Cadair Idris

Highlights

This site provides one of the finest assemblages of large-scale glacial erosional features in Wales, showing a wide range of landforms formed by glacial and periglacial processes and mass-movement. This major dispersal centre for Welsh ice allows studies of cirque development in relation to substrate, aspect and relief.

Introduction

Cadair Idris and Tal-y-llyn are outstandingly important for glacial and periglacial landforms. Cadair Idris contains a number of glacial and nivation cirques, including Cwm Cau which was described by W V Lewis as the finest cirque in Britain. This shows a very clear relationship to geological structure and opens out on to the Tal-y-llyn Valley, a classic over-deepened valley developed along the line of the Bala Fault. In addition to large-scale features of glacial erosion, the area is also renowned for a range of depositional landforms associated with mass-movement and periglacial processes. Most spectacular of these is the bar impounding Tal-y-llyn, formed by a huge landslide from Graig Goch. The Tal-y-llyn Valley also contains very fine examples of stratified screes, well exposed near Maes-y-Pandy. Other periglacial interests include protalus ramparts, notably at Craig-y-llam, and a large debris fan or blockstream near Bwlch Llyn Bach. The glacial and periglacial geomorphology of the area has been described by Watson (1960, 1962, 1965a, 1967, 1968, 1970, 1976, 1977a), and has also been mentioned by Miller (1946), Lewis (1938, 1949), Howe and Yates (1953) and Cox (1983).

Description and interpretation

The main ridge of the Cadair Idris massif, which rises to *c.* 890m OD, runs south-west to north-east and is bounded to the south by the glaciated valley of Tal-y-llyn and to the north by the valley of the Mawddach. To the west is Cardigan Bay and to the east the Dulas Valley.

Despite the scale and range of Late Pleistocene geomorphological features around Cadair Idris and Tal-y-llyn, the area has received little attention from geomorphologists. Aspects of the regional glacial history were discussed by Reade (1896), Jones and Pugh (1935) and Miller (1946), and Cwm Cau was referred to in studies of cirque formation by Lewis (1938, 1949). A bathymetrical study of Llyn Cau was undertaken by Howe and Yates (1953). Miller (1946) concluded that the Cadair Idris massif acted as a centre of ice dispersal with its own system of small glaciers emanating from the cirques at, for example, Cwm Gadair and Cwm Cau. According to Miller, the regional direction of ice movement appears to have been from NNE to SSW exploiting pre-existing valleys developed along the lines of structural weakness such as that of Tal-y-llyn.

Cirques

The site contains a number of well developed glacial cirques and nivation cirques — see (Figure 22). The Cadair Idris group of cirques is centred on Bwlch Cau to the south-west of the Cadair Idris summit. These demonstrate the relationship between cirque development and aspect and geological structure. In the group, magnificent cirques with precipitous head and side walls face north and east, with the more poorly developed south-facing Cwm Amarch (Watson 1960). The northern cirques are fashioned in a structural north-facing escarpment developed in a granophyre sill. Here, the steep back walls are formed by great joint blocks split from the sill: Cwm Gadair is a particularly fine example cut into this resistant igneous body. In contrast, the cirque of Cwm Amarch is cut in closely cleaved mudstones and acid volcanic rocks. The latter dip towards the cirque with the result that the back wall is much less precipitous.

Of the Cadair group of cirques, Cwm Cau is undoubtedly the most impressive. It is surrounded on three sides by rock walls varying between 305457m in height. The east-facing head wall and southern slopes are developed in highly

resistant Ordovician igneous rocks, while softer mudstones occupy a line of weakness along which the cirque floor has been excavated. The head wall of Cwm Cau is exceptionally steep, rising c. 335m in a horizontal distance of some 200m. The present day lake is dammed by morainic material beyond which the valley floor falls in level via a series of roches moutonnées, many of which take the form of miniature steps (Cox 1983).

The Tal-y-llyn Valley

The glacial morphology of this valley was described in some detail by Watson (1962). It is a straight valley trending north-east to south-west. For most of its length it cuts through mudstones but nearer its head it is developed in volcanic rocks. The trough lacks spurs and has well developed cliffs below the valley shoulder. Tributary valleys all hang above the main trough, which their streams enter by spectacular falls (Watson 1960). The valley has many features, including an over-deepened profile, produced by glacial erosion (Watson 1962), and the pronounced straightness of the main valley is clearly a reflection of geological structure (Watson 1960). The Tal-y-llyn is a classic example of a glacial trough, but it has perhaps become better known for its wide range of depositional landforms associated with periglacial and mass-movement processes.

The Tal-y-llyn landslide

The bar impounding Tal-y-llyn lake is the most spectacular of the landforms in the valley. It is a massive feature some 24m above the level of the lake and it extends down the valley for almost 1 km. Reade (1896) considered that this hummocky feature was a glacial-moraine damming the lake; subsequent work (Watson 1960) showed that the feature was a rock bar. More detailed studies (Watson 1968, 1976, 1977a) have shown that the feature is a landslide of mudstones from the face of Craig Goch, where a scar demonstrates the source of the material. Watson (1977a) concluded that the landslide had occurred in several stages.

Stratified screes or Grèzes Litées

Much of the Tal-y-llyn Valley has been infilled with periglacial scree derived from the steep valley sides. The scree is stratified in places and consists of alternating thin beds of coarse and fine debris, the coarse beds generally being the thicker (Watson 1965a, 1977a). The finer beds are silty but the coarse beds frequently have an open texture (Watson 1965a). Classic examples of stratified screes or Grezes Dees are well exposed in small quarries near Maes-y-Pandy in the southern part of the valley below the large landslide, and at the valley head where up to 18m of scree has been recorded (Watson 1968). A study of fourteen such sites in Mid Wales led Watson (1965a) to suggest that the stratified screes always rested on unsorted slope deposits. He considered that they had formed under periglacial conditions by freeze-thaw processes acting on the fine-grained mudstones of the region.

Moraines and protalus ramparts

Fine examples of cirque moraines and protalus ramparts occur within the area — see (Figure 22). Watson (1960) demonstrated that the pattern of moraines within the cirques, as well as the cirques themselves, show the strong influence of aspect. For example, the relatively poorly developed western cirque has no recognisable moraines, but those in Cwm Cau and Cwm Gadair, the north and north-east facing cirques, are well developed. Those in Cwm Gadair are symmetrically arranged across the lower end of the lake which usually drains by seepage through the boulder moraine (Watson 1960). In Cwm Cau the moraines are hummocky and similarly impound the cirque lake. They are thickest and rise highest on its south side. In both cirques, the moraines occur at a considerable distance from the back walls.

Well developed examples of protalus ramparts also occur within the area, both in the Tal-y-llyn Valley, below Craig-y-Llam, and near Cadair Idris, at Llyn Aran and beneath Twr Du — see (Figure 22). Watson (1967) considered that four protalus moraines occurred along the northern face of Cadair Idris, the easternmost forming the southern shore of Llyn Aran. He observed that, like the nivation cirque and protalus moraine described from Cwm Tinwen near Aberystwyth, none of the Cadair Idris examples occupied true glacial cirques. Rather, the protalus moraines occur in

slight embayments or recessions within the steep ridge. Unlike the glacial moraines described at Cwm Cau and Cwm Gadair, these protalus features occur close against the ridge or back wall, indicating that they probably originated as rockfall accumulations downslope from perennial snow patches.

Perhaps the most impressive protalus rampart is that at Llyn Bach beneath Craig-y-Liam (Watson 1977a). Here, the rampart rises more than 20m above the surrounding surface, and its external width is some 200m. The rampart curves at both ends into the slight embayment within the steep valley side. The narrow basin which the rampart should typically enclose had been infilled with head.

The cirque moraines and protalus ramparts within the Cadair Idris area have not been dated precisely. However, in view of the detailed palynological and geomorphological evidence from northern Snowdonia (for example, Ince 1981, 1983; Gray 1982a), and from the Brecon Beacons, South Wales (for example, Walker 1980, 1982a, 1982b), a Younger Dryas age would seem probable. This interpretation is corroborated by palynological and radiocarbon evidence from Llyn Gwernan to the north of Cadair Idris where the Younger Dryas is represented (Lowe 1981).

Alluvial fans and blockstreams

Alluvial fans are a common feature of the Tal-y-llyn Valley, covering large areas of the valley floor at the discordant junctions of the tributary valleys see (Figure 22). Watson (1977a) noted that the fans which spread across the valley floor are composed of mudstone gravel bedded at low angles. On the other hand, fans of coarse blocky igneous rock debris stand at higher angles. Fine examples of such fans occur at the junction of the Tal-y-llyn Valley with the tributary Nant Iago, below Cwm Amarch and at the exit of Nant y Gadair from Llyn Cau. They are believed to be associated with a periglacial regime (Watson 1977a). Watson (1968, 1977a) also described what he called an avalanche fan or blockstream some 3.5 km north-east of Tal-y-llyn lake.

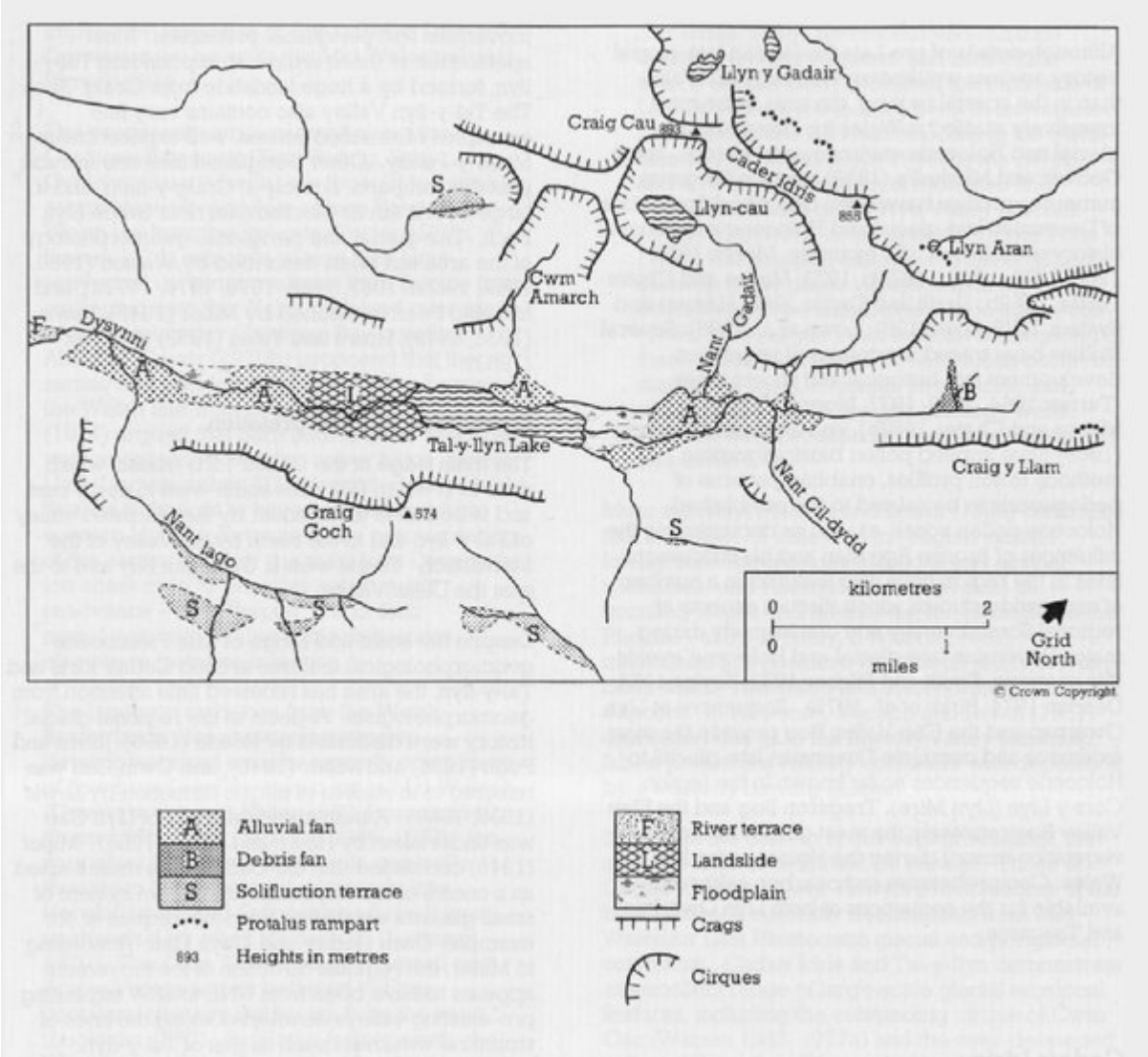
The Cadair Idris and Tal-y-llyn area contains an outstanding range of glacial and periglacial landforms which are important for reconstructing the Late Pleistocene history of the region. The area contains some of the finest glacial and nivation cirques in Wales and one of the most impressive glacial troughs. The landslide impounding Tal-y-llyn lake is also a remarkable geomorphological feature, as are the exposures of stratified scree in the Tal-y-llyn Valley. Together with the mountains of northern Snowdonia and the Brecon Beacons in South Wales, Cadair Idris provides an important example of large-scale glacial erosional features. The widespread development and range of periglacial landforms also makes the area of exceptional interest. The interpretation of this range of landforms is crucial to the understanding and reconstruction of Late Pleistocene events in the region as a whole.

The cirques of the Cadair massif demonstrate a close relationship between cirque development, aspect and relief, and provide, in a compact area, the best range of glacial landforms associated with a dispersal centre for Welsh ice in the Mid Wales uplands. The area is also noted for the wide range and fine development of landforms formed by mass-movement and periglacial processes; of these, the large landslide which impounds Tal-y-llyn lake, and the stratified screes, which are a characteristic feature of the region, are particularly impressive. Well developed cirque moraines and protalus ramparts demonstrate important evidence for cirque glacier and snow patch development during the Devensian late-glacial. The glacial and periglacial landforms are central to the discussion over whether or not the region was extensively glaciated during the Late Devensian.

Conclusions

Cadair Idris contains one of the finest assemblages of landforms caused by glacial erosion anywhere in Wales. It includes the cirque described as the most perfectly formed in the British Isles. The area also contains a wide range of periglacial landforms and deposits. Together the glacial and periglacial features combine to form one of the best teaching areas in the British Isles.

References



(Figure 22) Cadair Idris: principal landforms (after Watson 1977a)