Greylake (No. 2 Quarry)

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Highlights

This classic locality is the type-site for the Burtle Formation — a complex of shallow marine shelly sands, gravels and clays probably dating from more than one interglacial. The old Greylake No. 2 Quarry is the best known and most studied Burtle Beds locality, and has yielded rich fossil mollusc, foraminifer and ostracod assemblages as well as mammal bones. At least two phases of interglacial marine sedimentation can be demonstrated, with the marine beds separated by a well-developed calcreted palaeosol. The site may mark the southernmost limit of the Kenn glaciation in Somerset.

Introduction

The name 'Burtle Beds' was coined by Buckland and Conybeare (1824) for shelly sands and sandy gravels which form 'batches' — the local name for areas raised above the alluvial deposits of the Somerset Levels (Figure 9.3). They described the distribution of the shelly sands around King's Sedgemoor and suggested a littoral marine origin. Later, in a number of rather inexact reports (e.g. Poole, 1864), shelly sands were described from the lower part of the Parrett Valley but no precise locality details were given. Ussher (*in* Woodward, 1876) noted shelly marine sand at a number of localities near Middlezoy and Westonzoyland. The presence of marine sand in the Greylake pits was first noted by Ussher (1914), but detailed description of the site awaited the work of Bulleid and Jackson (1937), who described shelly sands and gravels from the uppermost 5 m of the sequence, down to the water-table. They listed a fossil mammal fauna of *Dama* cf. *dama, Cervus elaphus* Linné and *Bos primigenius* Bojanus and a diverse marine mollusc fauna. Two valves of *Corbicula fluminalis* (Müller), a freshwater bivalve now extinct in Europe, were found in the marine deposits.

In the early 1970s, Kellaway and his co-workers (Kellaway, 1971; Kellaway *et al.,* 1975) suggested that the Burtle Beds were outwash deposits associated with a glacial incursion into southern England. Kidson and colleagues reinvestigated the Burtle Beds and vigorously restated their marine interglacial origin (Kidson and Haynes, 1972; Kidson *et al.,* 1974; Kidson and Heyworth, 1976; Kidson, 1977; Kidson *et al.,* 1978; Hughes, 1980). Kidson *et al.* (1978) gave a definitive description of the beds visible in Greylake No. 2 Quarry in the mid-1970s (Figure 9.4). These workers conducted an intensive investigation of the stratigraphy, sedimentology, molluscs, foraminifers, ostracods, plant macrofossils and pollen. They demonstrated a sequence of basal non-marine deposits overlain by a silt–clay intertidal mudflat unit in turn overlain by the marine Burtle sands and gravels, and interpreted the evidence as showing the progress of a marine transgression to a mean sea level about 12 m higher than today's.

Amino-acid racemization ratios derived from *P. vulgata* and *Macoma balthica* (Linné) from Greylake No. 2 Quarry were given by Andrews *et al.* (1979), who assigned the site to their amino-acid Group 2, which they regarded as of last interglacial age. More recently, Hunt *et al.* (1984) obtained ratios on *Corbicula* from Greylake No. 1 Quarry, less than 400 m from this site. These ratios, in the light of subsequent research, suggest that these shells, and thus probably the deposits at Greylake No. 1 Quarry, date from Oxygen Isotope Stages 9 and 7, whereas at least part of the sequence at Greylake No. 2 Quarry is more recent, dating from Stage 5e.

During reinvestigation of the site for the GCR, a series of boreholes was drilled to the west of the old quarry. These proved a sequence of fine silts overlying shelly sands and then a strongly calcreted gravelly palaeosol overlying further marine sands.

Recently, Campbell *et al.* (in prep.) classified the lower sands as the Greylake Member of the Burtle Formation, and correlated them with Oxygen Isotope Stage 7; the upper marine sand unit is termed the Middlezoy Member and is correlated with Stage 5e.

Description

The deposits at Greylake No. 2 Quarry [ST 385 336] extend to around 9 m OD and thus stand 2–3 m above the local Holocene deposits. The sequence in the old quarry (following Bulleid and Jackson (1937) and Kidson *et al.* (1978)), and confirmed by the GCR boreholes to the west, can be summarized thus (maximum bed thicknesses in parentheses):

16. Olive-grey silts, containing freshwater molluscs and large specimens of *Cepaea* and other land snails, on which is developed a modern soil profile. (1.4 m)

15. Reddish-brown sandy silts on which is developed a modern soil profile. Bed 15 passes gradually into bed 14. (1.0 m)

14. Pale yellow-brown fine-medium sand, cross-bedded, with heavily but irregularly carbonate-cemented horizons, and sometimes weathered and reddened towards the top. Contains occasional to abundant shells of *M. balthica* and *Hydrobia* spp. (2.0 m)

13b. Pale yellow-brown, sandy shelly gravel with abundant *H. ulvae,* some *Hydrobia ventrosa* (Montagu) and a few *Phytia myosotis* (Draparnaud), *Littorina* spp., *M. edulis, O. edulis, Retusa* sp. and *Patella* sp. *C. fluminalis* and bones of *B. primigenius, Dama* cf. *dama* and *C. elaphus* were reported from this horizon by Bulleid and Jackson (1937). This bed may pass laterally into bed 13a. (0.3 m)

13a. Strong brown, mottled dark red, very stony clay passing down into a coarse sandy gravel strongly cemented with pedogenic calcium carbonate (a plugged calcrete horizon). (0.3 m)

12. Pale yellow fine sand, plane-bedded, with *Hydrobia ?ulvae.* (0.4 m)

11. Pale yellow-brown gravel with rare *M. balthica, C. edule, M. edulis, Littorina neritoides* (LAnne), *Helicella itala* (Linné), *Acroloxus lacustris* (Linné) and *Armiger crista* (Linné). (0.1 m)

10. Pale yellow fine sand, plane-bedded, with *H. ulvae,* some *H. ventrosa, M. balthica, Littorina* spp. and *Patella* sp. (0.9 m)

9. Blue-grey clay with sedge and grass stems in growth position, seeds of Chenopodiaceae

and one seed of *Betula pendula,* and abundant *H. ulvae* and *H. ventrosa.* Foraminifer and ostracod biocoenoses suggestive of estuarine mudflats are present. (0.4 m)

8. Blue-grey, silty fine sand with a few *H. ulvae* and *H. ventrosa.* The foraminifers and ostracods are consistent with deposition on estuarine mudflats, with some inwashed outer estuarine and marine taxa. (0.4 m)

7. Blue-grey clay with sedge and grass stems in growth position, seeds of Chenopodiaceae, and extremely abundant *H. ventrosa,* very abundant *H. ulvae,* rare *P. myosotis* and *Cerastoderma* sp. Foraminifer and ostracod biocoenoses suggestive of estuarine mudflats are present. (0.1 m)

6. Blue-grey, silty fine sand with abundant *H. ventrosa* and some *H. ulvae.* The foraminifers and ostracods are consistent with deposition on estuarine mudflats, with some inwashed outer estuarine and marine taxa. (0.6 m)

5. Blue-grey silt with very abundant *H. ventrosa,* abundant *H. ulvae,* rare *Lymnaea peregra* (Müller), a planorbid and foraminifers and ostracods consistent with deposition on estuarine mudflats, with some inwashed outer estuarine and marine taxa. (0.5 m)

4. Grey-brown silt passing downwards into fine sandy silt, with wood fragments, probably roots, replaced by iron oxides. (0.6 m)

3. Grey-brown gravel with frost-cracked pebbles. (0.3 m)

2. Grey-brown sandy clay. (0.2 m)

1. Grey-brown diamicton with a clayey matrix. Clasts include chalk and frost-cracked pebbles. (> 0.4 m, base unseen)

The upper part of the sequence described here is very similar to the descriptions and photograph of Greylake No. 1 Quarry given by Bulleid and Jackson (1937). Of particular interest is their description of 'earthy gravel' (beds 13a and 13b above, and their units iii and vi at Greylake No. 1 Quarry). Their plate XXVII shows the 'earthy gravel' as irregular weathering horizons cutting across the marine beds. Bed 11 or 13 seems to have been associated with a sandy channel fill from which M.P. Kerney recovered large amounts of freshwater mollusc remains (Gilbertson, 1984).

Interpretation

At least six major sedimentary units are present at Greylake No. 2 Quarry. The interpretation of several of these units is equivocal, with the present state of knowledge, and there is considerable scope for further research. The oldest unit is most proba bly beds 1–4 in the old quarry, which are deposits of fluvial, periglacial or possibly glacial origin capped by what is probably a palaeosol which contains evidence of forest growth. The presence of a chalk clast within the basal diamict is possibly suggestive of glacial transport, since chalk clasts were quickly lost downstream from the Chalk outcrop in southernmost Somerset as the result of normal cold-stage and warm-stage fluvial transport (Hunt, 1987). If this is the case, then Greylake is the southernmost locality in Somerset where glacigenic deposits, most probably referrable to the Kenn Formation, have been identified.

The second unit at Greylake No. 2 Quarry is the body of silts, clays, fine silty sands, fine gravels and shelly sands (beds 5–12). Beds 5–9 contain molluscs, ostracods, foraminifers and plant macrofossils all of which indicate deposition on estuarine tidal mudflats and among reed communities near High Water Spring Tides with salinity values around 15%0. Sedimentation appears to have kept abreast of sea-level rise during deposition of these beds (Kidson *et al.,* 1978). The fine sands of beds 10 and 12 are dominated by the molluscs *H. ulvae* and *M. balthica* and were therefore most probably laid down below Mean High Water Neaps (Kidson *et al.,* 1978) and quite probably near the low tide mark (Hughes, 1980). The ostracod assemblages are a thanatocoenosis with a good proportion of fully marine species, but the foraminifera are consistent with deposition in shifting sand shoals near or below low tide mark (Kidson *et al.,* 1978). The gravel (bed 11) interbedded with these sands includes the freshwater taxa *A. lacustris* and *A. crista,* and also *H. itala,* which is a sand dune species in this country. Kidson *et al.* (1978) suggest that this assemblage is consistent with deposition in the vicinity of a small stream passing through sand dunes at the back of a beach. The channel itself may have been visible in the mid 1970s but was never adequately recorded. This unit is capped by the cemented palaeosol (bed 13a), which is regarded as partially reworked by tidal action in the area documented by Kidson *et al.* (1978). Here, it is listed above as bed 13b. The deposits of beds 5–12, the Greylake Member, can probably be referred to Oxygen Isotope Stage 7 (Campbell *et al.,* in prep.).

In this account, it is assumed that the marine sequence recorded in the old quarry reflects more than one marine transgressive cycle, contrary to the interpretation of Kidson *et al.* (1978). The third unit comprises the classic Burtle sands and gravels of the Middlezoy Member. The basal bed (13b) is a lag deposit containing fossil molluscs, such as *C. fluminalis,* recycled from the Greylake Member. The mammal bones from this horizon — *C. elaphus, B. primigenius* and *Dama* cf. *dama* — are a warm-stage assemblage, but not ecologically very specific. The sands and gravels above this level contain mollusc, foraminifer and ostracod assemblages.

These and the mollusc assemblage in bed 13b are all consistent with deposition around Low Water Neap Tides. Kidson *et al.* (1978) computed a Mean Sea Level 12 m above the modern MSL and a high tide level of around 18 m OD for the peak of the marine incursion, which is equated here with Oxygen Isotope Stage 5e.

The fourth unit comprises the sandy silts and soil profile capping the quarry section (bed 15). Reddish sandy silts and silty sands are widespread around the Severn Estuary and seem to have been laid down as coversands during one or more of the cold stages (Gilbertson and Hawkins, 1978a).

The final unit is the olive silts (bed 16). The presence of thermophilous land snails like *Cepaea* suggests a Holocene age. It is suggested that these deposits occur as a veneer of overbank sediments which resulted from flooding in the Sedgemoor Levels.

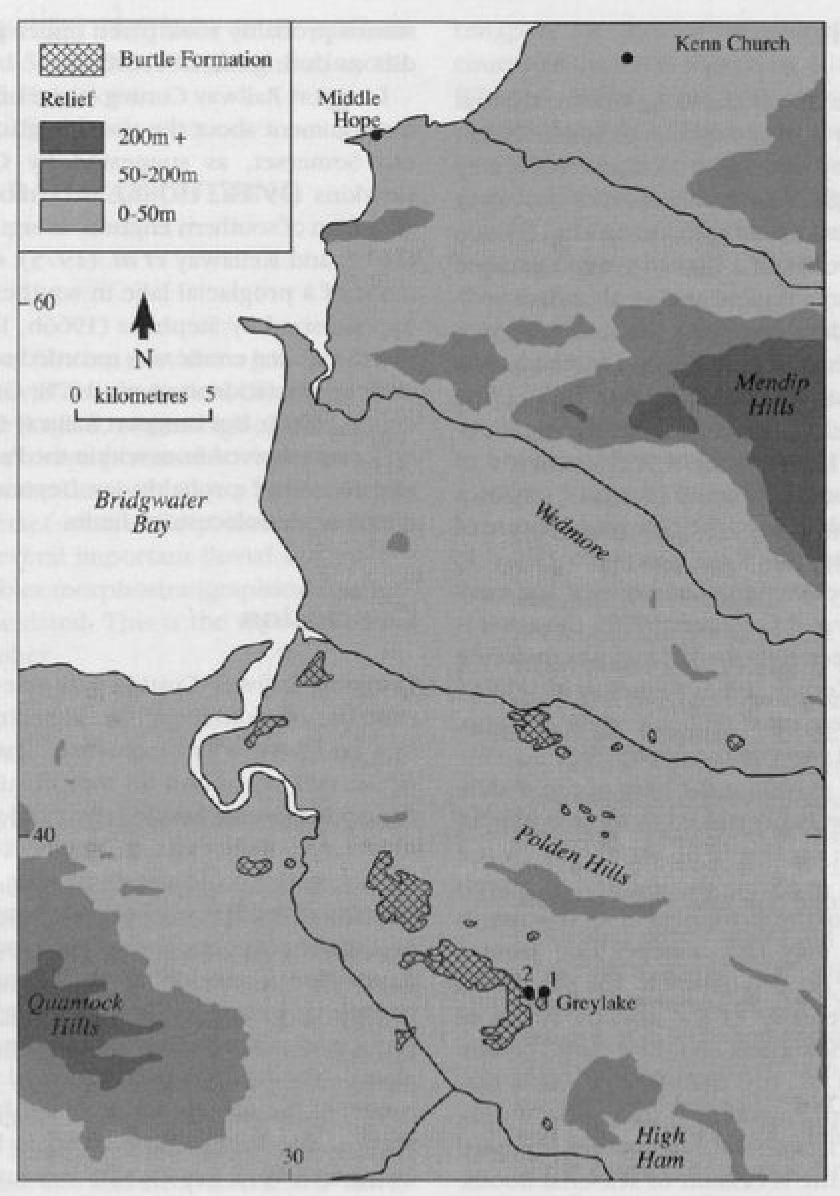
Amino-acid racemization ratios derived from *P. vulgata* and *M. balthica* from the old quarry at this site were given by Andrews *et al.* (1979), who assigned the site to their amino-acid Group 2. The ratios were closely comparable with amino-acid ratios associated with a U/Th date of 121 ka + 14/– 12 ka BP from Belle Hougue Cave, Jersey (Keen *et al.,* 1981) and similar ratios and dates from the Gower coastal caves (Bowen *et al.,* 1985; Sutcliffe *et al.,* 1987). This correlation implies that the Middlezoy Member at Greylake No. 2 Quarry was laid down by the Oxygen Isotope Stage 5e marine transgression. A considerable scatter was evident in their data, however, with some ratios being 'old' enough to imply correlation with Stage 7. Unfortunately, the precise stratigraphic context of these shells was not recorded.

The strong palaeosol developed on the Greylake Member at Greylake No. 2 Quarry, together with limited aminostratigraphic evidence from Greylake No. 1 Quarry, suggest that the Greylake Member is considerably older than Stage 5 (Hunt *et al.,* 1984; Hunt, 1990a) since one ratio on *C. fluminalis* from Greylake No. 1 Quarry is consistent with an age equivalent to Oxygen Isotope Stage 7 and another with a yet older stage. (*C. fluminalis* is not known to occur in deposits of Stage 5e age in Britain (Keen, 1990; Bridgland, 1994).) The Greylake No. 2 Quarry is thus of considerable importance as a well-dated example of sedimentation by the Stage 5e transgression overlying an older transgressive unit.

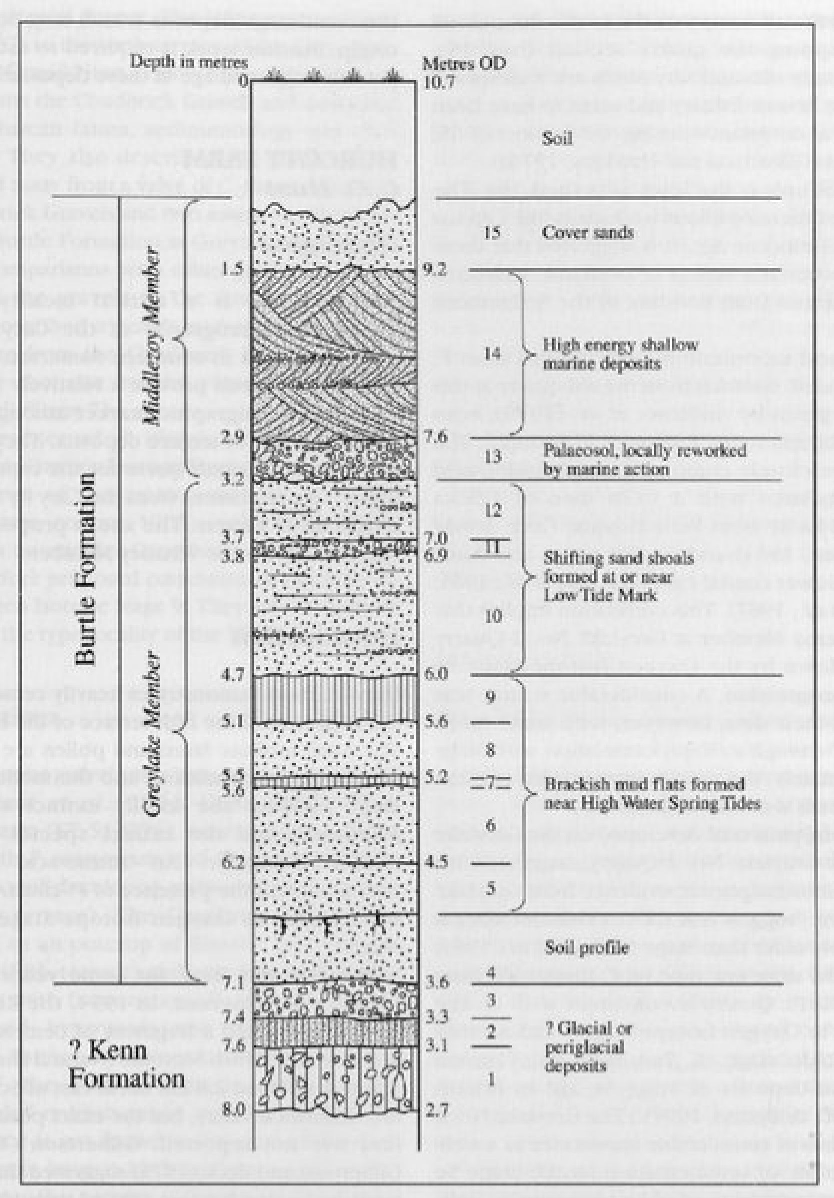
Conclusion

Greylake No. 2 Quarry is important because it provides a well-dated, very fossiliferous sequence laid down during the Oxygen Isotope Stage 5e marine transgression. These deposits contain a classic interglacial estuarine fauna and microfauna. The interglacial deposits overlie a palaeosol and a second, older, interglacial marine sand unit and then cold-stage deposits which may be of glacial origin. Further work is required to establish the precise origin and age of these deposits.

References



(Figure 9.3) The Burtle Formation of the Somerset lowland. (Adapted from Kidson et al., 1978 and Hunt, 1987.)



(Figure 9.4) An interpretation of the Quaternary sequence at Greylake No. 2 Quarry, adapted from Hughes (1980). Beds 1–15 are described in more detail in the text.