

Quaternary Geological Map of Ireland

Scale: 1:500,000

Derived from the Geological Survey Ireland Quaternary Sediments and Geomorphology Map and published under authority of the Director, Simon Velupillai, Geological Survey Ireland, 2017.

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For data sources see Geological Survey Ireland Quaternary Sediments and Geomorphology Map and OSNI 1:250,000 Quaternary Map of Northern Ireland.

Digital map compiled in ArcGIS 10.3, designed by the Cartography Unit and published under authority of the Director, Simon Velupillai, Geological Survey Ireland, 2017.

An Roinn Cumarsáid, Orliontaíochta ar son na hAiséiríe agus Comhaltas Department of Communications, Climate Action and Environment, © Ireland, 2017.



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Quaternary Sediments

- 1 Peat**
Peat is a post-glacial deposit, consisting mostly of partially decomposed vegetation. The peat may be deposited as blanket bog accumulating in elevated areas with excessive rainfall or as raised bog on a raised ground. Much of Ireland's peat has been cut away for burning as solid fuel or has been oxidized as the result of agricultural drainage schemes.
- 2 Lacustrine sediments**
Lacustrine sediments were deposited during deglaciation or post-glacially in depressions left behind by the ice during retreat. These sediments are generally composed of silt, silt and clay and are commonly overlain by peat bogs infilling former lakes.
- 3 Alluvium**
Alluvium is a post-glacial deposit along river valleys consisting of generally bedded gravel, sand, silt or clay in a variety of combinations, often with a high percentage of organic carbon (10 - 30%). Alluvium is mapped on modern day river floodplains or Holocene river terraces.
- 4 Wind-blown sand**
Wind-blown sand is deposited following ice sheet retreat. These deposits are composed of well-sorted medium to fine sands and are found along coastal areas in the form of sand dunes or sand sheets.
- 5 Marine and estuarine deposits**
Marine and estuarine deposits comprise sand and gravel beach sediments, raised beaches, tidal marsh deposits and estuarine silt and clay. These have been deposited as the ice sheet retreated from the continental shelf and sea levels rose.
- 6 Slope deposits**
Slope deposits consist of an assemblage of rock fragments, blocks and sediment at the base of steep slopes and cliffs in the form of sheets or cones. These are created by steep slope slope movements, continuous rock fall, slides, debris flow and periglacial processes. Very large slope failures took place immediately following the retreat of the last ice sheet, as the earth's crust rebounded. Similar scale slope deposits are still being formed today.
- 7 Glaciofluvial and glaciolacustrine sand and gravel**
Glaciofluvial and glaciolacustrine sand and gravel are indirect glacial deposits transported to their final position by melt-water during the ice sheet retreat and sorted in this process. Glaciofluvial deposits are generally represented by stratified sands and gravels; the sands are usually well-sorted and loosely packed. Glaciolacustrine sediments often include bottomset facies composed of fine sand and silt overlain by coarser sediments attributable to forest and forest facies.
- 8 Glaciomarine sediments**
Glaciomarine sediments are indirect glacial sediments that accumulated in subglacial environments including glaciolacustrine sediments, subaqueous fans and submarine avalanche deposits.
- 9 Tilted from limestones**
Tills are tightly packed, unsorted, unbedded glacial deposits possessing many different particle sizes with commonly sharp, angular to sub-angular clasts. Till forms beneath a glacier as it erodes the bedrock or pre-existing sediment that it is flowing over. Glacial till is the principal depositional agent, but gravelly and, in some cases, also silty. In Ireland, till lithology can often be related to the type of bedrock directly beneath it (Dunne et al., 2013). The composition of tills are categorized according to their dominant lithology. Till lithology is important, as it greatly influences the physical properties of tills, e.g. permeability and cohesion. The transport and deposition of tills by the movement of an ice sheet means that in some cases, tills of a specific lithology are 'trapped' across a lithological boundary. These 'traps' of till may be up to 10 km in length and can be recognized using field observations, maps of soil geochemistry and facies data.
- 10 Tilted from Devonian sandstones**
The action of ice sheets deposits till in a range of landforms that can be characterized and grouped as landform associations. These landform associations can be used as predictive tools to infer the nature and extent of past glacial events. The most common till dominated landform associations encountered in Ireland are: (i) ice-marginal moraines consisting of irregular ridges of the former position of the edge of an ice sheet; (ii) drumlin and ribbed moraine topography consisting of rising landscape composed of high frequency, low amplitude irregular ridges (ribbed moraine); both indicators of direction of movement of former ice sheets in the Northern sector of Ireland; (iii) rolling landforms comprising rounded or elongated low altitude and low frequency tills with generally gentle slopes and; (iv) flat to gently undulating topography or till plains - commonly occurring in low lying areas of the Irish Midlands.
- 11 Tilted from acidic volcanic rocks**
- 12 Tilted from basic igneous rocks**
- 13 Tilted from granites**
- 14 Tilted from metamorphic rocks**
- 15 Pre-Quaternary bedrock**

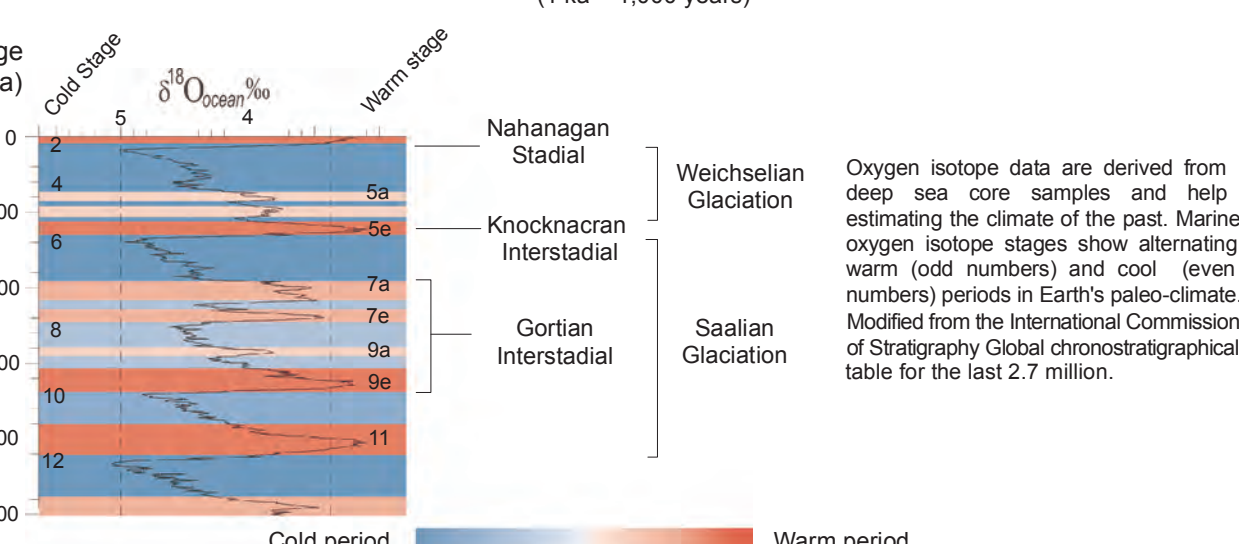
Geomorphology

- Drumlins**
Drumlins are smooth, oval-shaped hills composed of glacial sediments, typically with a long axis aligned with ice flow direction. Drumlins are very well preserved in the northern sector of Ireland. Ice directions associated with drumlin orientation are indicative of a number of ice sheets interacting in the region during the last glacial period. For cartographic reasons this map displays only c.10% of the 60,000 mapped drumlins in Ireland.
- Eskers**
Eskers are elongate, sinuous ridges composed of glaciofluvial sands and gravels. Eskers are formed by the winnowing of ice-walled channels and record deposition in subglacial, marginal or supraglacial drainage networks. The planform of an esker network may illustrate the geometry of a subglacial drainage network during deglaciation. Eskers are common across the central lowlands and are generally 10 - 20m high and 100 - 250m wide. Individual segments can be up to 10 km long.
- Moranes**
Moraine ridges demarcate the maximum extent of former ice sheets. Here a complex interaction of glacial and periglacial processes have combined to form a ridge of sediment. Moraines are particularly well expressed and well researched in mountain regions in Ireland, e.g. Wicklow and Kerry.

Dated Deposits

- Last Glacial**
Sites dated recording sediments deposited during the last glacial period: between the Kilnashnaghton Stadial at Marine Isotope Stage (MIS) 5 (c. 129 - 117 ka BP) and the Nahanagan Stadial at Isotope stage 2 (c. 12.9 - 11.7 ka BP).
- Last Interglacial**
Sites recording sediments deposited during MIS 6 (c. 132 - 120 ka BP) are rare in Ireland because of subsequent ice sheet coverage. Two key sites are Knocknacran in Co. Monaghan and the Screen Hills in Co. Wicklow. However, the Knocknacran dates could be interpreted as much later MIS 4. Similarly, the age of deposits at the Screen Hills are controversial, because they are based on pollen assemblages, rather than an absolute dating method.
- Middle Pleistocene**
Middle Pleistocene sites record sediments deposited between MIS 11 (c. 424 - 374 ka BP) and MIS 6 (c. 132 - 120 ka BP). Most sites have been assigned to the Danian interstadial (equivalent to the Holocene) on the basis of pollen assemblages, but it remains unclear whether this stage is equivalent to MIS 9 or MIS 11.
- Pre - Pleistocene**
Sites recording sediments deposited during the Pliocene (>2.600 ka BP). Ages have been largely inferred from floral and faunal assemblages within these deposits.

Marine Isotope stages of the last 500,000 years



The Quaternary Geology of Ireland

The Quaternary Period is the most recent period in the geologic time scale of the International Commission on Stratigraphy. This period, covering the last 2.6 million years, is subdivided into two epochs: Pleistocene (2.6 million to 10,000 years before present (BP)) and the Holocene (10,000 years BP to the present). Ireland was affected by a number of glaciations during the Pleistocene. The most recent glaciation, extending from 115,000 years ago to the Holocene, gave rise to most of the Quaternary sediments we see today. The erosive power of the last ice sheet removed much of the evidence for earlier glaciations. The Holocene, in Ireland, is the post-glacial period.

Ireland has a very rich legacy of glacial deposits and landforms. Glacial landforms, associated with the direct action or melting of ice, include ice-scoured bedrock from glacial erosion and ice-moulded glacial deposits expressed as drumlins, moraines and eskers. Mapping the shape and the spatial distribution of these landforms aided the reconstruction of the glacial history of Ireland. More than 80% of the Irish land surface is covered by sediments of Quaternary age. Postglacial sediments, covering a fifth of the land surface, were mostly deposited during the Holocene and include lacustrine and alluvial fans, peat bogs and coastal landforms.

Making the map: This All-Ireland Quaternary geology map at 1:500,000 scale is an amalgamation of Quaternary maps from Ireland and Northern Ireland. Soil geochemistry and radiometric data from the Tellus and Tellus Border projects were used to subdivide un differentiated till deposits in Northern Ireland to match the till types mapped in Ireland. Soil A-horizon geochemistry data from the two surveys were levelled and re-sorted using population distribution pairing. These data were divided into spatial clusters using principal component analysis of log-ratio values and k-means cluster analysis of the resulting component scores. The radiometric data were viewed as a ternary map of the ratio of radiocesium, potassium, thorium and uranium, from which, areas of different till lithology could be readily identified. Data from the Geological Survey of Ireland (Geological Survey Ireland, 2016), the Geological Survey of Northern Ireland and the relevant literature (Greenwood, 2008; Coors and McCarron, 2009; Greenwood and Clark, 2009; Benetti et al., 2010; Cofaigh et al., 2012; Finlayson et al., 2014) were compiled, homogenized and simplified to produce a seamless data set comprising sediment types, four geomorphological features and the location of key sites with Quaternary and pre-Quaternary dated sediments.

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Extent of the Irish Ice Sheet during the last Glacial maximum (c. 27 - 23 ka BP)

