Shaw's Gate Quarry

[SE 523 823]

J.K. Wright

Introduction

Shaw's Gate Quarry is a small disused quarry at 297 m O.D. on Shaw's Moor at the southern extremity of the Hambleton Hills (Figure 4.28). The quarry lies 0.5 km south of the A170, just off the minor road leading from the Hambleton Hotel to Kilburn. The quarry is thus only 2.5 km north of the northern margin of the Asenby–Coxwold Graben (Figure 4.1). It was first described by Blake and Hudleston (1877), but was not referred to again in the geological literature until the 1960s when Hemingway and Twombley (1963) published a detailed description of the exposures. Since then the site has received brief mention in the synopses of the Yorkshire Corallian published by Wright (1972) and Hemingway (1974). Photographs, a log and description were published by Powell *et al.* (1992).

The exact stratigraphical horizon represented in the quarry was initially unclear. Hemingway and Twombley (1963) placed the section within the Lower Leaf of the Hambleton Oolite Member of the Coralline Oolite. Subsequently, Wright (1972, 1983) showed that the Lower Leaf was exposed in the valleys to the south-east and north-east of Shaw's Moor, and that the quarry must lie in the Upper Leaf, probably in the Vertebrale Subzone.

Description

The quarry exposes 6 m of argillaceous oolite, a facies typical of the Hambleton Oolite in this area where oolite passes laterally into Birdsall Calcareous Grit a few kilometres to the south. Penecontemporaneous deformation of the Hambleton Oolite has been detected in at least five sites over a restricted area of about 21 km^2 at the southern end of the Hambleton Hills. Shaw's Gate Quarry displays by far the best examples of stratal convolution in this area. A log of the section is given in (Figure 4.29). The following section is taken from Powell *et al.* (1992).

	Thickness (m)
Coralline Oolite Formation	
Hambleton Oolite Member	
9. Undeformed, oolitic limestone	seen to 1.0
8. Grey, ooidal limestone with small oysters and *Nucleolites* sp. Hemingway and Twombley (1963) saw slump fragments	seen to 0.7
7. Yellow, sandy, sparsely ooidal limestone	0.32
6. Buff, sandy limestone with sparse ooids and contorted, sandy laminae. The base is erosive, with laminated, siliceous limestone and cross-bedded, fine-grained, calcareous sandstone infilling channels and troughs of slump folds	0.65–0.82
5. Pale-grey, laminated, ooidal limestone showing slump folding, penecontemporaneous faulting and injection into the overlying beds	0–0.40
4. Buff, calcareous, laminated siltstone	0–0.50
3. Buff, sandy limestone with sparse ooids and shell fragments. Grey, sandy ooidal limestone is present as slump balls in the upper part	0.55–0.70
2. Buff, very sandy limestone with shell fragments and sparse ooids	0.70

1. Buff, sandy, ooidal limestone containing large blocks of contorted, siliceous limestone and chert at all angles to the bedding	seen to 1.20

The penecontemporaneous deformation structures are best seen in beds 1, 3 and 8, and comprise deformed, disturbed and distorted sedimentary layers. The penecontemporaneous nature of the folding of the limestones is clearly evidenced where the upper surface of a folded bed is cleanly bounded by truncated bedding planes (Figure 4.30). Some down-folds are infilled with laminated limestone. Less marked movements are shown by the occurrences of slump balls within the sediment.

Bed 1 contains slumped blocks characterized by sharp-angled, overturned folds of amplitude greater than the thickness of the bed. Somewhat similar structures, isolated slump balls with sharp boundaries and containing contorted, laminated internal structures, typify the are naceous carbonates of the second disturbed unit (Bed 3). In contrast to the style of deformation in these lower disturbed beds, two distinct lithologies characterize the third phase of stratal deformation: a basal oolite and an overlying laminated limestone (Bed 5 and Bed 6). Two structures involved in this deformation are particularly well exposed on the west wall of the exposure (Figure 4.30). The folds here are asymmetric towards the north. Associated with these slumps, overlying laminated silts and fine calcarenites fill near-concentric scoured basins displaying dish-like geometry and presenting a form characteristic of festoon bedding. Such features are predominantly compaction or adjustment phenomena.

Hemingway and Twombley (1963) noted that the west face of the quarry displays a fine example of a fluid-escape pipe along which oolite has been extruded through the overlying laminated limestone (Bed 6 to Bed 8). Near to the fissure the laminated limestone can be seen to have lost its original depositional fabric and to have become homogenized. The final convolution phase saw slump fragments incorporated into the calcareous sandstone (Bed 8).

Interpretation

Convolute bedding such as that which occurs at Shaw's Gate consists of structures involving marked crumpling or complicated folding of well-defined sedimentation units. It has been suggested that the presence of two horizons with convolute folding necessitated the impact of sudden shock waves. The practically horizontal bedding pattern prevailing in the vicinity, as throughout the bulk of the Cleveland Basin during the Oxfordian, implies that the submarine slopes were very gentle at the time of deposition. Submarine sliding was thus considered unlikely as an explanation of this phenomenon by Hemingway and Twombley (1963), although Powell *et al.* (1992) suggest that the erosive bases and planar, truncated upper bedding surfaces do indicate deposition as submarine debris flows. Only two other occurrences of convolution phenomena are known from Yorkshire Jurassic deposits, in the Cloughton Formation between Ravenscar and Cloughton (Hemingway, 1974), and in the Lower Calcareous Grit at Cunstone Nab (Wright, 1983). Both these occurrences are close to the Peak Trough (Figure 4.1), a fault system that is known to have been active in the Jurassic Period (Milsom and Rawson, 1989). Shaw's Gate Quarry lies close to the Kilburn Fault, which has a throw of some 300 m to the south and which is the northern representative of the Asenby–Coxwold trough-fault system. Hemingway and Twombley (1963) considered that movement on this fault may have been initiated in Late Jurassic times and may have caused the convolution phenomena.

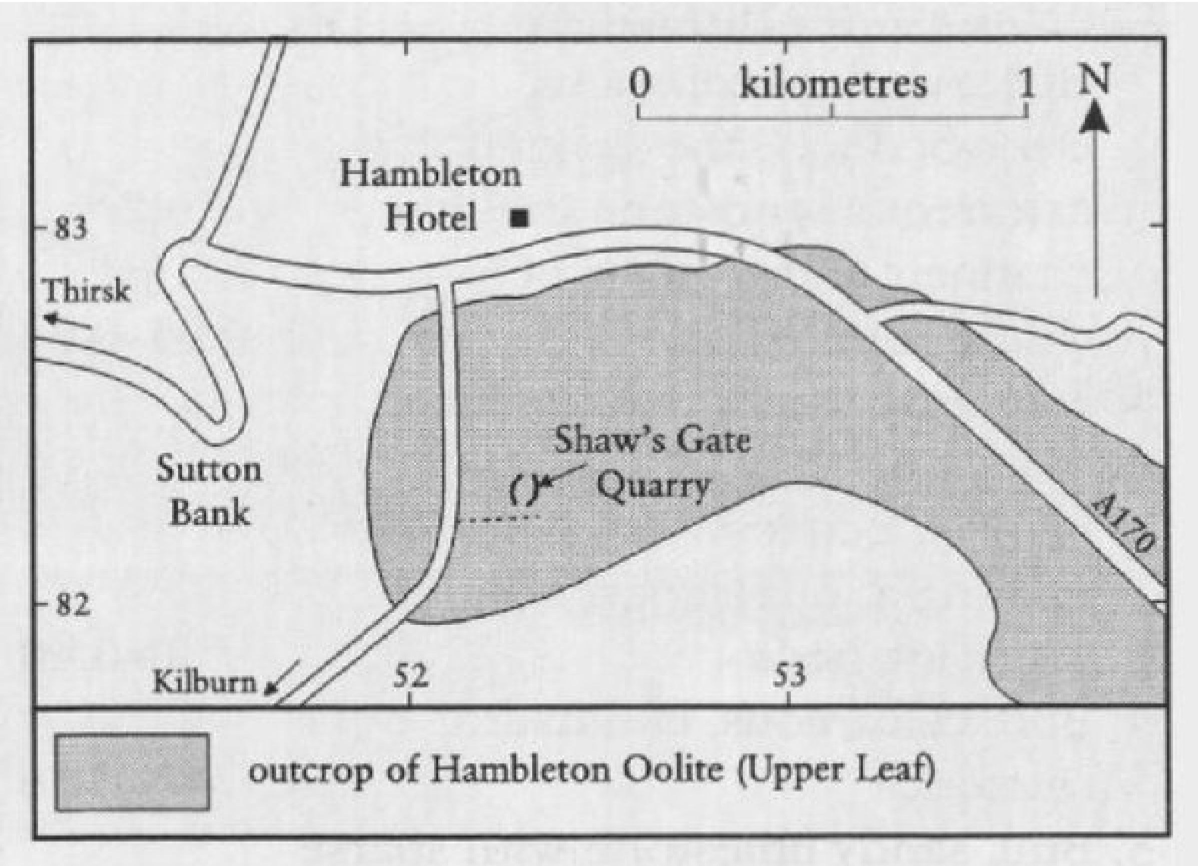
Early seismicity connected with the Asenby–Coxwold Graben could thus have been the mechanism through which the convoluted bedforms and dewatering structures were formed. Mobilization of the ooidal bed (Bed 5) is regarded by Hemingway and Twombley (1963) as having preceded its upward extrusion into the overlying strata. This site provides a fine example of the penecontemporaneous liquefaction of unconsolidated sediment. Features such as this, whilst well known within deep-sea clastic sequences, are rarely preserved in the shallow-shelf depositional environment (Reineck and Singh, 1980). Experimental tests on the fluidization of sediment highly charged with water (McKee and Goldberg, 1969) suggest that Bed 5 could have been extruded through liquefaction by several means. An increase in pressure could have been induced by a direct increase in hydrostatic load, a sudden increase in interstitial water, a change in packing of the sediment, or the sudden impact of a shock wave. In general, sedimentation took place under very slow, gentle conditions in the Yorkshire Corallian, and only the shock-wave hypothesis can account for the sudden change in conditions necessary for convolution to be initiated.

Dugué (1995) has described almost identical synsedimentary deformation structures from Late Oxfordian silty, spicular limestone (Calcaire gréseux de Hennequeville) in Normandy. As is the case at Shaw's Gate Quarry Dugué believed that the formation of these structures was due to liquefaction of unconsolidated sediment during earthquakes.

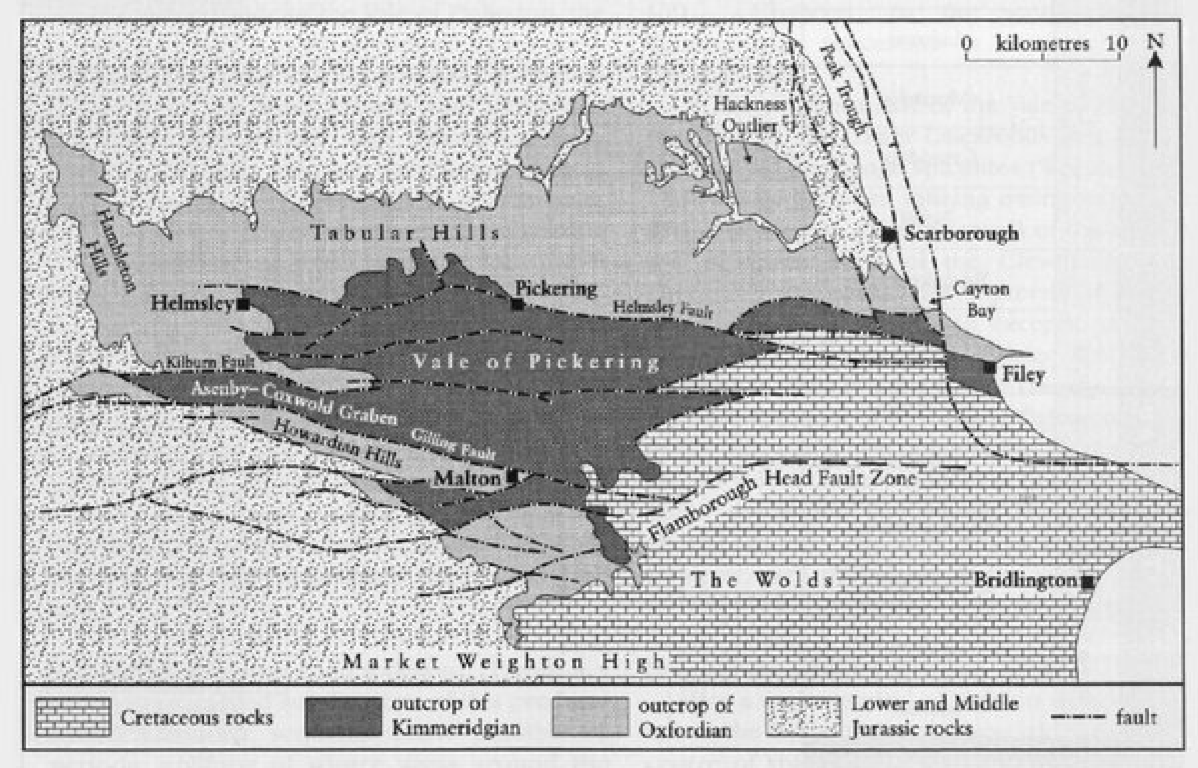
Conclusions

The Hambleton Oolite at this site is important in showing penecontemporaneous stratal deformation produced by slumping. It has been suggested by Hemingway and Twombley (1963) that the convolution and dewatering features at Shaw's Gate Quarry were the result of mass movements triggered by seismic shocks in heavily water-laden sediments. The shocks were possibly connected with movements on the Asenby–Coxwold trough fault system occurring nearby. Structures such as those present at this site are rare in shallow marine shelf carbonates, which normally become lithified very quickly.

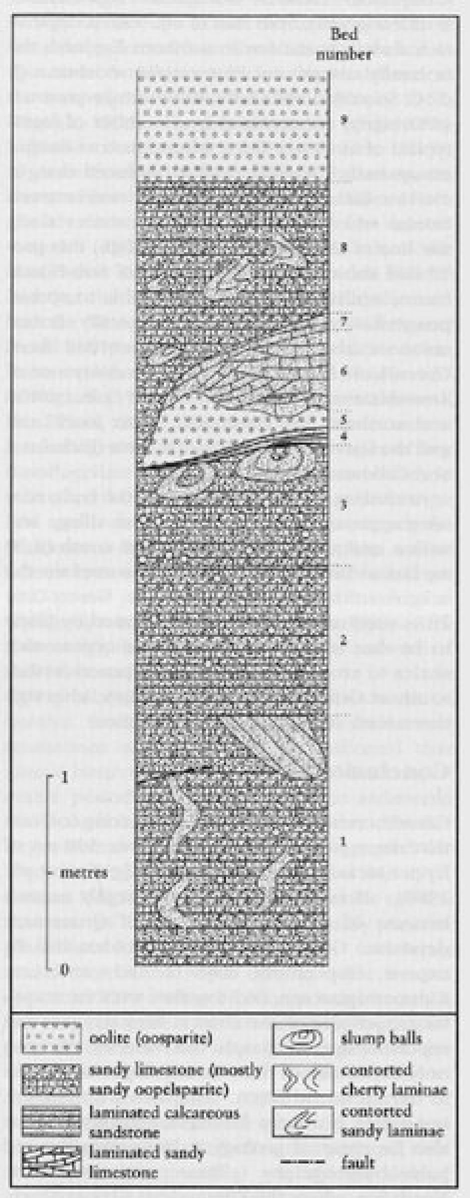
[References](#)



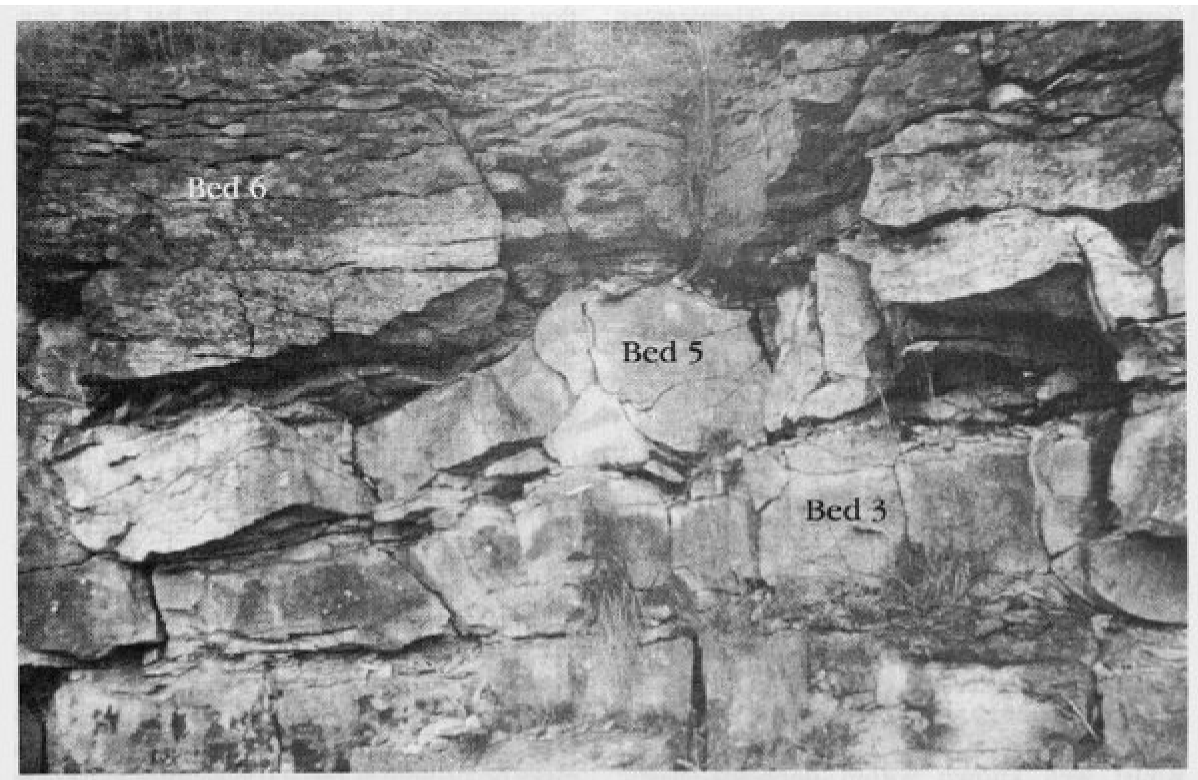
(Figure 4.28) Locality map of Shaw's Gate Quarry. Outcrop of the Hambleton Oolite from BGS Sheet 52 (Thirsk) (1992).



(Figure 4.1) Map showing the solid geology of the Oxfordian and Kimmeridgian beds in the Cleveland Basin, with the principal stuctural and geographical features. (Based on Versey, 1929, fig. 1; BGS 1:250 000 Solid Sheet 54N 02W (Tyne-Tees) (1981); BGS 1:1 500 000 Tectonic map of Britain, Ireland and adjacent areas (1996) and BGS 1:50 000 Sheet 54 (Scarborough) (1998)). In the Vale of Pickering there is a thick cover of Quaternary lacustrine deposits.



(Figure 4.29) Log showing the slump structures at Shaw's Gate Quarry (after Powell et al.,1992).



(Figure 4.30) View of Shaw's Gate Quarry showing a slump fold in oobiosparite (Bed 5). The flanks of the fold are filled with laminated sandy limestone (Bed 6). A load ball in Bed 3 is visible on the lower right. Height of face 1.5 m. (Photo: J.K. Wright.)