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# Gwern-y-Brain

[SJ 2180 1265]–[SJ 2180 1285]

## Introduction

This nationally important site includes a relatively shallow-water development of the laterally persistent Nod Glas Formation. Its lithologies and graptolite, trilobite and conodont faunas provide important evidence for regional basin topography and global biostratigraphical correlation.

The upper Caradoc Nod Glas Formation can be traced over large parts of central and North Wales and the exposures in the Gwern-y-Brain stream, 1 km north of Guilsfield near Welshpool (see '1' in (Figure 10.1)), marks its most southeastward extent. This is the only section in the formation to contain shelly fossils and conodonts as well as graptolites and thus provides an important link between the shelly and graptolitic zonal schemes in the Welsh Basin. The conodonts provide key evidence concerning the relative positions of graptolite and conodont bio-zonal boundaries and the base of the Ashgill Series.

Cave (1965) gave a detailed description, map and log of the section through the Nod Glas Formation and contiguous formations in Gwern-y-Brain. It was put into a wider stratigraphical context by Cave and Price (1978), who included a geological map of the area to the west and north of Guilsfield (Figure 9.20)a and formally corrected some major misconceptions made by other workers over the age-range of the Nod Glas Formation. The section is also covered in an excursion guide by Cave and Dixon (1993).

## Description

Intermittent outcrops in the bed and banks of the stream expose 2 m or so of phosphatic limestone (the Pen-y-garnedd Phosphorite Member) that is nodular in its uppermost part and overlain by about 6.5 m of dark-coloured shale with a few thin seams of phosphatic mudstone (the Pen-y-garnedd Shale Member). This upper member yields graptolites and shelly fossils including the trilobites *Flexicalymene onniensis* (Shirley) and *Onnia gracilis* (Bancroft). The formation is overlain unconformably at the northern end of the site by the lower Llandovery Powis Castle Conglomerate (Figure 9.20). The beds of the Nod Glas Formation dip north-west at about 25°, and although the base is not exposed, calcareous siltstones and limestones of the underlying Gaerfawr Formation crop out within a few metres of the lowest phosphatic limestone and are further exposed to the south. Cave (1965) equated the uppermost part of the Gaerfawr Formation with the upper Gelli-grîn Formation (see site report for Gelli-grîn).

Cave and Price (1978, p. 190) estimated that the uppermost 6 m or so of the Pen-y-garnedd Shale Member (and thus the Nod Glas Formation) is missing in Gwern-y-Brain. They estimated that, immediately to the south-west, the upper member is about 12.5 m thick; it is overlain by up to 38 m of homogeneous mudstones, termed the 'Trawscoed Mudstone Formation' and containing a Cautleyan (mid- Ashgill) shelly fauna. This in turn is overlain by the Powis Castle Conglomerate, the base of which thus lies on progressively older units as it is traced northwards.

## Interpretation

The Nod Glas Formation occurs widely in central and North Wales and marks the top of the Ogwen Group, representing a late Caradoc deepening event in the Welsh Basin. It was originally named by Pugh (1923) for black graptolitic shales between Corris and Aberllefenni in Gwynedd. That facies is typical of the unit in the deeper parts of the basin such as Cadair Idris (Pratt *et al.*, 1995, p. 48), and Cave (1965) considered the development with phosphatic limestones in the southern Berwyn Hills, as at Gwern-y-Brain, to represent a large submarine high (see also Temple and Cave, 1992, fig. 1). In the area north of Dinas Mawddwy, Pugh (1928) noted that part of the graptolitic facies passes into nodular limestones which Lockley (1980a, p. 39) considered to be equivalents of the Woolstonian Cymerig Limestone Member of

the Gelli-grŷn Formation. This represents a lower level than is inferred for the typical Nod Glas Formation elsewhere (Pratt *et al.*, 1995) and is certainly older than the development in Gwern-y-Brain.

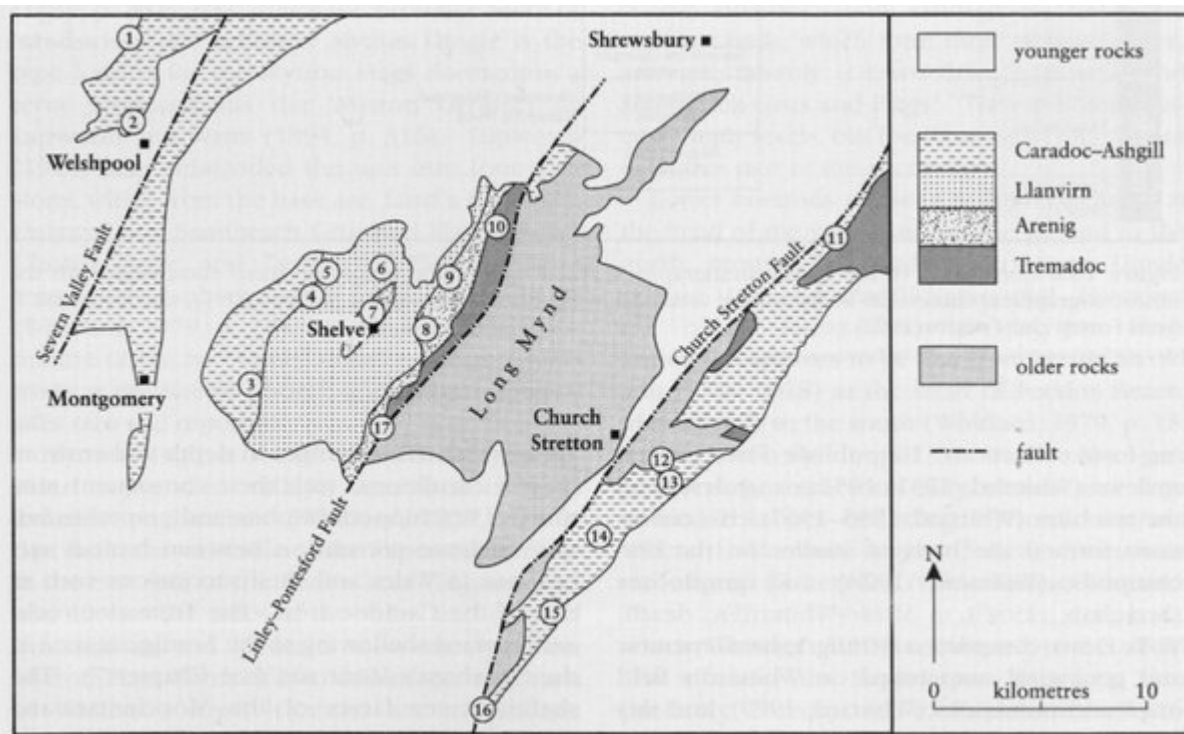
The various fossils recovered from the Nod Glas Formation at Gwern-y-Brain have an important, but as yet not fully resolved, bearing on the relative positioning of graptolite and conodont biozonal boundaries and the base of the Ashgill Series. The graptolites from the Pen-y-garnedd Shale Member represent the *clingani* Zone (Cave, 1965). Elsewhere, both lower and upper subzones of the *clingani* Zone may be present (Pratt *et al.*, 1995), and the *Pleurograptus lincalls* Zone faunas may be present locally, as near Llanystwmdwy (Price, 1984, p. 104). The boundary between the *clingani* and *linearis* bio-zones lies within the uppermost Caradoc Series (Fortey *et al.*, 1995). The occurrence of the trilobites *Flexicalymene onniensis* and *Onnia gracilis* in the Pen-y-garnedd Shale at Gwern-y-Brain is taken to indicate the Onnian Substage at the top of the Caradoc and is supported by an ostracod assemblage recorded at Welshpool by Jones (1986–1987, p. 108) that is similar to that from the middle of the type Onnian. If this age is applied to the whole of the Nod Glas Formation at Gwern-y-Brain, a hiatus is indicated at the base as well as the top of the formation (Cave and Price, 1978, fig. 2), because the underlying beds are of Woolstonian age (= 'upper Longvillian' of older usage).

Savage and Bassett (1985, p. 683) extracted two conodont faunas from the Pen-y-garnedd Phosphorite Member in Gwern-y-Brain. The lower, from the basal part of the member, included fairly abundant *Plectodina bullhillensis* Savage and Bassett, a species occurring only in samples from the Costonian to Woolstonian of the type Caradoc. If these conodonts are not long-ranging or reworked they raise the possibility that the base of the Phosphorite Member is as old as Woolstonian, which is the age of the underlying Gaerfawr Formation. The second sample, from immediately below the nodular bed at the top of the member, contained conodonts which they ascribed to *Amorphognathus ordovicicus*, suggesting that the base of the *ordovicicus* Zone lies within the Phosphorite Member. Compared with the graptolite and trilobite evidence from the site, this conodont zonal boundary seems to be at a substantially lower horizon than the level within the Ashgill at which it is reported elsewhere (see Fortey *et al.*, 1995, p. 23). The resolution of this difference has important consequences for any international agreement on the base of an acceptable chronostratigraphical unit at or about this level in the upper Ordovician.

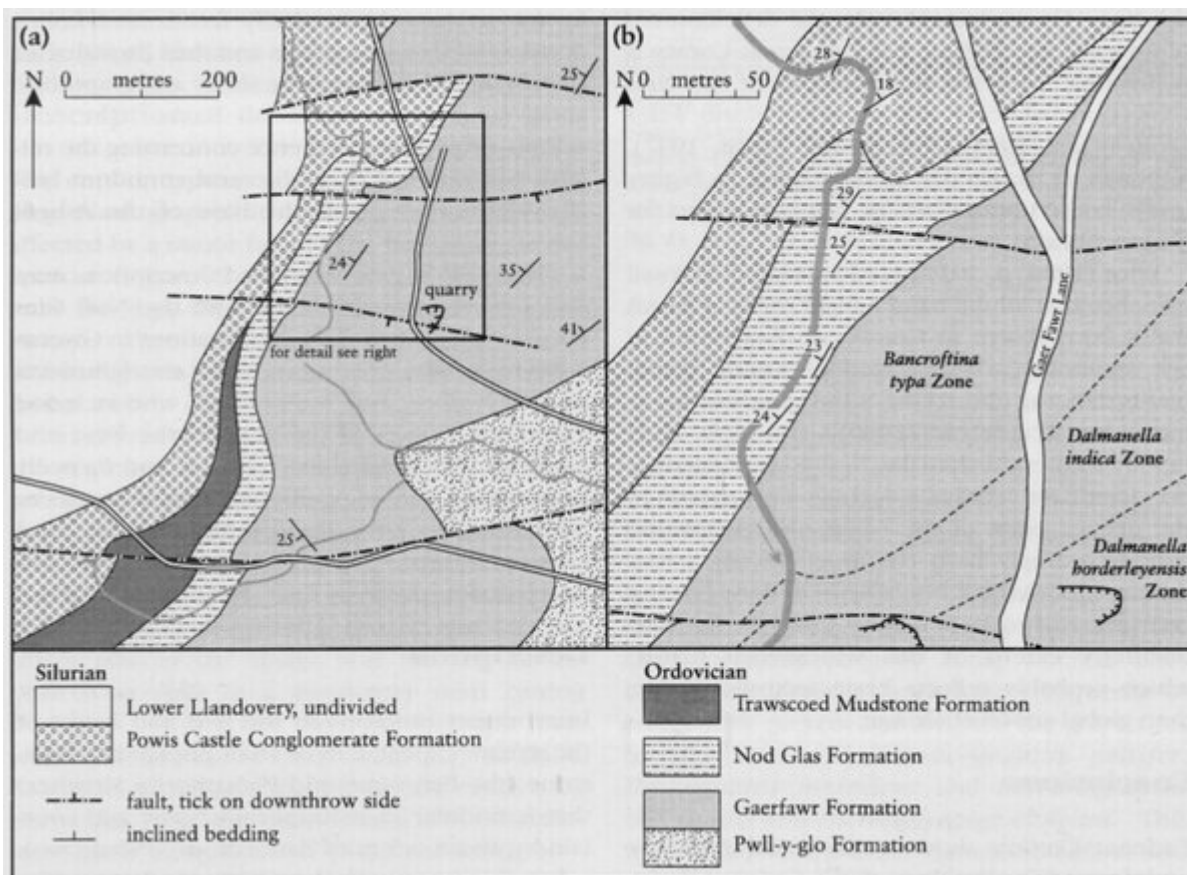
## Conclusions

The rocks in the Gwern-y-Brain section include a relatively shallow-water development of the Nod Glas Formation, which extends widely through central and north Wales. The locality is unique in that graptolites, shelly fossils and conodonts are associated in the unit, and these have an important bearing on international correlation and definition of the base of the Ashgill Series.

## [References](#)



(Figure 10.1) Map showing the distribution of Ordovician rocks in south Shropshire and eastern central Wales, from British Geological Survey (1994c). GCR sites as follows: 1, Gwern-y-brain; 2, Trilobite Dingle; 3, Spy Wood and Aldress dingles; 4, Meadowtown; 5, Betton Dingle; 6, Hope Valley; 7, Shelve Church; 8, Bergam Quarry; 9, Mytton Dingle; 10, Granham's Moor (Tremadoc, see Chapter 7); 11, Coundmoor Brook (Harnage); 12, Hope Bowdler; 13, Soudley Quarry; 14, Marshwood; 15, Onny River; 16, Coston Farm; 17, Linley Big Wood (Tremadoc, see Chapter 7).



(Figure 9.20) (a) Geological map showing the occurrence of the Nod Glas Formation and the overlying Trawscoed Formation (Ashgill) to the south of the Gwern-y-brain site, from Cave and Price (1978, fig. 3); (b) more detailed map of the Nod Glas Formation and contiguous units in the Gwern-y-brain section, after Cave (1965, fig. 3).