

Depositional environments and palaeogeography of the Station Quarry Beds (Brigantian), Derbyshire, England

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SUMMARY: The Station Quarry Beds were deposited during a transgressive episode at the beginning of the Brigantian in a structurally controlled basin on the Derbyshire carbonate platform. The initial flooding of this basin was marked by the deposition of sediment reworked from subtidal, shoreface and back barrier intertidal sediments on the karstified and calcretised surface of the Bee Low Limestones. As sea level continued to rise, low energy, sub-wave-base conditions, interrupted by occasional storms, were established within the intrashelf basin. The generally low-energy environment is attributed to the sheltered setting of the intra-shelf basin rather than water depth. The near normal to fully marine salinity, together with the well-oxygenated conditions of deposition, suggest that the intra-shelf basin was probably connected to a larger body of fully marine water.

The Station Quarry Beds represent the first episode of Brigantian sedimentation on the Derbyshire carbonate platform (Walkden 1977; Aitkenhead & Chisholm 1982). Their outcrop is restricted to the Miller's Dale area in what was formerly the central part of the Derbyshire carbonate platform (Fig. 1). The Station Quarry Beds are an important element of the Derbyshire carbonate platform because they represent the initial deposits of an intra-shelf basin which developed in response to reactivation of basement faults around the time represented by the Asbian/Brigantian boundary (Gutteridge 1987, 1989).

Previous work on the Station Quarry Beds has been concerned with their age and stratigraphical relationships (Cope 1937; Stevenson & Gaunt 1971; Butcher & Ford 1973; Walkden 1977; Aitkenhead & Chisholm 1982; Aitkenhead *et al.* 1985), but, with the exception of a microfacies study by Pazdzierski (1982), there has been no sedimentological study of them. The objectives of this paper are to discuss the depositional environments of the Station Quarry Beds and to obtain a more detailed picture of the sedimentation and palaeogeography of the Derbyshire carbonate platform around the Asbian/Brigantian boundary.

1. DISTRIBUTION OF THE STATION QUARRY BEDS

The distribution of the Station Quarry Beds, shown by Figure 1, is a result of a) the original extent of their deposition and b) an episode of intra-Brigantian erosion. Cope (1937) shows a N-S section (his figure 2) indicating that the Station Quarry Beds pinch out against the Taddington — Bakewell Anticline to the south. Stevenson & Gaunt (1971), on the basis of their thickness at outcrop and in the Litton Dale Borehole (SK15997498), show that the Station Quarry Beds thin

northwards because of onlap against the Longstone Edge Monocline. Butcher & Ford (1973) also demonstrate this onlap against the Longstone Edge

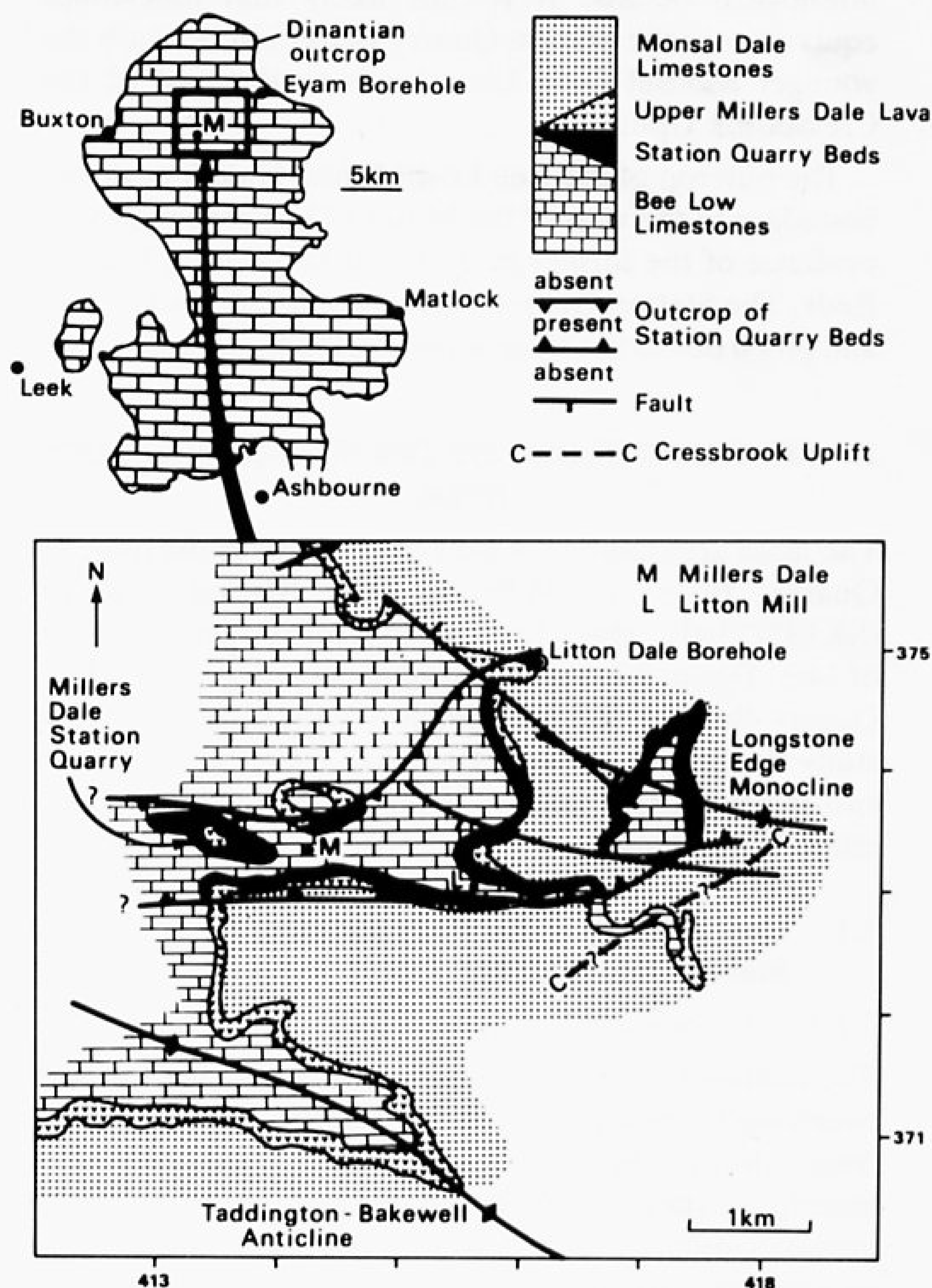


Fig. 1. Location of study area showing the outcrop of the Station Quarry Beds.

Monocline on the basis of the dip of the Station Quarry Beds relative to that of the underlying Bee Low Limestones. Pazdzierski (1982) indicates thinning of the Station Quarry Beds to the north and south against the Taddington — Bakewell Anticline and the Longstone Edge Monocline, also inferring onlap against these structures.

These stratigraphical relationships suggest that the Station Quarry Beds were deposited in a basin which formed within the Derbyshire carbonate platform as a result of the development of precursors to the present Taddington — Bakewell Anticline to the south and the Longstone Edge Monocline to the north.

The southeastern termination of the Station Quarry Beds is a result of intra-Brigantian erosion over the crest of the Cressbrook Uplift (Fig. 1). Evidence of the presence of the Station Quarry Beds further to the east is suggested by the occurrence of pebbles of a similar lithology in palaeokarstic pits in the top of the Bee Low Limestones at SK16157290 and SK16657270 (Butcher & Ford 1973; Walkden 1977; Pazdzierski 1982). In addition, Strank (1985) recorded a complete Asbian and Brigantian sequence in the Eyam Borehole (SK20967603), part of which must be equivalent to the Station Quarry Beds. Strank, however, gave no lithological details. It is thus likely that limestones equivalent to the Station Quarry Beds exist beneath the younger Monsal Dale Limestones to the east of the Cressbrook Uplift.

The outcrop of the Bee Low/Monsal Dale limestones boundary to the west of the Miller's Dale area shows no evidence of the former presence of the Station Quarry Beds. The Station Quarry Beds are thus inferred to thin and pinch out to the west of their present outcrop.

2. SEDIMENTOLOGY OF THE STATION QUARRY BEDS

The main area studied is the type locality of the Station Quarry Beds at Miller's Dale Station Quarry (SK13277340), where they reach a maximum thickness of 14m. Figure 2 is a sedimentological log of the Station Quarry Beds at this locality. For the purposes of this study the Station Quarry Beds have been divided into two facies on the basis of bedding characteristics and microfacies types.

2.1. Contact between the Bee Low Limestones and the Station Quarry Beds

2.1.1. Description

The contact between the Bee Low Limestones and the overlying Station Quarry Beds is marked by a change from thickly bedded (up to 5m), pale-coloured limestones (below) to medium-bedded (0.15m—0.3m) medium-to dark grey coloured limestones (above). On an outcrop scale the contact is planar with no apparent angular discordance. In detail, the upper surface of the Bee Low Limestones is undulatory on a scale of 0.1m

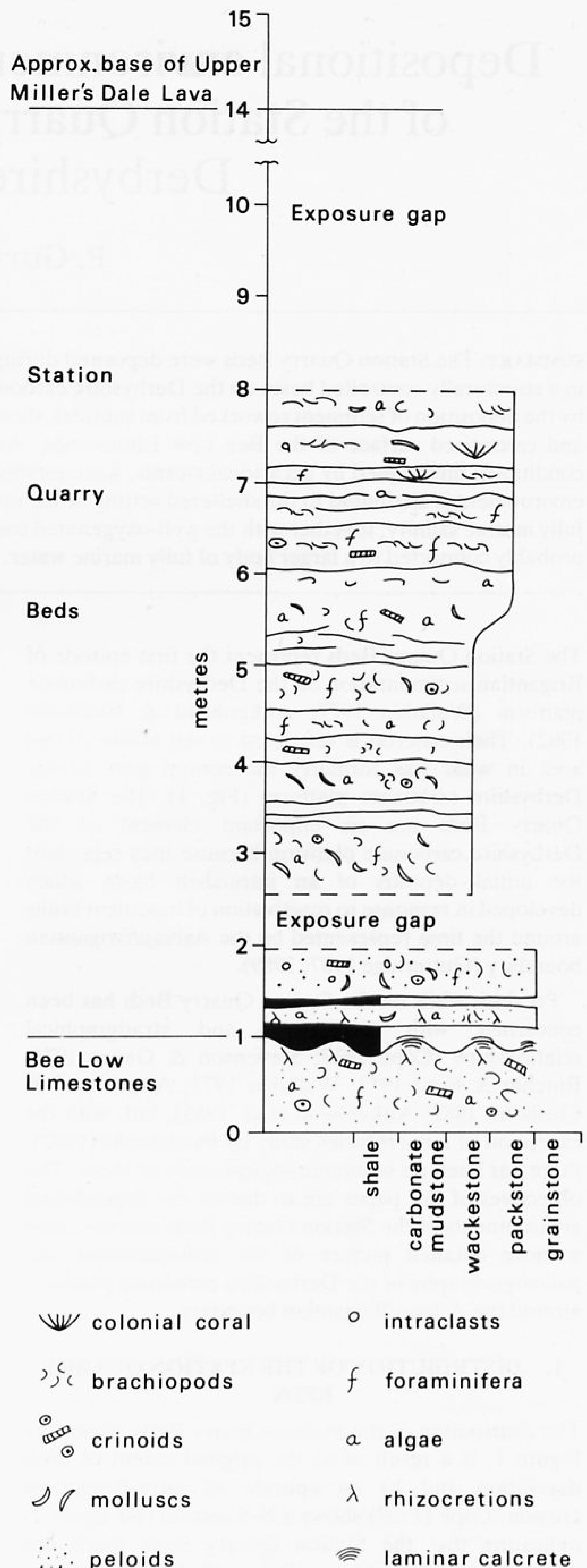


Fig. 2. Sedimentological log of the Station Quarry Beds at the type locality Miller's Dale Station Quarry (SK13277340).

amplitude and 0.25m to 0.3m wavelength; sporadic larger undulations with an amplitude of 0.5m and a wavelength of 0.5m to 1m are also present. Cope (1937), Walkden (1977) and Pazdzierski (1982) recorded some larger depressions up to 3m deep, which are now obscured. These undulations, which represent sub-circular pits which cut down into, and truncate fabrics within the Bee Low Limestones, are often capped by a brown laminated micritic crust which thins down their flanks. The topmost bed of the Bee Low Limestones contains rhizcretions, each of which consists of a spar-filled tube with an internal diameter of 200 μ m coated by concentrically laminated brown micrite with an external diameter of upto 600 μ m. A brown micritic matrix is present in the top few centimetres of the bed.

2.1.2. Interpretation

The pitted surface of the Bee Low Limestones has a morphology similar to mammillated surfaces described from elsewhere on the Derbyshire carbonate platform and interpreted by Walkden (1974) as having formed by palaeokarstic dissolution of limestones during subaerial exposure. Palaeokarstic dissolution may take place on an exposed, lithified limestone surface or beneath a soil cover. The mammillated morphology of the karstic surface and the occurrence of calcrete textures in the underlying Bee Low Limestones suggest that this may represent a covered karst which formed underneath a soil (Wright 1982).

Rhizcretions are formed by the precipitation of micritic calcite around former plant roots or fungal hyphae and are thus indicators of former emergent surfaces (Klappa 1980; Adams 1980; Adams & Cossey 1981). The brown micrite matrix resembles the pelleted and laminar calcrete textures described from the upper part of a Dinantian calcrete profile by Adams (1980). This brown laminar calcrete has also been recorded as a coating of palaeokarstic surfaces by Walkden (1974). Laminar calcretes are formed by lichen stromatolites, the calcification of root or fungal mats and by precipitation of calcite within calcrete profiles (Klappa 1979; Adams 1980; Adams & Cossey 1981; Wright *et al.* 1988), all of which indicate former subaerial exposure surfaces.

2.2. Limestone — Shale facies

2.2.1. Description

This facies occurs at the base of the Station Quarry Beds. It has a maximum thickness of 1.5m and consists of 2 to 4 limestone beds 0.2m to 0.5m thick alternating with shale beds 0.1m to 0.3m thick. The lowermost shale bed fills the palaeokarstic hollows in the underlying Bee Low Limestones. The shale is unfossiliferous and contains expandable clay minerals. The limestone beds have a sheet-like morphology. Each bed extends laterally for several tens of metres before thinning and pinching out. There are two types of limestone present in the Limestone — Shale facies:

i) Peloid bioclast intraclast grainstone/packstone (Fig. 3A). Bioclasts include: foraminifera, crinoids, fenestrate bryozoans, gastropods, thick-shelled molluscs, ostracods and an algal flora including ungdarellids, *Koninckopora*, stachenids and green algae. The bioclasts are disarticulated, fragmented, rounded and micritised. Non-skeletal grains include: oncolitically coated bioclasts and well-sorted spherical peloids 50 μ m-200 μ m in diameter. Two types of intraclasts are present: a) rounded intraclasts composed of bioclast wackestone with micritised gastropods, irregular fenestrae and rhizcretions (Fig. 3B), and b) platy shaped intraclasts composed of carbonate mudstone which contain tubular fenestrae (Fig. 3C).

ii) Bioclast packstone (Fig. 3D). Bioclasts include: foraminifera, brachiopods, molluscs, crinoids, ostracods, calcispheres, kamaenids and stachenids. Bioclasts are disarticulated, slightly abraded and micritised. Spar-filled tubular fenestrae with a sub-circular cross section up to 500 μ m in diameter are also present.

2.2.2. Interpretation

The unfossiliferous nature of the shale suggests that it is not marine and the presence of expandable clay minerals suggests a K-bentonite component of probable volcanic origin (Walkden 1972). The occurrence of the shale in association with a palaeokarstic surface and limestones containing calcrete features suggests that it may have been modified by soil-forming processes.

The moderate to good sorting of the interbedded peloid bioclast intraclast grainstone/packstone and the presence of oncolitically coated grains suggests a moderate to high energy of the environment with a high degree of reworking. The presence of micritised grains and the diverse algal flora indicate deposition in the photic zone. The restricted bioclast assemblage suggests that the depositional environment may have been hypersaline. The peloids are interpreted as faecal in origin and were probably produced by gastropods. The presence of rhizcretions in intraclasts indicates that emergent conditions were present in the vicinity, but not necessarily at the final site of deposition. The carbonate mudstone intraclasts were derived from an adjacent intertidal area (*cf.* Grover & Read 1978; Shinn 1983). Their platy shape suggests that they may have originated as desiccation flakes. The bioclast wackestone intraclasts represent original subtidal sediments deposited and reworked under high energy, occasionally emergent conditions such as occur in intertidal, beach or shoreface environments, but then apparently reworked and redeposited in a supratidal environment.

The bioclast packstone contains a diverse fauna and flora indicative of more normal marine salinity. The presence of algae and micritised grains suggest deposition within the photic zone. The presence of tubular fenestrae also indicates emergence. This sediment is similar to that constituting the main part of

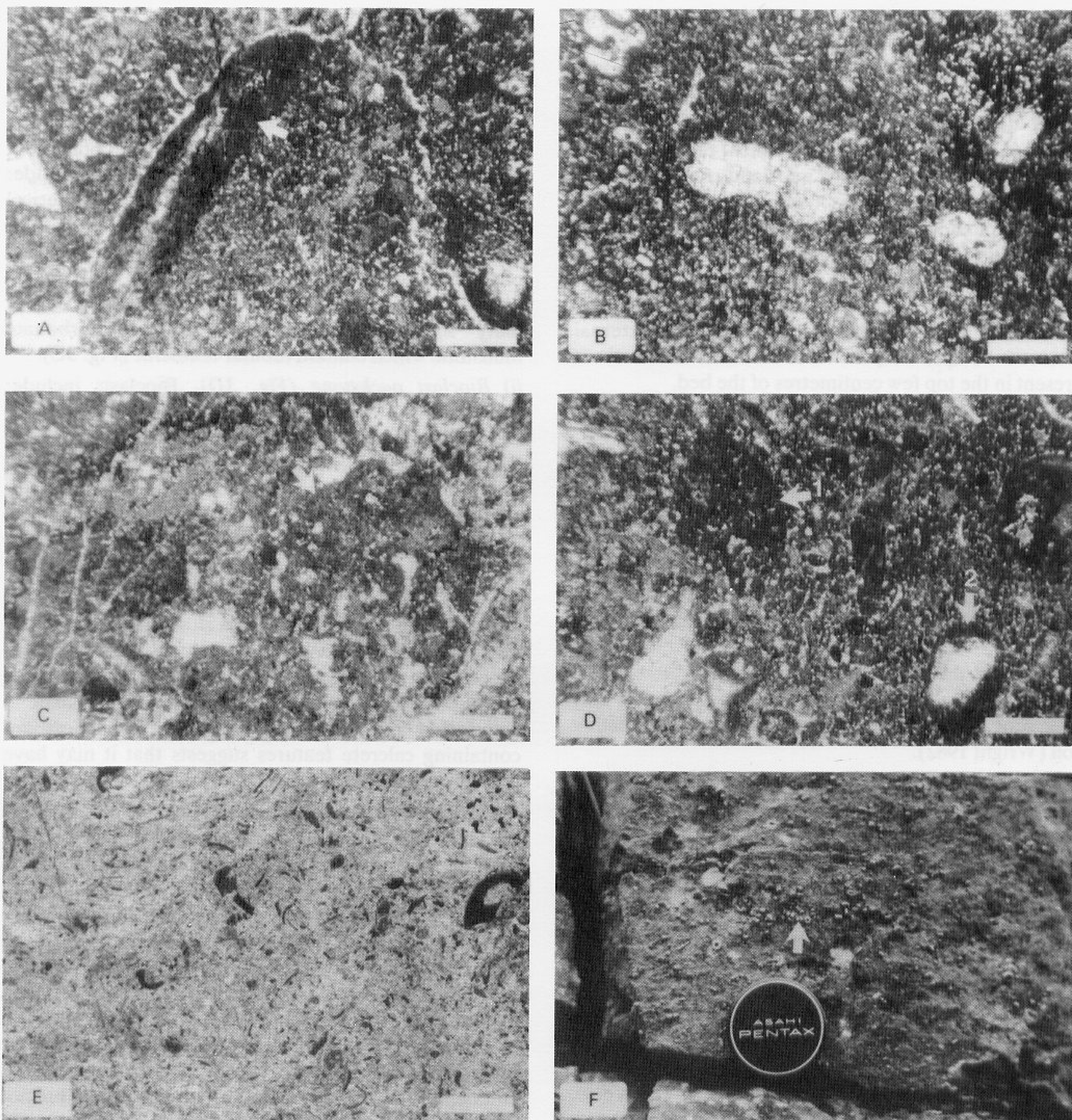


Fig. 3. A) Peloid bioclast intraclast grainstone/packstone interbedded with unfossiliferous shale in the Limestone—Shale facies. Contains faecal pellets, partly micritised bioclasts and an oncolitically-coated mollusc shell fragmented (arrowed). Scale bar = $250\mu\text{m}$.
 B) Tubular fenestra within bioclast packstone of the Limestone—Shale facies. Scale bar = $200\mu\text{m}$.
 C) Intraclast (edge arrowed) composed of bioclast wackestone containing irregular and tubular fenestrae present in the Limestone—Shale facies. Scale bar = $200\mu\text{m}$.
 D) Bioclast packstone of the Limestone—Shale facies containing carbonate mudstone intraclast (1) together with rhizcretion (2). Scale bar = $250\mu\text{m}$.
 E) Bioclast wackestone/packstone with arcuate alignment of platy-shaped bioclasts interpreted to have been produced by bioturbation. Negative print of peel. Scale bar = $500\mu\text{m}$.
 F) Remnant of grain-supported crinoidal lag deposit (arrowed) surrounded by matrix-supported bioturbated sediment. Lag deposit interpreted to have been formed during winnowing and mixed with the surrounding sediment by bioturbation. Lens cap is 49mm in diameter.

the Station Quarry Beds and is similarly interpreted as of subtidal origin (see section 2.3.2.).

The laterally discontinuous sheet-like geometry of these limestone beds suggests that they may represent storm washover lobes similar to those recorded from recent peritidal carbonate environments by Aigner (1985) and Wanless *et al.* (1988a). The presence of rhizcretions and other evidence of desiccation suggests that the limestones were reworked from subtidal, intertidal and shoreface environments and deposited in supratidal areas.

2.3. Bioclastic packstone/wackestone facies

2.3.1. Description

The bioclastic packstone/wackestone facies overlies the limestone — shale facies. This facies comprises medium to dark grey unsorted bioclast wackestone and packstone in which bedding is between 0.15m and 0.3m in thickness. The bedding planes are picked out by discontinuous shaley partings 0.01m-0.02m thick which represent pressure dissolution seams. The attitude of depositional layering can be inferred from scoured surfaces, layers of winnowed sediment and occasional upright colonial corals (*cf.* Simpson 1985).

This facies is similar to the bioclastic packstone intraclasts present in the limestone — shale facies described in section 2.2.1. Bioclasts present include molluscs (thick-shelled bivalves and gastropods), crinoid stems and ossicles, disarticulated brachiopod valves, whole and fragmented corals, sponge spicules, foraminifera (endothyrids, tetraxids and earlandids), bryozoans and ostracods. The algal flora includes green algae, kamaenids, stachenids and ungdarellids. The bioclasts are commonly bored and many show varying degrees of micritisation. Although the majority of the bioclasts are disarticulated there is little abrasion. Platy-shaped bioclasts occasionally show a preferential arcuate alignment; otherwise, they are randomly aligned (Fig. 3E). There are also sporadic discontinuous layers and patches of imbricated grain-supported brachiopod valves and other coarse bioclasts (Fig. 3F). These layers pass abruptly into and are surrounded by areas where bioclasts show a random or arcuate alignment. The limestones commonly display a mottled texture which is defined by patches of grain-supported sediment surrounded by matrix-supported sediment, by the segregation of fine and coarse bioclasts and by the patchy distribution of carbonate mud. Towards the top of the Station Quarry Beds, grain-supported sediment becomes more common and brachiopods and colonial corals become more abundant.

2.3.2. Interpretation

The presence of a diverse algal flora and the common occurrence of micritisation indicates deposition in the photic zone. The abundance of skeletal algae, foraminifera and molluscs compared with brachiopods and corals suggest somewhat hypersaline conditions.

The increasingly common occurrence of grain-supported sediments and the higher proportion of brachiopods and colonial corals towards the top of the Station Quarry Beds indicate a progressive change to higher energy conditions and normal marine salinity during deposition.

The presence of carbonate mud and the generally low degree of rounding and sorting of bioclasts suggest a generally low-energy environment. The occurrence of layers of disarticulated and stacked coarse bioclasts and local grainstone patches suggests occasional episodes of winnowing. The random and arcuate alignment of the bioclasts and the mottled nature of the sediment are attributed to bioturbation. All specimens examined show evidence of complete overturn of the sediment by bioturbation. This indicates that bottom conditions were oxygenated and that the rate of bioturbation was at least as fast as the sedimentation rate. This intensive bioturbation could also account for the disarticulation but lack of abrasion of the bioclasts. The abrupt lateral transitions between layers of stacked shells and matrix-supported sediment is interpreted as the result of mixing of winnowed layers with surrounding sediment by bioturbation. An alternative explanation for these patches of coarse-grained, grain-supported sediment is that they represent "tubular tempestites", described by Wanless *et al.* (1988b), which are found in intensively burrowed subtidal carbonate sediments. These form during storm reworking, when coarse sediment is deposited in open burrows and is preserved as tube-like accumulations of grain-supported coarse sediment surrounded by bioturbated, carbonate mud-rich sediment. In either case, these indicate deposition below normal wave-base and above storm wave-base.

3. DEPOSITIONAL SUMMARY AND PALAEOGEOGRAPHY

Aitkenhead *et al.* (1985) and Walkden (1974, 1987) concluded that the Bee Low Limestones were deposited on a flat-topped carbonate shelf in water depths of metres, to tens of metres. The Miller's Dale area would have been located near the centre of the Derbyshire carbonate platform. Walkden (1977) shows that the Asbian/Brigantian boundary on the Derbyshire carbonate platform is represented by a palaeokarstic surface. Thus, the episode of calcretisation and karstic dissolution of the upper surface of the Bee Low Limestones may reflect a time when much of the Derbyshire carbonate platform was emergent.

An episode of tectonism was also associated with the Asbian/Brigantian boundary. This was expressed by the reactivation of structures underlying the Derbyshire carbonate platform (Gutteridge 1987, 1989). At this time development of precursors to the Longstone Edge Monocline to the north and the Taddington — Bakewell Anticline to the south resulted in the formation of an intra-shelf basin in which the Station Quarry Beds were deposited. This intra-shelf basin probably formed a

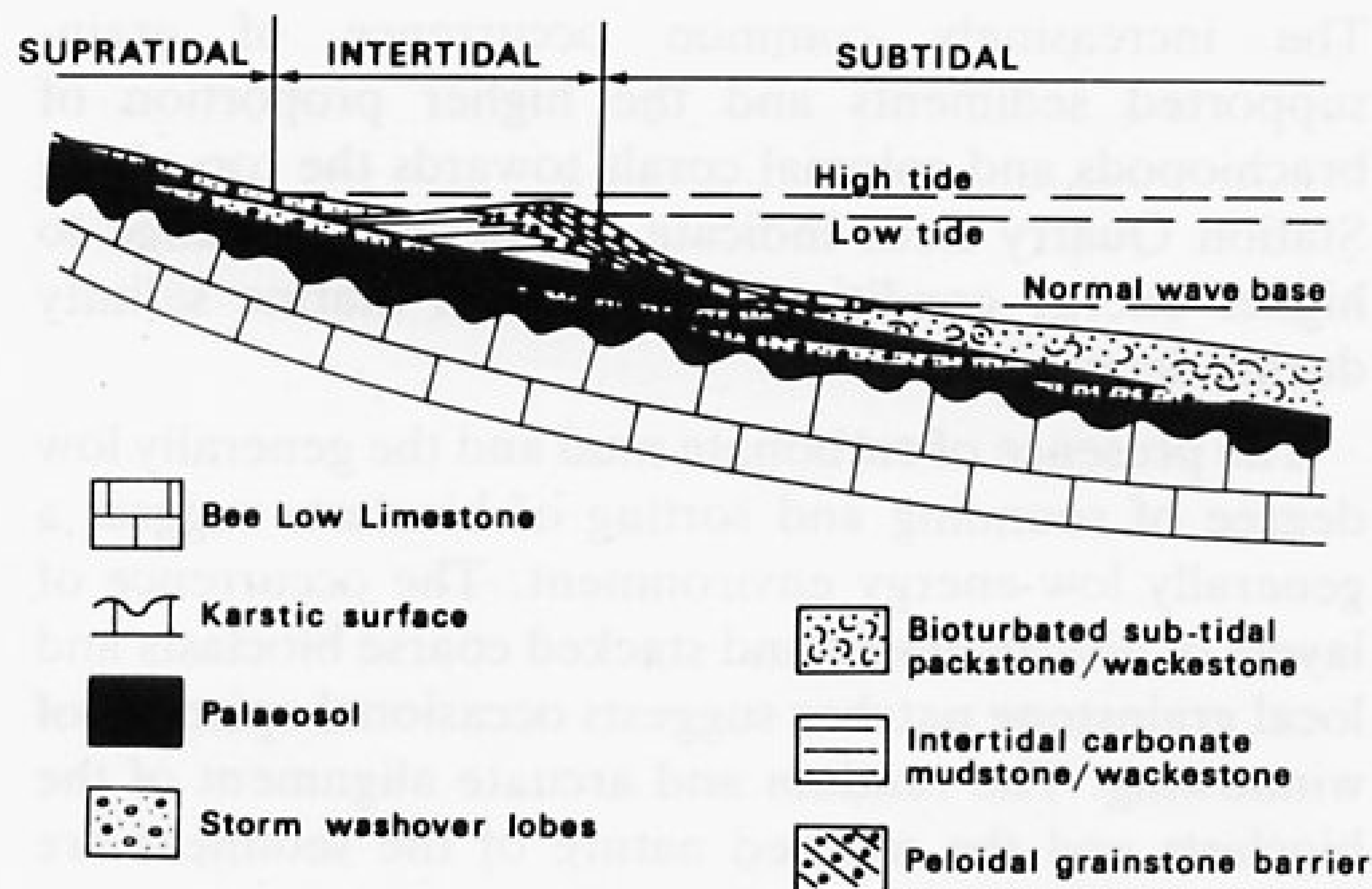


Fig. 4. Sedimentological model of the Station Quarry Beds transgression.

A barrier composed of peloidal grainstone separates a low energy subtidal area from an intertidal area. Storm washover lobes deposited in supratidal areas were derived by reworking of subtidal and barrier sediments. These lobes were later colonised by plants producing calcrete textures within the sediment. Intraclasts present in the washovers were derived from the subtidal and intertidal environments.

structurally controlled embayment within an initially emergent carbonate platform.

The initial flooding of this basin was marked by the deposition of storm washover lobes consisting of intertidal and subtidal sediment in supratidal areas. Any sedimentological model of the relative transgression must take account of the presence of reworked subtidal and shoreface sediments containing intraclasts of intertidal origin within these storm washover lobes. A possible model is presented in Figure 4, which shows a barrier shoreline, formed by wave-reworking of subtidal sediment, which sheltered a back-barrier intertidal area. This intertidal area fringed a karstified and calcretised supratidal area. Sediment reworked from subtidal and barrier sediments was deposited on the supratidal area as storm washover lobes. Intraclasts were reworked from adjacent subtidal and intertidal areas.

A similar interpretation was proposed by Riding & Wright (1981) to explain the occurrence of thin peritidal units within limestones deposited predominantly in open shelf environments within the Dinantian of South Wales. In this case, the karstified and calcretised surface of the Caswell Bay Oolite is overlain by the tidal flat and lagoonal facies of the Caswell Bay Mudstone which is separated from the overlying subtidal High Tor Limestone by a planar disconformity. They suggested that the peritidal facies of the Caswell Bay Mudstone was deposited behind a barrier (not preserved) which separated it from laterally equivalent subtidal facies represented by the High Tor Limestone. The postulated barrier was reworked during transgression of the open marine subtidal High Tor Limestone, producing the planar disconformity at the base of the High Tor

Limestone. In the case of the Station Quarry Beds, *in situ* intertidal sediments are not seen, their former presence being inferred from intraclasts. Peritidal and barrier facies may have been destroyed by a combination of reworking during the transgression and by bioturbation after subtidal conditions were established in the basin.

Relative sea level continued to rise resulting in the migration of facies belts up the depositional dip and onlap of the Taddington — Bakewell Anticline and the

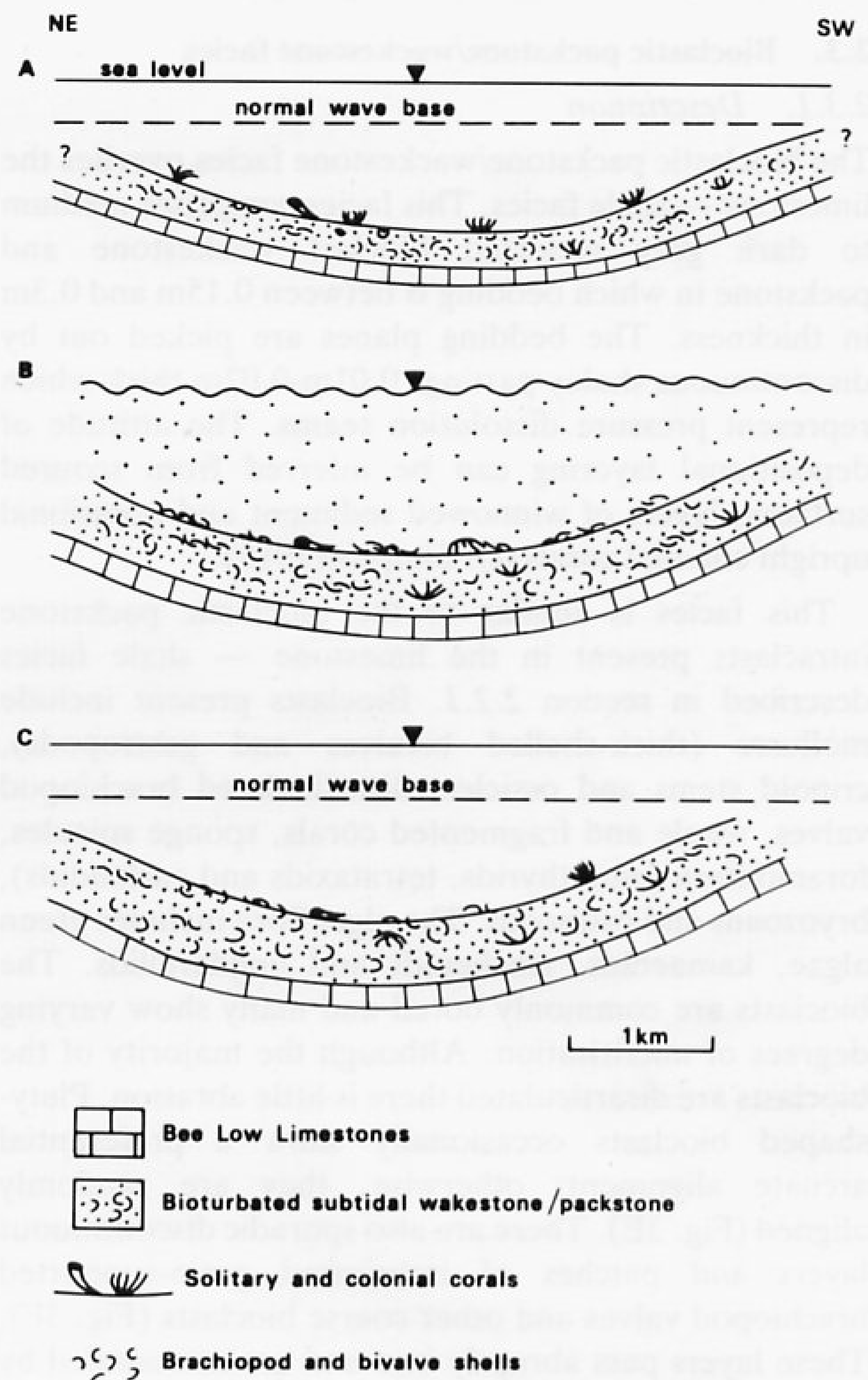


Fig. 5. Depositional environment of the Station Quarry Beds. The basin is formed by development of the precursor of the Longstone Edge Monocline to the NE and the Taddington — Bakewell anticline to the SE. The transgressive facies at the base of the Station Quarry Beds is not shown.

A) Quiet conditions with deposition below normal wave base. Bottom conditions are well oxygenated allowing intensive bioturbation of the sediment.

B) Storm reworking causes winnowing and suspension of fine-grained sediment producing lag deposits of coarse bioclastic sediment.

C) Return to quiet conditions: fine-grained sediment settles out of suspension and coarse bioclastic lag deposits are mixed with the sediment by bioturbation.

Longstone Edge Monocline. A sedimentological model for the deposition of the main part of the Station Quarry Beds is shown in Figure 5. This basin developed within a carbonate shelf and was thus surrounded by relatively shallow water. Frictional dampening of waves and currents over the surrounding shelf area would have produced an anomalously high wave base over the basin, resulting in sheltered conditions at relatively shallow depths. The generally low energy environment is more likely to have resulted from the structural setting of the basin rather than any great depth of deposition. The high degree of bioturbation within the Station Quarry Beds indicates a well-oxygenated environment and the diversity of bioclasts suggests deposition within a basin which was initially slightly hypersaline but later became fully marine. This implies that the basin in which the Station Quarry Beds were deposited was in communication with a body of well-oxygenated fully

marine water. If the basin was isolated more restricted conditions would have resulted. The connection to a more extensive body of marine water is inferred to have been eastwards to the Edale Basin. Direct evidence of this connection was removed during a phase of intra-Brigantian erosion caused by development of the Cressbrook Uplift (Walkden 1977).

The inferred palaeogeography of the Derbyshire carbonate platform during deposition of the Station Quarry Beds is summarised in Figure 6.

4. CONCLUSIONS

The Station Quarry Beds were deposited in a structurally controlled basin which developed in the emergent Derbyshire carbonate platform. The initial deposits of the Station Quarry Beds were storm washovers consisting of reworked subtidal and intertidal sediment deposited on supratidal areas. A relative sea-level rise flooded the basin, and subtidal, low energy sub-wave-base conditions, occasionally interrupted by storms, were established within the basin. The general low energy conditions were probably the result of the sheltered setting of the intrashelf basin. The near normal marine salinity and well-oxygenated conditions of deposition suggests that the intra-shelf basin was connected to a more extensive body of open marine water. Direct evidence for this connection was later removed by an episode of intra-Brigantian erosion. The Derbyshire carbonate platform was subsequently completely flooded by the transgression.

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References

- ADAMS, A. E. 1980. Calcrete profiles in the Eyam Limestones (Carboniferous) of Derbyshire: petrology and regional significance. *Sedimentology* 27, 651-660.
- ADAMS, A. E. & COSSEY, P. J. 1981. Calcrete development at the junction between the Martin Limestone and Red Hill Oolite (Lower Carboniferous) south Cumbria. *Proceedings of the Yorkshire Geological Society* 43, 411-431.
- AIGNER, T. 1985. *Storm depositional systems. Dynamic stratigraphy in modern and ancient shallow-marine sequences.* Lecture notes in Earth Sciences 3. 174pp. Springer-Verlag, Berlin.
- AITKENHEAD, N. & CHISHOLM, J. I. 1982. A standard nomenclature for the Dinantian formations of the Peak District of Staffordshire and Derbyshire. *Institute of Geological Sciences Report* 82/8.
- AITKENHEAD, N., CHISHOLM, J. I. & STEVENSON, I. P. 1985. *Geology of the country around Buxton, Matlock and Bakewell.* British Geological Survey Memoir, England and Wales, Sheet 111.
- BUTCHER, N. J. D. & FORD, T. D. 1973. The Carboniferous Limestone of Monsal Dale, Derbyshire. *Mercian Geologist* 4, 179-196.

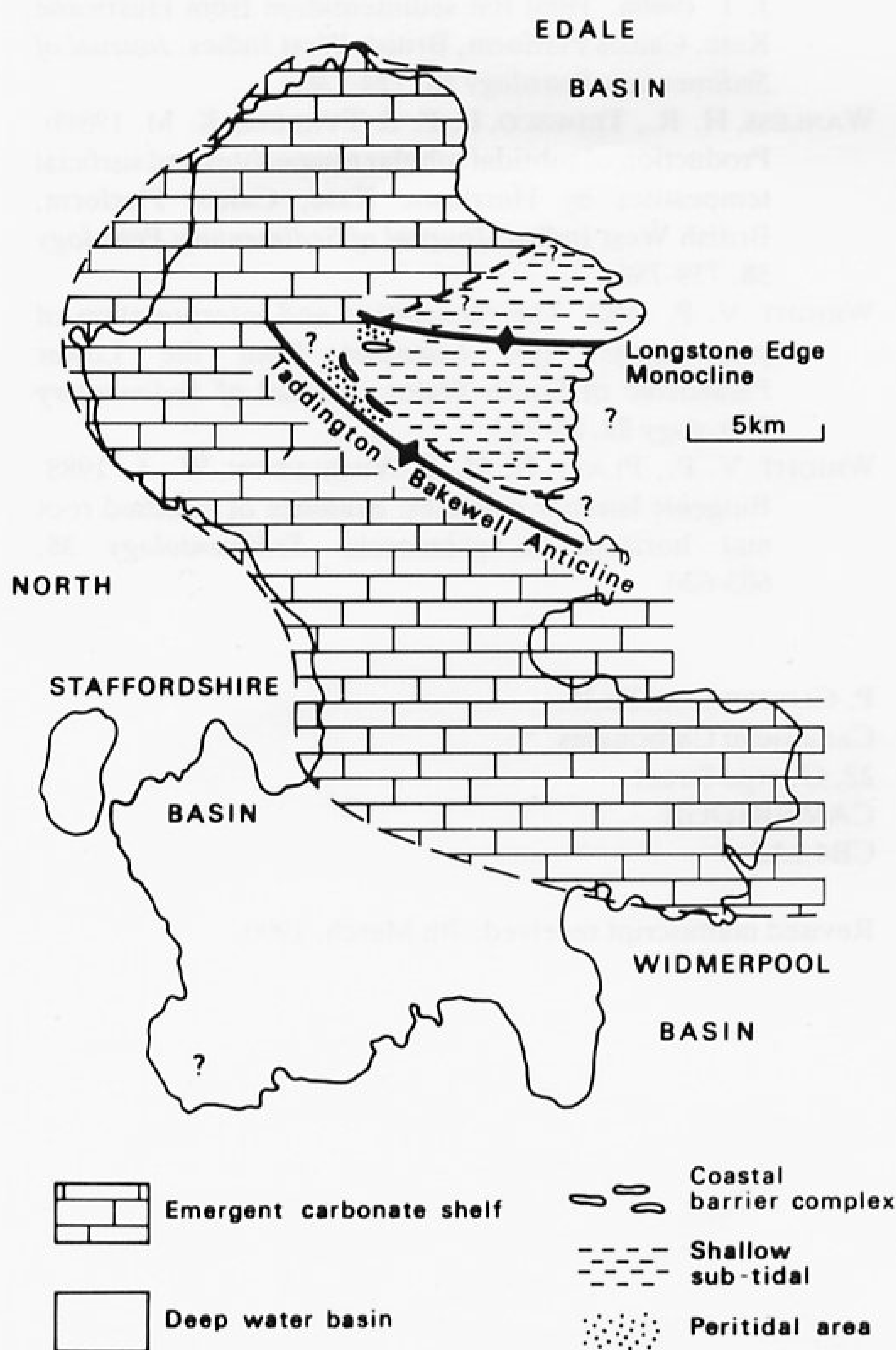


Fig. 6. Palaeogeography of the Derbyshire carbonate platform during deposition of the Station Quarry Beds. This shows the inferred palaeogeography during the early stages of the relative transgression when the intrashelf basin was partly flooded. Later, the Derbyshire carbonate platform was completely submerged.

- COPE, J. C. W. 1937. Some features of the D₁ — D₂ boundary of the Miller's Dale region, Derbyshire. *Proceedings of the Yorkshire Geological Society* **23**, 178-195.
- GROVER, G. & READ, J. F. 1978. Fenestral and associated vadose diagenetic fabrics of tidal flat carbonates, Middle Ordovician, New Market Limestone, Southwest Virginia. *Journal of Sedimentary Petrology* **48**, 453-473.
- GUTTERIDGE, P. 1987. Dinantian sedimentation and the basement structure of the Derbyshire Dome. *Geological Journal* **22**, 25-41.
- GUTTERIDGE, P. 1989. Controls on carbonate sedimentation in a Brigantian intrashelf basin, Derbyshire. Pp. 171-187 in ARTHURTON, R. S., GUTTERIDGE, P. & NOLAN, S. C. (editors). *The role of tectonics in Devonian and Carboniferous sedimentation in the British Isles*. Yorkshire Geological Society Occasional Publication 6.
- KLAPPA, C. F. 1979. Lichen stromatolites: criterion for subaerial exposure and a mechanism for the formation of laminar calcretes (caliche). *Journal of Sedimentary Petrology* **49**, 487-400.
- KLAPPA, C. F. 1980. Rhizoliths in terrestrial carbonates: classification, recognition, genesis and significance. *Sedimentology* **27**, 613-639.
- PAZDZIERSKI, G. 1982. *Facies variation in the Monsal Dale Limestones (Brigantian D₂) in the Monsal Dale area, Derbyshire, England*. Unpublished Ph.D. thesis, University of Sheffield.
- RIDING, R. & WRIGHT, V. P. 1981. Palaeosols and tidal-flat/lagoonal sequences on a Carboniferous carbonate shelf: Sedimentary associations of triple disconformities. *Journal of Sedimentary Petrology* **51**, 1323-1339.
- SHINN, E. A. 1983. Tidal flat environment. Pp. 171-211 in SCHOLLE, P. A., BEBOUT, D. G. & MOORE, C. H. (editors) *Carbonate depositional environments*. American Association of Petroleum Geologists Memoir **33**.
- SIMPSON, J. 1985. Stylolite-controlled layering in an homogeneous limestone: pseudo-bedding produced by burial diagenesis. *Sedimentology* **32**, 495-505.
- STEVENSON, I. P. & GAUNT, G. D. 1971. *Geology of the country around Chapel en le Frith*. Geological Survey of Great Britain Memoir, England and Wales, Sheet 99.
- STRANK, A. R. E. 1985. The Dinantian stratigraphy of a deep borehole near Eyam, Derbyshire. *Geological Journal* **20**, 227-237.
- WALKDEN, G. M. 1972. The mineralogy and origin of interbedded clay wayboards in the Lower Carboniferous of the Derbyshire Dome. *Geological Journal* **8**, 143-159.
- WALKDEN, G. M. 1974. Palaeokarstic surfaces in the Upper Viséan (Carboniferous) limestones of the Derbyshire Block, England. *Journal of Sedimentary Petrology* **44**, 1232-1247.
- WALKDEN, G. M. 1977. Volcanic and erosive events on the Upper Viséan carbonate platform, north Derbyshire. *Proceedings of the Yorkshire Geological Society* **41**, 347-366.
- WALKDEN, G. M. 1987. Sedimentary and diagenetic styles in late Dinantian carbonates of Britain. Pp. 131-155 in MILLER, J., ADAMS, A. E. & WRIGHT, V. P. (editors) *European Dinantian Environments*. Geological Journal Special Issue **12**.
- WANLESS, H. R., TYRRELL, K. M., TEDESCO, L. P. & DRAVIS, J. J. 1988a. Tidal flat sedimentation from Hurricane Kate, Caicos Platform, British West Indies. *Journal of Sedimentary Petrology* **58**, 724-738.
- WANLESS, H. R., TEDESCO, L. P. & TYRRELL, K. M. 1988b. Production of subtidal tubular tempestites and surficial tempestites by Hurricane Kate, Caicos Platform, British West Indies. *Journal of Sedimentary Petrology* **58**, 739-750.
- WRIGHT, V. P. 1982. The recognition and interpretation of palaeokarsts: two examples from the Lower Palaeozoic of South Wales. *Journal of Sedimentary Petrology* **52**, 83-94.
- WRIGHT, V. P., PLATT, N. H. & WIMBLEDON, W. A. 1988. Biogenic laminar calcretes: evidence of calcified root mat horizons in palaeosols. *Sedimentology* **35**, 603-620.

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