Bawdsey Cliff, Suffolk

[TM 345 385]–[TM 350 390]

Highlights

The natural coastal cliff section at Bawdsey is the largest and most spectacular section of the Red Crag presently exposed. It is of great importance in the history of Crag research being one of the first recorded localities (Dale, 1704). The section provides one of the best exposures of large-scale cross-bedded shell sands with many sedimentary features indicative of deposition by tidal currents. The shelly fauna is abundant and well-preserved. This is one of the few localities where the basal contact of the Red Crag with the London Clay can be studied and where 'boxstones' have been found in the basal conglomeratic lag deposit.

Introduction

This cliff section (Figure 11.7) and (Figure 11.8) lies on the North Sea coast approximately 1.5 km north of the mouth of the estuary of the River Deben. The section shows features attributed to high-energy subtidal bedforms from the lower part of the Red Crag succession and is the most extensive exposure (*c.* 500 m long) of Red Crag sediments exposed at the present time. Access to the site is along a coastal path on the seaward side of Bawdsey Manor from the quay. The cliff is unstable and subject to continued retreat.

Since 1704 when the presence of Crag at this location was first recorded (Dale, 1704) the section has been visited and described by many Crag workers and yielded many fossils to collectors.

Description

The extent of the Red Crag exposure at this locality has been very variable over the years, dependent largely on the rate of natural erosion along this undefended stretch of coastline. At the present time about 5 m of Red Crag are exposed (Figure 11.8) and there are small exposures, mostly at the northern end of the section, where the basal contact of the Red Crag with the London Clay is intermittently exposed about 5 m above the level of the beach shingle. The maximum thickness of Red Crag here probably exceeds 7 m.

The erosional contact between the London Clay Formation and overlying Red Crag is locally marked by a discontinuous lag deposit consisting of flint, phosphorite and quartz pebbles. This bed has apparently been better exposed in the past (e.g. Ovey and Pitcher, 1948). This lag deposit is immediately overlain by sediments containing layers of interlaminated mud and fine sand interbedded with shelly sands showing small-scale cross-bedding (unit 1). This is succeeded by a single large planar cross-set of shelly Red Crag (unit 2) which forms the bulk of the exposure in the cliffs (Figure 11.9).

At the southern end of the cliff section, the coarse cross-bedded shell sands of unit 2 rest upon a 25 cm thick bed of mud with thin continuous partings of very fine sand with subordinate silt. Below the muds are shelly cross-bedded sands. Foreset dip directions are west-south-west to west and thus opposed in direction to the laminae of unit 2 which are towards the north-north-east to north-east.

The foreset beds of unit 2 comprise alternating shell-rich medium- and coarse-grained and shell-depleted finer sand layers (Figure 11.10); mud drapes are absent. The shelly layers vary in thickness from1–2 cm to approximately 50 cm and locally show inverse grading. Shell imbrication is particularly well shown. Bottomset beds tend to be finer grained and the shells more fragmented. Small-scale cross-bedding in a direction opposed to the main foreset direction is common in these bottomset beds. This lamination is intimately intercalated with thin avalanche beds that continue down from the foresets.

The dominant sand transport direction implied from the foreset dips to the north-northeast is diametrically opposed to the main dip direction measured at inland exposures, the nearest of which is only 4 km to the north (Buckanay Farm, Alderton). This may be the result of mutually evasive ebb-flood pathways if the tidal currents were channelized as commonly occurs in an estuary (Nio *et al.,* 1980). Measurements of the slope-directed cross-lamination in the Red Crag indicate bedform migration in a west-north-west direction, i.e. diagonally across the bottomsets and basal foresets. The Red Crag bedforms probably formed and migrated subtidally within large embayments, possibly a large tidal inlet.

Shells are abundant in unit 2 but include a high proportion of abraded and fragmentary specimens. Nevertheless collectors have identified many species of mollusc from this locality. As early as 1827, Taylor described '*Murex reversus*' (=*Neptunea contraria*) and '*Pectunculus*' (=*Glycymeris*) as the commonest species. A faunal list is given by Prestwich (1871b). Boswell (1928) lists *Serripes groenlandicus, Arctica islandica, Spisula constricta, S. solida* var. *ovalis, Mya arenaria, M. truncata, Mytilus edulis, Macoma calcarea* var. *obliqua* and *M. praetenuis* as the most abundant bivalves.

Further evidence of the tidal nature of the environment comes from small exposures near the northern end of the section where the London Clay is seen to be overlain by cross-bedded sediments with conspicuous alternations of fine- and coarse-grained sand foresets with occasional thin mud drapes (Figure 11.11). These alternations are probably the result of tidal current variations and therefore reflect tidal rhythms. The foresets dip to the west-south-west. The Red Crag sediments just above the London Clay surface contain numerous small, well-rounded phosphatic pebbles. The cross-bedded unit is overlain by a package of horizontally bedded silt drapes separated by thin lami nae of fine sand (Figure 11.11) similar, and probably equivalent to, the laminated muds of Unit 1 at the southern end of the section.

Interpretation and evaluation

Bawdsey Cliff represents the largest and one of the most spectacular Red Crag exposures. Although not as renowned as other localities (e.g. Walton-on-the-Naze) as a fossil collecting locality, it is an excellent site for the study of sedimentary structures in a tide-dominated shallow marine environment. The thickness of the single cross-bedded set of unit 2 exceeds 5 m and is probably the largest of any exposed in the Red Crag. This indicates a bedform in excess of 5 m high and implies a more offshore location than for other Red Crag exposures. The large foresets dip to the north-north-east which is in an opposing direction to the regional direction implied by measurements in the lower part of the section at Bawdsey Cliff and at other localities. The section at Bawdsey Cliff is therefore important in the determination of the palaeotidal regime during Red Crag times.

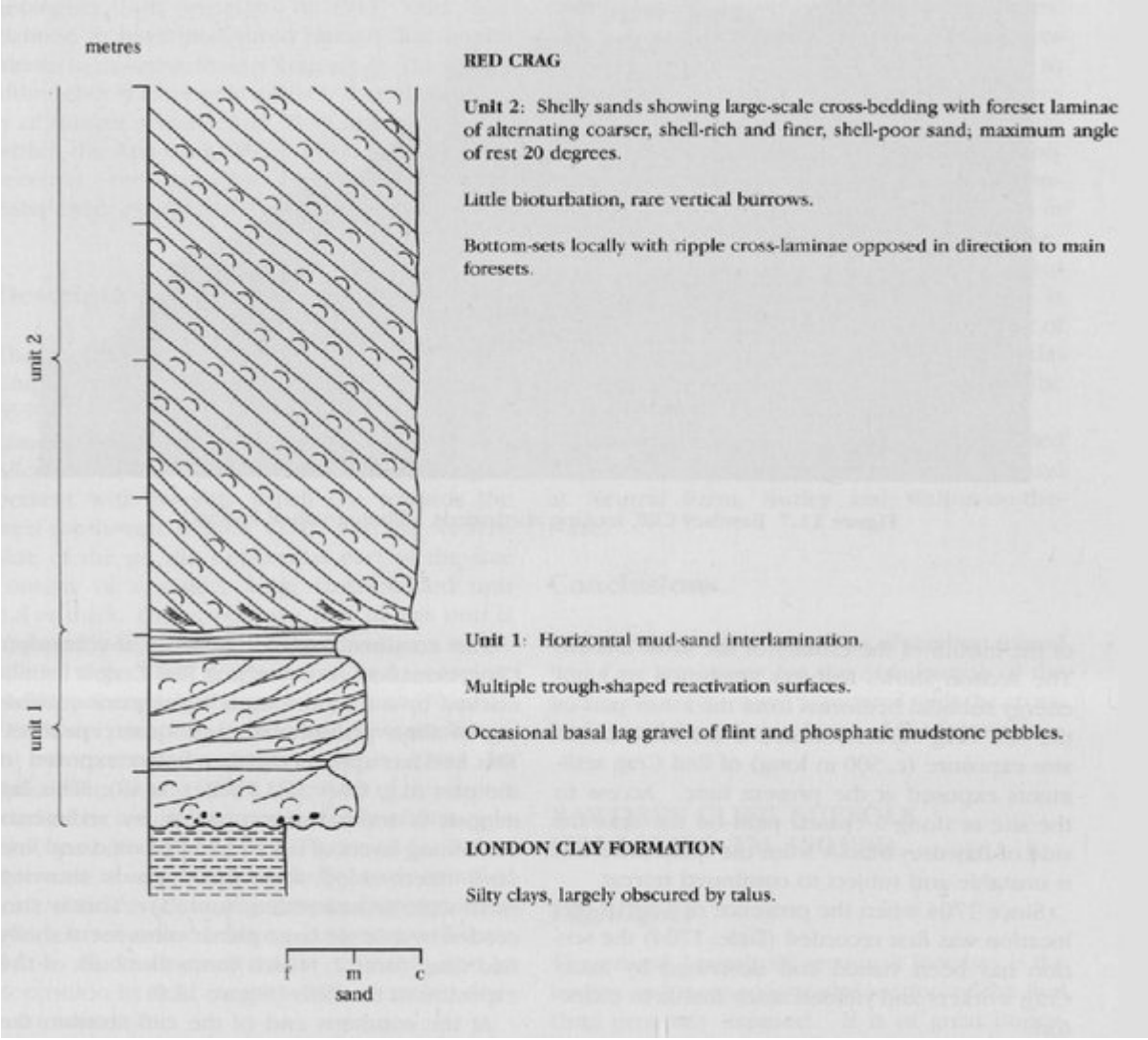
The section at Bawdsey Cliff also represents one of the few sites where the basal contact with the London Clay can be examined (also at Walton-on-the-Naze and, by excavation, at Rockhall Wood).

Conclusions

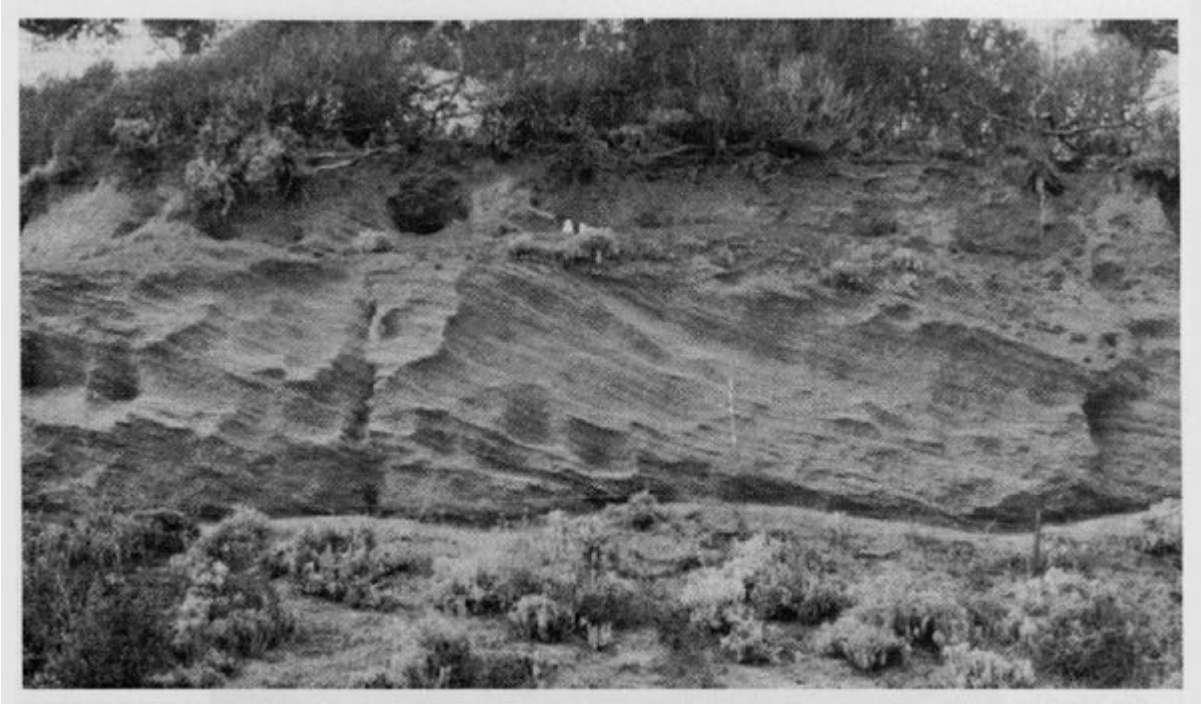
The Bawdsey Cliff section is the largest section of Red Crag presently exposed. It is of great sedimentological importance to the study of the internal structure of tide-dominated marine sandwave deposits in the Red Crag.

References

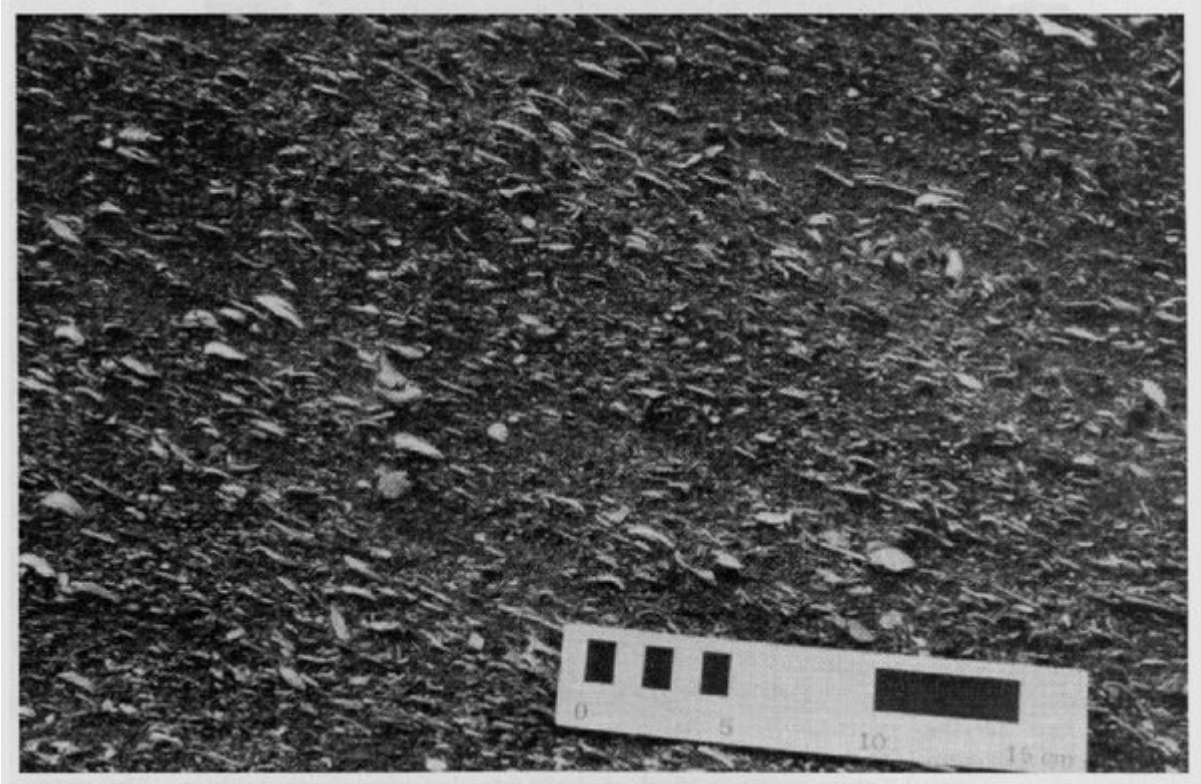
(Figure 11.7) Bawdsey Cliff, looking northwards. (Photograph: P Balson.)



(Figure 11.8) Composite summary log for Bawdsey Cliff. Metre scale approximate; f = fine, m = medium, c = coarse. (After Balson et al., 1991.)



(Figure 11.9) Large-scale cross-bedding in unit 2 at Bawdsey Cliff. Scale is 1 m long. (Photograph: P Balson.)



(Figure 11.10) Cross-bedded shelly sediments of unit 2 at Bawdsey Cliff (Photograph: P Balson.)

(Figure 11.11) Red Crag overlying London Clay (the contact is arrowed) in an exposure at the north end of the section. Alternating sandy and silty foresets represent tidal cycles. Scale is 1 m long. (Photograph: P Balson).