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Chalk biostratigraphy of the Wells-next-the-Sea district (1:50K Sheet 130) based on Foraminifera

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Summary

Samples from eleven sites in northern Norfolk extend from the latest Cenomanian and Turonian on the western margin of the Wells-next-the-Sea sheet, to the Campanian on the eastern Margin of the sheet. Foraminiferal zones (from which their macrofaunal equivalents can be inferred) can be assigned to most samples examined. Although certain key fossils in the Southern Chalk Province are missing, correlation is possible for most samples.

1 Introduction

Foraminifera from the following eleven Chalk localities were examined (Fig. 1):

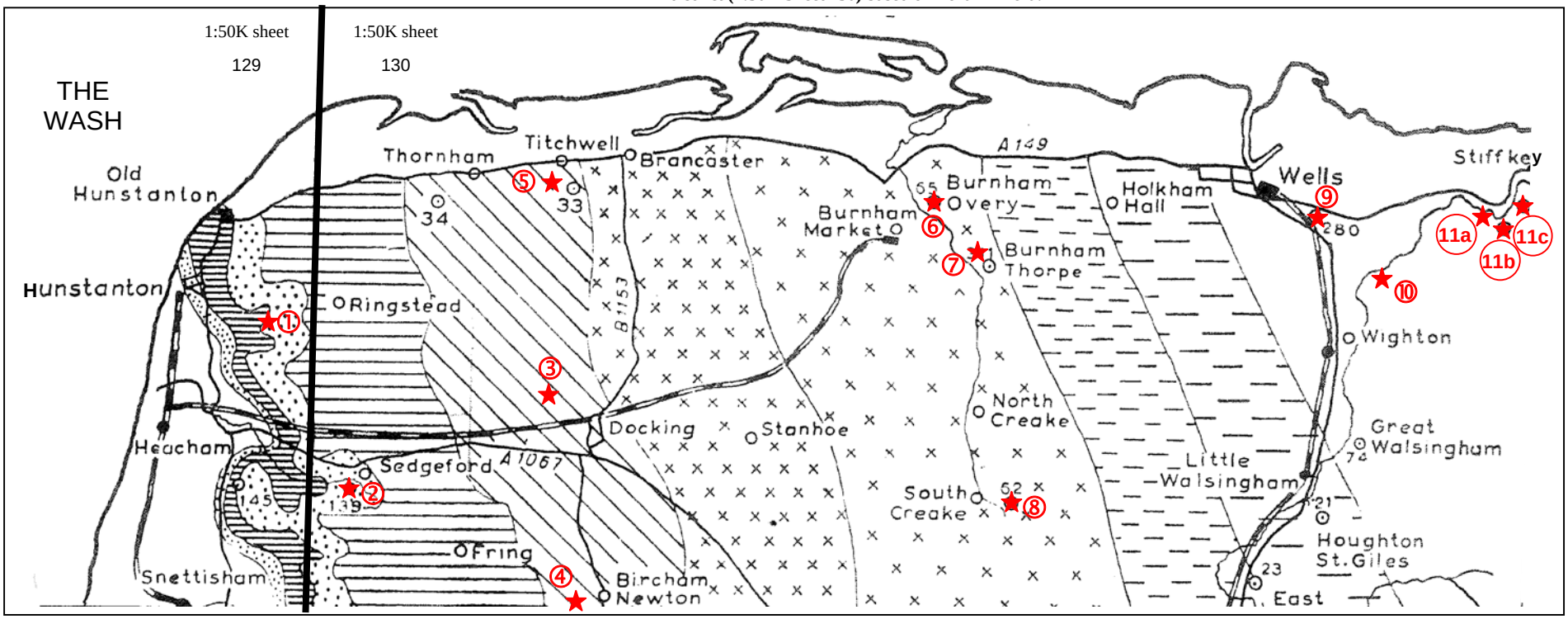
1. Barrett Ringstead Farm Pit	TF 689 400
2. Sedgeford	TF 7090 3621
3. Docking (Brash)	TF 7404 3777
4. Borehole NN2X, Great Bircham	TF 7567 3329
5. Titchwell	TF 762 433
6. Burnham Overy (Rowe's loc.65)	TF 843 432
7. Burnham Thorpe	TF 853 419
8. South Creake	TF 862 358
9. Wells	TF 928 429
10. Warham St Mary	TF 950 413
11. Stiffkey	a. TF 971 429
	b. TF 975 428
	c. TF 978 435

Faunas were compared with assemblages discussed by Bailey *et al*. (1983, 1984), Hart *et al*. (1989) and Wilkinson (2000).

The strike of the Chalk of the Chilterns is approximately NE-SW, but when the group extends into East Anglia, strike curves around to become N-S trending. In the Wells next-the-Sea district, the Chalk Group strikes slightly west of north, and it dips down towards the east. Peake & Hancock (1961) demonstrated this when they mapped out the macrofaunal zones through East Anglia, and although their zonal scheme requires some modification due to refinements during the last 40 years, it essentially holds true today (Fig. 1).

The oldest Chalk is confined to the south-west corner of sheet 130, where "Subglobosus Chalk" is shown by Peake & Hancock (1961). The labiatus Zone of Peake & Hancock (1961) is also present here and the foraminifera recorded from Sedgeford suggest an age no older than the Mytiloides Zone. However, for the most part, the Chalk of the western margin of the sheet falls within the *lata* macrofaunal Zone. No samples were available from this part of the district, so that this cannot be confirmed using microfaunas (although a site immediately to the west of the sheet, in the Hunstanton District, has been included herein as it has a bearing on the oldest chalks on Sheet 130). Samples further east, between Tichwell, Docking and Bircham Newton, contained foraminiferal markers that confirmed the *planus* Zone, at the top of the Turonian.

No samples were available from the Coniacian of the district, as shown by Peake & Hancock (1961), although the Santonian part of the coranguinum Zone was sampled at Burnham Overy, Burnham Thorpe and South Creake. The Campanian occurs on the eastern margin of the Wells-next-the-Sea district. Here foraminiferal zones equating with the *pilula* and *quadrata* macrofaunal zones were recorded.



....	'Varians Chalk'	....	*labiatus* Zone		*planus* Zone	x x x x x x x x x	*coranguinum* Zone		*Marsupites* Zone
	'Subglobosus Chalk'		*lata* zone	x x x x x x x x x x x x	*cortestudinarius* Zone		*Uintacrinus* Zone		*Gonioteuthus* Zone

Figure 1. Sample locations in the Wells-next-the-Sea district (1:50k Sheet 130) in relation to the biostratigraphy of Peake & Hancock (1961).

2 Biostratigraphy

2.1 BARRETT RINGSTEAD FARM PIT

The late Albian Hunstanton Chalk Formation is overlain by the Cenomanian in the adjoining Hunstanton district (1:50 K sheet 129). The stratigraphically lowest samples were from immediately adjcaent to the western limit of the sheet, at a disused pit NE of Barret Ringstead Farm, ESE of Hunstanton (TF689 400). These samples were examined by K.C. Ball. The lowest (SAG166 –168) are from immediately below and immediately above the hard ground developed below the sub-plenus erosion surface. These samples yielded typical late Cenomanian taxa occur, including

Dicarinella algeriana
Gavelinella baltica
Gavelinella cenomanica
Gavelinella intermedia
Plectina mariae
Praeglobotruncana stephani
Rotalipora cushmani

These faunas can be placed in the *Rotalipora cushmani* zone of Robaszinski & Caron (1989). However the concurrent range of *Dicarinella algeriana* and *Rotalipora cushmani* places the fauna in uppermost BGS6 or BGS7.

Immediately above, at the same locality, a sample (SAG169) was taken from a level of chalk pebbles between the Plenus Marl and sub-plenus hard ground (i.e. presumed Plenus Marl) *Dicarinella hagni* was added to the assemblage indicating a position in the higher part of the *Rotalipora cushmani* zone of Robaszinski & Caron (1989) and uppermost BGS6 or BGS7.

The presumed Plenus Marl sample (SAG170) yielded:

Dicarinella algeriana
Gavelinella baltica
Praeglobotruncana stephani
Dicarinella hageni

Although the sample was dominated by planktonic taxa, *Rotalipora* was not amongst them and *Whiteinella* occurred in flood abundance. BGS8 is suggested. The base of the Melbourne Rock, immediately above the Plenus Marl (SAG171), yielded an essentially similar fauna.

Higher in the Melbourne Rock (SAG172) the fauna comprised taxa such as:

Dicarinella canaliculata
Praeglobotruncana stephani
Dicarinella algeriana
Dicarinella hageni
Lingulogavelinella globosa

BGS8 is again indicated, but the absence of taxa such as *Gavelinella ammonoides* and *Arenobulima preslii* may suggest a position low in the Melbourne rock.

A ‘marl within the Melbourn Rock’ (SAG173) contained *Praeglobotruncana helvetica* so that the helvetica Zone can be suggested (this species first appears at the base of BGS 9 in southern England high in the *juddi* macrofaunal Zone). It was again present in the marl above the Melbourne Rock (SAG174) and in the overlying chalk at the top of the section. The highest sample yielded:

?Praeglobotruncana helvetica
Dicarinella algeriana
Dicarinella canaliculata
Dicarinella hagni
Marginotruncana pseudolinneana
Praeglobotruncana stephani

The top of the succession is, therefore, assigned to BGS9. The importance of this section is that the Cenomanian/Turonian boundary is at, or slightly west of the western limit of the Wells sheet.

2.2 SEDGEFORD

An exposure about 200 m SE of the church at Sedgeford (MPA52975) was examined for foraminifera. According to Peake & Hancock (1961) this site is of *labiatus* zonal age. Only a limited foraminiferal fauna was seen:

Gavelinella tourainensis
Lingulogavelinella globosa
Gyroidinoides nitidus
Hebergella delrioensis
Lenticulina sp

The presence of *Lingulogavelinella globosa* places the fauna within the upper part of foraminiferal zones BGS6 through to BGS9 (although it is rare above BGS8). The occurrence of *Gavelinella tourainensis* also suggests a position no higher than BGS 9 (although in Britain this 'Lazarus' species reappears briefly in the *planus* Zone). The ranges of the species recorded do not allow a refined age determination. The fauna could be as old as the late Cenomanian, but it is probably no older thanBGS 9 and the 'mid' part of the *Mytiloides* Zone.

2.3 DOCKING

Sandy brash from 2 km WNW of Docking (MPA52959) contained only a sparse foraminiferal assemblage, comprising by long-ranging, non-keeled, planktonic species such as:

Whiteinella archaeocretacea
Hedbergella brittonensis
Heterohelix globosus.

Of the rare benthonic taxa, *Gavelinella tourainensis* is the most useful biostratigraphically. This is a 'Lazarus species' as it evolved in the late Cenomanian, but disappears from the record throughout the *lata* Zone, reappears at the base of the *planus* Zone, before going into extinction at the top of the same zone. Its presence here suggests the upper part of foraminiferal zone BGS12 (although the zonal indices were not found).

2.4 GREAT BIRCHAM, BOREHOLE NN2X

Two samples from this borehole were examined. The lower sample (MPA52957), from a depth of 49.5-50.4 m, contained a sparse fauna that included:

Gavelinella tourainensis
Arenobulimina preslii
Globigerinelloides bentonensis

The best fit for the impoverished assemblage in the lower sample is upper BGS8 or BGS9 (upper *juddi*-'middle *Mytiloides* zones). *Gavelinella tourainensis* temporarily disappears from the record at the top of BGS9 (within the *Mytiloides* macrofaunal zone). *Arenobulimina preslii* is a

long ranging form, but is consistently present in and above the upper part of BGS8 (and the upper part of the *juddi* macrofaunal zone). With the absent of keeled planktonic species, the latter taxon is the best indicator of the oldest possible age.

The upper sample (MPA 52958), from 32.5-33.8 m, was less fossiliferous, although *G. bentonensis* was again present indicating an age no younger than BGS10 (the species became extinct at or close to the top of the *Mytiloides* Zone).

2.5 TICHWELL PARISH PIT

The disused Parish Pit at Tichwell was sampled on its southern face. It was thought at the time that the section was of uppermost Turonian or lower Coniacian in age and Northern Province Chalk. Eight sample were examined from this section (SAG140-147), but all the samples examined contained an essentially similar foraminiferal association. *Stensioeina granulata granulata* was found throughout and several other species were recorded including:

Reussella kelleri (northern form)
Gavelinella ammonoides
Marginotruncana marginata
Osangularia cordieriana

The entire sampled section can be placed in BGS14 on the basis of the presence of *Stensioeina granulata granulata, Osangularia cordieriana* and the absence of *Stensioeina exsculpta exsculpta*. This zone equates with the earliest coranguinum Zone. In southern England this fauna is indicative of a position immediately above the Upper East Cliff Marls and well below the Hope Point Marl (and stratigraphical equivalents).

2.6 BURNHAM OVERY

At Burnham Overy, Rowe's locality 65 was sampled (SAG148). The east face of this disused pit was said to coranguinum zonal age (Coniacian or Santonian) by the collectors of the samples. The foraminiferal fauna included

Stensioeina exsculpta exsculpta
Reussella kelleri
Stensioeina polonica
Stensioeina incondita
Marginulina pseudolinneana

The presence of *S. polonica* places the assemblage within the eponymous foraminiferal zone of Bailey et al (1983) and BGS 17 of Wilkinson (2000) and equivalent to the upper part of the coranguinum zone. In southern England, the fauna is characteristic of the Seaford Chalk between the Chartham Flint and Peake's Sponge Bed. It is not clear which foraminiferal subzone the fauna falls within, due to the absence of key taxa. In southern England, *R. kelleri* is absent or extremely rare below the top of BGS17i (i.e. below Whitaker's 3" Flint) and species characteristic of the upper subzone (BGS17iii) were not present. The 'best fit' places the fauna in BGS17ii, but BGS17i cannot be ruled out entirely.

Samples SAG149-150 yielded essentially similar faunas to SAG148, but included *Reussella szajnochae praecursor* in addition. The inception of this species is characteristic of BGS17iii in southern England, so a position high within the *coranguinum* Zone is inferred. It suggests a laterally equivalence to a position immediately below the Barrois Sponge Bed to Peake's Sponge Beds of the southern England stratigraphy.

2.7 BURNHAM THORPE

The Northern Province coranguinum Zone is exposed at a quarry at Burnham Thorpe(SAG39). The moderately diverse fauna lacked planktonic taxa, but included:

Reussella szajnochae praecursor
Reussella kelleri
Stensioeina polonica
Cibicedes beaumontianus

Stensioeina polonica is important in that it places the assemblage into BGS17 (in southern England this zone is placed between the Chartham Flints and Peake's Sponge Bed in the upper part of the *coranguinum* macrofaunal zone. *Reussella szajnochae praecursor* is rare in the sample, but its presence suggests subzone BGS 17iii –in southern England, between the Barrois Sponge Bed and Peake's Sponge Bed (and lateral equivalents).

2.8 SOUTH CREAKE

A sample (SAG185) was taken from the NE face of the disused pit to the NE of South Creake. The sample collectors considered this to be coranguinum zone of the Northern Province. It yielded

Dicarinella canaliculata
Stensioeina exsculpta exsculpta
Stensioeina polonica
Reussella szajnochae praecursor
Reussella kelleri
Gavelinella ammonoides

The sample is essentially similar to SAG149-150 at Burnham Overy (Rowe's locality 65).

2.9 WELLS QUARRY

The Wells Quarry was sampled at nine points. SAG30 yielded

Stensioena pommerana
Gavelinella stelligera
Reussella szajnochae praecursor
Reussella kelleri
Praebulimina reussi
Stensioeina granulata gracilis
Stensioina exsculpta incondita
Neoflabellina rugosa

The fauna is indicative of the upper part of foraminifera zone BGS19 and equivalent with the upper part of the *pilula* macrofaunal zone. *Neoflabellina rugosa* is present, though rare, in the BGS19; *Stensioena pommerana* appears in the upper part of BGS 19 and *Reussella kelleri* disappears from the record at the top of the same foraminiferal zone

Gavelinella cristata was added to this assemblage in SAG31, a characteristic species that defines the base of BGS 18 and extends through to the top of BGS 19. *Stensioeina granulata perfecta* was noted in SAG32, a species which also disappears from the record at the top of BGS 19 at or close to the *pilula/quadrata* boundary. Although a number of samples contained impoverished or poorly preserved assemblages, the fauna remained essentially similar through the section to SAG35 where the last specimen *of Gavelinella cristata* was again found.

The top of the section SAG36-38, lacked species characteristic of BGS19 and yielded only long ranging taxa. Without the presence of species such as *Gavelinella usakensis* or

common *Bolivinoides culverensis*, zone BGS20 cannot be identified with certainty, but the disappearance of BGS19 indicators may suggest that the top of the succession is basal *quadrata* zonal age. In southern England the BGS19/BGS20 zonal boundary is close to the Arundel Sponge Bed.

2.10 STIFFKEY HALL FARM

Six samples (SAG25-29 and SAG201) Stiffkey Hall Farm pit were examined for calcareous microfaunas, the collectors placing them 'restricted *quadrata* Zone'. The stratigraphical lowest sample was SAG201, which was collected from a hole in the floor of the pit, at the 'horizon of Belemnitella praecursor'.

Stensioeina granulata gracilis
Stensioein exsculpta incondita
Pullenia quaternaria

The concurrent range of *Pullenia quaternaria* and *Stensioeina granulata gracilis* suggests a position within BGS20iii (and laterally equivalent to the Whitecliff Marl to Scrathell's Marl 1 interval of southern England). SAG25 yielded an essentially similar fauna and although SAG26 and 27 lacked *P. quaternaria,* they yielded *Gavelinella clementiana* indicating a similar age (and it is worth noting that SAG27 also contained radiolaria).

Samples SAG28 and 29 were taken at a slightly different locality (TF971 429). *Gavelinella clementiana* and *Pullenia quaternaria* were present in SAG28 and SAG29 yielded specimens tentatively assigned to *Gavelinella usakensis* and *Gavelinella trochus* (two species that are very rare in Norfolk; they are normally found in southern England) and both are indicative of BGS20.

A seventh sample, SAG202, was collected from a 'pit by the new road beyond Hall Farm, near the river' (TF 978 435). This was the stratigraphically highest sample, collected from the 'hard bed near the top of the section'. The concurrent range of *Stensioeina granulata incondita* and *Gavelinella clementiana* places the sample in BGS20iii (= upper *quadrata* macrofaunal zone).

2.11 CHALK HILL FARM, WARHAM ST MARY

Four samples (SAG186 to 189) were collected from the bottom 7 feet of a 25 feet high section in a disused pit near Chalk Hill Farm, Warham St Mary, Norfolk. The collectors considered that this was 'restricted quadrata zone' and lower Campanian. All the sample were essentially similar, yielding:

Bolivinoides culverensis
Pullenia quaternaria
Gavelinella clementiana

In southern England these taxa are indicative of foraminiferal subzone BGS20iii (the upper *quadrata* macrofaunal Zone). In southern England they appear at the Whitecliff Marl and extend up to the base of Scratchell's Marl 1.

References

BAILEY, H.W., GALE, A.S., MORTIMORE, R.N., SWIECICKI, A. AND WOOD, C.J. 1983. The Coniacian-Maastrichtian stages of the United Kingdom, with particular reference to southern England. Newsletter on stratigraphy, 12, 29-42.

BAILEY, H.W., GALE, A.S., MORTIMORE, R.N., SWIECICKI, A. AND WOOD, C.J. 1984. Biostratigraphical criteria for the recognition of the Coniacian to Maastrichtian stage boundaries in the Chalk of north-west Europe, with particular reference to southern England. *Bulletin of the Geological Society of Denmark.*, 33, 31-39.

HART, M.B., BAILEY, H.W., CRITTENDEN, S., FLETCHER, B.N., PRICE, R.J. & SWIECICKI, A. 1989. Cretaceous. *In*: Jenkins, D.G. & Murray, J.W. (eds) *Stratigraphical atlas of fossil foraminifera, second edition*, 273-371.

PEAKE, N.B. & HANCOCK, J.M. 1961. The Upper Cretaceous of Norfolk. *In*: LARWOOD, G.P. & FUNNEL, B.M. (eds)*The Geology of Norfolk* (1978 reprint), 293-339.

WILKINSON, I.P.2000. A preliminary foraminiferal biozonation of the Chalk Group (In preparation for the Holostrat Project: Upper Cretaceous). *British Geological Survey Internal Report*, IR/00/13, 21pp.