Marquis of Anglesey's Column

[SH 535 715]

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Introduction

The geological interest of this site resides in the fact that it includes the best, and most accessible, exposures of blueschist in Great Britain. Blueschist is an unusual metamorphic rock produced by the subduction of oceanic crust and is, therefore, known worldwide from sites of ancient and modern plate convergence such as California, Japan, New Caledonia and Corsica. Preservation of blueschist is rare, and this is especially the case for pre-Mesozoic examples. The Anglesey blueschists are Precambrian in age and as such are one of the oldest, and quite probably the oldest, assemblage of blueschists in the world. The presence of blue glaucophanic amphibole, typical of blueschist, in Anglesey was first recognized by Blake (1888) who described rocks exposed at this locality. Later descriptions, and additional petrological, geochemical, and isotopic data were published by: Adye (1906), Greenly (1919), Holgate (1951), Gibbons and Mann (1983), Horák and Gibbons (1986), Gibbons and Gyopari (1986), and Dallmeyer and Gibbons (1987).

Description

The Anglesey blueschist is exposed as a series of crags in woods beneath the Marquis of Anglesey's Column (Figure 7.8). The rocks comprise fine-grained, intensely foliated and lineated, dark blue-grey schists in which the foliation is folded by intrafolial folds. The mineralogy of these rocks comprises: amphibole, epidote, albite, chlorite and quartz. The amphiboles are of especial interest because many crystals are polymineralic (Figure 7.9), with a blue glaucophanic rim and a green core of actinolite and/or barroisite (Adye, 1906; Greenly, 1919; Gibbons and Gyopari, 1986). Dallmeyer and Gibbons (1987), who produced ^{40}Ar–^{39}Ar uplift ages of 560–550 Ma, have confirmed the late Precambrian age of these rocks.

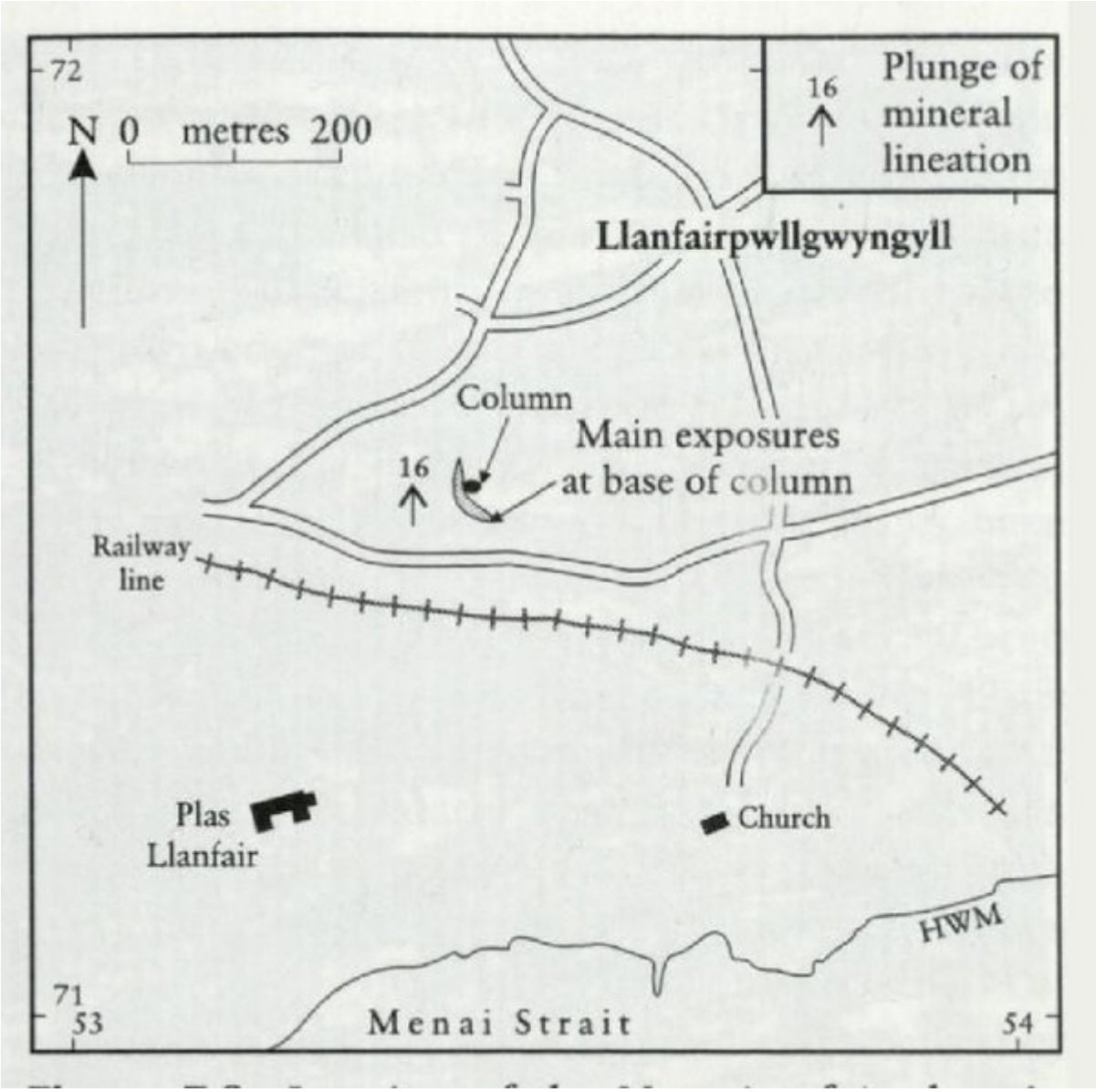
Interpretation

The initial interest of this site focused on the fact that the rocks had an unusual mineralogy and were unique within Great Britain. Dewey (1969) and Wood (1969) were the first to emphasize the tectonic significance of this site in terms of its preservation of evidence for former plate subduction. They interpreted the rocks as having been produced by the rapid tectonic burial of oceanic crust and incorporation into an accretionary prism within which high pressures were attained at relatively low temperatures. It is this unusual combination, of high pressures and low temperatures, that allows the blueschist mineral assemblage to crystallize. Several plate tectonic models followed, although the highly faulted and complex nature of Anglesey geology imposed little constraint on such interpretations. There was thus no agreement on whether the oceanic slab dipped south-east (Dewey, 1969; Rast *et al.,* 1976; Virdi, 1978; Barber and Max, 1979; Coward and Siddans, 1979; Anderton *et al.,* 1979; Gibbons, 1980) or northwest (Baker, 1969; Shackleton, 1975). Thorpe (1974) and Barber *et al.* (1981) suggested a double subduction system, with the Benioff (subduction) zones dipping in either opposing directions, or both towards the south-east. Gibbons (1983, 1987, 1990), observing the narrow, fault-bounded outcrop of the Anglesey blueschists, suggested that it is a small slice of a former subduction system that has been strike-slip faulted into its present position within the Menai Strait Fault System. The concept of 'exotic' or 'suspect' terranes was thus introduced to the interpretation of Anglesey geology, based primarily on the existence of the Anglesey blueschists. This view was refined by Gibbons and Horák (1996) into a model whereby the blueschists were preserved as a slice of accretionary prism — termed the 'Aethwy Terrane' in Chapter 1 — caught up in a transition from orthogonal subduction to transcurrent faulting (Figure 1.4). The only other locality in Wales where glaucophanic blue amphibole is found is at the GCR site on Penrhyn Nefyn foreshore; these exposures appear to represent a continuation of the same blueschist belt.

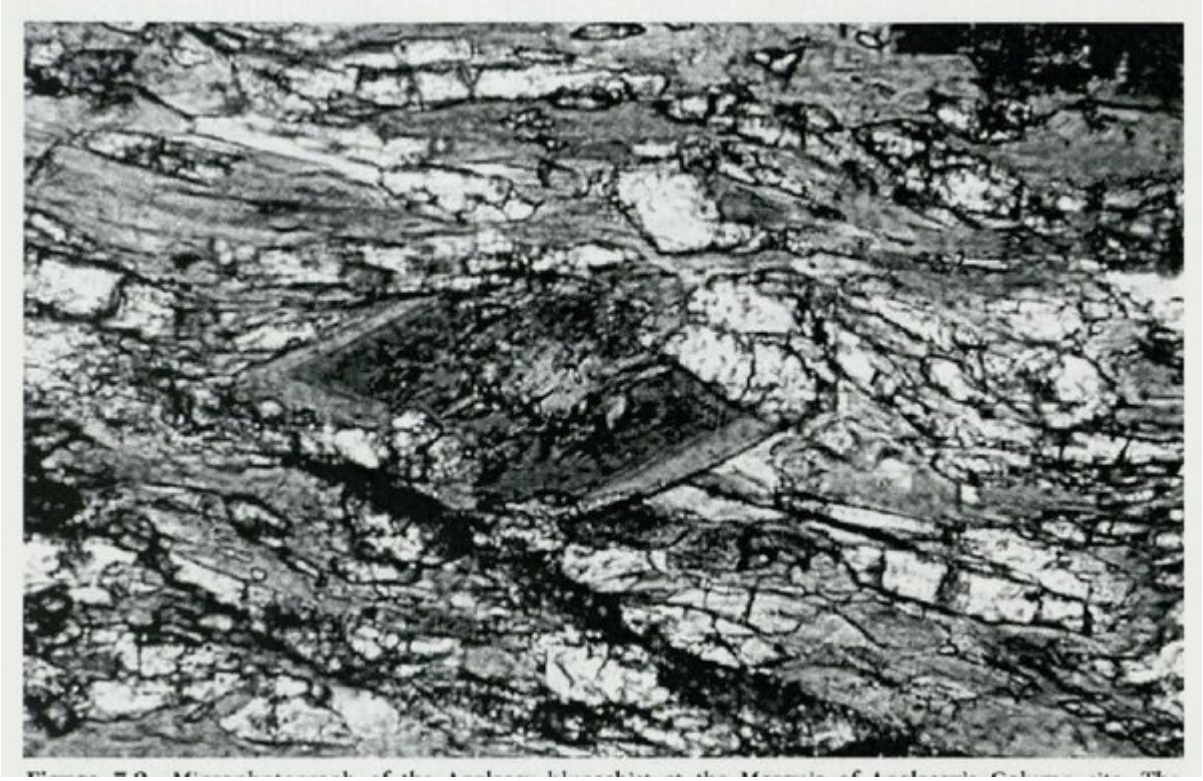
Conclusions

The exposures of metamorphic rocks beneath the Marquis of Anglesey's Column are of international interest. They preserve fresh blue amphibole-bearing assemblages typical of rocks subducted at oceanic trenches along modern destructive plate margins, where cold rocks are buried quickly and so subjected to high pressures whilst remaining 'refrigerated' at relatively low temperatures. Such blueschists are only relatively rarely exposed around the world and are a sure indication of former subduction having taken place. Old blueschists (>300 Ma) are even rarer, and the Anglesey examples have been shown to be Precambrian, which makes them amongst the oldest such rocks known in the world. They are of added mineralogical interest because they contain polymineralic amphiboles; individual crystals have been preserved in the act of recrystallizing from a green to blue amphibole as pressures increased. Their preservation as a narrow strip — named the Aethwy Terrane — within a steep fault zone has been interpreted as not only indicating former plate subduction but also is suggestive of a significant component of transcurrent fault movement having acted upon the basement rocks of Anglesey. Application of the maxim *'the present is the key to the past'* allows comparisons to be made between the processes that produced and preserved the Anglesey blueschists with those operating at currently active plate margins such as along western North America.

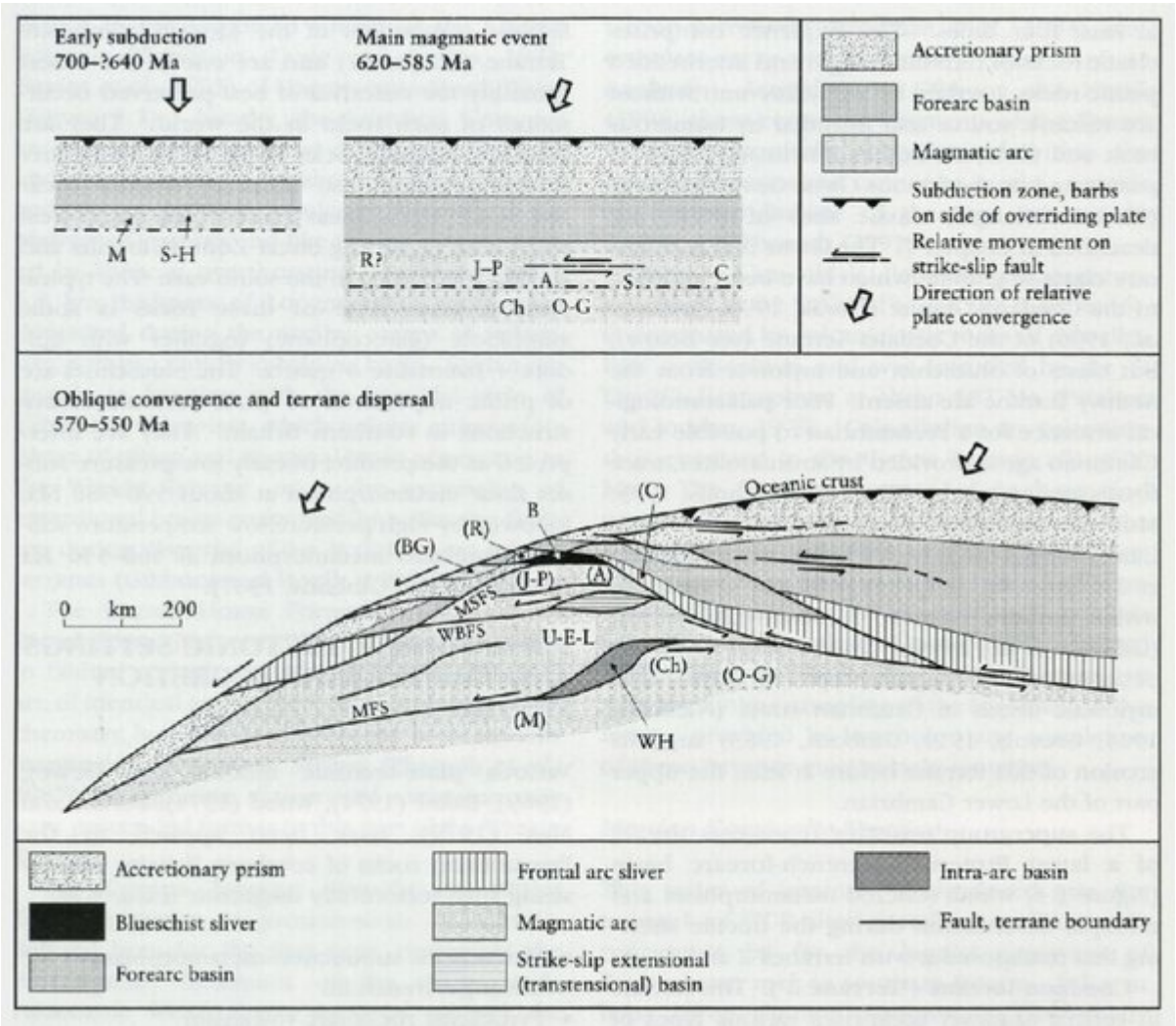
References



(Figure 7.8) Location of the Marquis of Anglesey's Column site. Note that the area to the north of the railway line is mainly underlain by metabasaltic blueschist with a foliation (not shown) that is flat-lying, varying about the horizontal.



(Figure 7.9) Microphotograph of the Anglesey blueschist at the Marquis of Anglesey's Column site. The blueschist consists of glaucophanic, blue amphibole (pale grey areas) and epidote (white laths). The crystal at the centre has an actinolitic core (pale grey) surrounded by barroisite (darker grey), with the outer pale-toned rim of the crystal being blue glaucophane. (Photo: W. Gibbons.)



(Figure 1.4) Model for the late Precambrian evolution of the Avalonian subduction system: episodic Precambrian magmatism (top two cartoons) followed by the dispersal of terranes by transcurrent faulting along the plate margin as convergence became increasingly oblique during the latest Precambrian (modified from Gibbons and Horik, 1996). Note that the presence of the Monian Composite Terrane within this system cannot be proved until Arenig time. A = Arfon Group; B = Anglesey blueschists; BG = Bwlch Gwyn Tuff and related strata (Anglesey); C = Coedana Complex; Ch = Charnian Supergroup; J-P = Johnston Plutonic Complex and Pebidian Supergroup; M = Malverns Complex; MFS = Malverns lineament or fault system; MSFS = Menai Strait fault system; O-G = volcanics in Orton and Glinton boreholes; R = Rosslare Complex; S = Sam Complex; S-H = Stanner-Hanter Complex; U-E-L = Uriconian Group, Ercall Granophyre, Longmyndian Supergroup; WBFS = Welsh Borderland fault system; WH = Warren House Formation. The same letters in brackets (lower cartoon) refer to the relative positions of those volcanic belts that were by then extinct.