Post-Mesozoic (post-Variscan) structural history, Northern Ireland

Mitchell, W I (ed.). 2004. The geology of Northern Ireland-our natural foundation. Geological Survey of Northern Ireland, Belfast.

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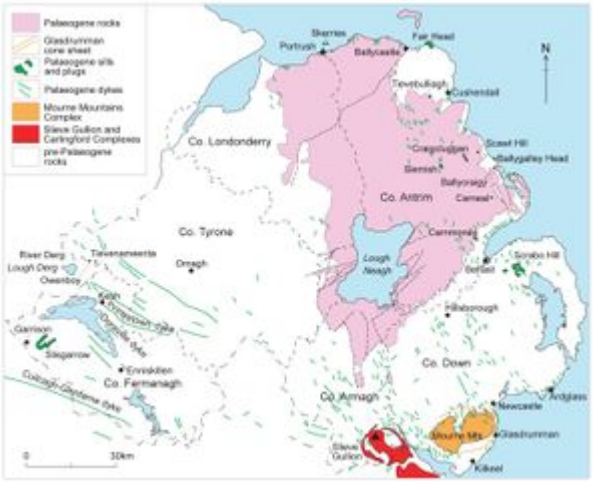
Introduction



Distribution of Palaeogene minor intrusions in Northern Ireland. (P947872)

The post-Mesozoic structural development of Northern Ireland continued to be dominated by tensional tectonic forces related to the opening of the North Atlantic Ocean and separation of the North American and European plates. In north Co. Antrim, a reconstruction of the post-Carboniferous stress history, based on basement/cover relationships, revealed at least four separate tectonic phases (Tables 17.1 and 17.2) between the late Carboniferous and Palaeogene [1].

Opening of the North Atlantic Ocean

Regional deformation in the late Jurassic and Early Cretaceous created a sub-Late Cretaceous unconformity that increases in magnitude from east to west in Northern Ireland. Thus, in south and east Co. Antrim basal Cretaceous strata rest on either the Late Triassic Penarth Group or Early Jurassic Waterloo Mudstone Formation (see Triassic article and see Jurassic article). In contrast, at the western margin of their outcrop the unconformity is more pronounced and basal Cretaceous strata overstep both those units and older Triassic and Carboniferous rocks, and rest on the early Palaeozoic Tyrone Igneous Complex on Slieve Gallion. However, tectonic activity continued into the Late Cretaceous and the effects of further uplift, faulting and gentle folding resulted in the minor unconformities and erosion surfaces that affect both the Hibernian Greensands and the Ulster White Limestone formations (see Cretaceous article). By the end of the Cretaceous period (65Ma) the continental crust in the North Atlantic region had stretched and thinned under the influence of a tensional regime. The separation of the North American and European continental plates was accomplished by a complex sequence of events which involved multiple spreading centres and

culminated in the opening of the North Atlantic Ocean.

The creation of new oceanic crust at the mid-Atlantic ridge and increasing separation of the continental plates was accompanied by an upsurge of 'in-plate' magmatic activity as the thinned continental crust moved across hotspots (plumes) in the earth's upper mantle. In Northern Ireland and throughout the North Atlantic Igneous Province, the Palaeocene (65-52Ma) was a period of intense intrusive and extrusive igneous activity [2]. Graben and half-graben sedimentary basins formed in Northern Ireland and particularly offshore on continental crust at the northwest margin of Europe as sea-floor spreading and plate rotation set up a tensional regime. In many of these basins, the sedimentary fill contains stratigraphical evidence of contemporaneous volcanic activity.[2]

At this time, the crust was also subjected to localised doming and uplift as magma from the upper mantle and lower crust forced a path to the surface. In Northern Ireland, two phases of extensional deformation are recognised in the Late Cretaceous and early Palaeogene rocks [3]. Both structural phases are characterised by a particular stress regime but have similar trends for the maximum component of horizontal stress.

In Northern Ireland, several types of structural features are associated with early Palaeogene magmatic activity.

Intrusions controlled by ring fractures

Wide-diameter annular fractures are closely associated with the intrusion of the central igneous complexes in Northern Ireland. The Mourne Mountains granites (see Palaeogene intrusive igneous rocks article) were emplaced in five separate phases of magma injection at two centres comprising the eastern Mournes (G1-G3 granites) and the western Mournes (G4-G5 granites). Successive phases of granite intrusion are believed to have followed the same ring fractures and were accommodated by continuing subsidence of the central block of Silurian country rocks [4].

In the Slieve Gullion Complex (see Palaeogene intrusive igneous rocks article), where some igneous activity reached the surface, granophyre and porphyritic felsite dykes were emplaced in concentric ring fractures, with a diameter of about 11km, at the southwest end of the late Caledonian Newry Igneous Complex (see Late Palaeozoic intrusives article).

In southeast Co. Down a cone-sheet system intrudes the Silurian rocks around the eastern centre of the Mourne Mountains Complex. These intrusions were emplaced in inward-dipping, conical fractures that were generated by the emplacement of the rising granite magma. The best example of a composite acid cone-sheet is exposed at Glasdrumman Port (see Palaeogene intrusive igneous rocks article).

Doming associated with magmatism

In Northern Ireland there is limited evidence of doming associated with magmatism during the Palaeogene. Along the eastern contact of the Mourne Mountains Complex, eg. at Ballagh Park [J 385 289], there is evidence of structural drag and strike swing in the Silurian country rocks.

Crustal dilation

Swarms of northwest-southeast trending dykes occur in Northern Ireland. The number of dykes increases in the vicinity of intrusive centres such as Slieve Gullion and the Mourne Mountains and in parts of Co. Fermanagh. In general, the dykes in Northern Ireland were intruded along fractures

that are orientated normal to the direction of major rifting between Greenland and Northern Europe (P947872). [2]

Late to post-Palaeogene faulting

The outcrop pattern of the Palaeogene Antrim Lava Group (see Mantle plumes, ocean spreading and the North Atlantic Igneous Province, Palaeogene extrusive igneous rocks article) and the Oligocene Lough Neagh Group (see Late Palaeogene (Oligocene) sedimentary basins article) indicates that major faulting continued in Northern Ireland after the cessation of magmatic activity and that there are two distinct groups of late to post-Palaeogene faults. This pattern has been confirmed by regional geophysical surveys and satellite imagery which supports the occurrence of the mapped faults together with many hitherto unmapped structures.

NNW-SSE trending faults

An early group of late to post-Palaeogene faults trending NNW-SSE is responsible for the compartmentalisation of the basalt outcrop in Co. Antrim. Similar faults also transect Palaeogene intrusive centres of the Mourne Mountains and Slieve Gullion and, in general, pre-date the northeast-southwest trending faults.

Northeast-southwest trending faults

The second group of faults in Northern Ireland that were active in the late Palaeogene include most of the northeast-southwest trending major normal faults and include the Tow Valley, Sixmilewater and Carnlough faults. These faults are parallel to earlier, Caledonian, structures and developed in the Palaeogene stress systems. Many of these faults were reactivated in the Neogene (late or post-Oligocene; 38–12Ma) and, in conjunction with NNW-trending splays, may have been responsible for basin subsidence associated with deposition of the Lough Neagh Group adjacent to the Tow Valley Fault in north Co. Antrim. The three basins at Ballymoney, Coagh and Crumlin all contain thick deposits of lignite (see Late Palaeogene (Oligocene) sedimentary basins article).

References

1. ↑ Kerr, I D V. 1987. *Basement/Cover structural relationships in the north Antrim area, Ireland*. PhD. Thesis, The Queen's University of Belfast.
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4. ↑ Richey, J E. 1927. The structural relations of the Mourne Mountains (Northern Ireland). *Quarterly Journal of the Geological Society of London*, 83, 653–88.

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