Furley Chalk Pit, Membury, south-east Devon

[ST 276 043]

Introduction

Furley Chalk Pit is one of ten or more chalk pits in the Membury outlier (Figure 3.30), and the only one that has been exposed in recent years. Even at the time of the late 19th century geological survey of the area all but the Furley Chalk Pit were overgrown. Furley Chalk Pit, strictly speaking 'the pit adjacent to the Membury to Furley road' but within Membury Parish, was being worked for lime when visited by Jukes-Browne and Hill (1903). It was still in work in 1955 (Smith, 1957b), but has not been in use for about 40 years. The workings extend over an area of about 3 hectares for about 200 m along a low Chalk escarpment. Their maximum depth was about 15 m, but all except for a small area exposing 7 m of chalk in the highest (eastern) face has now been backfilled. The pit has provided the only information on the Upper Cretaceous (Cenomanian–Lower Turonian) deposits and their relationship to the underlying Lower Cretaceous (Albian) Upper Greensand in the fault-bounded Membury outlier (Figure 3.31). As elsewhere in the region, the Cenomanian deposits are highly condensed and richly fossiliferous, with several different reworked faunas. The stratigraphy differs in detail from that of the other Upper Cretaceous outliers. The overlying Turonian Holywell Nodular Chalk Formation succession is lithologically different from that of the nearest coastal sections and the successions in the Wilmington and Chard outliers. The individual character of the Furley succession testifies to the continuing influence of nearby deep-seated faults throughout the Cenomanian and Turonian ages.

Description

Descriptions of the section were given by Jukes-Browne and Hill (1903), Smith (1957b), and Smith and Drummond (1962). The lithostratigraphy and ammonite biostratigraphy were described by Kennedy (1970) and Wright and Kennedy (1984), and details of the foraminiferal biostratigraphy were given by Hart (1975, fig. 2). This latter paper includes some lithostratigraphical details of beds in the higher part of the succession that are missing from Kennedy's section. Wright and Kennedy (1984) commented that it was inappropriate to apply the term 'Chalk Basement Bed' to the complex conglomerate that overlies the Upper Greensand. Hart (1991) identified a calcisphere bio-event, which he used to establish a correlation with the lower part of the Chalk succession at Hooken Cliff. Jukes-Browne and Hill (1903) recorded small scrapes of gritty and nodular chalks (Melbourn Rock?) in several pits in Membury village and concluded that, in contrast to the successions in the surrounding areas, much of the Cenomanian strata were in Lower Chalk facies. Despite the absence of faunal confirmation of this observation, the Membury outlier has been commonly quoted as an abnormal local development of Lower Chalk, and the most westerly in England.

Lithostratigraphy

Smith (1957b) recorded that the pit was floored by hard calcareous grit at the top of the Upper Greensand. The junction with an overlying pebbly 'Basement Bed' and glauconitic chalk was exposed in an excavation. Smith and Drummond (1962) and Kennedy (1970) also described these basal beds. The section summarized in (Figure 3.31) is based on the references cited above, with some additional observations.

The Upper Greensand is succeeded by a 0.3 m complex conglomerate, which has been termed the 'Chalk Basement Bed', although Wright *et al.,* (1984, p. 14) regarded the use of this term (e.g. by Kennedy, 1970) as inappropriate. However, they were prepared to apply this term to the similar bed at Snowdon Hill Quarry (see GCR site report, this volume), presumably on the basis that the clasts there are incorporated in a soft glauconitic chalk matrix. The conglomerate terminates in a hardground penetrated by a *Thalassinoides* burrow system.

Biostratigraphy

Several different derived faunas can be recognized in the complex conglomeratic 'Basement Bed'. Weakly phosphatized pebbles of sandy limestone at the base contain glauconitized Lower Cenomanian ammonites, including *Hyphoplites curvatus arausionensis* (Hebert and Munier-Chalmas), *Hypoturrilites gravesianus* (d'Orbigny), *Mantelliceras* spp. and *Schloenbachia varians (*J. Sowerby). Kennedy (1970) correlated this fauna with the *Mantelliceras saxbii* assemblage' of Bed A2 of the Cenomanian Limestone (Figure 3.4) and (Figure 3.21) and indicated that elements of the *Mantelliceras* gr. *dixoni* assemblage' (i.e. *dixoni* Zone) were absent. The absence of heteromorph ammonites from the list preclude correlation with the *carcitanense* Subzone Wilmington Sand Basement Bed fauna, while the apparent absence of *Inoceramus virgatus* Schlüter suggests that this derived fauna is indicative of the *mantelli* Zone rather than the *dixoni* Zone. However, Wright and Kennedy (1984) suggested that fossils derived from the *dixoni* Zone might also be present.

The *remanié* phosphatized fauna of the higher part of the Basement Bed appears to include ammonites from several different zones/ subzones of the Middle Cenomanian Substage. The assemblage contains representatives of the *Turrilites costatus* Subzone and, particularly, of the *T. acutus* Subzone of the *Acanthoceras rhotomagense* Zone, including the subzonal indices, as well as common examples of the zonal index fossil of the overlying *Acanthoceras jukesbrownei* Zone. It includes: *Acanthoceras jukesbrownei* (Spath) (specimens from here were illustrated by Kennedy, 1971), *A. rhotomagense* (Brongniart) (one specimen illustrated by Kennedy, 1971), *Anisoceras plicatile (*J. Sowerby), *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo), *C. (N.) a. spinosum* (Kossmat), *C.* (*Calycoceras*) *bathyomphalum* (Kossmat), *Calycoceras* (*Proeucalycoceras*) *picteti* Wright and Kennedy (a paratype), *Lechites* cf. *gaudini raricostatus, Lotzeites* sp., *Parapuzosia* (*Austiniceras*) sp., *Schloenbachia coupei* (Brongniart), *Scaphites equalis* J. Sowerby (common), *Turrilites acutus* Passy and *T. costatus* Lamarck.

The Basement Bed is capped by a hardground and is penetrated by a *Thalassinoides* burrow system that is infilled by sediment piped down from the overlying 0.6–0.75 m bed of bioturbated glauconitic sandy chalk. The descriptions of the succession above the hardground given by Kennedy (1970) and Wright and Kennedy (1984) are contradictory. Kennedy (1970) stated that the glauconitic chalk contained small broken phosphates and that he had collected unphosphatized fossils including *Calycoceras* (*Calycoceras*) *naviculare* (Mantell) and the belemnite *Praeactinocamax plenus* (Blainville), which would indicate the *geslinianum* Zone. This dating of the sediment is supported by the foraminiferal evidence (Hart, 1975). This bed was overlain by a thin bed, less than 0.2 m thick, of highly glauconitic chalk containing phosphatized fossils, including *Schloenbachia lymense* Spath, that are suggestive of the derived *guerangeri* fauna at the base of Bed C, both in the coastal sections and at Wilmington Quarry (see GCR site report, this volume). This apparent inversion of the usual succession does not make sense. However, in Westphalia, northern Germany, *S. lymense* is recorded as ranging up into the *geslinianum* Zone (Kaplan *et al.,* 1998), so perhaps this apparent inversion is a normal succession. On the other hand, Wright and Kennedy (1984) stated that it was the 0.6–0.75 m unit that had yielded the phosphatized ammonites, and attributed these to both the *jukesbrownei* and *guerangeri* zones.

The higher part of the Furley Chalk Pit succession, still partly exposed, is unusually unfossiliferous, and Jukes-Browne and Hill (1903) commented on this. Hart (1991) reported a flood occurrence of the calcisphere *Pithonella* in the interval from 1.5 m beneath, to 3 m above the flint, and suggested that this could be correlated with a near-global bio-event that had been recognized in the Lower Turonian deposits of southern England at Hooken Cliff (see GCR site report, this volume) and Dover (see Folkestone to Kingsdown GCR site report, this volume). This interval at Furley Chalk Pit corresponds to a significant increase and a concomitant decrease in the proportions of benthic and planktonic foraminifera respectively (cf. Hart 1975, fig. 2). An ammonite collected from an unspecified horizon 'well above the basement bed' was identified as a *Schloenbachia* of Upper Cenomanian character (Smith and Drummond, 1962), implying that the higher part of the succession belonged to the Lower Chalk, but this critical specimen was subsequently redetermined (Kennedy, 1970), as a Turonian *Watinoceras.* Kennedy (1970) recorded *Inoceramus* (i.e. *Mytiloides) labiatus* (Schlotheim) below the lowest nodule bed, confirming that the lower part of this succession falls in the Lower Turonian *Mytiloides* spp. Zone. Comparison of the microfaunal data from Furley Chalk Pit (Hart, 1975, *fig.* 2) and from the section at Beer Roads, to the north-east of the Hooken Cliff GCR site (Hart and Weaver, 1977; Hart, 1997, fig. 2), indicates that that the highest part of the Furley succession falls within the *Helvetoglobotruncana helvetica* planktonic foraminiferal Interval Zone. No macrofossils have been recorded from the highest part of the succession.

Interpretation

There is a remarkable change in the Cenomanian and Turonian successions between the Wilmington and Membury outliers. At Furley Chalk Pit, there is apparently no evidence of the thick Lower Cenomanian (*dixoni* Zone) Wilmington Sand and 'Grizzle' seen 6 km to the south-west in the Wilmington Quarry and Reeds Farm Pit GCR sites. The pebbles of sandy limestones with glauconitized Lower Cenomanian ammonites in the lower part of the Basement Bed could perhaps represent a lateral equivalent of either the basal Cenomanian (*carcitanense* Subzone) Basement Bed of the Wilmington Sand, or of the *dixoni* Zone 'Grizzle', but the absence of records of the biostratigraphically diagnostic coralline sponge *Acanthochaetetes ramulosus* (Michelin) and the inoceramid bivalve *Inoceramus virgatus* respectively means that these pebbles cannot be dated. A similar problem is found at Snowdon Hill Quarry although there a bed of sandy limestone is actually intercalated between the Upper Greensand and the Basement Bed (see GCR site report, this volume).

The ammonite assemblage in the green-coated pebbles is Lower Cenomanian in age (cf that of the Hooken Member, Bed A2). The assemblage in the phosphatic pebbles is Middle Cenomanian in age, and it probably correlates in part with the (derived *costatus* Subzone) assemblage at the base of the Little Beach Member (Bed B) in the coastal sections. However, it appears to belong largely to the *acutus* Subzone, as at Snowdon Hill Quarry. The derived *Acanthoceras jukesbrownei* Zone faunal elements form part of the indigenous fauna of the higher part of the Little Beach Member of the coastal sections. The succeeding glauconitic sandy limestone is lithologically and faunally similar to the Pinnacles Member (Bed C) at the base of the Holywell Nodular Chalk Formation.

The overlying succession, up to the base of the beds of nodular chalk, can be unequivocally assigned to the Holywell Nodular Chalk Formation (i.e. the Connett's Hole Member of Jarvis *et al.,* 1988) on microfloral, microfaunal and macrofaunal evidence. The calcisphere (*Pithonella*) flood above and below the flint horizon enables correlation with at least the lower part of this formation. The record of *Mytiloides labiatus* below the lowest of the nodular beds also supports correlation with this formation. The absence of any records of the keeled planktonic species *Marginotruncana sigali* (Reichel), indicative of the succeeding *M. sigali* Interval Zone, or of the giant agglutinating foraminifer *Labyrintbidoma* (formerly *Coskinophragma),* suggests, but does not prove, that the highest beds in the quarry do not reach the top of the *Helvetoglobotrunca belevetica* Interval Zone, i.e. that they lie below the base of the *sigali* Interval Zone. In the Beer Roads section on the coast (Hart, 1997, fig. 2), the boundary between the Holywell Nodular Chalk and flinty New Pit Chalk formations is more or less coincident with the base of the *sigali* Interval Zone. This implies, by extrapolation, that the preserved thickness of Holywell Nodular Chalk Formation at Furley Chalk Pit could be as much as 14 m. However, it is noteworthy that there is no evidence here, in this apparently expanded section, for the development of the Beer Stone lithology found in the Hooken–Wilmington Trough. On lithological grounds alone, ignoring the microfaunal evidence, the description of the highest beds as being chalk with marl seams suggests that they may belong to the New Pit Chalk Formation.

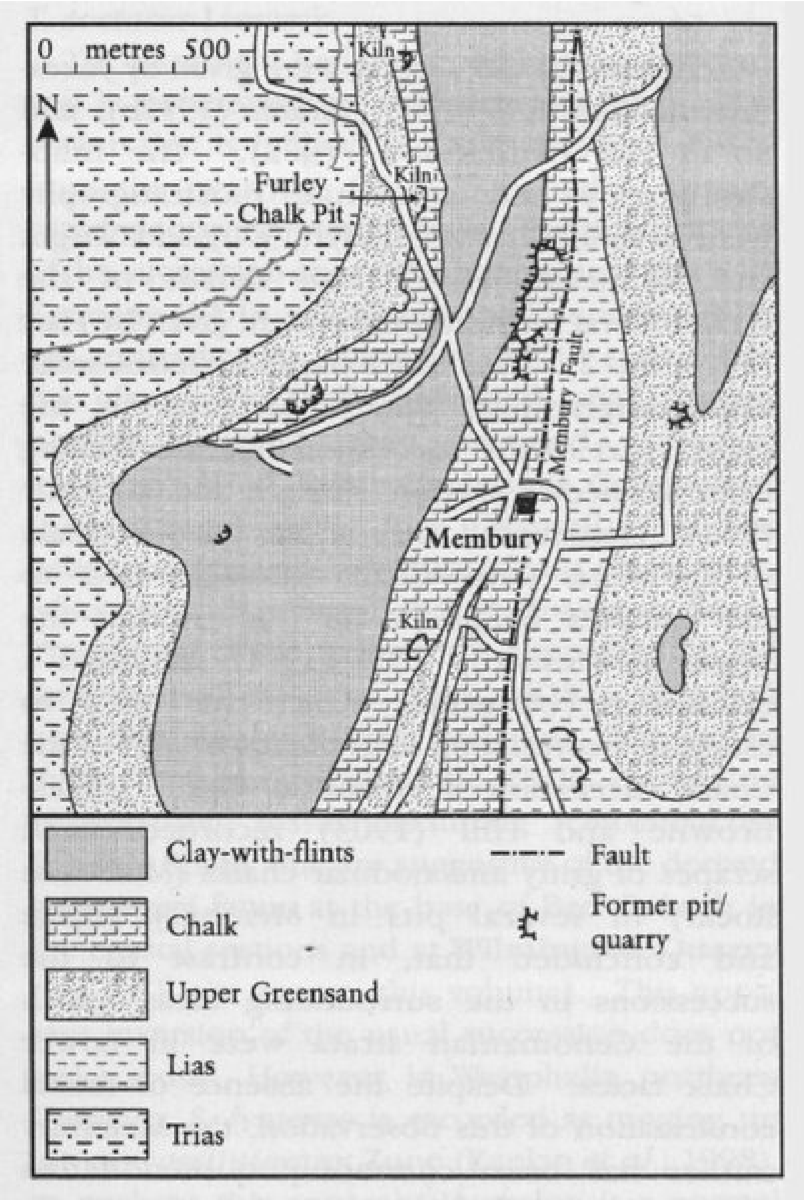
The Membury outlier is delimited to the east by a major fault (the Membury Fault) that cuts through the underlying Trias (Figure 3.19) and (Figure 3.30). Jukes-Browne and Hill (1903) considered that the Upper Cenomanian succession in the outlier was in typical Lower Chalk facies, an observation that has led subsequent authors to state that this was the most westerly Lower Chalk in Britain. However, the faunal evidence shows that there is no Lower Chalk (i.e. Grey Chalk Subgroup) at Furley Chalk Pit, the apparent 'Lower Chalk' here being actually an expanded succession of the basal White Chalk Subgroup (Holywell Nodular Chalk Formation). However, it is possible that 'Lower Chalk' is actually present in the outlier, but close to the Membury Fault in Membury village. Jukes-Browne and Hill (1903, p. 122) believed that there were up to 60 ft (15 m) of Lower Chalk exposed in a line of pits close to the fault (Figure 3.30). Even at that time these pits were overgrown and there was no supporting faunal evidence for this interpretation. However, comparison with the rapid lateral variation in the Cenomanian sediments at the Hooken Cliff GCR site, close to tectonic structures weaker than the Membury Fault, suggests the possibility that the condensed Cenomanian sequence at the Furley site may pass into Grey Chalk facies adjacent to the fault.

Conclusions

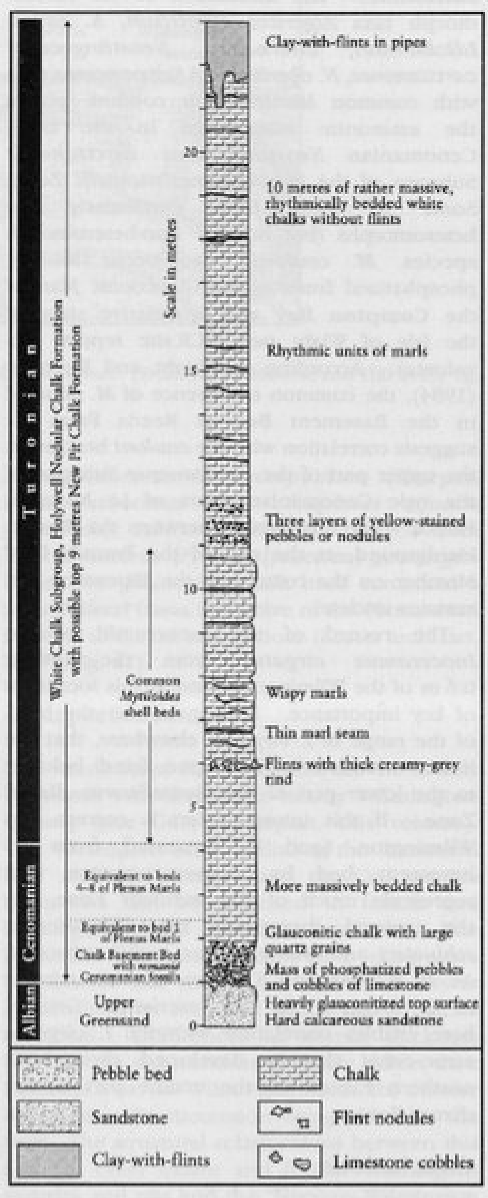
This site has provided the only detailed information on the Upper Cretaceous (Cenomanian–Turonian) deposits of the fault-bounded Membury outlier, and their relationship to the underlying Upper Greensand. The succession here differs significantly from those of the Chard and Wilmington outliers to the east and west respectively, and from those on the

Devon coast. The individual character of the succession in this outlier testifies to the continuing influence on sedimentation of nearby deep-seated faults throughout the Cenomanian and Turonian ages.

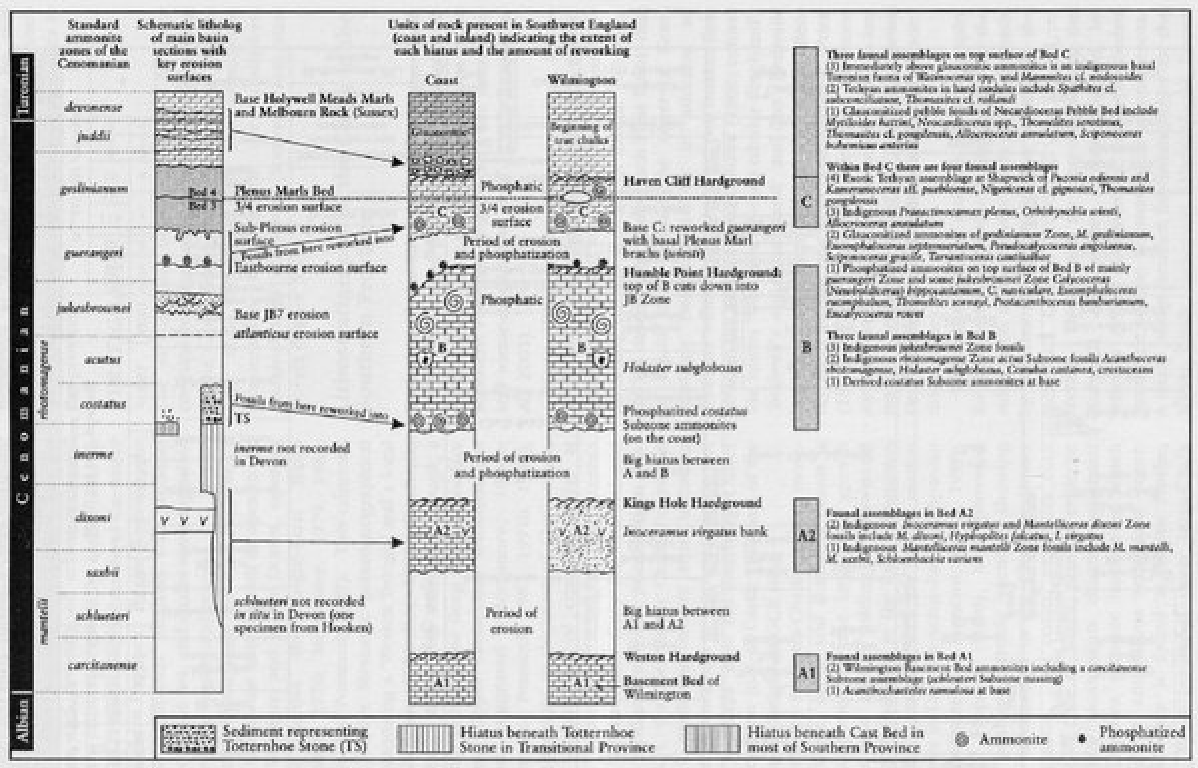
References



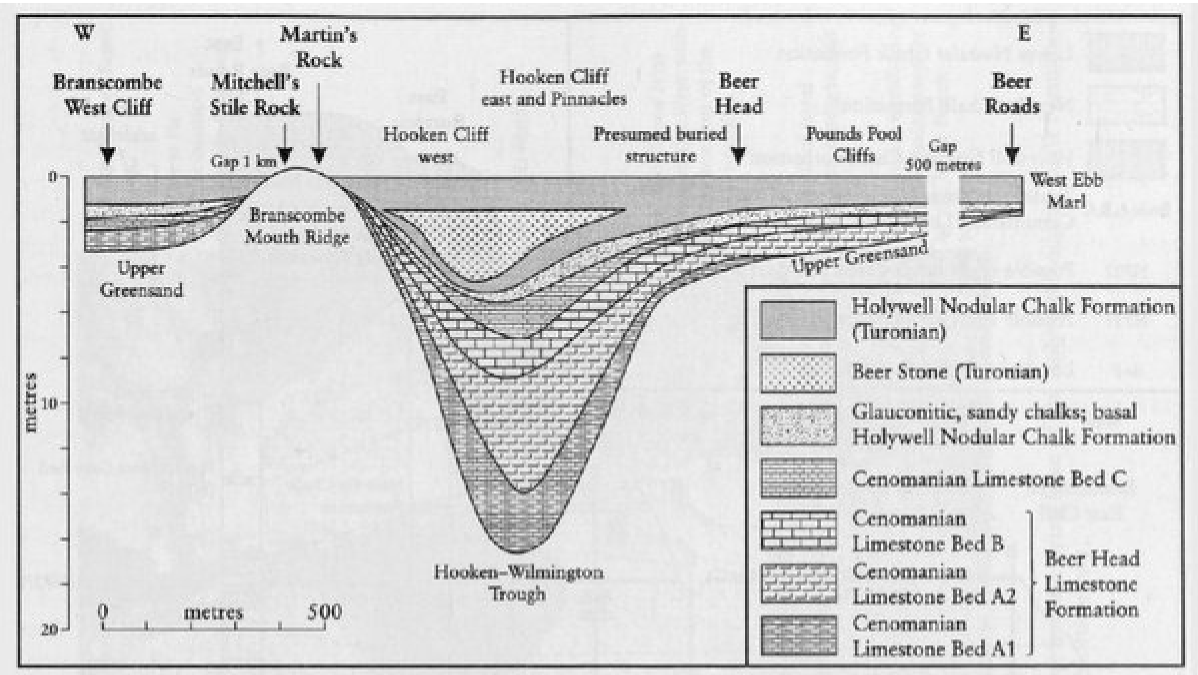
(Figure 3.30) The geological setting of the Furley Chalk Pit GCR Site.



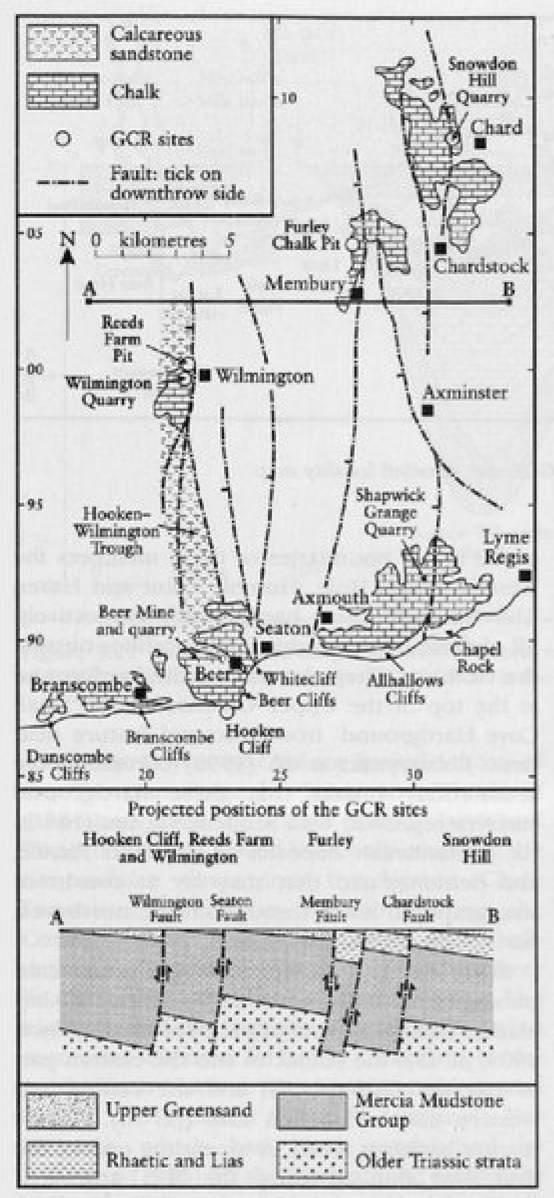
(Figure 3.31) Furley Chalk Pit, south-east Devon, showing an unusual development of Chalk without hardgrounds and only one flint band in contrast to all other known localities at this horizon in Devon, more like a Sussex succession. (Based on Kennedy, 1970, fig. 14; and Hart 1975, fig. 2.)



(Figure 3.4) Schematic relationship between the Cenomanian deposits of the thicker successions in Sussex and Kent and the condensed Cenomanian Limestone (A, B, C). Because of tectonics the age of the Chalk Basement Bed is different in different places.



(Figure 3.21) Schematic and simplified view of lateral variation in the Cenomanian and Early Turonian deposits of Hooken Cliffs and adjacent areas. The datum is the West Ebb Marl.



(Figure 3.19) Geological sketch map and section showing the position of the Upper Cretaceous GCR sites in relation to outcrop and structure.