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## Queensferry Shore, City of Edinburgh

[NT 132 784]–[NT 142 785]

### Introduction

The Queensferry Shore GCR site consists of the foreshore exposures on the south side of the Firth of Forth and on either side of the Forth Railway Bridge [NT 132 784]–[NT 142 785]. These contain a more-or-less complete section through the middle part of the West Lothian Oil-Shale Formation (Strathclyde Group) and are of Asbian age. The sequence, which is exposed on the westerly dipping east limb of a syncline, has been described in detail by Peach *et al.* (1910) and Carruthers *et al.* (1927). Guides to the succession have been published by Tulloch (in Mitchell *et al.*, 1960), MacGregor (1968), Tulloch *et al.* (1971) and McAdam (in McAdam and Clarkson, 1986).

### Description

The lowest beds in the sequence comprise mudstones with cementstones and thin oil shales, including the Dalmahoy Oil Shale, and are exposed at the eastern end of the section. Above this, mudrocks (9 m) include the two prominent cementstones known as the 'Queensferry Cements'. The lower Queensferry Cement is yellowy buff in colour and is noted for its oil-filled cavities (McAdam in McAdam and Clarkson, 1986). The upper Queensferry Cement is oolitic. The Pumpherston Shell Bed, which is rich in thin-shelled bivalves, gastropods, *Lingula* and orthoconic cephalopods, lies about 1 m higher. This shell bed forms the base to a 25 m-thick succession of dark shales and oil shales, which are known as the 'Pumpherston Oil Shale'. The shales contain cementstone and ironstone bands, phosphatic coprolites, fish remains and, close to the top, a band with *Naiadites* and *Euestheria*. Capping this locally, and seen here at the high-water mark, is a unit of sandstone and dolomitic limestones. These contain desiccation structures and, at the top, laminated domes of stromatolitic algal limestones (Figure 2.19). These beds, known as the 'Bogwood Limestone', have been described in detail by Maddox and Andrews (1987).

The beds between this and the Burdiehouse Limestone are largely sandstones, which exhibit a variety of cross-bedding and other sedimentary structures. The limestone itself and the overlying Camps Shale are not well exposed but can be seen in small exposures on the shore. The limestone contains abundant ostracodes and also fish remains and plant fragments.

Above these is the 90 m-thick, massive and cross-bedded Dunnet Sandstone, which crops out from 60 m east of the Forth Bridge to nearly 530 m west of the Forth Bridge. At the western end of the sandstone outcrop, the overlying Dunnet Shale, the highest bed at the site, can be seen.

### Interpretation

Miospore evidence shows that the sequence is of Asbian age and that the base of the section includes the junction between the *Perotrilites tessellatus*–*Schulzospora campyloptera* (TC) Zone and the overlying *Raistrickia nigra*–*Triquitrites marginatus* (NM) Zone (Neves *et al.*, 1973; and see (Figure 2.2)). The correlation of the Pumpherston Shell Bed with the Macgregor Marine Bands (Wilson, 1974, 1989) is consistent with a position close to this boundary, and records of B Zone goniatites from the Pumpherston Shell Bed in boreholes in West Lothian (Currie, 1954) support the Asbian age determination for these beds.

The shales, oil shales, and limestones of the West Lothian Oil-Shale Formation were deposited in large water bodies ('Lake Cadell') which were ponded up in the Midland Valley by a delta to the east (Greensmith, 1965; Loftus, 1984; Loftus and Greensmith, 1988; Whyte, 1994) (Figure 2.3). These lacustrine beds contain abundant faunas of thin-shelled ostracodes and fish remains, good examples of which can be seen within the Queensferry section. Although these water bodies were remarkably persistent, the situation was essentially dynamic and the characters of the lakes changed over

time causing varying degrees of stratification of the water mass. Some of the carbonates, such as the Bogwood Limestone, were deposited in shallow conditions (Maddox and Andrews, 1987) while others, such as the Burdiehouse Limestone, may have been deposited in more extensive stratified water bodies with water depths of 50–100 m (Loftus and Greensmith, 1988). Occasional marine influxes gave rise to shell beds with a restricted fauna, and delta progradations led to the occurrence of thick sandstone units such as the Dunnet Sandstone.

## Conclusions

The Queensferry Shore is the best available section through the West Lothian Oil-Shale Formation and demonstrates the range of facies developed during its deposition. It has yielded stratigraphically important miospore assemblages and includes the Pumpherston Shell Bed, which is an important unit for correlation in the eastern parts of the Midland Valley. The section contrasts in character with coeval successions in Fife and is a vital link in understanding the depositional environments and palaeogeography of the time.

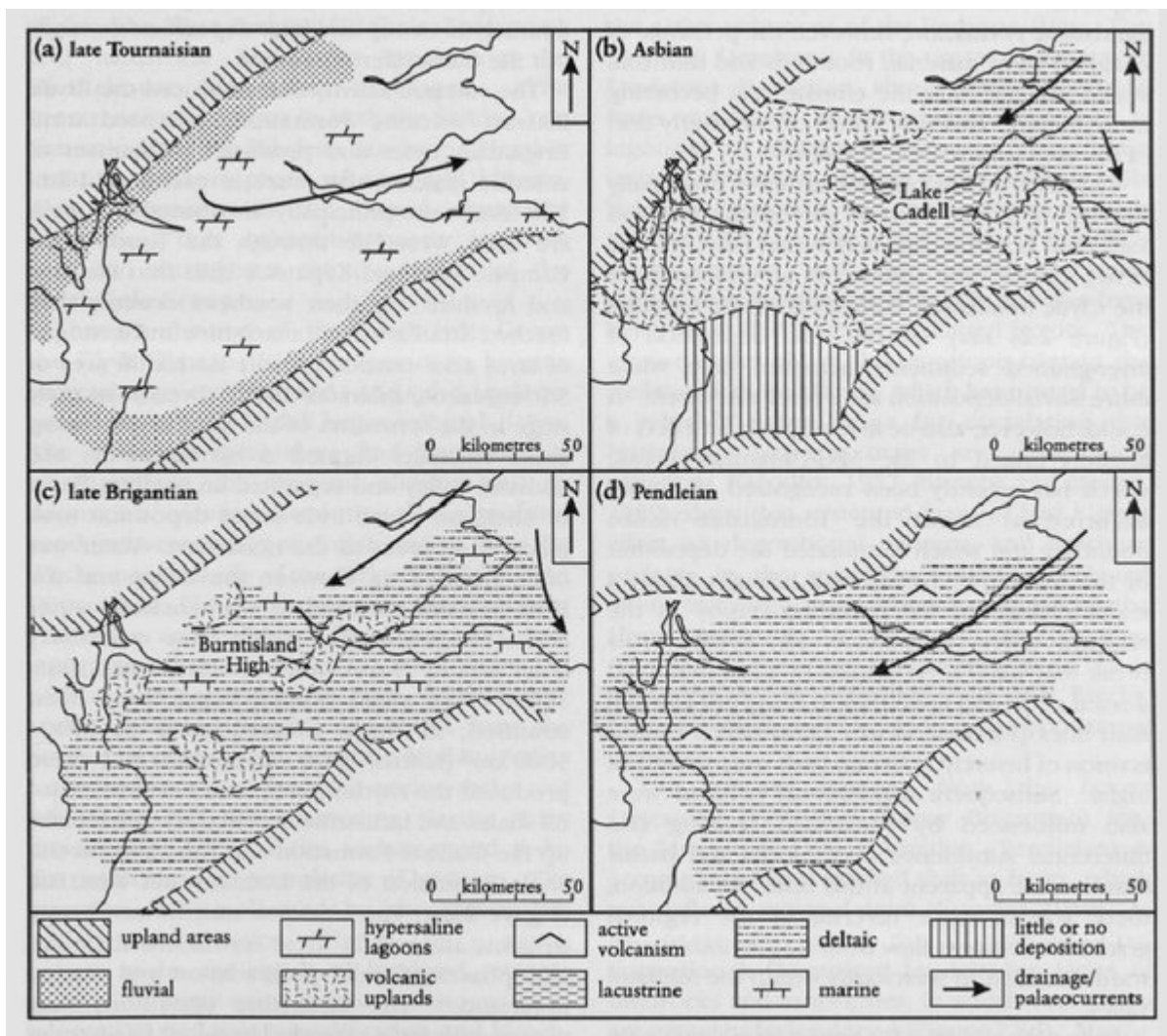
## References



*(Figure 2.19) Stromatolitic algal domes in the Bogwood Limestone, West Lothian Oil-Shale Formation (Strathclyde Group, Asbian) at the Queensferry Shore GCR site. (Photo: M.A. Whyte.)*

Chronostratigraphy		Biostratigraphy	Lithostratigraphy				
Series	Stages	Miospore zones	Western Midland Valley	West-Mid Lothian	Mid-East Lothian	Fife	Group
Namurian	Yeadonian to Chokierian	(undivided)	Passage Formation		Passage Formation		Clackmannan Group
	Arnsbergian	TR	Upper Limestone Formation		Upper Limestone Formation		
	Pendleian	NC	Limestone Coal Formation		Limestone Coal Formation		
			Lower Limestone Formation		Lower Limestone Formation		
Viséan	Brigantian	VF	Lawmuir Fm	West Lothian Oil-Shale Formation	Aberlady Formation	Pathhead Formation	Strathclyde Group
			Kirkwood Formation			Sandy Craig Formation	
	Asbian	NM	Clyde Plateau Volcanic Formation	Gullane Formation		Pittenweem Formation	
				Arthur's Seat Volcanic Formation	Garleton Hills Volcanic Formation	Anstruther Formation	
	Holkerian	PU	Clyde Sandstone Formation	Ballagan Formation		Fife Ness Formation	
				Ballagan Formation		Clyde Sandstone Formation	
Arundian	CM		Ballagan Formation		(base unseen)		
Chadian	PC		Ballagan Formation		(base unseen)		
Tournaisian	Famennian	(undivided)	Kinnesswood Formation			(base unseen)	Inverclyde Group

(Figure 2.2) Simplified Lower Carboniferous stratigraphical chart for the Midland Valley of Scotland. Note that below the Brigantian Stage, the position of stage boundaries is uncertain and that below the NM miospore zone only recorded zones are indicated. (H — Hurllet Limestone; TH — Top Hosie Limestone; I — Index Limestone; C — Castlecary Limestone.) The Bathgate Group comprises the Salsburgh Volcanic Formation, the Bathgate Hills Volcanic Formation and the Kinghorn Volcanic Formation. Based on various sources and including information from Whyte (1981), Chisholm et al. (1989) and Browne et al. (1996, 1999).



(Figure 2.3) Lower Carboniferous palaeogeographical reconstructions of the Midland Valley area: (a) late Tournaisian (Ballagan Formation, Inverclyde Group); (b) Asbian (Sandy Craig Formation, Strathclyde Group); (c) late Brigantian (Lower Limestone Formation, Clackmannan Group); (d) Pendleian (Limestone Coal Formation, Clackmannan Group). Based on various sources and including information from Craig (1991) and Whyte (1994).