CAISTOR ST EDMUND CHALK PIT

OS Grid Reference: TG238048

Introduction

Caistor St Edmund Chalk Pit is a working quarry, 4 km south of Norwich (Figure4.24). The quarry was formerly largely exploited for Chalk, but latterly, as operations have moved eastwards towards the area with thicker overburden, the overlying sands and gravel have been worked at the expense of the Chalk. It provides the last remaining well-exposed inland section of part of the Beeston Chalk Formation of the Upper Campanian 'Norwich Chalk', and is the last inland section of any size in the Upper Campanian succession of the Transitional Province. It is rich in macrofossils, and well- preserved microfaunas can be extracted from the relatively soft chalks. The section includes the boundary between two of the informal local subzones of the *Belemnitella minor* I Zone of the standard northern European belemnite zonal scheme for the Upper Campanian succession (Figure 2.13, Chapter 2; Figure 4.5).

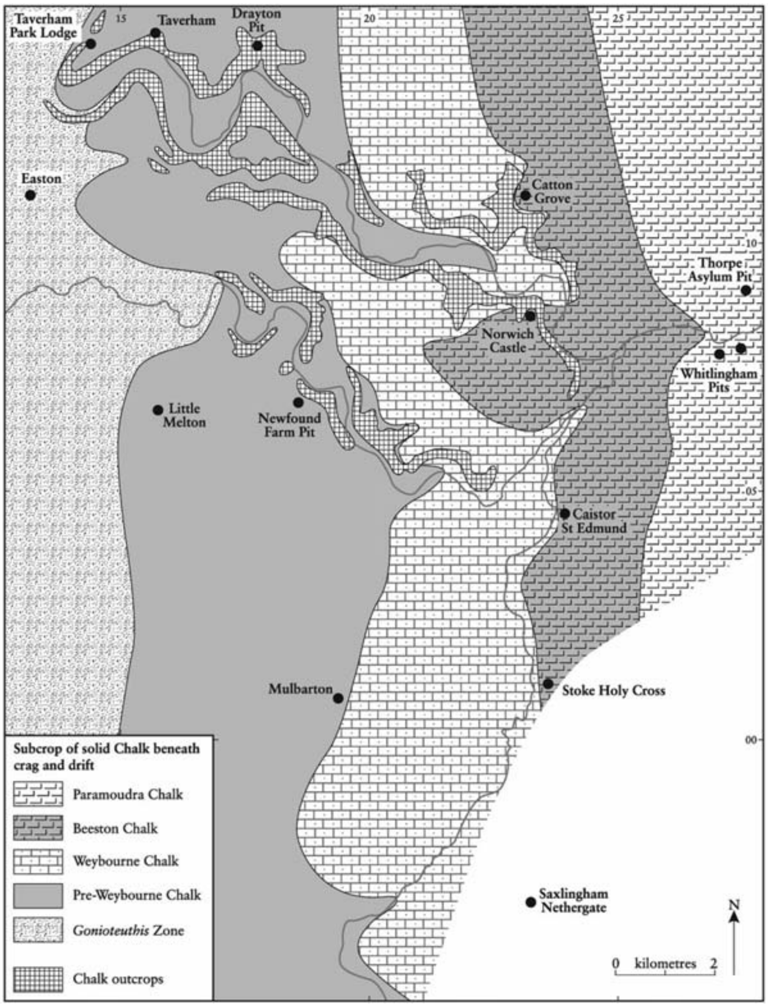

Figure 4.24: The location of Caistor St Edmund Chalk Pit and Catton Grove Chalk Pit, and other sections mentioned in the text, around Norwich, Norfolk. (After Cox et al., 1989.)

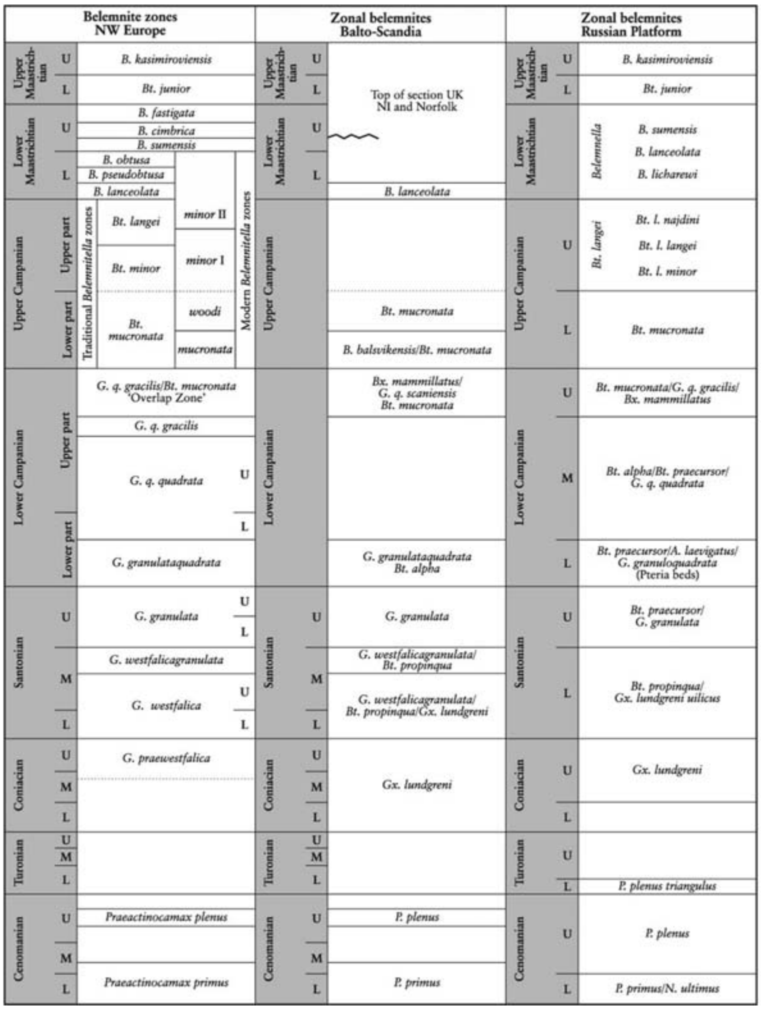

Figure 2.13: Comparison of Upper Cretaceous belemnite zones across Europe, which are only partly represented in the UK and mainly on the Anglo-Brabant Massif. (After Christensen, 1991.) (A. = Actinocamax; B. = Belemnella; Bt. = Belemnitella; Bx. = Belemnellocamax; G. = Gonioteuthis; Gx. = Goniocamax; N. = Neohibolites; P. = Praeactinocamax.)

Stage		Southern England	Norfolk (Peake and Hancock, 1961, 1970)	Belemnites	Echinoids	Norfolk (Johansen and Surlyk, 1990)	Norfolk (Christensen, 1995, 1999)	
Maastrichtian	Upper	Not represented	Not represented	*Belemnella kazimirovensis*	Not represented		Not represented	*Belemnella*
				Belemnitella junior				
	Lower		Grey Beds	*Belemnella licharewi*	*Echinocorys* aff. *limburgica*	Beacon Hill Grey Chalk		*Belemnella sumensis*
			White Chalk with *O. lunata*		*Echinocorys ciplyensis*	Little Marl Point Chalk Member		
			Sponge Beds			Trimingham Sponge Beds Member		
			Porosphaera Beds	*Belemnella lanceolata*	*Echinocorys belgica*	Sidestrand Chalk Member	*Belemnitella minor* II [*minor* III]	*Belemnella obtusa*
			Sidestrand Chalk		*Echinocorys* passage forms			*B. pseudobtusa* *B. lanceolata*
Campanian	Upper		Paramoudra Chalk	*Belemnitella langei* dominant	*Echinocorys pyramidata* Portlock	Paramoudra Chalk Member	*Belemnitella minor* II	
					?			
			Beeston Chalk		*Echinocorys conoidea* *Galerites roemeri-abbreviatus*	Beeston Chalk Member	*Belemnitella minor* I	
					Echinocorys aff. *conoidea* *Cardiotaxis ananchytis*			
			Catton Sponge Bed	*Belemnitella mucronata minor* and allied forms common	*Echinocorys ovata* auctt.	Catton Sponge Bed		
		Highest Chalk Isle of Wight and Dorset *Belemnitella mucronata* Zone Base of Zone in Hampshire -------(2)-------	Weybourne Chalk		*Echinocorys gibba* *M. stolleyi*	Weybourne Chalk Member	*Belemnitella woodi*	
			Pre-Weybourne Chalk [Eaton Chalk]		*Echinocorys subglobosa fonticola*	Eaton Chalk Member		
				Belemnitella mucronata sensu stricto	*Echinocorys subglobosa* *C. heberti*		*Belemnitella mucronata* sensu stricto	
					Echinocorys pyramidata auctt. var. *quenstedi*			
					Echinocorys marginata approaching *subglobosa*			
			Pre-Weybourne Chalk [Basal Mucronata Chalk]		*Echinocorys lamberti*			
					Echinocorys lata fastigata			
	Lower (pars.)	*Gonioteuthis quadrata* Zone	*Gonioteuthis* Zone	*Gonioteuthis quadrata*	?			

Figure 4.5: The ‘high' Chalk of Norwich and north Norfolk based on Peake and Hancock (1961, 1970); Wood (1988); Johansen and Surlyk (1990); and Christensen (1995, 1999).

Description

The Caistor St Edmund Chalk Pit section was described by Peake and Hancock (1961) and by Wood (1988). Additional details were given by Pitchford (1991), Johansen and Surlyk (1990), and Christensen (1995). The palaeoecology, depositional environment and faunal analysis were documented by Godwin (1998). The geochemistry of the hollow ‘potstone' flints and their chalk fill was used by Clayton (1986) in the development of a model for flint formation.

Lithostratigraphy

The quarry exposes a *c*. 13 m section (Figure 4.25) through the lower part of the Beeston Chalk. Peake and Hancock (1961, fig. 6) described 30 ft (9.14 m) of Chalk between the then working floor of the quarry and the base of the Norwich Crag. Wood (1988, fig. 8) recorded an additional 7 m of section in a deep part of the quarry that was normally flooded, giving a total exposed thickness of some 16 m. Additional graphic logs that also included the lowest beds, with the exception of the basal 1.7 m recorded by Wood, were published by Johansen and Surlyk (1990) and Pitchford (1991). Pitchford accurately logged the lateral variation of the flints over a standard 5 m-wide section, and recorded the distribution of the relatively weakly developed nodular chalk. Figure 4.25 is a modified version of Wood's log. The deepest part of the quarry is now largely filled with loose sand washed down from above the Chalk and is dangerous to approach.

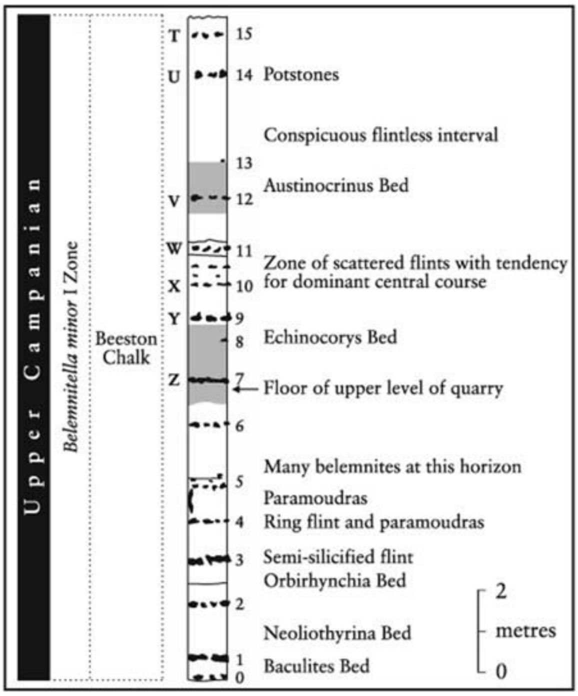

Figure 4.25: The Campanian Chalk (White Chalk Subgroup) at Caistor St Edmund Chalk Pit, Norwich (see Figure 4.24 for location). (Letters T–Z for flint bands are those of Peake and Hancock, 1961; numbers 1–15 are those of Wood, 1988.)

The succession consists of relatively soft, distinctly yellow chalk that is to a greater or lesser extent flinty throughout, and entirely devoid of marl seams. The second flint from the bottom of the deepest section formerly visible is semi- tabular, and 0.15 m thick. The interval up to the conspicuous semi-continuous flint 7, at the base of the main face, includes a ring flint, 0.22 m thick, from which arise sporadic paramoudras. The Johansen and Surlyk log (1990, fig. 1) shows a paramoudra even higher in the succession. The chalk from immediately below flint 7 up to the next higher flint band (9) is replete with conspicuous large fragments of inoceramid bivalve shell. There is a similar concentration of shell debris in the interval from below flint 12 up to flint 13. Between the two belts of shell debris, and marking the top of an irregular grouping of three flint bands, there is a weakly indurated near-planar hardground, overlain by a concentration of echinoids (*Echinocorys*). At the top of the section, there is a conspicuous line of very large flints (14), including hollow potstones, above a virtually flintless interval, some 3 m thick.

Macrofossils

The section is generally extremely fossiliferous, particularly the lower part, which contains the high-diversity fauna of well-preserved corals, brachiopods, bivalves, belemnites and echinoids that characterizes the Beeston Member (see Wood, 1988).

The succession falls into the higher part of the *Belemnitella mucronata* Zone of the traditional scheme. The quarry is very rich in belemnites. Extensive, bed-by-bed collections, particularly from here, and from other *mucronata* Zone sections in the vicinity of Norwich, and the exposures on the coast, enabled Christensen (1995) to establish a refined belemnite zonal scheme based on the genus *Belemnitella*. The succession falls within his *Belemnitella minor* I Zone, which is further subdivided into three informal local subzones defined by the co-occurrence, with the zonal index fossil, of particular additional belemnite taxa. The greater part of the succession belongs to Subzone 1, characterized by the occurrence of *Belemnitella* '*langei*'. Large examples of the zonal index fossil are conspicuous in the lower belt of inoceramid shell-debris chalk. The base of the succeeding Subzone 2, marked by the entry of *Belemnitella najdini* Kongiel and *B. pauli* Christensen, is situated at the top of the lower belt of inoceramid shell debris.

This quarry, then much smaller, was one of Rowe's fossil collecting localities (Rowe, in manuscript; Norfolk locality 166). The fossils collected by him from here are preserved in the

Natural History Museum, London. Although the succession contains fossils throughout, several particularly fossiliferous horizons have been named (Wood, 1988).

In the deepest, now inaccessible part of the section, the Baculites Bed yielded poorly preserved, weakly glauconitized specimens of baculitids and nautiloids. From this bed, or possibly from an even deeper level in a trial hole, the Goff collection (Norwich Castle Museum) additionally includes the hetero-morph ammonites *Neancyloceras bipunctatum* (Schlüter) and *Neocrioceras* (*Schlueterella*) sp.. The overlying Neoliothyrina Bed contained large (gerontic) individuals of the terebratulid brachiopod *Neoliothyrina obesa* Sahni.

The Orbirhynchia Bed, which overlies a slightly hardened omission surface, yielded an amazingly diverse macrofossil assemblage. The rhynchonellid *Orbirhynchia* makes up about 10% of the brachiopod assemblage. The remaining brachiopods are dominated by *Carneithyris carnea* (J. Sowerby) and *Cretirhynchia arcuata* Pettitt, with subordinate *Ancistrocrania parisiensis* (Defrance), *C. norvicensis* Pettitt, *Kingena* sp., *Kingenella* sp. nov., *Neoliothyrina obesa* and *Terebratulina chrysalis* (Schlotheim). The fauna additionally comprises 11 species of bivalves, including five pectinaceans, *Belemnitella* ' *langei* ', cirripedes, asteroid marginals, ophiuroid ossicles, cidarid spines and plates, and *Galerites roemeri* (Desor).

The Echinocorys Bed, at the top of the lower inoceramid shell-debris belt, contains predominantly crushed individuals of the morphotype (*Echinocorys* aff. *conoidea* Goldfuss) that characterizes the type Beeston Chalk. A smaller, more globose, morphotype is found on the minor hardground immediately above flint 11. The echinoids can also occur in nest-like accumulations at the level of the flint; a large flint in Norwich Castle Museum from this horizon contains 20 individuals.

The Austinocrinus Bed contains crinoid stem ossicles belonging to an *Austinocrinus* that is probably transitional between *A. rothpletzi* Stolley, and the *A. bicoronatus* (Hagenow) that characterizes the basal Maastrichtian of the **Overstrand to Trimingham Cliffs** glacio-tectonic masses (see GCR site report, this volume). The bed also contains numerous small brachiopods, mainly small *Carneithyris carnea* and *Cretirhynchia arcuata*.

Microbrachiopods

Johansen and Surlyk (1990) placed the Caistor St Edmund Chalk Pit in their undivided *Rugia tenuicostata–Terebratulina longicollis* microbrachiopod Zone, which is more or less co-extensive with the Upper Campanian Substage.

Microfossils

The quarry falls within the higher part of the UKB18 *Bolivinoides decoratus* benthic foraminiferal Interval Zone (cf. Hart *et al*., 1989, p. 314, figs 7.16, 7.25; Figure 1.5, Chapter 1), a unit earlier given separate subzonal status (B3iv) by Swiecicki (1980). The base of the B3iv Subzone is seen at the **Catton Grove Chalk Pit** GCR site; and the subzone was also recognized in the backfilled Frettenham Pit (TG 246 173), even higher in the Beeston Chalk. The top of the UKB18 Zone is marked by the entry of *Bolivinoides miliaris* Hiltermann and Koch and *B. sidestrandensis* Barr at, or just below, the base of the Paramoudra Chalk Formation (Swiecicki, 1980).

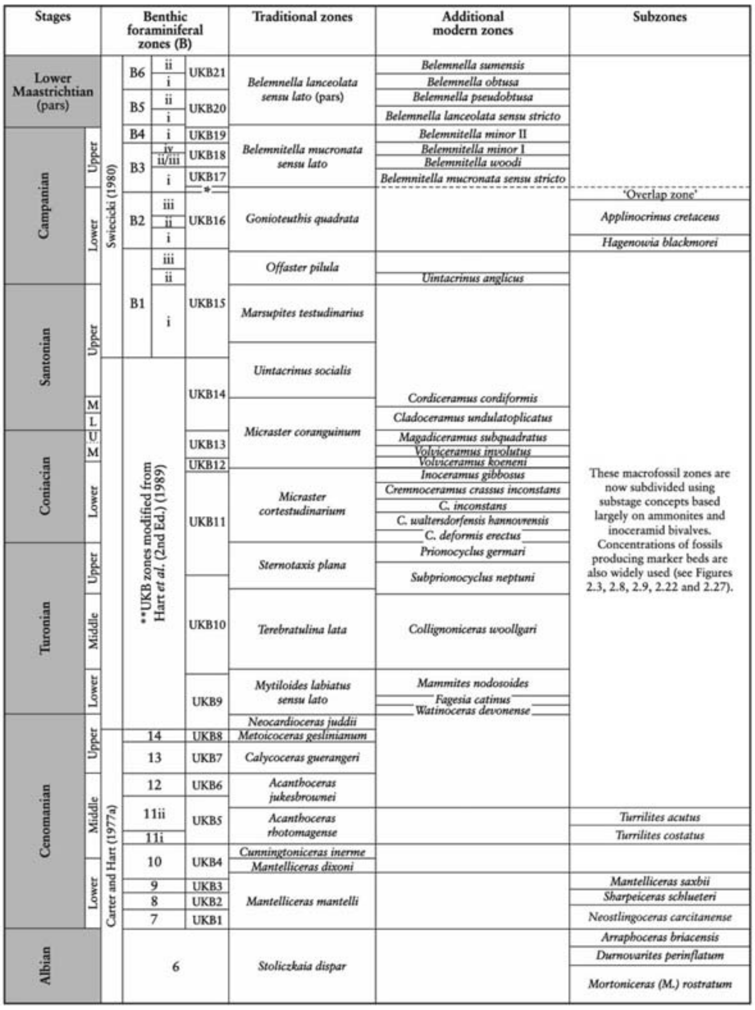

Figure 1.5: Zones of the Upper Cretaceous Chalk. (= Gap in UKB scheme; ** = UKB zonal scheme modified for this book.)*

Interpretation

The quarry provides the sole remaining useful inland section in the Beeston Chalk Formation in the higher part of the Upper Campanian succession of Norfolk.

The comparative field relationships of the Caistor St Edmund Chalk Pit and the nearby Halfway House (TG 2330 0268) and Stoke Holy Cross (TG 2536 0140) chalk pits suggests that the base of the quarry lies above the Catton Grove Chalk Pit–Stoke Holy Cross composite section. The absence, from the top of the Stoke Holy Cross section, of the basal semi-tabular flint 2 and the associated *Baculites* and *Neoliothyrina* Beds of the Caistor section (see above), as well as of *Belemnitella* ‘ *langei* ', precludes the possibility of an overlap between the two sections.

A similar, and presumably correlative, line of potstones above flintless chalk to that seen at the top of the quarry was exposed in trenches in the almost totally degraded sections (TG 2496 0683) cut into a glacially emplaced raft of Chalk at Crown Point Pit, Trowse Newton (Wood, 1988). The latter locality yielded much museum material labelled ‘Trowse', including the types of the common Norwich Chalk brachiopod *Carneithyris carnea*. The Caistor St Edmund Chalk Pit GCR site is, therefore, indirectly of importance in the interpretation of the stratigraphical position of such material.

The only other sections in this part of the succession are discontinuous, intermittent coastal exposures on the Chalk rock platform east of Sheringham, which are relatively difficult to interpret, and may be structurally complex.

The Beeston Chalk macrofossil fauna at Caistor St Edmund Chalk Pit, and in the stratotype Beeston Chalk, is closely comparable with that of the Portrush Chalk Member of the Ulster

White Limestone Formation, as seen on the north coast of County Antrim in Northern Ireland (Fletcher, 1977; Fletcher and Wood, 1978). The lower part of this member similarly contains laterally continuous belts of inoceramid bivalve shell debris, and is characterized by the same *Echinocorys* morphotypes. The lower part of the Caistor section, with its ring flints and paramoudras, is the possible correlative of the underlying Garron Member in Northern Ireland.

The lower part of the section yields an extremely high-diversity fauna with well-preserved pectinacean bivalves, large brachiopods with colour banding and corals. This is inferred to be a warm-water fauna on the basis of the large size, strong ornament and colour-banding of the shells and the diverse coral fauna.

Conclusions

Caistor St Edmund Chalk Pit provides the last remaining well-exposed inland section of part of the Beeston Chalk Formation of the Upper Campanian ‘Norwich Chalk', and is the last inland section of any size in the Upper Campanian succession of the Transitional Province. The equivalent strata on the Norfolk coast are poorly exposed and are to some extent structurally disturbed, rendering interpretation difficult. It is rich in macrofossils of all groups, and well-preserved microfaunas can be extracted from the relatively soft chalks. Collections of belemnites from here proved crucial to the development of the scheme of local belemnite zones originally recognized in Norfolk by Christensen (1995), and now part of the European standard belemnite zonal scheme. Of particular importance is the boundary between two of the informal subzones of the *Belemnitella minor* I Zone for the Upper Campanian succession. The pit is also well known for the hollow ‘potstone' flints, which are conspicuous just below the top of the section and have been used in developing a model for the formation of flint.

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