Amroth Coast

Highlights

Amroth shows the best sequence of middle Langsettian to middle Duckmantian strata in Pembrokeshire, and provides an important comparison with sections in the main part of the South Wales Coalfield. The sequence includes the distinctive Amroth Freshwater 'Limestone'.

Introduction

Coastal exposures between Wiseman's Bridge and Amroth, Dyfed [SN 148 062]–[SN 168 069] show middle Langsettian to middle Duckmantian strata on the north crop in Pembrokeshire. Although broken up into a series of blocks by Variscan faulting, it has proved possible through a combination of litho-and biostratigraphy to establish a continuous succession. The geology was dealt with in a number of early studies, the most important by De la Beche (1846) and Strahan *et al.* (1914). Jenkins (1954, 1962) was able to establish the continuity of the sequence, enabling detailed sedimentological analyses to be made subsequently (Williams, 1966, 1968).

Description

Lithostratigraphy

The combined sequence exposed here is some 250 m thick, with six named coal seams (Figure 4.8) and (Figure 4.9). The lower 100 m, up to just below the Fiddlers Seam, consist mainly of lacustrine and back-swamp deposits (Williams, 1968). A distinctive feature of this interval at Amroth is the so-called 'Amroth Freshwater Limestone', underlying the Kilgetty Coal. It is not a limestone in the strict sense, but a calcite or ankerite-cemented siltstone, with more than 20% detrital quartz, probably deposited in a lacustrine setting (Williams, 1968; Kelling and George, 1971; George and Kelling, 1982).

Above the Fiddlers Seam are *c.* 75 m of mainly mudstones and shales with a number of coals and/or seat earths. They appear to represent fluvio-deltaic sediments, probably deposited in floodbasin lakes in a middle delta-plain setting. In such a model, the mudstones and shales would represent mainly overbank deposits, while the coals/seat earths would reflect emergent conditions. Towards the top of this interval, high energy channel sandstones and siltstones occur (Figure 4.10). They reveal variable palaeocurrent directions and Williams (1966, 1968) attributes them to a highly sinuous river system running in a westerly or northwesterly direction.

Overlying this fluvial channel deposit is *c.* 0.3 m of dark shales, that are thought to represent the Vanderbeckei Marine Band. Thereafter, there are about 30 m of mudstones and siltstones, showing a gradual return to non-marine conditions (Williams, 1966, 1968). The lower 10 m are intertidal, with abundant ripple marks. These are succeeded by mudflat and sand-bar deposits, fluvial channel-fill deposits, and eventually a coal seam (the Timber Seam). The topmost 30 m of the Amroth succession, overlying the Timber Seam, see a return to predominantly marine deposits.

Biostratigraphy

Marine bands

Only one horizon in the Amroth section has been found to contain marine fossils: a shale, *c.* 175 m above the base. To date, it has only yielded a limited assemblage of *Lingula, Dunbarella, Conularia* and indeterminate bivalve fragments (Jenkins, 1962; Williams, 1966). On its own, such an assemblage is not sufficiently diagnostic for it to be identified with any of the marine bands in the main part of the South Wales Coalfield. However, it occurs in the middle of the *A. modiolaris* non-marine bivalve zone (see below) and is almost certainly a correlative of the Vanderbeckei Marine Band. It thus marks the boundary between the Langsettian and Duckmantian stages.

Non-marine bivalves

These have been found at 13 levels within the Amroth succession, numbered in ascending stratigraphical order 1–13 by Jenkins (1962). They fall into four groups: no. 1, the Amroth Freshwater Limestone; nos 2–8 in the lacustrine dominated sequence between the Amroth Freshwater Limestone and the Fiddlers Seam; no. 9 between the Garland and Rock seams; and nos 10–13 between the Vanderbeckei Marine Band and the Timber Seam.

The Amroth Freshwater Limestone contains abundant shells of the *Carbonicola* cf. *bipennis* (Brown) type, thus indicating the *C. bipennis* Subzone (lower to middle *Carbonicola communis* Zone). Other, larger shells were identified by Jenkins (1954) *as Carbonicola* cf. *aldamae* (Brown), a species known from the lower C *communis* Zone of the main part of the South Wales Coalfield (Trueman and Weir, 1947). Later, Jenkins (1960, 1962) re-named these larger shells as *cf. Anthracosia regularis* (Trueman), but they do not have the umbonal structure typical of *Anthracosia* and are well below the normal strati- graphical range of that genus.

Jenkins' Bed 2, immediately above the Kilgetty Seam, yields an assemblage which, although indicative of the C *communis* Zone, is not diagnostic of a particular subzone. However, the overlying six horizons (nos 3–8) yield assemblages dominated by large shells, typical of those normally found in the *Carbonicola pseudorobusta* Subzone. Interestingly, the lowest of these beds (no. 3) also contains shells similar in general shape to *C. bipennis* (Brown), which suggests that it represents a transitional phase between the typical C *bipennis* and C *pseudorobusta* subzones.

The bivalves from between the Garland and Rock seams (bed no. 9) were identified by Jenkins (1954, 1960) as *Carbonicola oslancis* Wright and C cf. *rhomboidalis* Hind, clearly indicating the *Carbonicola cristagalli* Subzone. Consequently, the boundary between the C *communis* and *A. modiolaris* zones probably lies somewhere between the Fiddlers and Garland seams.

The highest bivalves come from four horizons above the Vanderbeckei Marine Band. They all clearly belong to the *A. modiolaris* Zone (Jenkins, 1954, 1960), and the lowest (no. 10) has yielded an assemblage of the *Anthracosia ovum* Subzone. No evidence has been found of the *Anthracosia regularis* Subzone at Amroth.

It has often been stated that the succession at Amroth extends up into the 'similis–pulchra' zone (e.g. George and Kelling, 1982), but there is no biostratigraphical evidence to support this assertion. In Pembrokeshire, the only bivalve assemblages of this zone are from the coast at Broad Haven, and near Picton Point on the Cleddau (Jenkins, 1954, 1960, 1962).

Plant macrofossils

Plant fossils are not particularly abundant at Amroth. The best evidence is from two beds, above the Fiddlers and Garland seams (Goode, 1913). These have yielded assemblages including *Neuropteris obliqua* (Brongniart) Zeiller, *Alethopteris* cf. *urophylla* (Brongniart) Goppert and *Eusphenopteris* cf. *sauveurii* (Crépin) Novik, which indicate the upper *Lyginopteris hoeninghausii* Zone (Goode's records of *Macroneuropteris scheuchzeri* (Hoffmann) Cleal *et al.* and *Annularia sphenophylloides* (Zenker) Gutbier are probably in error, this being well below the normal stratigraphical ranges of these species).

Goode (1913) described a sphenophyte assemblage of restricted diversity, just below the Fiddlers Seam. Such assemblages are often associated with Upper Carboniferous lacustrine deposits (e.g. Scott, 1979).

In Jenkins' (1962, P1. 5), a plant bed is shown immediately overlying the Kilgetty Seam, but no reference is made to the species found.

Interpretation

This is the best exposure of upper Langsettian and lower Duckmantian strata on the north crop of Pembrokeshire. Coeval strata are present near Broadhaven (Jenkins, 1962), but the succession there is not as complete, especially in the upper Langsettian. The Cleddau exposures of these strata also show a much less complete succession than at Amroth.

The general pattern of sedimentation seen at Amroth is consistent with that found on the north crop in the main part of the South Wales Coalfield, such as in the Gwendraeth Valley (Archer, 1968). In particular, predominantly lacustrine deposits occur in the upper *Carbonicola communis* Zone of both areas, although these conditions would seem to have lasted somewhat longer in Pembrokeshire. However, there is no evidence in the main part of the South Wales Coalfield of the complex of fluvial sandstones immediately below the Vanderbeckei Marine Band (e.g. Matthews, 1955).

The Amroth Freshwater 'Limestone' is only known from here. Jenkins (1962) found a similar 'limestone' near Broadhaven, but this lies above the Kilgetty Seam and contains non-marine bivalves of the C *pseudorobusta* Subzone (Jenkins, 1960). No such 'limestones' are known from the main part of the South Wales Coalfield.

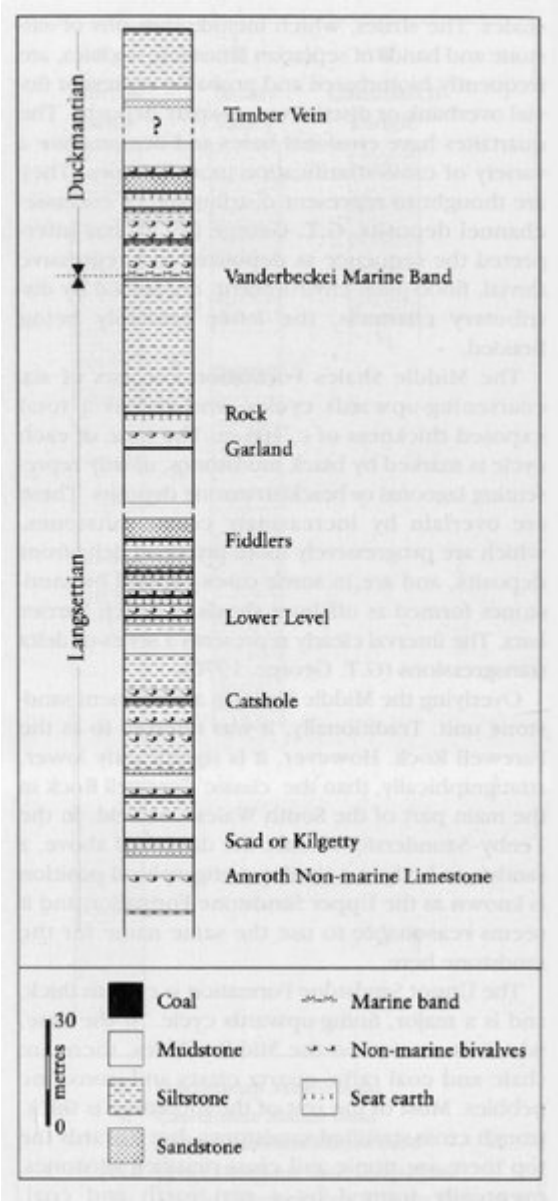
Detailed comparisons of thickness with the main part of the South Wales Coalfield are difficult, because Amroth shows neither the bottom of the *C. communis* nor the top of the *A. modiolaris* zones. The only interval for which a comparison is possible is between the base of the *A. modiolaris* Zone (between the Fiddlers and Garland seams) and the Vanderbeckei Marine Band, which is *c.* 85 m thick at Amroth. This is in general agreement with the succession in the Gwendraeth Valley, on the western part of the north crop (Archer, 1968).

Sequences in Ireland overlap only in part with that at Amroth. The top part of the Leinster Coalfield has yielded bivalves of the *C. bipennis* Subzone (Eagar, 1964), but there is no evidence of the upper *C. communis* Zone or *A. modiolaris* Zone. Nevill (1961) claims that the upper part of the Slieveardagh Coalfield also belongs to the lower to middle *C. communis* Zone, but there is little palaeontological evidence to confirm this view.

Conclusions

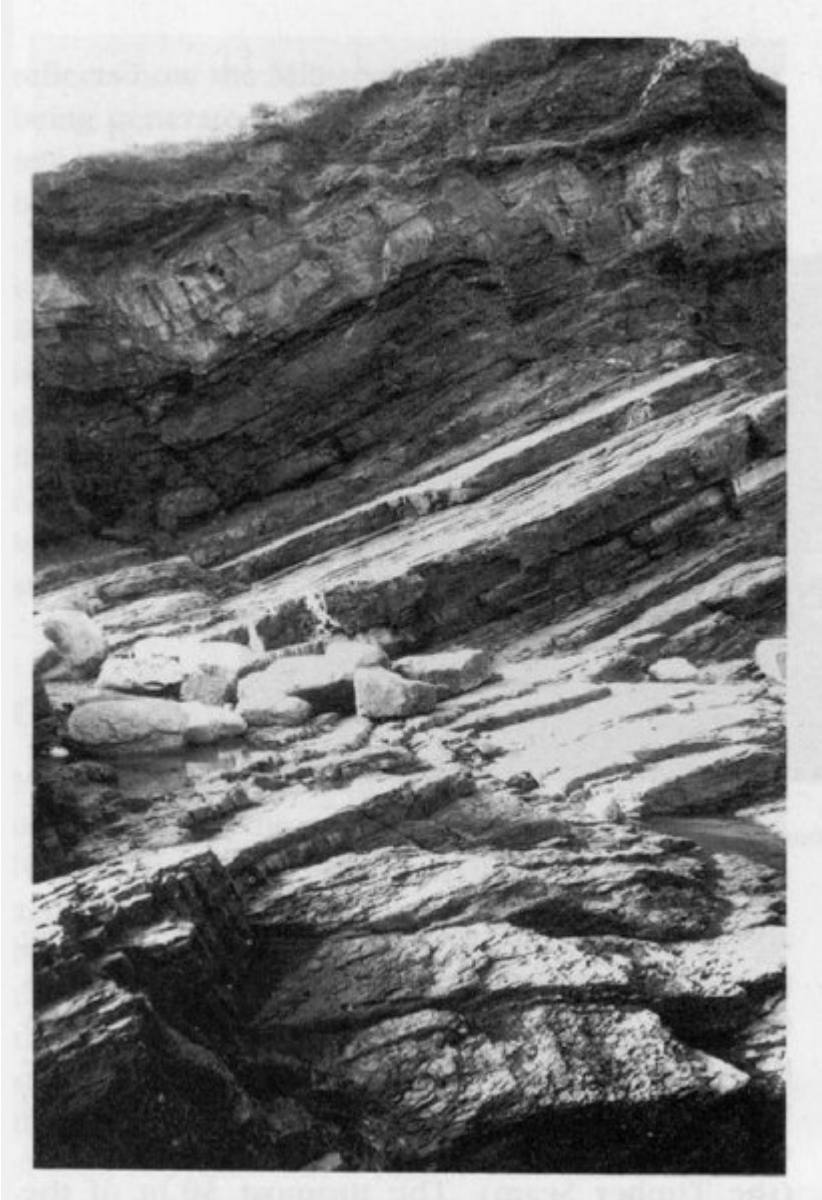
Amroth Coast is the most extensive natural exposure of Coal Measures rocks in southern Britain. It is possible to show how these rocks were formed in a river delta that flowed southwards from an upland area in present-day central Wales, some 312–314 million years ago. Recognizable deposits include mudstones and shales formed in flood-plain lakes, sandstones formed in the river channels, and coals representing the remains of swamp forests growing on the delta. Of especial interest is the occurrence of the so-called Amroth 'Freshwater Limestone' (in fact probably a calcite or ankerite-cemented mudstone) thought to have been deposited in a lake. Fossils are also abundant here, including marine shells, non-marine bivalve shells and plants. These make it possible to correlate the Amroth sequence with similar aged rocks elsewhere in South Wales, and to build up a picture of patterns of sedimentation in the region.

References



(Figure 4.8) Coal Measures exposed along the Amroth Coast. After Jenkins (1962, pl. 5).

(Figure 4.9) Coal Measures exposed along the Amroth Coast. (Photo: C.J. Cleal.)



(Figure 4.10) Amroth Coast GCR site, north of Wiseman's Bridge. Typical sequence of shales and crevasse splay sandstones of the Productive Coal Formation. (Photo: C.J. Cleal.)