
Fremington Quay, Devon

[SS 517 337]

Introduction

The Fremington Quay GCR site is located on the southern bank of the River Taw estuary [SS 517 337] near Barnstaple in north Devon. It provides the most complete succession through the Pilton Formation, a clastic sequence of Famennian-Courceyan age which encompasses the Devonian–Carboniferous boundary. Whilst the exposure is relatively poor and tectonically complex, it provides the stratotype for the upper part of the formation. Rich brachiopod, bivalve and trilobite faunas facilitate comparison with sequences in Devon, Cornwall and Germany (Paul, 1937; Richter and Richter, 1951; Goldring, 1955, 1957), whilst, more recently, miospore assemblages have provided stratigraphical refinement (O'Liathain, 1993). The most informative account of the site geology is by Goldring (1970).

Description

Phillips (1841) first introduced the name 'Pilton' into the geological literature when describing strata now known to straddle the Devonian–Carboniferous boundary. Since then, the rich fossil assemblages of the Pilton Formation have attracted the attention of many research workers and resulted in several museum collections and palaeontological monographs (e.g. Whidborne, 1896–1907) which later formed the basis for Goldring's (1955, 1957) careful stratigraphical analysis. Goldring (1970) subsequently described the regional setting of the Pilton Formation and provided more detail on the faunal divisions recognized within it. A tabulation of Pilton fossils collected during the British Geological Survey mapping project around Barnstaple was compiled by Edmonds *et al.* (1985) who also recount the historical evolution of this stratigraphical interval.

The Pilton Formation is a particularly important stratigraphical unit in north Devon, consisting of sandstones, siltstones and shales that yield a diverse neritic fauna. Lithologically the formation is divided into two parts: a lower part where thick, fine-grained calcareous sandstones and graded siltstones/shales predominate, and an upper division with fewer sandstones, each tending to be thinner and more lenticular than their older counterparts. Towards the top of the formation, dark shales with siliceous horizons become increasingly common and it is these lithologies that are represented at Fremington.

Exposures exist on the muddy foreshore of the River Taw estuary and in the low cliffs that are mantled with raised beach deposits. They are best examined by walking from north to south, starting near the disused limekiln [SS 517 340] and finishing at the quay [SS 517 335]. In general, the succession dips and youngs to the south but is much complicated by steep folds and minor thrust faults (Figure 10.5).

Opposite the limekiln, and for 150 m southwards, the Pilton Formation consists of folded and cleaved shales with sparse lenticular sandstones and phosphatic nodules. Modern tidal sediments often obscure the blue-grey, lustreous shales, which have yielded a sparse Famennian macrofauna with *Phacops accipitrinus* and *Whidbornella caperata*. Well-preserved and diverse miospore assemblages dominated by *Retispora lepidophyta* and *Verrucosisporites nitidus* have also been recovered from the upper part of this section, confirming a latest Famennian age (O'Liathain, 1993).

At the first prominent exposure of blue-grey shales beneath the low dig and from overlying grey-green shales, a more diverse shelly fauna has been recovered. It is dominated by productellid brachiopods such as *Avonia schmidtii*, *Cleiothyridina roysii*, *Ovatia spinulifera*, *Productinella fremingtonensis* and *Strophonema paeckelmanni* and includes the trilobites *Phillibole duodecimae* and *P. hercules*. This assemblage is indicative of earliest Carboniferous (Courceyan) times. Again, further age refinement is provided by laevigate miospore genera such as *Punctatisporites* and *Retusotriletes*, which characterize the basal Carboniferous VI miospore zone (Figure 10.3). The marked palaeontological change that occurs between these two apparently conformable sections defines the Devonian–Carboniferous boundary to within a few metres.

Southwards, the exposure is much disrupted by faulting. A useful reference point, however, is a thin lamprophyre dyke [SS 517 336] which is overlain by folded siliceous shales with calcareous and siliceous concretions. The fauna here includes *Brachymetopus maccoyi*, *Piltonia salteri*, *Productinella fremingtonensis* and *Unispirifer tornacensis*, which together suggest a slightly higher position in the succession (Goldring, 1978) and a possible late Tournaisian age. The presence of well-preserved bryozoan fronds and crinoid debris indicates that the fauna has been little transported.

Approaching the quay at the southern end of the site, the shales become increasingly imbricated, but remain quite fossiliferous. Lenticular sandstones and black, organic-rich shales with crinoidal bands yield most of the same brachiopod taxa that occur just above the Devonian–Carboniferous boundary, plus *Brachythyrus ratingensis* and *Derbyia steinhagei*.

Interpretation

The Pilton Formation is about 500 m thick and incorporates a diverse neritic fauna that indicates deposition in a transgressive setting — the brachiopods and bivalves in coastal waters, and the trilobites and ammonoids in deeper water (Edmonds *et al.*, 1985). Goldring (1955) collected new faunas widely from the Pilton Formation and established their stratigraphical significance by defining three local range and assemblage zones (Figure 10.6). The oldest (A) zone has been further subdivided by Goldring (1970), but in essence it is characterized by productellid brachiopods such as *Cyrtospirifer verneuili* and *Whidbornella caperata* which also occur in the Late Devonian Etroeungt Schichten of Germany (Paul, 1937). In addition, the presence of *Phacops accipitrinus* clearly indicates correlation with the *Wocklumeria* ammonoid zone.

Fremington is the type locality for the middle (B) zone, which is dominated by phillibolid trilobites and productoid brachiopods. Selected taxa are shown in (Figure 10.6), the majority of which characterize the early Courceyan sequence (including the *Vaughania vetus* coral–brachiopod zone) according to Riley (1993). Only *Brachymetopus maccoyi* and *Unispirifer tornacensis* range up into the Viséan Series. Ammonoids are rare in the Pilton Formation but *Gattendorfia crassa* has been reported from neighbouring localities. This reinforces the early Courceyan age determination for zone B because Bartsch and Weyer (1988) note that *G. crassa* occurs within the *Siphonodella sandbergi* conodont zone (see (Figure 10.3)). That the Devonian–Carboniferous boundary falls between Goldring's zones A and B has been further corroborated by characteristic miospore assemblages (O'Liathain, 1993).

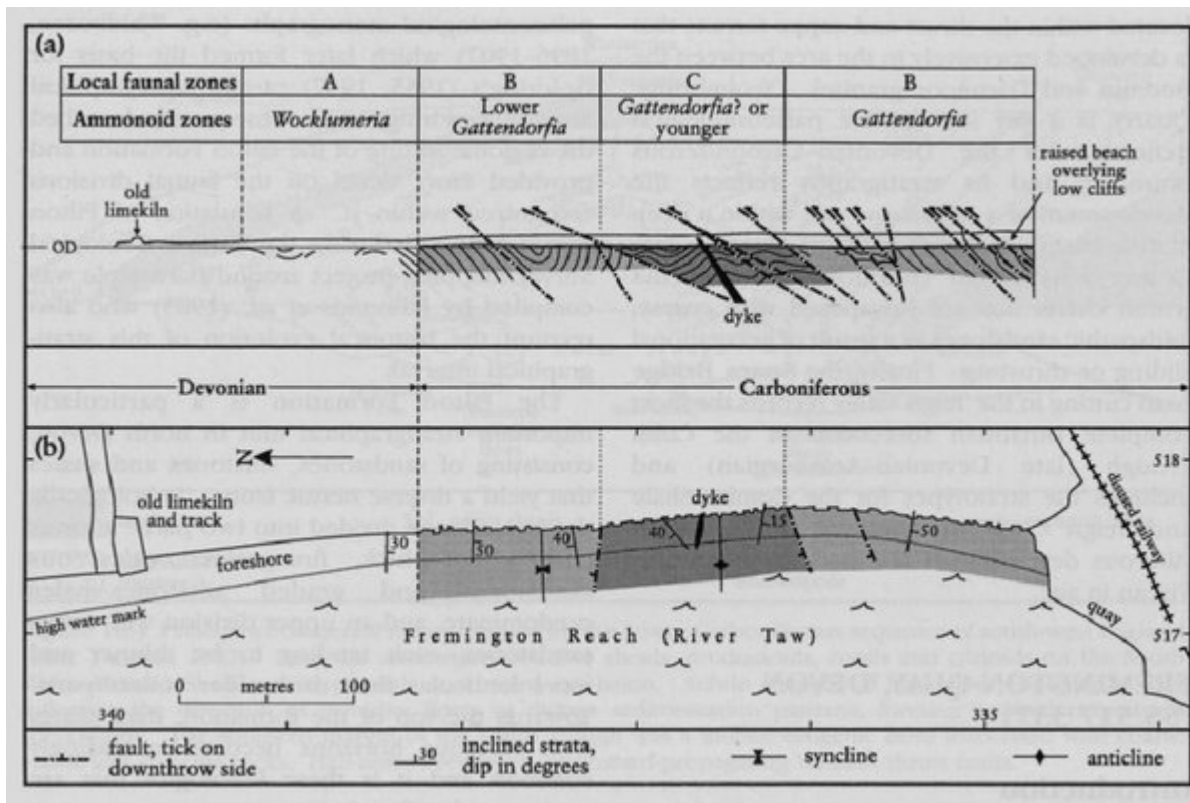
Zone C is the youngest recognized, but Goldring (1970) cautions that nowhere has a conformable passage between zones B and C been observed. Characteristic species include *Piltonia salteri*, *Productinella fremingtonensis* and *Unispirifer tornacensis*, along with longer-ranging taxa such as *Brachymetopus maccoyi* and *Imitoceras*. Further work is required to establish whether zone C falls within or above zone B.

Correlations are not easily made between the clastic Pilton Formation and the carbonates of the South Wales–Mendip Shelf area because they represent quite different facies. However, there is a much closer comparison to be drawn between the Pilton Formation and the German Etroeungt Schichten, both of which supported a diverse brachiopod assemblage during Late Devonian times (Paul, 1937). As the transgression progressed and deeper water conditions were established during Courceyan times, philli-bolid trilobites became established in the Devon area (Prentice, 1967), Cornwall (Selwood, 1960) and Germany (Richter and Richter, 1951).

Conclusions

This site provides critical information about the stratigraphy of the upper part of the Pilton Formation. Extensive historical research has focused on the collection and identification of diverse fossil assemblages that define the base of the Carboniferous System in a continuous section and allows accurate correlations to be made at a local and regional scale. Although complicated by faulting, the southern end of the site is the type locality for Goldring's (1955) zone B fossil assemblage of Courceyan age.

[References](#)



(Figure 10.5) (a) Section and (b) map of the shoreline geology at the Fremington Quay GCR site, north Devon. After Goldring (1970).

Series	Stages	Conodonts (Stewart, 1981)	Miospores (Higgs <i>et al.</i> , 1988a,b)	Ammonoids (Riley, 1993)	Others (see Figure caption)
Viséan	Brigantian	<i>nodosus</i>	NC	P ₂	a-c
			VF	P ₁	b-d
	Asbian	<i>bilineatus</i>	NM	B ₂	Posidonia Beds
			TC	B ₁	
	Holkerian	<i>texasus</i>	TS	<i>Bollandites</i> – <i>Bollandoceras</i> BB	
Arundian	?	Pu	<i>Fascipericyclus</i> – <i>Ammonellipsites</i> FA		
Chadian	<i>anchoralis-latus</i>	CM	<i>Pericyclus</i>		
Tournaisian	Courseyan	<i>typicus</i>	?	<i>Gattendorfia</i>	ostracodes brachiopods trilobites
		?	PC		
	<i>crenulata</i>	BP			
	<i>sandbergi</i>	HD			
	<i>duplicata</i>	VI			
	<i>stulcata</i>				

(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 Courseyan 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).

Selected taxa			
<i>Imitoceras</i> sp.			█
<i>Piltonia salteri</i>			█
<i>Cleiothyridina roysii</i>		█	█
<i>Ovatia spinulifera</i>		█	█
<i>Productinella fremingtonensis</i>		█	█
<i>Brachymetopus maccoyi</i>		█	█
<i>Brachymetopus woodwardi</i>		█	█
<i>Avonia schmidti</i>		█	
<i>Strophonema paeckelmanni</i>		█	
<i>Phillibole duodecimae</i>		█	
<i>Phillibole hercules</i>		█	
<i>Angustibole porteri</i>		█	
<i>Gattendorfia crassa</i>		█	
<i>Unispirifer tornacensis</i>	█		█
<i>Phacops accipitrinus</i>	█		
<i>Whidbornella caperata</i>	█		
Local faunal zones	A	B	C
Age assessment	Late	Early	?Late
	Famennian	Courceyan	

(Figure 10.6) Selected ammonoid, brachiopod and trilobite taxa of the Pilton Formation and their distribution in Goldring's (1955, 1970) local faunal zones.