Duchy Quarry, Derbyshire

[SK 094 768]

Introduction

The Duchy Quarry GCR site is a disused quarry [SK 094 768] near Peak Dale, 5 km to the northeast of Buxton. It offers an outstanding section of the Chee Tor Rock; part of the Bee Low Limestones (see Aitkenhead and Chisholm, 1982). The existence of subaerial weathering phenomena (palaeokarsts and palaeosols) in this otherwise shallow marine sequence make it a key site for monitoring sea-level and environment changes across the Derbyshire Platform during Asbian times. The section also includes a number of fossiliferous lithostratigraphical marker bands important for the correlation of successions across the platform area. Logs of the succession are provided by Stevenson and Gaunt (1971) and Berry (1984).

Description

This site was originally selected as one of the type sections of the Bee Low Limestones by Aitkenhead and Chisholm (1982). The section is ascribed to the upper part of the Chee Tor Rock (Green *et al.,* 1869; Cope, 1933), that part of the Bee Low Limestones sequence immediately below the level of the Lower Millers Dale Lava (Stevenson and Gaunt, 1971). It comprises 33.5 m of pale, massive and rather homogeneous, fine-grained limestones (principally calcarenites) and is characterized by closely spaced vertical joints (Figure 7.9). Typical lithologies include bioclastic and peloidal grainstones with a few packstone layers. Besides the ubiquitous crinoid debris, comminuted brachiopod and coral fragments also occur at various levels in the sequence.

At the base of the section, a spectacular potholed surface or 'palaeokarst' (see Walkden, 1972b, 1974) with solution pits up to 20 cm deep, and once visible across much of the quarry floor, is now partly obscured by A similar surface occurs 13 m higher in the sequence. Clay wayboards up to 0.6 m thick above these surfaces most probably represent palaeosols derived from the weathering of pyroclastic deposits (volcanic ash) deposited over the sub-aerially exposed limestone surfaces during periods of platform emergence (Walkden, 1972a, 1984). K-bentonite residues of a volcanic origin (Walkden, 1972a) are also recorded from a prominent stylolite 7.5 m above the quarry floor.

Three prominent lithostratigraphical marker bands occur 3.5 m, 15.2 m and 26 m above the base of the section. From the base to the top these are respectively the Duchy Quarry Algal Band, the Lower Davidsonina septosa Band and the Upper Davidsonina septosa Band, and each of these has proved useful in the correlation of Asbian successions across the Derbyshire Platform (Stevenson and Gaunt, 1971). *D. septosa* does however occur, both in association with and without 'algae', at several other levels in the section (Stevenson and Gaunt, 1971).

The Duchy Quarry Algal Band (0.3 m) contains microbial oncoids up to 7 cm in diameter with micrite laminae enclosing the calcified tubes of the cyanobacterium *Girvanella* concentrically arranged around a nucleus of either crinoid or brachiopod shell fragments (e.g. *D. septosa*). Encrustations of the demosponge *Chaetetes depressus* occur between the micrite laminae of some oncoids. The associated fauna includes fragments of solitary and colonial corals, foraminifera and an abundance of the dasycladacean alga *Koninckopora.*

A faunal assemblage typical of the Asbian Stage is reported from the Lower D. septosa Band (0.25 m) including *D. septosa, Delepinea comoides, Gigantoproductus* sp. *edelburgensis* group, *Linoprotonia, Megachonetes* sp. *papilionaceus* group, *C. depressus, Dibunophyllum bourtense, Siphonodendron* cf. *sociale, S. martini, Palaeosmilia murchisoni, Syringopora,* gastropods, foraminifera and *Koninckopora* (Mitchell in Stevenson and Gaunt, 1971). A somewhat similar brachiopod fauna is reported by the same author in the Upper D. septosa Band (*c.* 0.5 m) (= '*Cyrtina septosa* Band' of Cope, 1936, 1939).

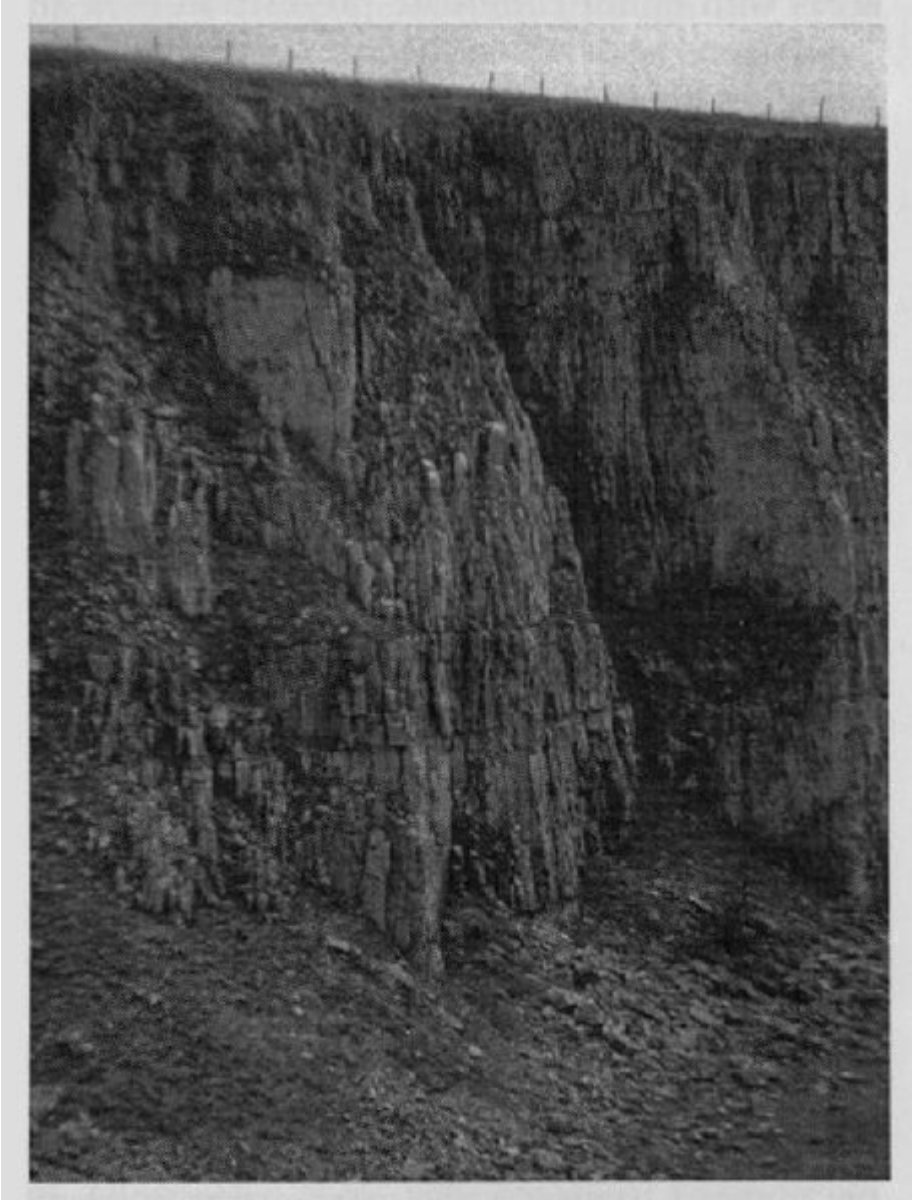
Interpretation

The succession at Duchy Quarry is typical of the upper part of the Bee Low Limestones across much of the Derbyshire Platform. It represents part of a laterally extensive carbonate sand-sheet formed in the warm, clear and subtidal waters of a shallow shelf sea. A predominantly subtidal setting is confirmed by the presence of microbial oncoids and *Koninckopora* at several levels in the sequence. The uniformity of sediment texture, high level of bioclast fragmentation and absence of sedimentary structures is attributed to the combined effects of extensive wave and current action and biottutation (Sadler, 1964a; Aitkenhead *et* al., 1985; Gutteridge, 1987). Prolonged episodes of platform emergence and subaerial weathering are indicated by the presence of palaeokarsts and palaeosols (Walkden, 1972a, 1974). These features most probably form the tops to minor shallowing-upward sedimentary cycles which are as yet imprecisely defined within the sequence (Walkden, 1984, 1987).

Conclusions

The section at Duchy Quarry offers one of the best and most easily accessed sections of the Chee Tor Rock in central Derbyshire. The alternation of shallow marine strata with subaerial exposure features (palaeokarsts and palaeosols) reveals important information on the nature of sea-level fluctuations across the Derbyshire Platform during Asbian times. The site has considerable potential as an educational resource for demonstrating aspects of carbonate sedimentology and as a research site.

References



(Figure 7.9) General view of the thick-bedded and strongly jointed Asbian grainstone facies in the Chee Tor Rock (Bee Low Limestones) at Duchy Quarry The height of the quarry face is approximately 30 m. (Photo: P.J. Cossey.)