Holywell Bridge, North Yorkshire

[SE 027 533]

Introduction

The Holywell Bridge GCR site is a railway cutting situated either side of the A59 Skipton to Harrogate road 3 km east of Skipton [SE 027 533]. The section offers one of the finest Courceyan–early Chadian sections in the Craven Basin. This extends from the top of the Haw Bank Limestone through the Skipton Castle Shales into the base of the overlying Skipton Castle Limestone (Figure 6.2). Early details relating to the site geology were presented by Hudson and Mitchell (1937) and Hudson (1944b). Later micropalaeontological work by Metcalfe (1976, 1981) on the distribution of conodonts, and by Fewtrell and Smith (1978) on the distribution of foraminifera, led to a better understanding of the stratigraphy of the section. Aspects of the sedimentology were reported by Barraclough (1983) and Gawthorpe (1986).

Description

This Lower Carboniferous section lies close to the core of the Skipton Anticline (Hudson and Mitchell, 1937; and see (Figure 6.1)), but on its southern limb, close to the Skipton Rock Fault (Arthurton, 1983). The succession dips steeply to the south-east such that the older beds (the Haw Bank Limestone) exposed at the north-west end of the cutting are progressively overlain by younger beds (the Skipton Castle Shales and Skipton Castle Limestone) to the south-east. A log of the section based on the work of Gawthorpe (1986) is illustrated in (Figure 6.20).

At the base of the section, within the upper part of the Haw Bank Limestone (*c.* 18 m), two units of approximately equal thickness occur: a lower unit comprising an alternating sequence of thinly bedded argillaceous packstone/ wackestone and mudstone; and an upper unit of more continuous packstone/wackestone devoid of mudstone (Barraclough, 1983; Gawthorpe, 1986). While bioturbation and sharp-based, laminated and graded calcarenites are more common in the lower of these units, dolomite, chert and algae are more prevalent in the higher unit (Metcalfe, 1981; Gawthorpe, 1986). A rich coral fauna, originally recorded by Hudson and Mitchell (1937) from near the top of their '*Zaphrentis konincki* Beds' (= Haw Bank Limestone) and re-evaluated by Mitchell and Somerville (1988), includes a number of stratigraphically useful taxa, among them *Caninophyllum patulum, Cyathoclisia modavensis, Zaphrentites delanouei, Sychnoelasma hawbankense* and *S. koninckí,* an assemblage regarded as typical of the late Courceyan *Caninophyllum patulum* Zone ((Figure 1.4), Chapter 1). Other faunal elements of the Haw Bank Limestone include brachiopods, colonial corals and crinoids (Gawthorpe, 1986).

Above these beds the Skipton Castle Shales is a fissile mudstone unit (*c.* 11 m) containing, as a minor component, some thin-bedded and occasionally sharp-based graded units of argillaceous packstone (Barraclough, 1983; Gawthorpe, 1986). Fossils recorded from these beds include the zaphrentid coral *Fasciculophyllum ambiguum* (Hudson, 1944b) and the remains of bryozoans, crinoid debris and brachiopods (Gawthorpe, 1986).

The overlying Skipton Castle Limestone (*c.* 13 m) is dominated by thick-bedded 'algal' packstones with subordinate developments of thinner-bedded argillaceous packstone (Barraclough, 1983; Gawthorpe, 1986). A distinctive nodular band of oncoids containing the alga *Pseudochaetetes* '*Solenopora*' *garwoodi* occurs approximately 5 m above the base of the unit. Subsequent work by Barraclough (1983) and Gawthorpe (1986) indicated the presence of several other 'algal' horizons in this part of the succession. Additional fossils reported from this unit include solitary and colonial corals, brachiopods, crinoids and ostracodes (Hudson, 1944b; Gawthorpe, 1986).

Courceyan conodont assemblages recovered from the Haw Bank Limestone and Skipton Castle Shales at this site by Metcalfe (1981) include the distinctive forms *Polygnathus communis communis* and *Pseudopolygnathus minutus.* Late Tournaisian foraminiferal assemblages are also reported from the section (Fewtrell and Smith, 1978).

Interpretation

In a regional assessment of the Dinantian sequences of the Craven Basin, Gawthorpe (1986) suggested that the Holywell succession formed part of an early Carboniferous limestone–mudstone facies deposited on a gently sloping carbonate ramp in water depths, 'indicated by the presence of algae', of around 75–100 m ((Figure 6.4)a); the occurrence of bioturbation and the absence of soft-sediment deformation here being taken as evidence of deposition under aerobic conditions on a sea floor that lacked significant topographical expression. The alternation of mudstone- and limestone-dominated parts of the succession (Figure 6.20) was attributed to the periodic influx of terrigenous mud which inhibited the production of lime sediment. The sharp-based calcarenites most probably developed as storm deposits formed during periods of high energy (Gawthorpe, 1986).

Earlier, Ramsbottom (1974) indicated that the development of the '*Solenopora*' Hand marked the terminal regressive (shallowing) phase at the top of the first eustatically controlled 'Major Cycle' he recognized in the Lower Carboniferous successions of the north-eastern part of the Craven Basin. The same band was subsequently used to define the top of the Courceyan Stage in the Skipton area (George *et al.,* 1976).

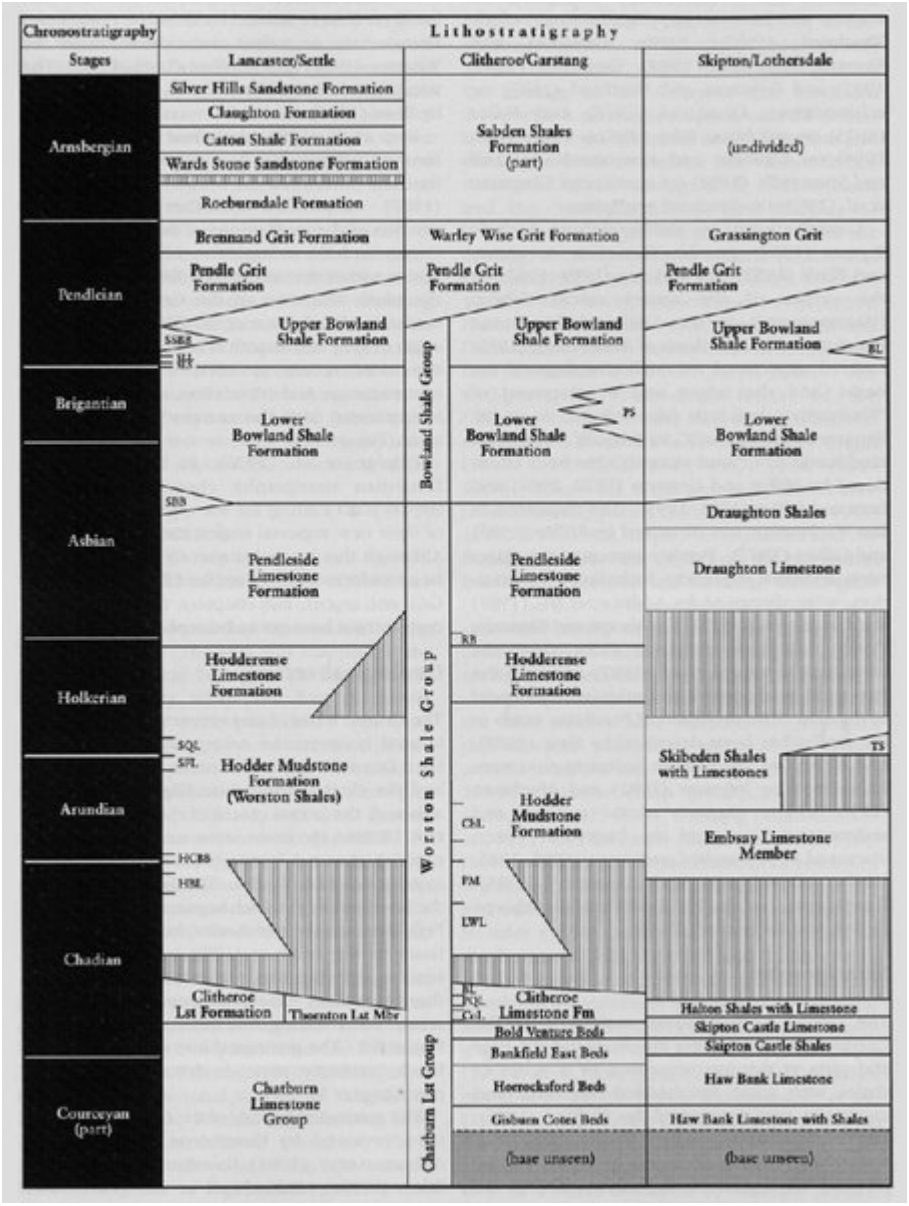
A Courceyan-early Chadian age for the Holywell section is supported on the combined evidence of macrofossil and microfossil distributions (Hudson and Mitchell, 1937; Hudson, 1944b; Fewtrell and Smith, 1978; Metcalfe, 1981; Mitchell and Somerville, 1988), and Metcalfe (1981) assigned the entire section to his *Pseudopolygnathus minutus* conodont zone; the lateral equivalent of the *Scaliognathus anchoralis–Polygnathus bischoffi* Subzone of Varker and Sevastopulo's (1985) conflated conodont zonal scheme for the British and Irish Dinantian Series, which spans the Courceyan–Chadian boundary (Riley 1993; see (Figure 1.4), Chapter 1).

Regional studies generally equate the Holywell succession to the upper part of the Chatburn Limestone Group (= Chatburn Limestone Formation of Fewtrell and Smith, 1980) of the Clitheroe district (Earp *et al.,* 1961), though precise correlations between the two areas remain uncertain (Figure 6.2). The prominent '*Solenopora*' Band in the Skipton Castle Limestone was equated by Ramsbottom (1974), George *et* al. (1976) and Metcalfe (1981) with a similar band in the Chatburn Limestone Group between the Horrocksford Beds and the Bankfield East Beds in the Clitheroe area (see Chatburn Bypass GCR site report, this chapter). However, the equivalence of the Holywell succession with units stratigraphically higher in the Chatbum Limestone appears to be indicated by Fewtrell and Smith (1980). This view was later supported by Riley (1995) who equated the base of the Skipton Castle Limestone with the base of the Bold Venture Beds at Clitheroe; a view which effectively lowered the Courceyan–Chadian boundary to a position within the Haw Bank Limestone (Figure 6.2).

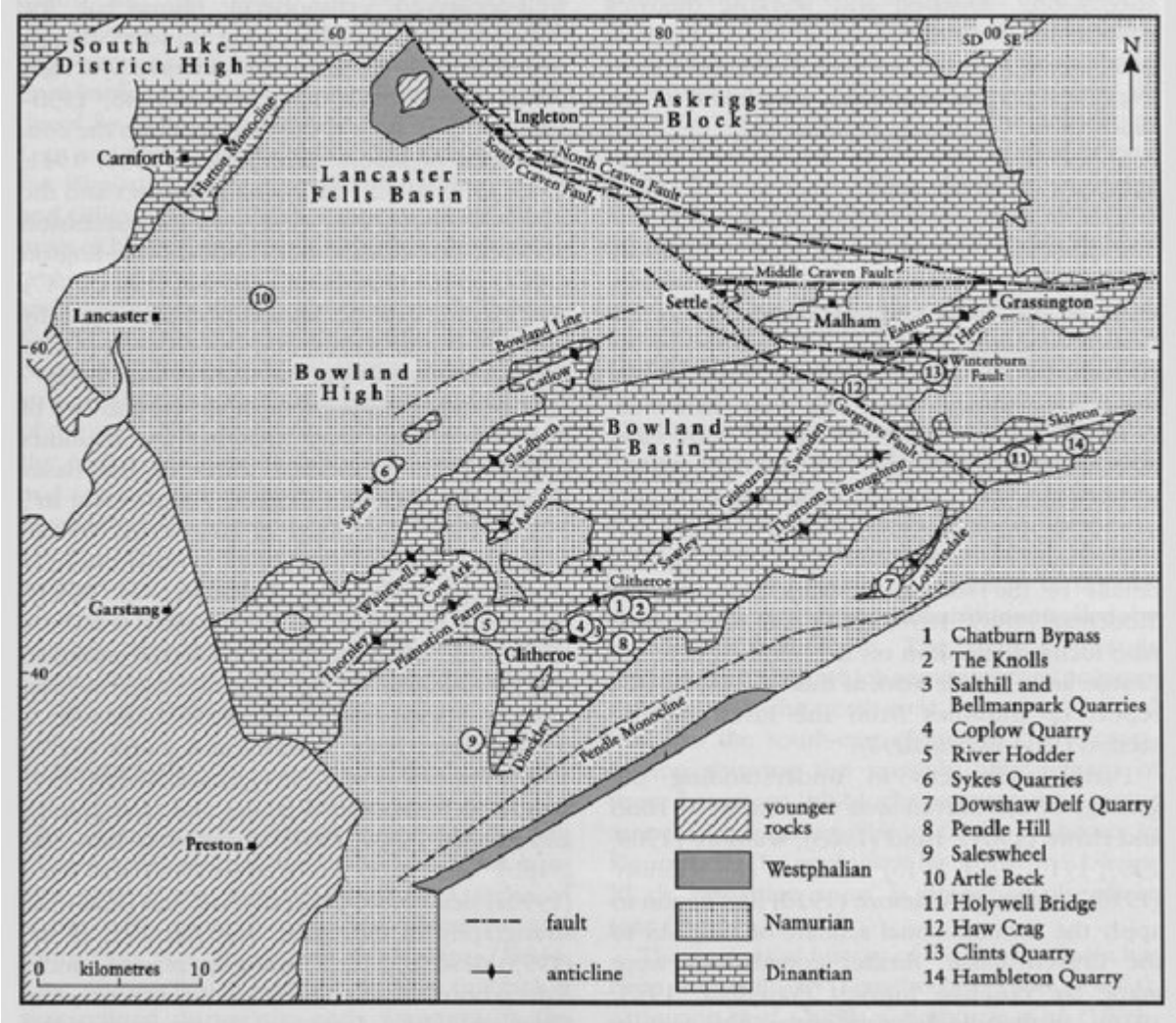
Conclusions

This classic mixed-interest site offers an outstanding Courceyan-early Chadian section of the Haw Bank Limestone, Skipton Castle Shales and Skipton Castle Limestone, a relatively deep-water (75–100 m) marine sequence deposited on a gently inclined sea floor in the northeastern part of the Craven Basin during early Carboniferous times. A prominent marker bed containing 'algal' structures near the base of the Skipton Castle Limestone marks the position of the stratigraphically significant Courceyan–Chadian boundary. The site is important for the regional, national and international correlation of early Dinantian successions and vital to reconstructions of early Carboniferous palaeogeography within the Craven Basin.

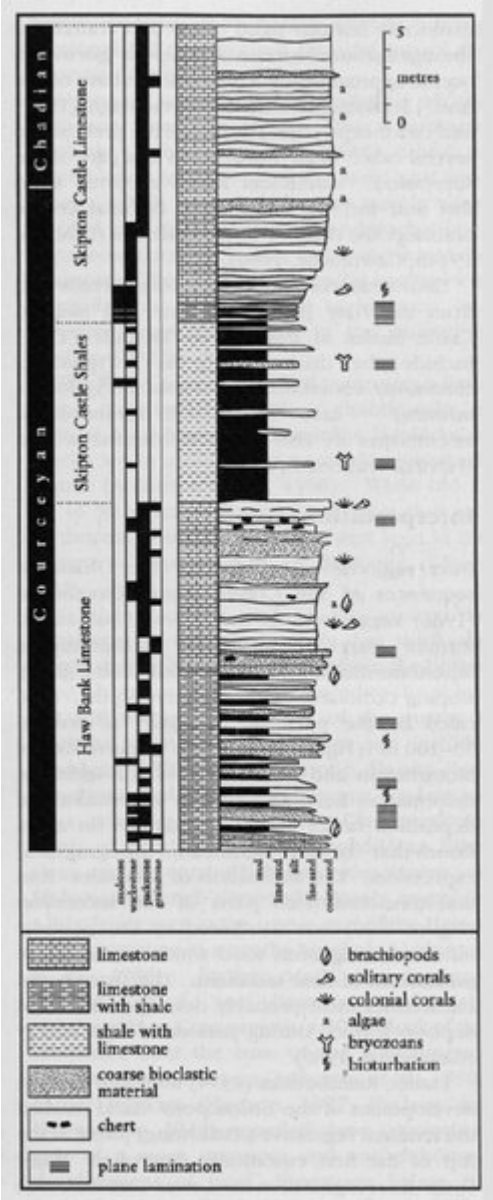
References



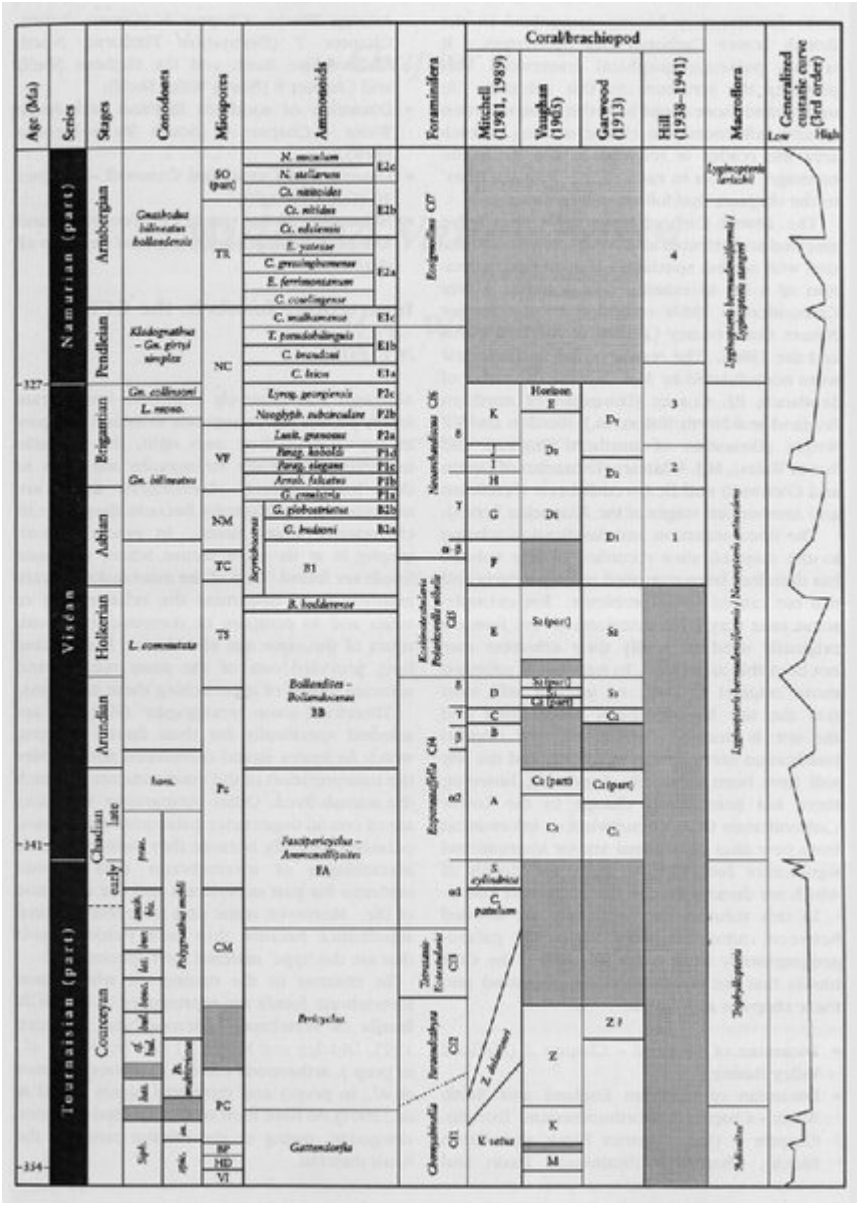
(Figure 6.2) Simplified stratigraphical chart for the Lower Carboniferous succession of the Craven Basin. (HBL — Hetton Beck Limestone Member; HCBB Haw Crag Boulder Bed; SFL — Scaleber Force Limestone Member; SQL — Scaleber Quarry Limestone Member; SBB — Scaleber Boulder Bed; SLS — Sugar Loaf Shales; SLL — Sugar Loaf Limestone; SSBB School Share Boulder Bed; CoL — Coplow Limestone Member; PQL — Peach Quarry Limestone Member; BL — Bellman Limestone Member; LWL — Limekiln Wood Limestone Member; PM — Phynis Mudstone Member; ChL — Chaigley Limestone Member; FIB — Rad Brook Mudstone Member; PS — Pendleside Sandstones Member; TS — Twiston Sandstone Member; BL — Berwick Limestone.) Areas of vertical ruling indicate non-sequences. Not to scale. Compilation based on Hudson and Mitchell (1937), Metcalfe (1981), Arthurton et al. (1988), British Geological Survey (1989), Riley (1990a, 1995), Aitkenhead et al. (1992), Brandon et al. (1995, 1998).



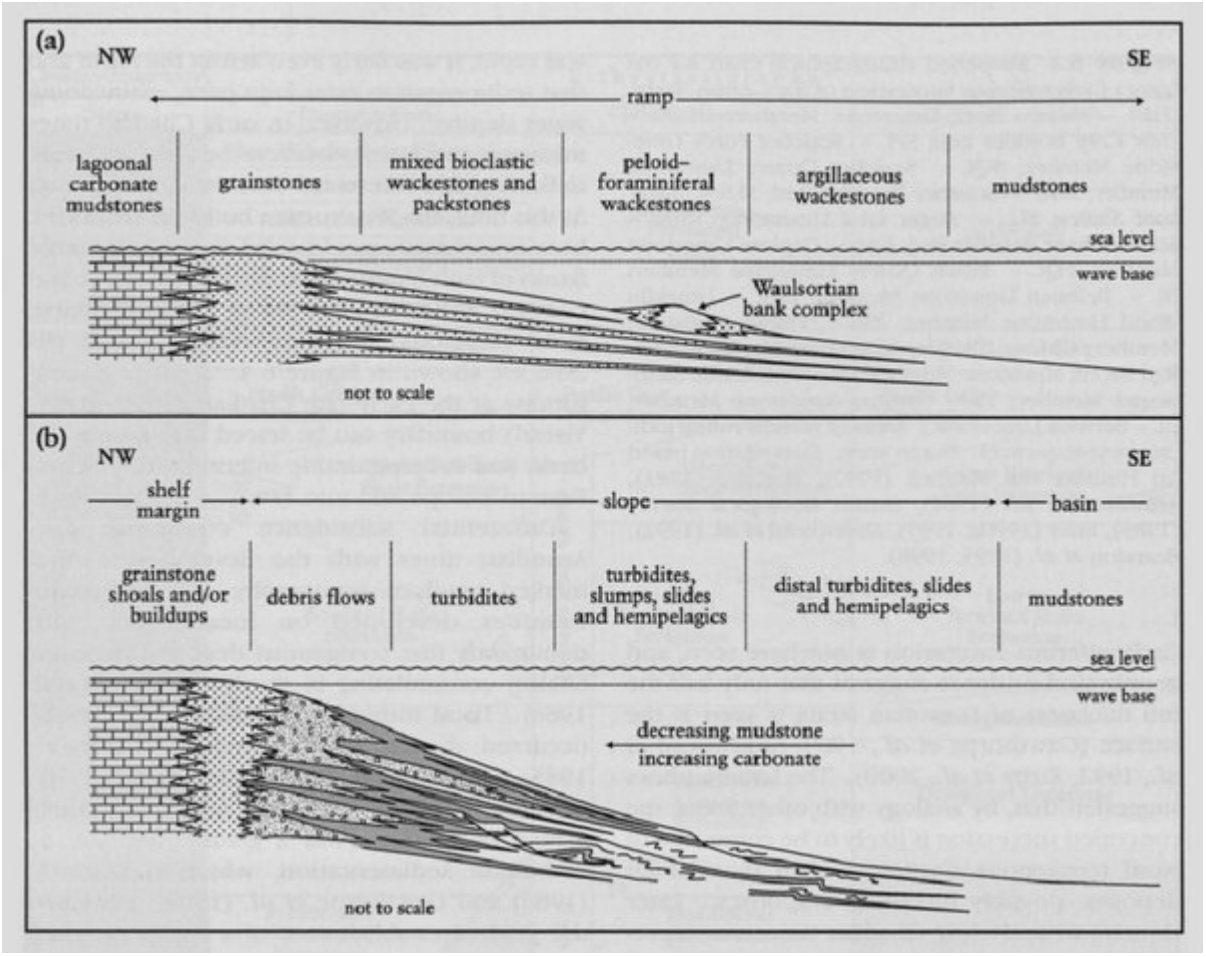
(Figure 6.1) Geological map of the Craven Basin illustrating the distribution of Carboniferous outcrops and the locations of GCR sites described in the text. Note that in the Bowland Basin area, the hinge traces of major folds within the Ribblesdale Fold Belt are also shown. The Central Lancashire High lies to the south of the Pendle Monocline beneath the area obscured by the key. Based on Riley (1990a) and Brandon et al. (1998).



(Figure 6.20) Sedimentary log of the Haw Bank Limestone–Skipton Castle Limestone ramp succession (Courceyan–Arundian) at the Holywell Bridge GCR site. After Gawthorpe (1986). The stratigraphical terminology used here follows that of Metcalfe (1981).



(Figure 1.4) Chronostratigraphical and biostratigraphical classification schemes for the Lower Carboniferous Subsystem. After Riley (1993, fig. 1) with additional information for the Pendleian and Arnsbergian stages supplied by the same author. Absolute age data from Guion et al. (2000) based mainly on information by Lippolt et al. (1984), Hess and Lippolt (1986), Leeder and McMahon (1988) and Claoue-Long et al. (1995). Ammonoid abbreviations used in this figure: N. — Nuculoceras; Ct. — Cravenoceratoides; E. — Eumorphoceras; C. — Cravenoceras; T. — Tumulites; Lyrog. — Lyrogoniatites; Neoglyph. — Neoglyphioceras; Lusit. — Lusitanoceras; Parag. — Paraglyphioceras; Arnsb. — Arnsbergites; G. — Goniatites; B. — Bollandoceras. Conodont abbreviations used: Gn. — Gnathodus; Gn. collinsoni — Gnathodus girtyi collinsoni; L. mono. — Lochriea mononodosa; L. — Lochriea; horn. — Gnathodus homopunctatus; prae. — Mestognathus praebeckmanni; and,. — Scaliognathus anchoralis; bis. — Polygnathus bischoffi; bur. — Eotaphrus burlingtonensis; lat. — Doliognathus latus; bout. — Dollymae. bouckaerti; bul. — Eotaphrus bultyncki; has. — Dollymae bassi; siph. — Siphonodella; Ps. — Pseudopolygnathus; in. — Polygnathus inornatus; spit. — Polygnathus spicatus. Stipple ornament shows interzones (conodonts and miospores) or non-sequences (brachiopods).



(Figure 6.4) (a) Lateral facies variations along the carbonate ramp that characterized the Craven Basin during the Courceyan–Chadian interval. (b) Facies variations down the slope environments of the Craven Basin during the Arundian–Asbian interval. After Gawthorpe (1986).