Y Glyderau

Highlights

This major site shows outstanding examples of glacial landforms. Structurally controlled cirques, moraines and protalus ramparts combine to form some of the most spectacular glaciated scenery in Wales. Cwm Idwal, in particular, shows a diverse assemblage of features attributable to the final corrie glaciation of the region.

Introduction

Y Glyderau (the Glyders) are important for their assemblage of well developed glacial and periglacial landforms. The principal features include a series of impressive cirques, notably Cwm Idwal, and the classic glacial trough of Nant Ffrancon. Moraines are present in most of the cirques and some have been assigned on the basis of pollen analysis to the Younger Dryas. A number of the depositional landforms, for example in Cwm Idwal, are controversial in origin. The interest of the site is enhanced by well developed periglacial features, including a massive protalus rampart along the eastern flank of Nant Ffrancon, a fine series of vegetated periglacial stripes below Y Garn, numerous scree slopes, and the summit tors of Y Glyderau. The area was one of the first to be studied in Wales (for example, Darwin 1842; Mackintosh 1845; Ramsay 1860; Kidson 1888, 1890; Jehu 1902; Davis 1909) and has since featured in many geomorphological studies (Seddon 1957; Smith and George 1961; Embleton 1962, 1964a; Unwin 1970, 1973, 1975; Escritt 1971; Addison 1977, 1978, 1983, 1986, 1988; Watson 1977a; Gray *et al.* 1981; Campbell 1985b; Gemmell *et al.* 1986). Features in the area attributable to the Younger Dryas were recently described by Gray (1982a). The periglacial landforms of the site have been discussed by Ball and Goodier (1970). The area has featured in a number of studies of Devensian late-glacial and Holocene vegetational and environmental changes (Woodhead and Hodgson 1935; Godwin 1955; Seddon 1962; Switsur and West 1973; Burrows 1974, 1975; Evans and Walker 1977; Ince 1981, 1983).

Description and interpretation

The Glyderau lie east of the main Snowdon massif and west of the Carneddau. Bearing a similar range of large-scale features of glacial erosion to the Snowdon area (for example, cirques, aretes, troughs), the Glyderau differ because the cirques show marked structural alignments (Unwin 1970, 1973): they show a preferred north-east orientation and open onto the trough of the Nant Ffrancon Valley. This striking glacial trough is enclosed at its upper end by a 'trough end', where a belt of grits and rhyolite crosses the valley (Watson 1977a). Examples of ice-smoothed bedrock and roches moutonnées are found in the area, especially to the north and east of Llyn Idwal. The Glyderau cirques and Nant Ffrancon were probably scoured by glacier ice on several occasions during the Pleistocene, but the principal depositional features of the area consist of a number of small cirque moraines formed during the Devensian late-glacial. These depositional landforms, although common in most of the cirques, are frequently of contentious origin, none more so than those in Cwm Idwal. The depositional landforms of the area have been mapped and described by Seddon (1957), Unwin (1970, 1973, 1975), Escritt (1971), Gray (1982a) and Addison (1986, 1988).

Cwm Idwal

Cwm Idwal is one of the best developed glacial erosional features in Wales and as such is notable as one of the first to be described (Darwin 1842). The site is a large, north-east facing cirque occupied by Llyn Idwal. This lake is surrounded by a complex of glacial and possibly periglacial depositional landforms which are the subject of continuing controversy — see (Figure 37). Darwin (1842) observed that the appearance of these landforms was fresh even in comparison with those he had seen in South America and remarked — "It is, I think, impossible … to stand on these mounds and for an instant to doubt that they are ancient moraines."

Four principal series of deposits have been recognised within the cirque (Escritt 1971; Gray 1982a; Campbell 1985b) — see (Figure 37):

1 A diffuse outer moraine at the north end of Cwm Idwal

2 Morainic mounds on either side of the constriction in Llyn Idwal which have been interpreted by some authors as marking a glacial limit (Godwin 1955; Seddon 1962)

3 A group of landforms that curves away from the lake at its north-eastern end and which may represent moraine deposited by ice from nearby Cwm Clyd (Escritt 1971)

4 A contentious group of landforms on the west bank of Llyn Idwal that comprises a series of elongated mounds parallel to the western wall of the cirque

These features have been interpreted variously as lateral moraines (Jehu 1902; Godwin 1955), nivation ridges or protalus ramparts (Unwin 1970) or fluted moraine ridges (Gray *et al.* 1981). More recently, Addison (1986) mapped three further groups of features.

Dating the moraines

The traditional interpretation of landforms in Cwm Idwal is simply of an older series moraine at the lip of Cwm Idwal, and a younger series moraine (Younger Dryas) at the constriction half-way along Llyn Idwal (Seddon 1957, 1962; Unwin 1970, 1975). Despite pollen analyses and radiocarbon dating at a number of sites, the sequence of events is still unresolved.

Following Woodhead and Hodgson's (1935) pioneering work on the peats of Snowdonia, the first detailed pollen analytical study in the Glyderau by Godwin (1955) described a Holocene sequence from a small peat bog situated between the morainic mounds at the constriction of Llyn Idwal — see (Figure 37). He tentatively suggested that this group of moraines had formed during the Younger Dryas (Pollen Zone III). In 1962, Seddon described a sequence of deposits extending back to Pollen Zone I of the Devensian late-glacial from a site in the Nant Ffrancon Valley — see (Figure 37). There, the pollen and lithostratigraphic records revealed a period of cold tundra conditions in Pollen Zone III. Seddon suggested that during this phase moraine and nivation ridges were formed in adjacent cirques such as Cwm Idwal. Radiocarbon dates from the Nant Ffrancon site (Burrows 1975) and at Cwm Cywion in the Glyderau (Ince 1981, 1983) provide strong evidence that a short-lived glacial pulse, between about 11,000 and 10,000 BP was responsible for many of the cirque moraines in the area. This is the case elsewhere in Britain.

Seddon (1962), however, provided evidence to suggest that not all of the cirque moraines were formed during this Younger Dryas event. At Cwm Dwythwch in Snowdonia, he described a late-glacial pollen sequence behind a 'diffuse' cirque moraine. This, therefore, precluded a Younger Dryas age for the moraine and indicated that 'diffuse' cirque moraines elsewhere might also be earlier in the Devensian than the Younger Dryas. Gray (1982a) has suggested that the moraine groups in Cwm Idwal all belong to the Younger Dryas, some perhaps being recessional or even fluted moraine features, but a pre-Younger Dryas age cannot at present be ruled out for the 'diffuse' outer features (for example, Addison 1986).

Devensian late-glacial and Holocene environmental and vegetational history

Seddon (1962) described a sequence of deposits extending back to Pollen Zone I of the late-glacial from a site [SH 632 633] in the Nant Ffrancon Valley. The basal sediment was a layer of stiff blue clay, which he interpreted as solifluction inwash. Pollen analysis showed that this bed belonged to Pollen Zone I, when low scrub and open-herb vegetation indicative of tundra conditions was present. This clay is overlain by organic mud (averaging 1.40m thick), containing pollen indicating a change to open-birch woodland in Pollen Zone II. Above is a second solifluction clay in which a rapid decline in tree pollen shows a return to tundra conditions in Pollen Zone III. During this cold phase, moraine and nivation ridges (protalus ramparts) were formed in adjacent cirques. Overlying beds at Nant Ffrancon are wholly organic passing up into a modern raised *Sphagnum* and *Eriophorum* bog.

The Nant Ffrancon site was also investigated by Burrows (1974, 1975) who examined plant macrofossils and provided radiocarbon dates from the late-glacial sequence. Burrows revealed the occurrence of what he considered to be a

pre■Allerød interstadial, apparently equivalent to the Bølling (Pollen Zone Ib). He also suggested that at Nant Ffrancon there was evidence for a period of cooling between the Bølling and Allerød. The beginning of Pollen Zone II was dated at 11,900 ± 500 BP (Q-1124) and the deteriorating climate associated with the recrudescence of ice in local cirques was dated at 11,000 ± 400 BP (Q-1123). Moore (1975b), however, questioned the validity of this interpretation of the sequence, in particular throwing doubt on the occurrence of the Bølling oscillation. Switsur and West (1973) provided a comprehensive framework of radiocarbon dates from the Holocene sequence at Nant Ffrancon.

At Llyn Clyd, Evans and Walker (1977) studied a Holocene sequence containing pollen and diatoms from the small lake situated behind a moraine — see (Figure 37). More recently, Ince (1981, 1983) used pollen analysis and radiocarbon dating of basal samples from behind the moraine at Cwm Cywion to show that organic sedimentation commenced in the early Holocene at around 10,000 BP. Ince's studies place an age limit on the final cirque glaciation of the area.

Periglacial landforms and features

The geomorphological interest of the Glyderau is enhanced by well developed periglacial landforms which include a large protalus rampart on the eastern edge of the Nant Ffrancon Valley (Gray 1982a), a fine series of vegetated periglacial stripes beneath the summit of Y Garn (Ball and Goodier 1970), numerous scree slopes (Ball 1966), and the frost-shattered summits of the Glyderau themselves. Although impressive, and an integral part of the overall landform assemblage, the periglacial landforms and features of the Snowdon and Glyderau massifs do not match the scale and variety of those developed in the Carneddau.

The Glyderau are important for some of the most spectacular glaciated scenery in Wales, especially large-scale features of glacial erosion, such as the cirques which overhang the Nant Ffrancon Valley. In contrast to the cirques of the Snowdon massif, those in the Glyderau show very marked structural alignment and many contain fine examples of depositional landforms (moraines and protalus ramparts) associated with the final cirque glaciation of the region. Cwm Idwal contains a particularly diverse assemblage of landforms attributable to the Younger Dryas. The controversial nature and age of some of these landforms make the site of considerable interest.

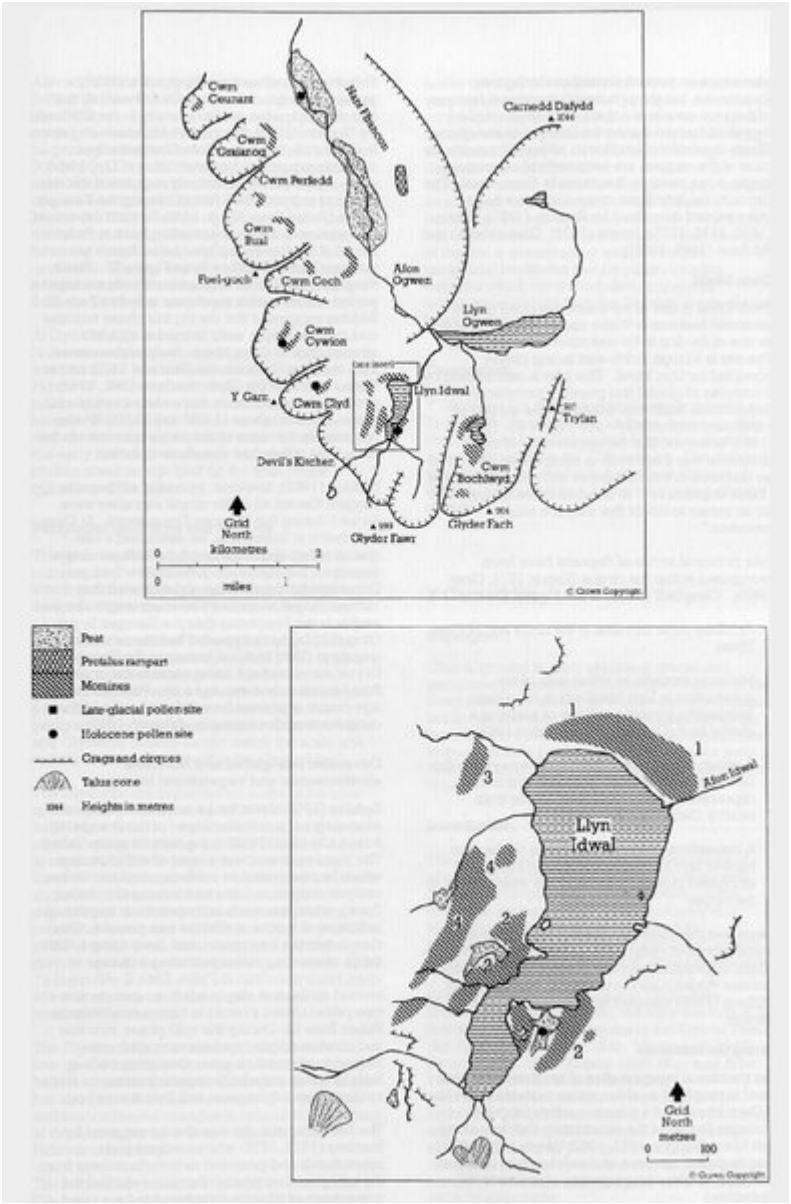
The Glyderau also contain important Devensian late-glacial and Holocene deposits which not only help to constrain the ages of moraines in the area, but also provide detailed records of vegetational and environmental changes in upland Wales. Many of these changes have been calibrated with radiocarbon dating.

The large-scale features of glacial erosion within Y Glyderau are some of the finest in Wales, and unlike those of Yr Wyddfa (Snowdon), demonstrate very clearly the influence of geological structure on cirque development. Like Snowdon, the Glyderau demonstrated important evidence for establishing the Glacial Theory in Great Britain. Although glacial deposits are widespread in the cirques of the Glyderau massif, Cwm Idwal, in particular, has long been noted for its diversity of depositional landforms, the age and interpretation of which are still controversial. The geomorphological interest of the site is enhanced by well developed periglacial landforms and by pollen bearing deposits which record detailed changes in vegetational history from the Devensian late-glacial to modern times.

Conclusions

Y Glyderau are important for the same reasons as Yr Wyddfa (Snowdon). In addition, however, they contain Cwm Idwal which has figured in scientific investigations since the 17th century. The detailed information now available from Cwm Idwal is of outstanding importance for reconstructing climatic change.

References



(Figure 37) Y Glyderau: principal landforms (after Campbell 1985b)