Geology of the Llanidloes area: Geological description - Cenozoic

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Links to other pages in this category can be found at the foot of the page.
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Palaeogene to Neogene

The uplift that affected the British Isles and established the broad drainage pattern of the region probably began during the early Cenozoic (Eocene) and culminated in the mid Cenozoic (Miocene). The reasons for this uplift are contentious (summarised in King, 2006[1]); theories include rifting and mantle upwelling in the north Atlantic that elevated the north-western margin of the European plate or uplift of the foreland ahead of, and as a result of, lithospheric loading by the Alpine mountain belt. It is likely that both processes were influential at different periods during the early to mid Cenozoic, as the present-day global plate tectonic configuration became established. Progressive denudation of Wales created a series of peneplaned surfaces (Brown, 1960[2]; Jones, 1951[3], 1955[4]; Walsh et al., 1999[5]) on which the modern river system became established (Dobson and Whittington, 1987[6]); remnants of these surfaces are preserved within the Cambrian Mountains today.

Quaternary

Plate tectonic reconfiguration and changing ocean circulation patterns led to an overall global cooling from the Early Eocene onwards, bringing about a succession of ice ages that affected much of the British Isles during the Pleistocene. The main agents of erosion and deposition during these periods were ice sheets, valley glaciers and their meltwaters which, together with periglacial processes, modified the landscape by changing drainage patterns, oversteepening and overdeepening valleys and depositing a range of superficial materials. Although the Llanidloes district was probably covered by ice on more than one occasion, the landforms and glacial deposits preserved there are considered to result wholly from the last major glacial event, which occurred from about 26 000 to 14 500 BP. During this episode, known as the Late Devensian Glaciation, a Central Wales Ice Sheet accumulated in the Cambrian Mountains and spread outwards into the river valley systems until, at its greatest extent, ice probably covered the whole of the district.

The material eroded and carried by the ice, including that formed during earlier periglacial processes (and possibly earlier glaciations), was deposited as a veneer of **till** (diamicton) over the bedrock during both advance and retreat of the ice sheet. Till deposits range from blue-grey, brown and orange-yellow gravelly, sandy and silty clay to clayey gravel with a variable proportion of cobbles and boulders, mostly of Lower Palaeozoic rocks (**Plate P775120**). They have been extensively modified by periglacial processes including solifluction, which has locally imparted a crude slope-parallel fabric to the clasts and has created a series of high-level terrace-like features, particularly in the north of the district.

Plate P775120 Poorly sorted, blue-grey till, weathering brown in upper part of section, containing subrounded to angular clasts, mainly of sandstone, Cwm Cledan, west of Carno [SN 9243 9650].

The **hummocky glacial deposits** that lie within the Severn Valley near Penstrowed [SO 0706 9124], on the flanks of Afon Carno at Caersws [SO 0344 9290] and around Cerist Bridge [SN 9643 8808] are interpreted as remnants of moraines, which accumulated during pauses in the retreat of ice along the valleys during deglaciation of the region. These heterolithic deposits comprise irregular mounds and ridges of clayey gravel, locally with beds and lenses of sand and gravel, laminated clay and till. Although the modern fluvial system has breached the moraines, in places they appear to represent constructional landforms that formerly extended across the valley floor and impounded glacial meltwater. Boreholes in the Severn valley near Caersws penetrated a succession of blue-grey laminated silts and clays, probably representing **glaciolacustrine deposits** that accumulated in ephemeral lakes behind the morainic dams; comparable clays were encountered in boreholes near Llandinam.

The undifferentiated **glaciofluvial deposits** that occupy parts of the valleys of the Afon Carno and

Afon Trannon are mainly composed of gravel, sand and silt, which was carried by meltwater and deposited downstream from the retreating ice. They display an irregular surface morphology, possibly resulting from the in situ melting of bodies of stagnant ice and, thus, represent a late glacial period of aggradation that has been incised by the present-day river system. The most extensive deposit, along the Carno valley in the north of the district, is probably the remnant of a valley sandur; a comparable deposit occurs in the Trannon valley near Trefeglwys, although its morphology is suggestive of a fan or delta, which built out into the glacial lake occupying the Severn valley to the east. Well-defined **glaciofluvial fan deposits** of sand and gravel, contiguous and gradational into the undifferentiated glaciofluvial deposits, occur in places along the Trannon and Carno valleys.

In the tundra-like periglacial conditions that followed the retreat of the ice, intense seasonal freeze-thaw shattered rock and weakened previously deposited glacial materials. Downslope mass movement by a variety of processes including creep and saturated flow formed the range of **head** deposits that blanket most of the valley slopes and infill topographical hollows. They comprise highly variable gravelly, sandy or silty clay, locally stratified and with a preferred downslope clast orientation. Head deposits within the district have only been recorded where their morphology allows them to be mapped; elsewhere they are not distinguished from their parent materials. Distinctive, localised deposits of stratified gravel, usually consisting of angular mudstone fragments in a silty clay matrix, are separately recorded as **head gravel** and, for the most part, represent accumulations of frost-shattered bedrock (nivation scree).

The modern drainage pattern was largely established throughout the district during the Holocene (beginning about 11 700 years BP; Walker et al., 2009[7]) when, with a few exceptions (Jones, 1951[3]), the rivers Wye, Severn and their tributaries re-established their previous courses. Incision of the rivers into the previously deposited materials was a response to isostatic readjustment and changing base level, and it produced a series of elevated **river terrace deposits**, composed of stratified sands and gravels. Gently sloping spreads of **alluvial fan deposits**, usually of less well-ordered sand and gravel, accumulated where tributaries emerged into the main valleys; they also show evidence of river incision and dissection. The **alluvium** that forms the floodplain of many valleys is the deposit of the modern river system, typically comprising silt and clay with localised organic clay, and beds and lenses of sand and gravel.

As vegetation was re-established under the more temperate climatic conditions of the Holocene, **peat** deposits began to accumulate in enclosed hollows and the poorly drained upland areas became sites of self-supporting (ombrogenous) bog (**Plate P775121**); peat has also built up in the abandoned meanders of the main river valleys. Small lakes, pools and poorly drained hollows within the previously glaciated landscape have become sites for the deposition of organic-rich silts and clays that constitute **lacustrine alluvium**.

Plate P775121 Thick accumulations of hill peat blanket much of the upland area around Plynlimon and Trannon [SN 8280 8940].

The generally wetter conditions of the Holocene have promoted the development of **landslides**, particularly in superficial deposits on oversteepened slopes that have been undercut by rivers and streams. It is likely that some landslides originated in the immediate postglacial (paraglacial) period, and many remain intermittently active to the present day.

The influence of man on the landscape during the Holocene has been significant. Mining activities and quarrying have left the district with excavated areas of **worked ground** and a variety of spoil of varying thickness. Much of the spoil is mine waste, but refuse tips, embankments, archaeological sites and all other areas where the ground has been raised above its natural level are grouped as **made ground**. Much of the waste and overburden has been subsequently moved and regraded to the point where the original extent of cut and fill or worked-out ground cannot be determined with any certainty; such areas are classified as **landscaped ground**.

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Geology of the Llanidloes area - contents

Navigation menu

Personal tools

Namespaces

- Page
- Discussion

☐

Variants

Views

- Read
- Edit
- View history
- PDF Export

☐

More

Search

Search Go

Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 7 July 2016, at 10:34.

- Privacy policy
- About Earthwise
- Disclaimers
-

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