](http://www.geology.ie)) For Northern Ireland's geological heritage see [http://www.ehsni.gov.uk/landscape/earth\\_science.htm](http://www.ehsni.gov.uk/landscape/earth_science.htm)



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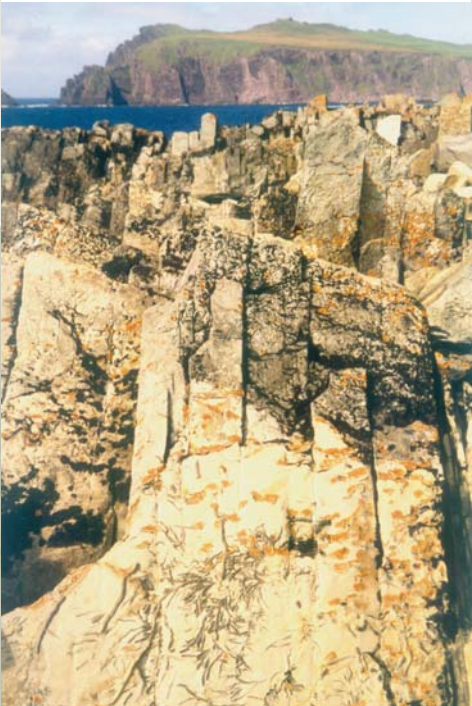
The role of geology in Ireland's coastline

There would be no coast without geology. The never-ending interplay of land and sea is determined by the fundamental geology of the land, how the sea destroys or builds it, and the relative levels of each through time.

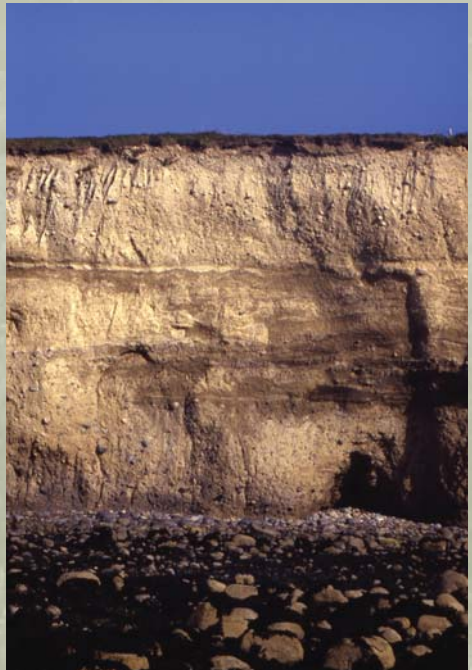
Long continuous coastal sections allow much better interpretation than piecing together the geology from only a few inland quarries. But for soft rocks or unconsolidated sediments the slow retreat of the cliffs also provides continual fresh exposures as the sea removes material from collapses and slides, especially during storms.

On the coast where sediment deposition rather than erosion occurs, the processes of sedimentation (e.g. dunes, sand bars, mudflats and lagoons), and the animal life within, all provide valuable comparisons for understanding ancient sedimentary environments now preserved as rocks.

Some of our coasts are internationally famous amongst geologists. The coast of West Clare is widely used by the oil industry to understand the Carboniferous age rocks and structures that formed in a delta environment. They can see onshore what they are normally trying to interpret from boreholes drilled offshore and from geophysical data, in oil basins from around the world. Between Rush and Skerries lies a superb section through 330 million years old limestone. This sequence formed in a tropical sea on the edge of a continent; in fact all around the coast are geological sections and landforms of scientific importance and natural aesthetic value.



Fossils of worms burrowing in sands 420 million years ago have survived to the present day in the Dingle peninsula.



Unconsolidated glacial till behaves very differently to hard bedded rocks and provides different character to coastlines.

From a purely geological perspective present human worries about sea level change through global warming can seem inconsequential. However, understanding how both climate and sea level have changed in the past, through the study of geology, can be the key to genuine interpretation of today's patterns and a means to predict the immediate future.

Exposures of rock around Ireland's coasts provide some absolutely critical sections for scientific understanding and are some of the best places imaginable for sheer exuberant appreciation of nature's splendour. With such a long coastline around the whole island there is an enormous range of interactions between the sea and different rocks and sediments, landforms and structures - geodiversity.

For geologists studying hard rocks, the sea keeps sections of cliff and foreshore free of soil and weathered rock debris. They show three-dimensional exposures, and are often the best places to study the geology of an area.



A sand volcano in West Clare, originally formed by water escaping from sand beds around 300 million years ago, one of many stories told by the rocks.



Streedagh, County Sligo. A tidal lagoon lies behind a sand barrier connecting small islands.



Valentia harbour: The view from Valentia to Cahirciveen shows the former river valley drowned by rising sea levels after the Ice Age, typical of Cork and Kerry coasts.



The sea exploits joints and faults in rocks to leave free standing stacks.



# Irish Coastal Geology

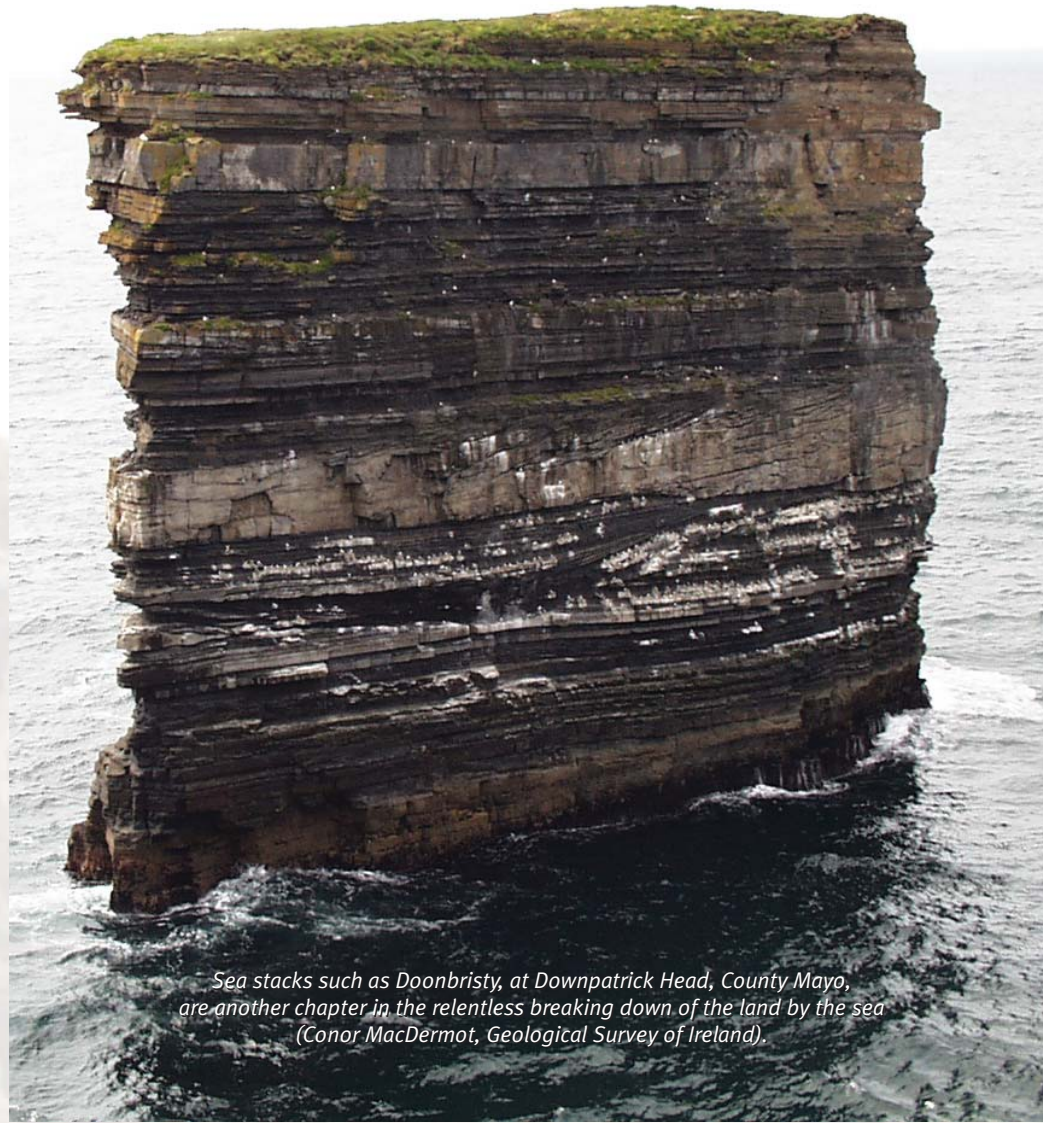
## Natural dynamic patterns of change

Whilst the coast offers excellent opportunities to see all types of geology in cliff exposures, it also shows the geomorphology – the development of different coastal landforms. The range of landforms produced is enormous, and they are all dynamic – the changes which occur within people's lifetimes are extremely rapid compared to some geological changes.

The shape of cliffs and coasts – the geodiversity – is dependent on the characteristics of the rock mass. The relative resistance to erosion determines headlands and bays. The spacing and orientation of physical breaks in rock such as bedding, joints, folds and fractures, influences whether we get cliffs or otherwise. The weathering a rock has undergone will weaken it for erosion by the sea.



*A drumlin is being eroded by the sea near Barna, Co. Galway – the face collapses as the sea removes glacial till at the base and undercuts the mixed sediment.*



*Sea stacks such as Doonbristy, at Downpatrick Head, County Mayo, are another chapter in the relentless breaking down of the land by the sea (Conor MacDermot, Geological Survey of Ireland).*



*Blow holes or puffing holes are a spectacular sight when the swell of the sea is channelled underground in enlarged passages to fountain out of an inland window.*



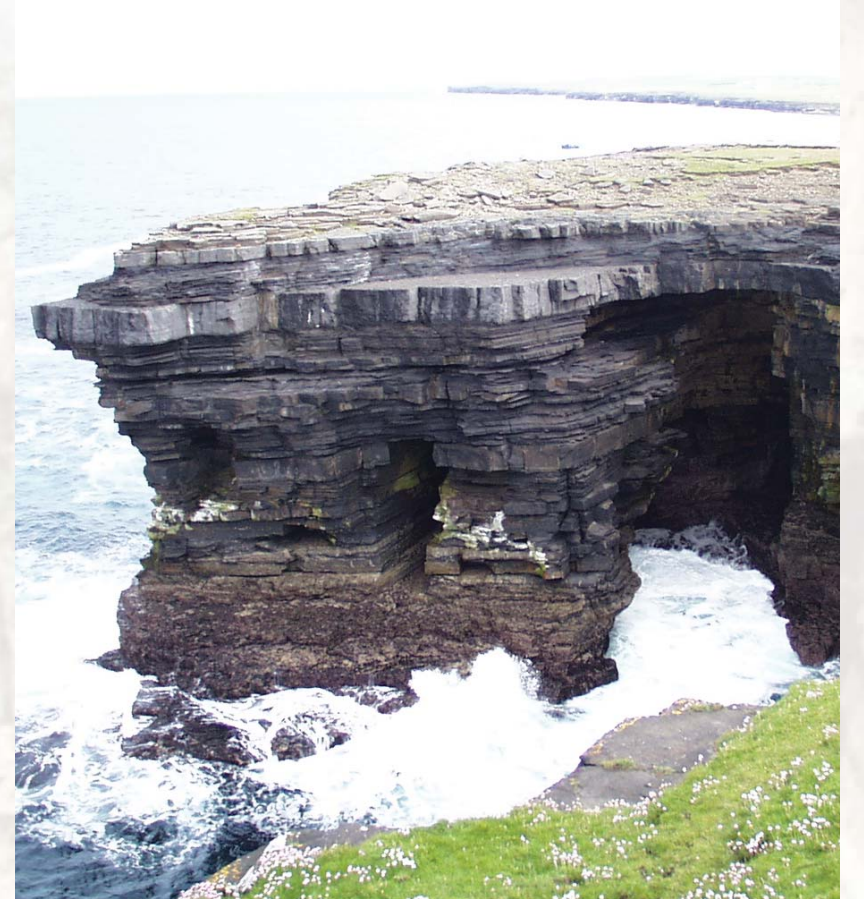
*The view downwards from the clifftop at Mullaghmore, Co. Sligo, shows how the thickness of the horizontal rock layers – the beds – and the spacing of the vertical fractures – the joints – controls the size and shape of blocks the sea can erode. These blocks are cubes about one metre in size.*



*Clew Bay is renowned for its drowned drumlin field – rising sea levels after ice sheets melted flooded the low lying areas leaving numerous islets.*

Accumulating sediment on beaches or offshore will develop protection against erosion, but will be subject to continual shifting with the tides and currents. Following the end of the Ice Age about 10,000 years ago the sea rose and flooded many river valleys to form the long inlets of the north and west coasts.

A myriad of influences have been and still are at work and there is no doubt that our geological heritage in the coastal zone is some of the very finest.



*The formation of sea caves, undercut cliffs and natural arches are all influenced by the internal structures of the rocks as well as other properties. Near horizontal compact beds of sandstone like these lend themselves to a wide variety of landforms. (Conor MacDermot, Geological Survey of Ireland).*



*Natural arches such as the Bridges of Ross in County Clare are one of the spectacular features produced by the eternal battle between sea and rock. The gentle folds of near horizontal beds of strong sandstone provides the right structural strength, but eventually the sea will break the bridges (Clare McAteer, Geological Survey of Ireland).*

## Human Impacts and Coastal Geology

### Dredging

As the demand for aggregate grows, marine sands and gravels in shallow water are likely to become increasingly attractive as sources of supply. It will be important to ensure that any extraction does not result in depletion of beaches and mudflats. There will be a strong onus on the industry to show no serious impacts on coastal geology as well as marine life.

### Coastal quarries

In countries like Norway and Scotland, coastal superquarries are developed which reduce the need to quarry elsewhere, and lessen the transport impacts. Development of coastal superquarries in Ireland would need a national debate, as suitable rock types are likely to be in areas of high scenic and nature conservation value.

### Beach protection and replenishment

Coastal protection against erosion in one place may reduce the supply of sand to a beach further along the coast. These impacts may be compensated for by depositing dredged aggregate where beach loss occurs. Soft engineering, of boulders dumped offshore, may also absorb energy to protect vulnerable beaches.



*Even simple coastal protection measures like these may obscure critical rock exposures, for understanding regional geology of an area, or for teaching purposes. When engineers and local authorities have full information available to them on Natural Heritage Areas and County Geological Sites, consultation can take place before work begins to ensure geological heritage is not overlooked*

### Sand dunes

Sand dunes are important coastal landforms, and are also often protected habitats. Although they are naturally dynamic and may change with storms and seasons, human activity is the most destabilising influence. This is normally through damage to vegetation cover.

Cover Photo: The spectacular sea cliffs at Mizen Head, County Cork. The ravine is viewed from the bridge across to the lighthouse visitor centre.

Inset Cover Photo: Unconsolidated glacial sediments north of Greystones, Co. Wicklow, are prone to collapse and slips which cause the cliffs to retreat

### Oil and gas exploration

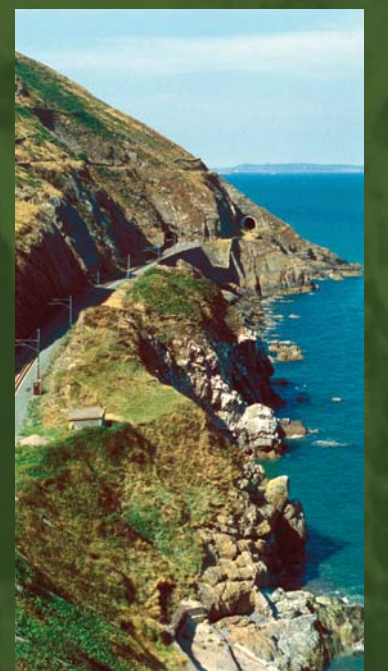
Most of Ireland's territory is offshore and although GSI Seabed mapping is now giving outline knowledge, the subsurface is still poorly known. Exploration for hydrocarbons has little actual impact on coastal geology, taking place far from shore, though other impacts are well known such as oil spills, and seismic impacts on marine animals.



*The staining of copper minerals seen in the sea cliffs at Dooneen, Allihies, West Cork, is typical of the geological indications of economic resources exploited by humans from Bronze Age times onwards. (J.Pulsford, Geological Survey of Ireland)*

### Coastal armour

Hard engineering solutions to coastal 'protection' are generally problematic with often-detrimental impacts experienced in adjacent areas. Hard rock boulders are used in some essential situations such as supporting the railway line in Killiney Bay, in Dublin. Rocks such as those from Arklow Head quarry may be deposited directly where needed by barge.



*A thorough understanding of geology and any active erosion processes is required to ensure that transport routes such as the railway around Bray Head, Co. Wicklow, are safe, stable and long-lasting.*

### Earthquakes and tsunami

Although in global terms, Ireland is on a very stable part of the earth's crust, occasional earthquakes do occur and may cause disruption of communications and other services on the sea floor, as well as damage on land. There is a very slight concern that a volcanic event or a massive submarine slide in the Canaries could cause a tsunami that would affect southern Ireland as the waves travel 1000's of km. Irish geologists are participating in attempts to set up an early warning system for the north east Atlantic Ocean.

An initiative of The Heritage Council [www.heritagecouncil.ie](http://www.heritagecouncil.ie)  
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