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# Pen Benar

[SH 315 283]

## Introduction

Pen Benar shows the most north-westerly outcrop of Tremadoc rocks in Wales. The lower Tremadoc *flabelliformis* and *tenellus* zones are proved, but the lithofacies present are coarser-grained than those of contemporaneous strata seen elsewhere in North Wales. Palaeogeographically the site is of regional significance, as it represents a position near the north-west margin of the Welsh Basin.

In the area of St Tudwal's Peninsula, the Dol-cyn-afon Formation of the Tremadoc is exposed only adjacent to the Sarn-Abersoch Thrust and north of Abersoch. The formation is strongly deformed. Pen Benar provides the best section, but tight folding and abundant minor faulting obscure details of the succession. Nicholas (1915) described the exposures and recorded the faunas. The rocks in this area were subsequently re-examined by Crimes (1969), and geological excursion guides to the section are included in Roberts (1979) and Cattermole and Romano (1981).

## Description

The oldest beds exposed, assigned to the *flabelliformis* Zone, are thrust up approximately 30 m west of the old landing place [SH 3152 2836], where they dip steeply westwards. They consist of rusty-weathering, dark-grey, laminated and mottled mudstones, similar to other Welsh lower Tremadoc rocks. Pale-grey mudstones, up to 10 cm thick and often showing microfaulting, occur occasionally; they have sharp bases and become darker upwards, indicating an origin from waning-flow events. *Rhabdinopora flabelliformis* (Eichwald) can be found. West-dipping thrusts imbricate this lower part of the sequence, and minor folds that verge south-east plunge at about 25° to the NNE. To the west [SH 3149 2836], mottled and structureless dark-grey mudstones yield *Adelograptus tenellus* (Linnarsson). These mudstones extend westwards and include a bed of feldspathic sandstone, suggestive of volcanic activity nearby.

Above this horizon the rocks become more arenaceous, with thin beds of grey-green siltstone and fine sandstone (Figure 7.6) that are planar and laterally continuous or else may become lenticular and preserve ripple cross-lamination. Bioturbation is common. Large (1.5 m) sideritic concretions are commonly associated with the coarser horizons. These arenaceous beds are also exposed beneath the thrust associated with the *Rhabdinopora*-bearing strata and can be traversed eastwards beyond the old landing place, where there is an anticlinal hinge. At the eastern edge of the site a vertical fault introduces Arenig strata that are folded into a syncline and which, farther east, rest once again on strata of Tremadoc age, as described by Nicholas (1915, p. 120).

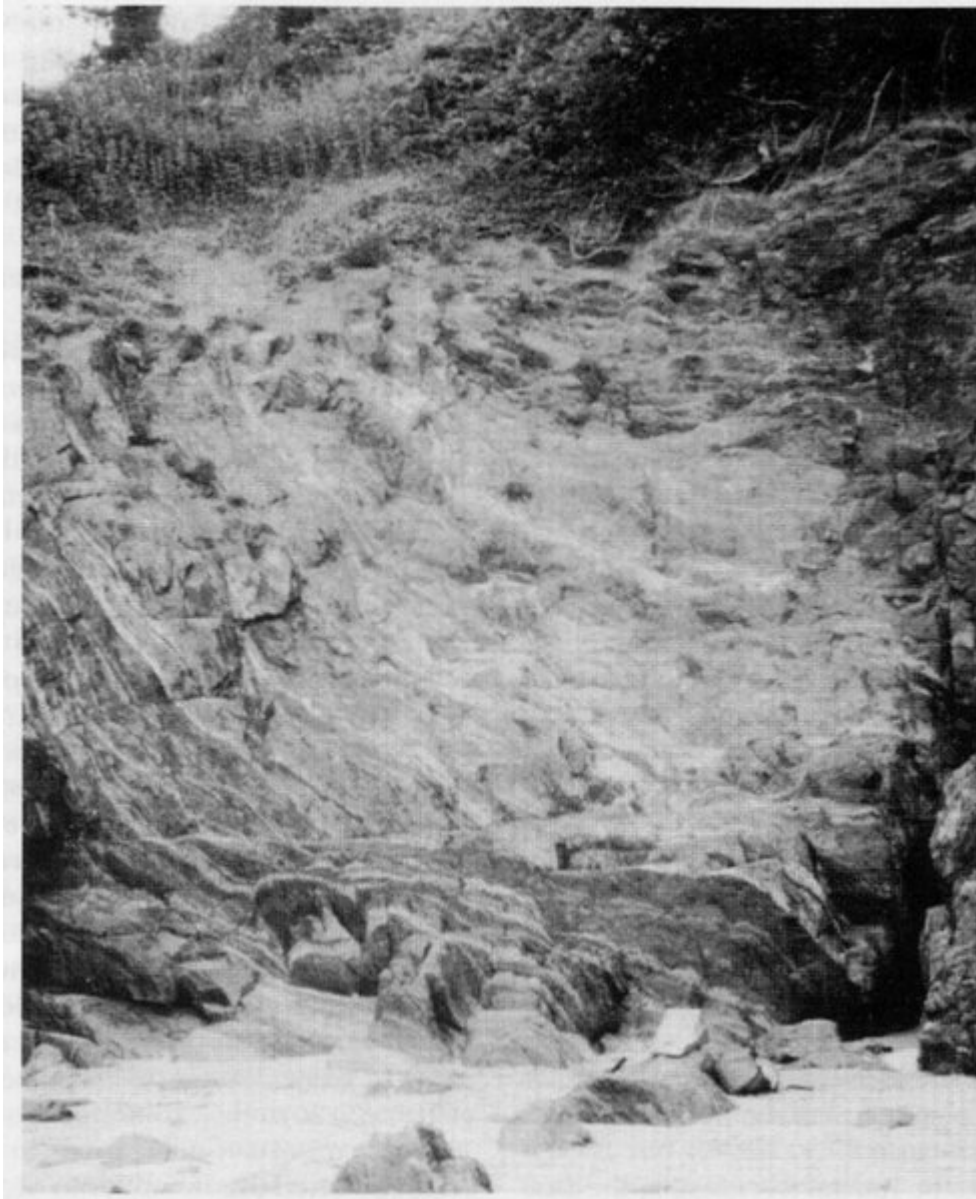
## Interpretation

The lowest strata at Pen Benar are assigned to the lower Tremadoc *flabelliformis* and *tenellus* zones and lithologically resemble Fearnside's 'Dictyonema band'. The sandstones and graded mudstones higher in the sequence indicate deposition from waning-flow events, such as turbidite or storm events. These coarser beds overlie beds with *Adelograptus tenellus* and have been placed in the *tenellus* Zone (Nicholas, 1915), though faunal proof is lacking. If Nicholas' assignment is correct, it indicates that coarser lithofacies developed earlier in St Tudwal's Peninsula than in other parts of Wales, suggesting that uplift or shallowing occurred earlier there than elsewhere: in the rest of North Wales the Upper Sandstone Member is developed in the upper Tremadoc, whereas the sandstones of Pen Benar appear to correlate with the lower Mudstone Member. If this is confirmed, it may be due to the proximity of the positive Anglesey–Wexford axis. It remains possible, however, that there is a hiatus in the Pen Benar sequence and that the sandstone beds there correlate with the similar unfossiliferous Upper Sandstone Member of the Tremadoc area.

## Conclusions

The locality at Pen Benar is the most north-westerly outcrop of Tremadoc rocks in Wales. The fossils allow correlation with lower Tremadoc rocks elsewhere in Wales and Shropshire. However, the rocks here differ from those elsewhere in containing many sandy beds, suggesting that the water depth here may have been less than in other early Tremadoc strata in Britain.

### References



*(Figure 7.6) Pen Benar, Abersoch. Laminated sandstone units in mudstones of the lower part of the Dol-cyn-afon Formation, such as are not commonly developed in the flabelliformis and tenellus zones. (Photo: J.K. Prigmore.)*