Yeolmbridge Quarry, Cornwall

[SX 322 875]

Introduction

The Yeolmbridge Quarry GCR site is a large, partially flooded quarry near Launceston, Cornwall [SX 322 875]. It provides an invaluable reference section for the Yeolmbridge Formation, a succession of black silty slates and limestones that are generally poorly exposed in the area. Early records of trilobites and ammonoids established an Upper Devonian age for the slates in the lower, submerged part of the quarry, but Tournaisian macrofaunas and miospores have since been discovered in the overlying horizons. Several authors (e.g. Reid *et al.,* 1911; Selwood, 1960) have described fossils from this site that establish a conformable succession spanning the Devonian–Carboniferous boundary. The regional setting further suggests that sedimentation occurred in the vicinity of a submarine rise that was drowned as sea level rose during early Carboniferous times (Stewart, 1981; Selwood *et al.,* 1998).

Description

Yeolmbridge Quarry was first described by Reid *et al.* (1911) as one of several Devonian inners that occurred near Launceston. Subsequent regional mapping has shown that they result from complex faulting and form part of a widespread tract of Upper Devonian and Lower Carboniferous rocks in the region between Boscastle, Launceston and Okehampton (see (Figure 10.1)). Correlation between these isolated successions relies critically upon the recognition of distinctive lithofacies, and in this respect the quarry is particularly notable because it also provides a variety of key fossil assemblages.

As parts of the succession are concealed beneath water, the presence of the underlying Devonian strata must be inferred from historical records. Reid *et al.* (1911) described Upper Devonian faunas from distinctive nodular limestones found in the spoil heaps of early workings. Subsequent re-examination of this material by House and Selwood (1957) determined a *Wocklumeria* Zone age. This supports a correlation with the Stourscombe Formation (Figure 10.2).

The exposed part of the quarry is developed entirely within the Yeolmbridge Formation and comprises a 12–15 m succession of dark-grey to brown silty slates with finely banded micaceous siltstones and infrequent cross-bedded sandstones up to 15 cm thick. Horizons of soft, black carbonaceous shale and thin (20 cm) micritic limestones occur intermittently. The youngest part of the sequence occurs in the southern face of the quarry where a 3 m green and grey slate unit is overlain by a thin tuff band and dark shales containing numerous decalcified limestone nodules (Witte, 1983).

Selwood (1960) discovered proetid trilobites and ammonoids at this locality, mainly within the decalcified limestone nodules exposed high in the southern face. The diverse fauna included species of *Cyrtosymbole* ('*Afacrobole*)and the Important arnmonoid *Gattendorfia,* which established a Tournaisian age for this part of the Yeolmbridge Formation. In an attempt to corroborate this age determination, Whiteley (1983) prepared palynological samples from shale horizons immediately above the fossiliferous nodules. These yielded a miospore assemblage dominated by species of *Punctatisporites* and *Retusotriletes,* with subordinate representatives of *Auroraspora macra, Calamospora, Grandispora echinata, Raistrickia* cf. *condylosa* and *Verrucosisporites nitidus.* This palynoflora is referred to the mid-Tournaisian VI miospore zone (Figure 10.3) according to comparisons with other assemblages from western Europe (Clayton *et al.,* 1977; Higgs *et al.,* 1988a,b); it thus provides an age determination in accord with Selwood's (1960) macrofauna.

Interpretation

An understanding of the stratigraphy in the Yeolmbridge area has evolved only slowly, hindered by complex facies relationships and poor exposure. Selwood (1960, 1971) first established a local succession based on the distribution of ammonoids and trilobites, noting that the Devonian–Carboniferous boundary occurred in the black slate facies of the

Ireolmbridge Beds'. More detailed mapping in the surrounding area and a careful analysis of conodont faunas allowed Stewart (1981) to recognize the age-equivalence of several distinctive lithologies within the Upper Devonian and erect a more formal stratigraphy that typically characterizes a tectonic unit known as the 'Petherwin Nappe' (Isaac *et al.,* 1982). However, part of that stratigraphy also occurs at Yeolmbridge where, in contrast, it appears to be largely in *situ* (or autochthonous) and is exposed through a combination of high-angle faults that locally breach the Upper Carboniferous cover rocks (Selwood *et al.,* 1998).

The dark, siliceous slates of the Stourscombe and Yeolmbridge formations at this site contain some limestone beds and horizons containing decalcified, fossiliferous nodules. Elsewhere, these formations pass laterally into more calcareous units (within the Petherwin Formation; see (Figure 10.2)) where the limestone nodules coalesce to form flaser-bedded limestones up to 50 cm thick. The limestones are richly fossiliferous and contain ammonoids, brachiopods and conodonts, the latter indicating deposition in shallow water. Stewart (1981) compared this distinctive facies with the German Cephalopodenkalk described by Schmidt (1925) from the Rheinisches Schiefergebirge.

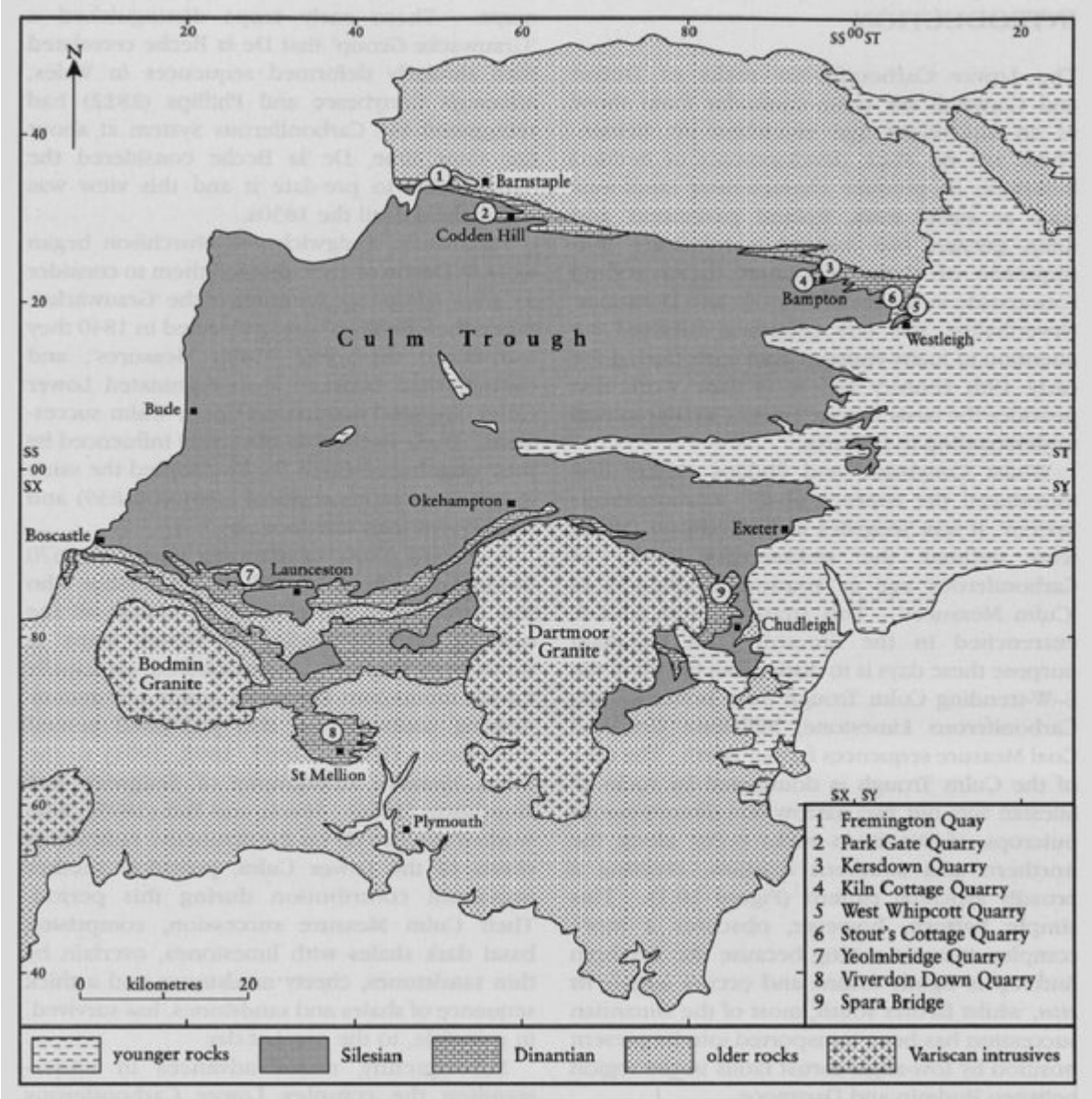
In terms of depositional environments, the Cephalopodenkalk characterizes submarine rises from which fine material is winnowed and transported into adjoining basinal areas (Figure 10.12). Denser shell debris and (laser-bedded limestones dominate the core of the rise but they are typically thin, stratigraphically condensed and areally restricted. They pass laterally into more extensive calcareous slates with nodular limestones on the rise margins and this is the setting envisaged for the Yeolmbridge succession. In the basinal areas, thicker argillaceous sequences bearing pelagic ostracodes and some brachiopods occur.

The black shale facies at this site persisted from Upper Devonian to Tournaisian times, suggesting that the associated submarine rise was a relatively long-lived feature. Stewart (1981) noted that the decline of rise-controlled sedimentation occurred during late Tournaisian times as limestone conglomerates, thought to represent slump deposits, developed along the over-steepened margin of the rise (Figure 10.12). At the same time, black shales progressively onlapped the rise complex and more uniform bathymetric conditions became established during Viséan times.

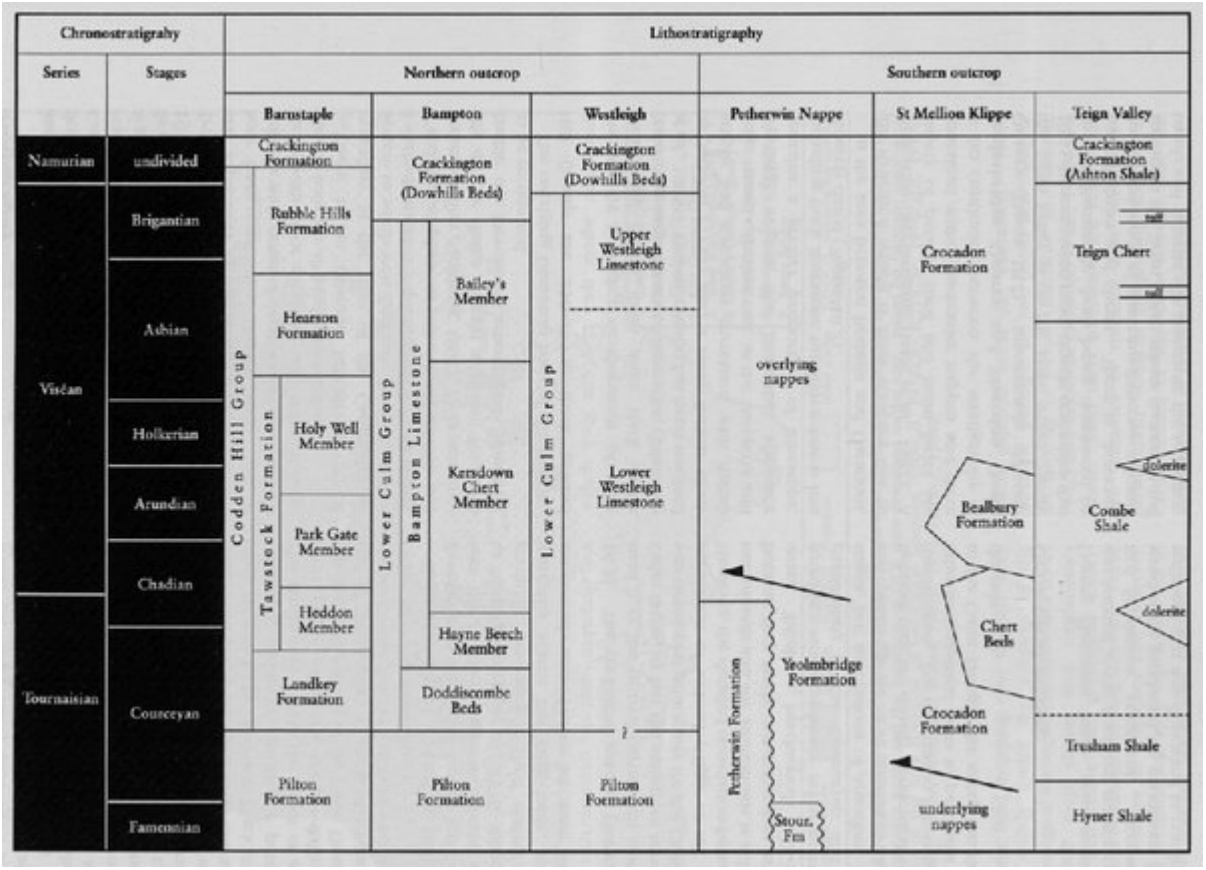
Conclusions

This site is of great historical importance because crucial fossils were found here when the quarry was actively worked in the early 20th century. They confirmed an Upper Devonian age for the oldest strata, which are no longer exposed. Overlying slates and limestones contain Lower Carboniferous fossils and thus establish a conformable passage across the Devonian–Carboniferous boundary. The Yeolmbridge succession also provides evidence for a long-lived submarine rise that influenced patterns of sedimentation in this part of the Culm Trough.

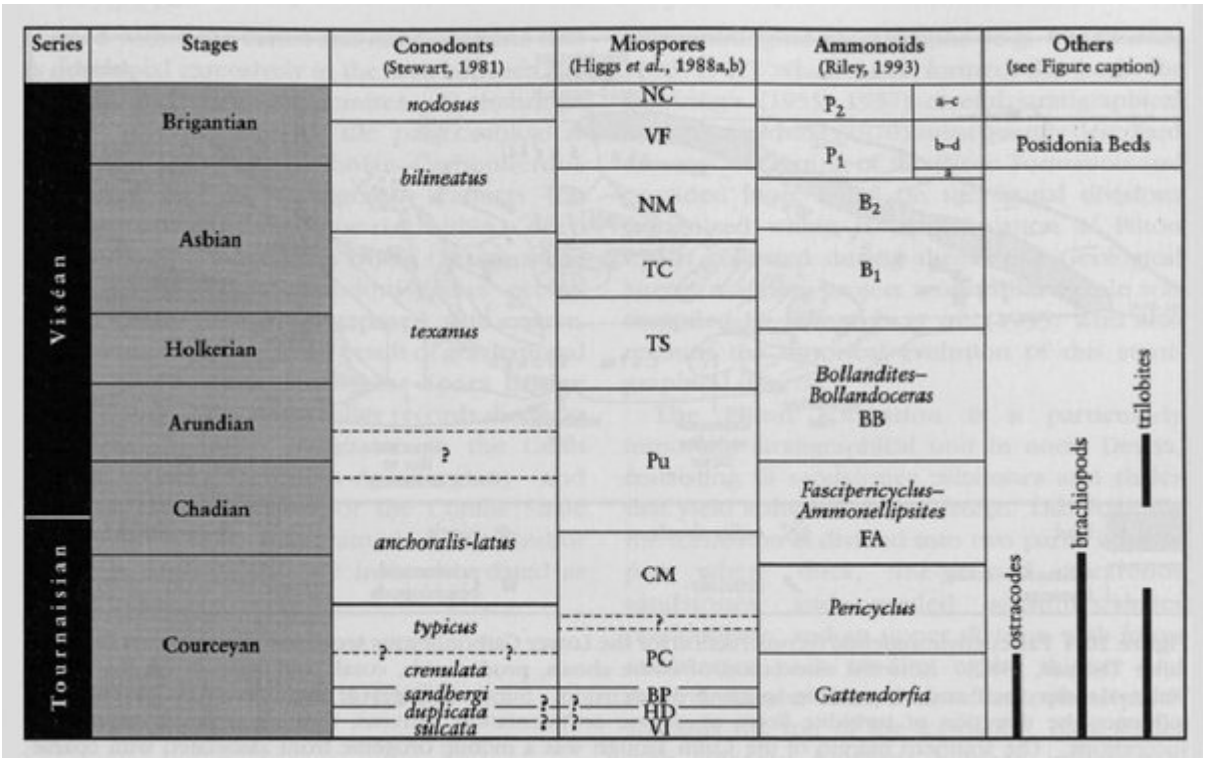
References



(Figure 10.1) Simplified geological map of central south-west England showing the northern and southern outcrops of Dinantian strata and the locations of GCR sites described in the text. Based on [British] Geological Survey maps of the area (Institute of Geological Sciences, 1969c,d, 1974a,b,c,d, 1975c, 1976c,d,e, 1977d, 1980a,b, 1982; British Geological Survey, 1993b, 1994, 1995b,c, 1998).

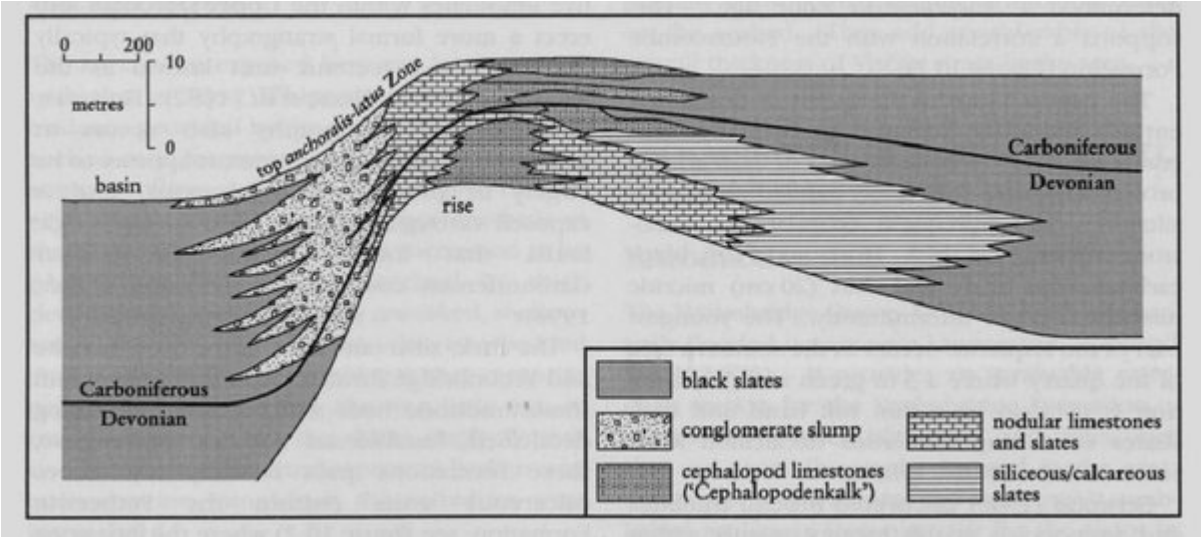


(Figure 10.2) Simplified stratigraphical chart for the Lower Carboniferous strata of the Culm Trough. Compilation based on information from Seiwood and Thomas (1987), Jackson (1991) and Owens and Tilsley (1995). Much of the stratigraphical nomenclature in the Culm Trough is informal and is reproduced here according to common usage. The aim is to summarize a range of differing successions rather than imply that the rock units are well dated and have isochronous boundaries. Note that the Chert Beds and the Bealbury Formation in the Crocadon Formation of the St Mellion Klippe may be olistoliths or isolated thrust-bound units; see Viverdon Down Quarry GCR site report (this chapter) for further details. Half-arrows represent thrust faults. Stour. Fm — Stourscombe Formation. Not to scale.



(Figure 10.3) Biostratigraphical schemes for the Lower Carboniferous strata in the Culm Trough based on conodonts, miospores and ammonoids. The distribution of other useful fossil groups is also shown; entomozoid ostracodes are

locally abundant in the Courceyan Stage (Selwood et al., 1982; Gooday, 1983), as are diverse trilobite and brachiopod faunas (Goldring, 1955, 1970). Trilobites are more sporadic in the Chadian (Owens and Tilsley, 1995) and younger stages (Prentice, 1967) but the concurrence of Posidonia becheri and Neoglyphioceras spirale is a common feature within the early Brigantian Posidonia Beds (Thomas, 1982; Riley, 1993).



(Figure 10.12) Speculative reconstruction of the depositional environments associated with the development of a submarine rise in the southern part of the Culm Trough. After Isaac (1998).