Pant-y-llyn

[SN 606 166]

Highlights

Pant-y-llyn is the only turlough in the Welsh karst, and is the only clearly defined example of a seasonal lake in Britain. It demonstrates the complex interaction between geological, geomorphological and hydrological controls on groundwater levels in a karst aquifer.

Introduction

Turloughs are seasonal lakes that occur in lowland karst terranes and are best developed on the Carboniferous Limestone of western Ireland (Coxon, 1986, 1987a, b; Drew and Daly, 1993). Their water levels and intermittent appearance are related to the fluctuations of the regional water table, and they have no surface drainage, influent or effluent except for direct rainfall in the very small basin. The seasonal lake of Pant-y-llyn lies on the narrow Carboniferous Limestone outcrop near Llandybie (Figure 6.1). It slowly fills every autumn, and remains full until it drains in spring; the cyclicity is clearly related to the seasonal water table variations and is barely influenced by individual storm events. Pant-y-llyn appears to be the only turlough in Britain, as the ephemeral lakes in the chalk karst of East Anglia are in partially plugged dolines and do not have simple patterns of annual flooding.

The turlough is briefly described by Davies and Stringer (1991), Campbell *et al.* (1992) and Hardwick and Gunn (1995). The important biology of the site is described by Rundle (1993) and Blackstock *et al.* (1993), and the nearby caves are recorded by Adams and Jones (1984), Jones *et al.* (1984) and Jones (1991).

Description

The turlough is located in a closed depression within a saddle which is cut north to south through the narrow, broken limestone escarpment; it is 1500 m west of a deeper valley which carries the Afon Marlas through the limestone ridge. Quarries have removed much of the limestone both east and west of Pant-y-llyn. At its maximum extent in winter, the lake is 160 m long and up to 60 m wide, with a surface level of 160 m and a maximum depth of 3 m (Figure 6.22). The bed of the turlough is covered by a thin layer of organic debris, underlain by deposits of yellow-brown, silty clay. The lake level usually falls slowly through April, May and June, by draining through fissures in the bed; in summer the site is dry. Standing water first appears in autumn in a small pool at the northern end of the depression, where the main springs and sinks lie. It remains full over the winter; when it ices over, a small patch remains unfrozen over the spring site where warm groundwater emerges.

Pant-y-llyn lies on the northern margin of the South Wales coalfield syncline (Figure 6.1). The rocks in the area dip south at 20–40°, and include the Devonian Old Red Sandstone, the Dinantian Lower Limestone Shale, followed by about 200 m of limestone, and the Namurian Basal Grit. The turlough is underlain by the Bettws Fault, with an apparent downthrow to the west of about 200 m. This has brought the Dinantian Limestones into contact with the Devonian Sandstones; the eastern bank of the depression is cut into the sandstone, while the rest of the turlough lies on the limestone (Figure 6.22). The topography of the area consists of a low fragmented escarpment of Carboniferous Limestone, with a series of strike valleys running NE–SW, such as the Nant Gwenlais valley. The Bettws Fault zone appears to have offered a zone of weakness through the escarpment; during the Pleistocene, this was exploited either by ice moving south or by glacial meltwater (Bowen, 1965). More than 6 m of glacial till lies both north and south of the turlough, but is absent under the turlough site.

The regional drainage on the surface and in the limestone is eastwards to the lower outcrop in the Marlas valley. The Bettws Fault breaks this trend, as the limestones are not in contact across it; groundwater in the Pant-y-llyn block is

therefore impounded, and its water table fluctuates between levels of 155 m in summer and 160 m in winter. Sinks and springs at higher levels drain the limestone west of a minor fault west of Ogof Glan Gwenlais (Figure 6.22). About 50 m above the level of the turlough, Ogof Pant-y-llyn has 350 m of phreatic rifts and bedding cave passages. Ogof Glan Gwenlais has 200 m of old phreatic passage aligned on the strike at an elevation of about 165 m (Figure 6.22).

Interpretation

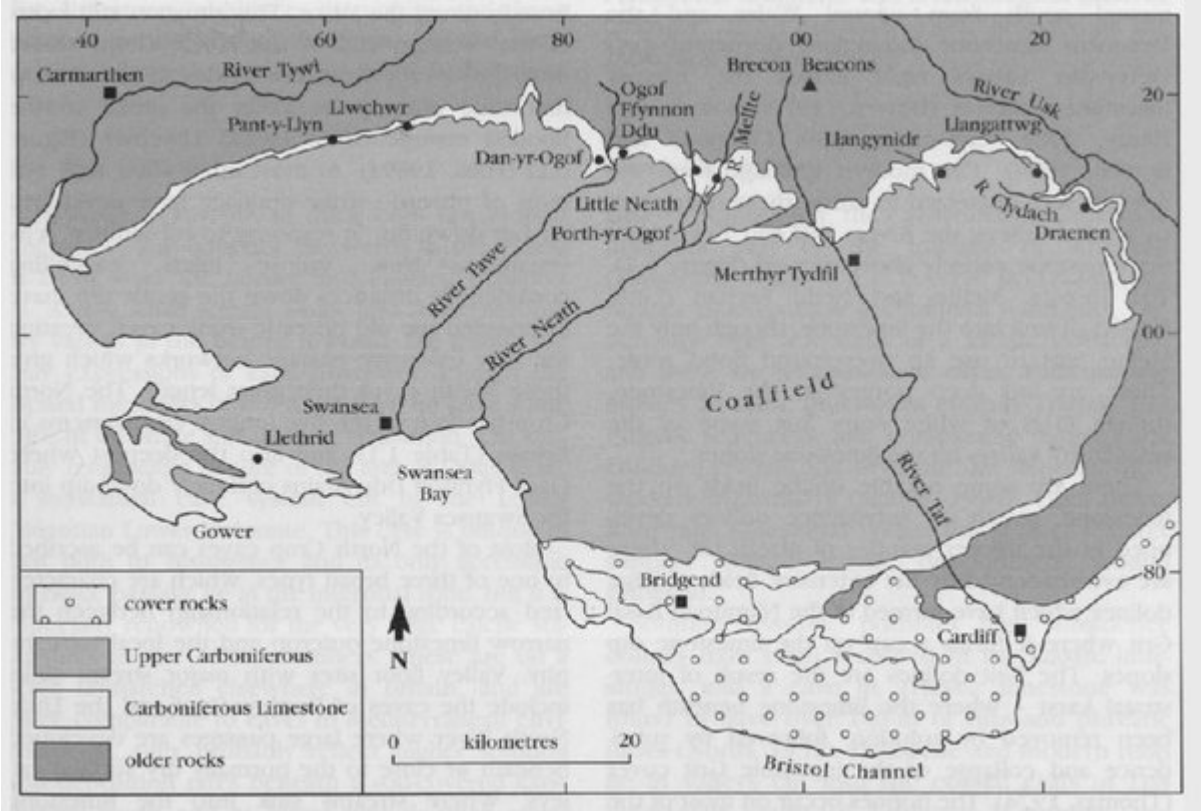
Pant-y-llyn conforms to the three main criteria for distinguishing turloughs from other seasonal lakes (Coxon, 1986): it exhibits seasonal flooding to a depth of over 0.5 m for part of the year and a dry floor for part of the year, it is recharged via ephemeral springs or estavelles, and it empties via swallets or estavelles with no surface outlet. Dye tracing by Hardwick and Gunn (1995) indicated that the turlough was probably not fed by discrete well defined conduits, but instead receives and loses its water to the local groundwater body in its western flank. Recharge is mainly from the west, where the unbroken aquifer continues along the strike of the limestones, and outflow is to the west, as sandstone lies to the east. Tracing studies, limited by the lack of access to land around the quarries, have shown that water from the turlough reappears in fissure risings in the floor of the temporarily inactive Glangwenlais Quarry (Figure 6.22), and then flows into the Nant Gwenlais; it may also feed into the Nant Gwenlais from other unknown springs or seepages. The lower spring in the Gwenlais valley east of the Bettws Fault is fed only from the limestone around the Cil-yr-ychen Quarry.

Seasonal recharge and discharge of the turlough reflect seasonal variations in the groundwater surface. The local water table level is partly dictated by spring levels, which are where the valleys intercept cave conduits on inception horizons at various stratigraphic levels in the dipping limestone; there appears to be none in the youngest beds which have the lowest outcrop just west of the Bettws Fault. Groundwater storage is in fracture and bedding plane fissures opened by solution, but flow is probably impeded by both the immaturity of the karst and large amounts of inwashed clastic sediment. Perched water tables may lie behind rising phreatic loops and sediment chokes. A combination of these factors accounts for the turlough water table being perched 5–10 m above the Gwenlais valley. The water table fluctuation is caused by the limited capacity of conduits draining the groundwater to the risings. Excess recharge in autumn and winter raises the piezo-metric surface, causing the turlough to fill from fissures in the limestone; as recharge declines in late spring and early summer, the piezometric surface lowers and the turlough drains out via the same fissures in its bed. Direct drainage eastwards is impeded by the impermeable Devonian strata on the eastern side of the Bettws Fault. The flow pattern is not known in detail, but the known caves do demonstrate the importance of flow along the strike. The relationships between rainfall and tur-lough recharge, and the lag times involved, are still not known in detail, nor is the exact catchment area of the turlough.

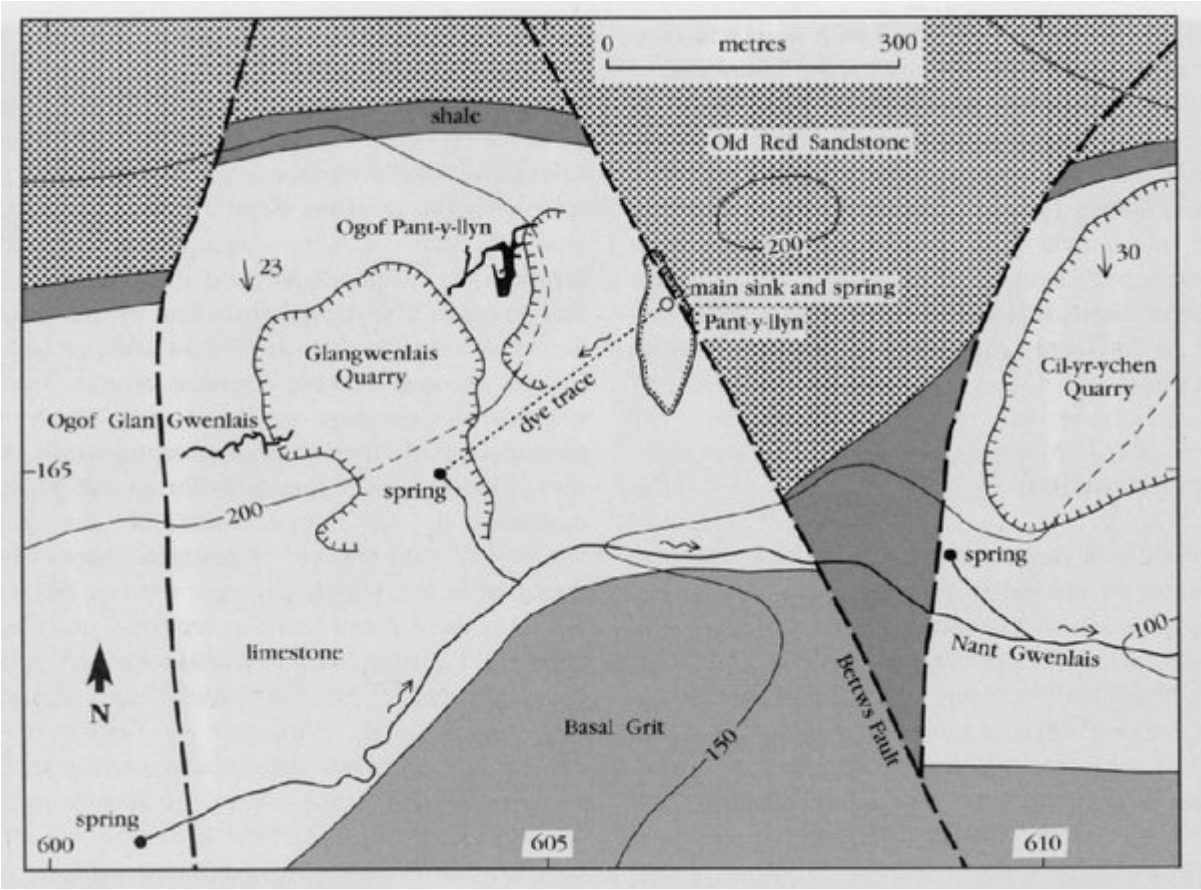
Conclusions

Pant-y-llyn is a small turlough which reaches its maximum size in winter, when it measures 160 m long and 3 m deep. In late spring and early summer the lake drains through its floor. The lake appears to be the surface expression of the local water table. Dye tracing shows that the turlough drains to the Glangwenlais Quarry to the west and to the Nant Gwenlais via an unknown route. Pant-y-llyn is the only known turlough in Britain.

References



(Figure 6.1) Outline map of the karst areas around the perimeter of the South Wales coalfield, with locations referred to in the text. The cover rocks in the south are Triassic and Jurassic mudstones and thin limestones.



(Figure 6.22) Geological map of the area around Pant-y-llyn.