National Stone Centre, Derbyshire

[SK 288 553]

Introduction

The complex of disused quarries at the National Stone Centre [SK 288 553], north of Wirksworth (Figure 7.17) provides a spectacular three-dimensional view of the stratigraphical evolution and sedimentology of limestones deposited at the edge of the Derbyshire Platform during Brigantian times. The exposed succession, which includes parts of both the Monsal Dale Limestones and the Eyam Limestones, also reveals important sections through some late Brigantian carbonate mud-mounds. The locality, also known as the 'Steeplehouse Quarries Complex' (the original GCR site name) or the 'Coal Hills Quarry Complex' (Walkden, 1982), has been an important focus of geological research for many years. Significant early accounts of the site stratigraphy were provided by Shirley (1959) and Smith *et al.* (1967). Later sedimentological and palaeontological work by Walkdcn (1970, 1982), Timms (1978), Weaver and Jeffcoat (1978), Gutteridge (1983, 1989a, 1995) and Oakman (1984) focused attention primarily on the character of the carbonate mud-mounds and their relationship to surrounding strata. Fossilized shark remains recorded by Ford (1964) from the Eyam Limestones at a part of this site (Steeplehouse Quarry, [SK 2875 5535]) are re-evaluated in an earlier GCR volume, *Fossil Fishes of Great Britain* (Dineley and Metcalf 1999).

Description

Approximately 27 m of the topmost beds of the Monsal Dale Limestones (= Matlock Limestones of Frost and Smart, 1979) occur at this site. These are best exposed in Lower Coal Hills Quarry [SK 2880 5505], Shaw's Quarry [SK 286 552] and Coal Hills Quarry [SK 2875 5515] (Figure 7.17). These consist mainly of crinoidal grainstone and packstone with some evidence of cross-stratification. They are overlain by an undulatory erosion surface that appears to cut down-section to the south. At least two carbonate mud-mounds are developed at the top of the formation (Figure 7.18). The mud-mounds comprise largely unbedded accumulations of fine-grained carbonate mud with irregular depositional cavities lined by marine cement and pocket-like accumulations of a mixture of in-situ and reworked brachiopods and bivalves (Gutteridge, 1983, 1995). The flanks of the mud-mounds comprise thick beds of coarse crinoidal grainstone that dip away from the mud-mound cores. The mud-mounds contain a diverse brachiopod fauna including *Antiquatonia, Buoctonia, Eomarginifera, Schizophoria* and *Spirifer* together with bivalves, fenestrate bryozoans crinoids, goniatites and nautiloids. A list of the macrofauna from the mud-mound facies is given by Timms (1978).

The carbonate mud-mounds contain brown vadose calcite cements that form an asymmetrical lining of depositional cavities, as well as speleothem-like deposits in fissures that are locally overlain by crinoidal material. An impersistent calcrete is also present at the top of the mud-mounds (Gutteridge, 1983). In the south-east corner of Coal Hills Quarry, a large cave-like cavity in the mud-mound facies is lined by brown calcite flowstone. The flowstone is cut by stylolites and contains traces of fluorite and hydrocarbon residue. Some light-brownish clay is also present in the cave. The boundary between the Monsal Dale Limestones and the Eyam Limestones is located at the top of the mud-mounds and represents an exposure surface (Gutteridge, 1989a).

Above this, the lowest beds of the Eyam Limestones (*c.* 23 m thick) drape the topography of the mud-mounds in the underlying Monsal Dale Limestones. The Eyam Limestones (= Cawdor Limestone of Frost and Smart, 1979) comprise a bioclastic grainstone–packstone facies dominated by crinoid debris, gigantoproductids and reworked corals; the limestones become increasingly cherty towards the top of the succession. Some beds with layers of intraclasts and very coarse, well-rounded bioclasts are also present. Evidence of large-scale cross-stratification is visible in the face of Coal Hills East Quarry [SK 2875 5525], Shaw's Quarry, and in a small quarry [SK 2855 5520] north of Shaw's Quarry. The crinoidal limestones appear to thin and become darker towards the south. Intervals of dark, thinly bedded biomicritic limestone with abundant whole but disarticulated *Gigantoproductus* valves preserved in a convex-down position, are also present. Taxa recorded from these beds are detailed by Smith *et al.* (1967).

The quarries to the north of the High Peak Trail at Coal Hills West Quarry [SK 2850 5530] and Steeplehouse Quarry expose an 11 m sequence comprising bioclastic grainstones with reworked brachiopods and crinoids, well-sorted thickly bedded crinoidal grainstone, some beds of whole gigantoproductids, and scattered developments of nodular and tabular chert.

A notable bed at Steeplehouse Quarry contains scattered fish debris, including the dermal denticles of the primitive shark *Petrodus* (Ford, 1964; Dineley and Metcalf, 1999). This bed lies at least 10 m above the top of the mud-mound in Coal Hills East Quarry but to the west it lies within 3 m of the top of the Shaws Quarry mud-mound core.

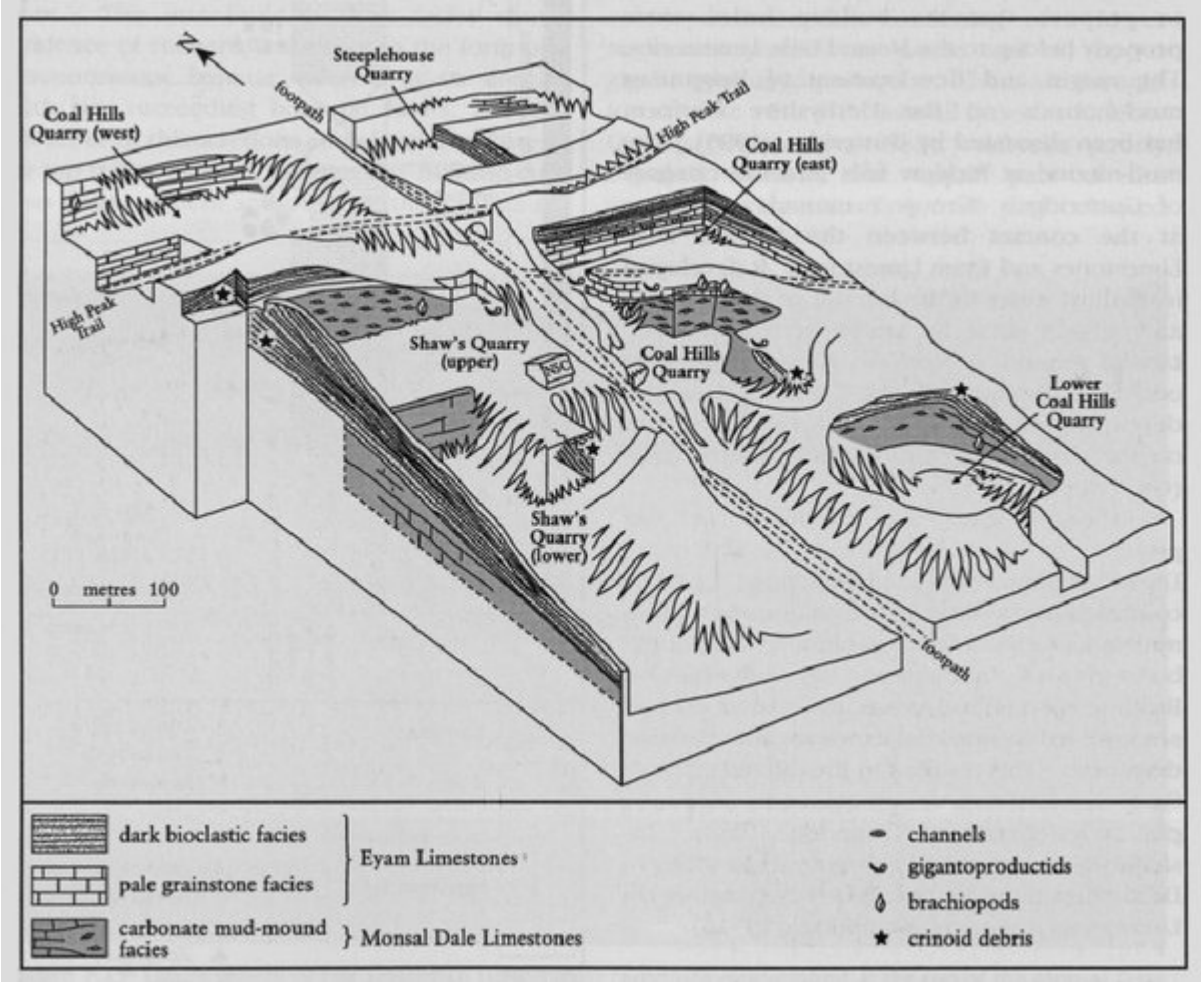
Interpretation

Both the Monsal Dale Limestones and the Eyam Limestones are Brigantian age. The Monsal Dale Limestones were deposited in a high-energy, subtidal setting mainly above normal wave- base. Scattered carbonate mud-mounds were present in this setting. These mud-mounds are thought to have originated by the production of carbonate mud within an algal-bacterial mat that bound the surface of the mud-mound structures (Gutteridge, 1983, 1995). The Eyam Limestones rest with a stratigraphical break on the Monsal Dale Limestones — a stratigraphical break that probably also relates to the development of lowstand wedge deposits (the Pendleside Sandstones Member) in the Craven Basin (see Pendle Hill GCR site report, Chapter 6). The presence of mineralization and other features that formed during post-Dinantian burial (Gutteridge, 1983) show that both the flowstone and the cave are Dinantian age. The precipitation of vadose cements in cavities and fissures, calcrete development and cave formation all indicate a period of subaerial exposure at the Monsal Dale Limestones-Eyam Limestones boundary. This boundary may represent a period when the whole of the Derbyshire carbonate platform was emergent (Gutteridge, 1989a). Crinoidal material within fissures in the core facies of carbonate mud-mounds was deposited during the initial transgression of the Eyam Limestones. The brown clay in the cave is interpreted as a later, probably Pleistocene, infill. The Eyam Limestones were deposited as a high-energy bioclastic carbonate sand-body with some large-scale sedimentary bedforms and channels. The general facies relationships, thickness changes and palaeocurrents in the Eyam Limestones suggest that the main transport direction of carbonate sediment was off shelf to the south.

Conclusions

These quarries expose a complex of crinoidal grainstone carbonate sand-bodies with large-scale sedimentary structures and scattered carbonate mud-mounds that formed the upper part of the southern margin of the Derbyshire Platform during Brigantian times. A wide variety of rarely preserved features, including ancient cave deposits and speleothem cements formed during a late Dinantian period of subaerial exposure, are also present. Together with other disused quarries in the Wirksworth area (e.g. Baileycroft Quarry and Dale Quarry), the National Stone Centre offers one of the finest three-dimensional views of the facies relationships and stratigraphical evolution of a late Dinantian platform margin in England.

References



(Figure 7.17) Block diagram illustrating the relative distribution of quarries at the National Stone Centre, Wirksworth. Note that in this figure an element of an east-west shortening is illustrated in the vicinity of the footbridge. NSC indicates the approximate position of the National Stone Centre building. After Walkden (1982).

(Figure 7.18) Carbonate mud-mound at Coal Hills Quarry (National Stone Centre) at the top of the Monsal Dale Limestones. Note that the massive mud-mound core facies (middle), seen here draped by bedded crinoidal grainstones of the Eyam Limestones (left), is now largely quarried away. (Photo: P.J. Cossey.)