

The stratigraphical distribution of Mid-Cretaceous Foraminifera near Ventnor, Isle of Wight

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ABSTRACT. Ventnor No. 2 Borehole, located near Ventnor, Isle of Wight, penetrated the basal part of the Chalk Group and the Selborne Group before terminating in the upper part of the Lower Greensand Group (Sandrock Formation). The borehole was examined for Foraminifera, and although they were not seen in the Sandrock Formation and Monks Bay Sandstone Formation, the remainder of the borehole yielded moderately low diversity assemblages dominated by agglutinated species. Foraminiferal zones 3 to 6 (*H. dentatus* to *M. fallax*/*M. rostratum* macrofaunal zones) were identified in the Gault Formation and zones 6 (lower) to 6a (*M. fallax*/*M. rostratum* to *A. briacensis* macrofaunal zones) were identified in the Upper Greensand Formation. Assemblages from the overlying West Melbury Marly Chalk Formation were used to identify foraminiferal zones BGS1-BGS3 (*M. mantelli* and *M. dixoni* macrofaunal zones).

Key words: Selborne Group, foraminifera, Isle of Wight, biostratigraphy

1 Introduction

Despite the fact that microfossils such as foraminifera have been widely used as biostratigraphical tools to subdivide and correlate Albian and Cenomanian successions of mainland Britain (e.g. Price, 1977, Carter and Hart, 1977; Hart et al., 1989, 1990; Hart, 1973, 2000, 2004; Woods et al., 2001, 2009; and references therein), the mid Cretaceous succession of the Isle of Wight has received scant attention. Albian and Cenomanian foraminifera from

outcrops at Compton Bay, Culver Cliff and Rocken End were outlined by Carter and Hart (1977), but microfaunal dating was generally inconclusive. The present work improves the calcareous microfaunal biostratigraphy by tracing foraminifera through the Albian and Cenomanian succession in Ventnor No.2 Borehole. Although the Sandrock and Monk's Bay Sandstone formations proved to be barren, foraminifera were recorded throughout the remainder of the borehole.

Ventnor no.2 Borehole (SOBI Registered number SZ57NE27; location: N.G.R. SZ 55666 77576, 101.36 m above O.D.) was sited, to the west of Ventnor, Isle of Wight (Fig. 1). It proved 17.17 m of the Chalk Group (West Melbury Marly Chalk Formation), 79.47 m of the Selborne Group (Upper Greensand and Gault formations) and 5.36 m of the Lower Greensand Group (Monk's Bay Sandstone Formation, formerly the Carstone of the Isle of Wight, and Sandrock Formation, base not seen). It was terminated at a depth of 144.06m.

2 Previous work

Although the first comprehensive taxonomic studies of Albian foraminifera from southern England were published over a century go (Chapman, 1891 - 1898), biostratigraphical applications were carried out much later (Hart, 1973; Carter and Hart, 1977; Price, 1977a,b; Hart et al., 1989). The foraminiferal zones originally recognised in the Gault formation were correlated to the 13 beds of Price (1874, 1876), but the scheme has gradually evolved with the addition of further zones and subzones (e.g. Hart, 1973; Carter and Hart, 1977; Hart et al., 1990, 2000), so that the numbering scheme has become somewhat cumbersome and in need of revision. In addition, there have been significant changes to the established standard ammonite zonal scheme for the Upper Albian (Owen and Mutterlose, 2006; Kennedy and Latil, 2007) (Table 1). This has resulted in difficulties in correlating the foraminiferal zonal scheme, which pre-dates these changes, with the new macrofaunal biostratigraphy, although

1 this has been attempted herein (Table 2). Faunas from the Upper Greensand (e.g. Carter and
2 Hart 1977; Woods et al., 2001) can be related to the well established Gault assemblages of
3 southern England mentioned above, although their use in detailed biostratigraphy is difficult
4 due to facies differences.
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9 Foraminiferal biostratigraphy of the British Chalk also began during the 1970's (e.g. Carter
10 and Hart, 1977). However, sample positions were not always related to detailed stratigraphical
11 and lithological information, limiting their usefulness somewhat. The biostratigraphical
12 scheme used for Ventnor Borehole No. 2 (Table 3) is based on several data sets (Hart et al.,
13 1989 and references therein), together with unpublished PhD theses and data gathered during
14 mapping throughout southern England by the British Geological Survey (Wilkinson, [herein](#)).
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26 **3 Stratigraphical framework**

27 The Albian (Monk's Bay Sandstone, Gault and Upper Greensand formations) and
28 Cenomanian (West Melbury Marly Chalk Formation) succession crops out across the central
29 part of the Isle of Wight, between Compton Bay and Sandown Bay, with a smaller exposure
30 in the Blackgang-Luccombe Bay area (Fig. 1). The lithostratigraphical units were defined by
31 Hopson (2005) and Hopson et al. (2008) and are therefore only briefly described herein.
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43 **3.1 Lower Greensand Group**

44 **The Sandrock Formation** straddles the Aptian/Albian boundary (e.g. Casey 1961; Owen,
45 1999). It comprises fine-grained, sometimes cross-bedded sandstones with a pebble bed at the
46 top and an erosive upper boundary (at 100.84 m depth in Ventnor No. 2 Borehole). The
47 single sample examined for calcareous microfaunas, from 101.5m, proved to be barren
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54 **The Monk's Bay Sandstone Formation** (Fig. 2), which comprises ferruginous, medium to
55 coarse-grained, often bioturbated sandstone, with occasional pebble beds, was defined by
56 Hopson et al. (2008). It varies considerably in thickness from 2 m at Compton Bay to 22 m at
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Red Cliff, but in Ventnor No. 2 Borehole it comprises 2.64 m of dark green, silty, medium to coarse grained sandstone with occasional 'coal' chips, overlain by 1.56 m of dark grey, orange-brown mottled, fine- to medium-grained sandstone with layers and lenses of dark grey clay and pockets of coarse sand and gravel. Although sparse, low diversity foraminiferal assemblages have been recorded in the formation (Hopson et al., herein). However, all samples from Ventnor No. 2 borehole proved to be barren.

3.2 *Selborne Group*

The Selbornian Stage of Jukes-Browne and Hill (1900) was formally modified to its lithostratigraphical counterpart, the Selborne Group, by Hopson et al. (2008).

The Gault Formation (Fig. 2) of the Isle of Wight differs considerably from the clays and silty clays at the type section at Copt Point, Folkestone. Here it comprises a succession of medium and dark grey, often bioturbated, silty and sandy clays, up to 30 m thick. In the lower part it becomes more arenaceous as it passes transitionally into the Monks Bay Sandstone Formation (the base is placed at the top of the uppermost brown sandstone). Gale et al. (1996) recorded minor lithological variations in the formation; alternations of silt, fine sand and clay rich units occur in the east of the island, but a more arenaceous siltstone occurs throughout the succession in the west. Insole et al. (1998) also pointed out that lithological variations occur in the distribution of glauconitic and phosphatic seams. In Ventnor No. 2 Borehole, medium to dark grey, micaceous silts and clays extend from 96.64 m up to 51.50 m depth. The boundaries are difficult to place in the borehole. The lower boundary is gradational passing up from fine sandstone (of the Monks Bay Sandstone) to micaceous siltstone, whereas the upper boundary passes up from micaceous siltstone to medium grey, slightly sandy, micaceous siltstone of the "Passage Beds" (basal Upper Greensand Formation).

The Upper Greensand Formation (Fig. 2), which attains a thickness of 45 m on the Isle of Wight, comprises glauconitic siltstones and fine-grained sandstones, with thin bands of

1 limestone and chert concretions. The lower boundary is transitional (silty Gault passes up into
2 fine sands), but the formational base is placed at the base of the first brown silt or fine-grained
3 sandstone. The formation was divided into six informal units by Jukes-Browne and Hill
4 (1900) and Osborne White (1921), but these were rationalised into three beds by Insole et al.
5 (1998): Passage Bed, Malm Rock Bed and Chert Bed (Table 4). The chert appears to have
6 been derived from solution of sponge spicules and radiolaria during an early stage of
7 diagenesis and prior to compaction (Insole et al., 1998). These organisms were frequently
8 found in the Upper Greensands of the Selborne area (Woods et al., 2001), but were not
9 observed in Ventnor No. 2 Borehole. The upper formational boundary is placed at an erosion
10 surface where pale, weakly glauconitic siltstone is overlain by dark green, glauconite-rich
11 calcareous sandstone (Glaconitic Marl Member at the base of the West Melbury Marly Chalk
12 Formation).

30 **3.3 Chalk Group**

31 **The West Melbury Marly Chalk Formation** (Fig. 2) was observed at the top of Ventnor No. 2
32 Borehole (down to 17.17 m depth), with 2.12 m of Glaconitic Marl Member at its base. The
33 cored succession (Fig. 3) correlates well with the succession at Compton Bay described by
34 Mortimore et al.. (2001). On the south side of the Isle of Wight, the West Melbury Marly
35 Chalk Formation comprises buff, grey and off-white, soft, marly chalk and hard grey
36 limestone arranged in couplets. The Glaconitic Marl Member consists of bioturbated,
37 glauconitic, calcareous sandstone and siltstone with phosphatic pebbles.

51 **4 Stratigraphical distribution of Foraminifera in Ventnor No. 2 Borehole**

54 **4.1 Gault Formation (Fig. 4)**

55 Foraminifera are not common in the lower part of the Gault and assemblages comprise
56 entirely agglutinated forms; *Tritaxia singularis*, *Cribrostomoides nonionoides rotunda*

(specimens resembling *C. n. angulosa* are probably partially crushed specimens) and *Haplophragmoides chapmani* dominate the faunas. These long ranging forms have their origins in the lower Albian and extend through much of the stage. Species characteristic of the lower Albian and the basal part of the Middle Albian (*dentatus* Zone), as described by Price (1977a,b) and Magniez-Jannin (1975) were not encountered, although the rare specimens of *Saccamina* sp might be synonymous with *Saccamina* sp.1 of Price (1977a). *Haplophragmoides chapmani* is rare in the lower Albian of Europe (Price, 1977a) and has not been recorded from the UK below the *lyelli* Subzone (*dentatus* Zone). Its first up-section occurrence in the basal Gault of Ventnor No. 2 Borehole is interpreted as being indicative of the basal *dentatus* Zone and equivalent to Foraminiferal Zone 3 of Carter and Hart (1977). *Arenobulimina macfadyeni* is a good marker for the Middle Albian where it is generally frequently found, but it extends into the *cristatum* Zone (basal Upper Albian). The species has a very patchy distribution between 88.0 m and 82.0 m and is probably indicative of the foraminiferal zones 3 or 4 of Carter and Hart (1977) and Price (1977a,b), although species of *Hoeglundina*, which is characteristic of these zones elsewhere, were not present.

Foraminifera with hyaline tests appeared at 78.15 m, with *Lenticulina rotula*, a species that is consistently present throughout the remainder of the Albian. This is a long ranging taxon with no biostratigraphical importance. However, it does appear to indicate a switch in lithological or palaeoenvironmental conditions such that, for the first time, hyaline species survive.

A fauna more characteristic of the mid-Albian appears for the first time at 70.6 m, including *Arenobulimina chapmani*, *Gavelinella intermedia*, *Gavelinella berthelini* and *Citharina pinnaeformis*. The last named was used by Carter and Hart (1977) as the zonal indicator for foraminiferal zones 4a and 5, species of *Hoeglundina* (absent in the present borehole) separating the former from the latter zone. Price (1977a) indicated that the *C.*

1 *pinnaeformis* became extinct at the top of the *varicosum* Zone (*binum/choffati* subzone), but
2 Hart et al. (1990) and Hart (2000) extended its range to the top of Bed XI (*inflatum* Zone). In
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4 the Ventnor No.2 Borehole this species is not common, but it was recorded at 70.6 and 61.65
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6 m, the highest record being immediately below the silt between the depths 59.32 and 51.50 m.
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8 This is very similar to the situation at Copt Point, Kent, where the last specimens of *Citharina*
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10 *pinnaeformis* are immediately underneath the silty Gault Bed XII.
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15 The first appearance of *Eggerellina mariae* at 64.65 m is also stratigraphically useful
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17 in that it is known to evolve in the upper part of Foraminiferal Zone 5 or close to the 5/5a
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19 zonal boundary (the range given by Carter and Hart, 1977, differs slightly from that given by
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21 Price, 1977a). Other species that appear for the first time at 64.5 m include *Valvulineria* aff.
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23 *loetterlei* (*sensu* Jannin, 1967), *Vaginulina mediocarinata* and *Bulbophragmium cylindracea*.
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25 The first appearance of *Valvulina* aff. *loetterlei* is in the *cristatum* Zone, and although it
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27 appears to be confined to that zone, its scarcity in the latest part of its range means the exact
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29 extinction level is not fully understood and may vary locally. In Ventnor No.2 Borehole,
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31 *Valvulina* aff. *loetterlei* ranges from a depth of 64.65 to 58.65 m, but is not seen in the highest
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33 Gault. *Vaginulina mediocarinata* first appeared in Europe in the *loricatus* Zone according to
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35 Price (1977a), but Hart et al. (1989) showed its first appearance to be in the uppermost
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37 *dentatus* Zone, although it is rare and patchy in the lower part of its range. However, in
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39 southern England it is consistently present in Foraminiferal Zone 4a of Carter and Hart (1977)
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41 (*cristatum* Zone) and through to the top of the Gault. It is not represented in the lower part of
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43 its range in the Ventnor No.2 Borehole. *Bulbophragmium cylindracea* (or possibly *Cribratina*
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45 *cylindracea*, the generic assignment is unclear) first appeared in the upper part of the
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47 *varicosum* Zone (*binum/choffati* subzones) and ranges through into the Cenomanian. Its
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49 presence in Ventnor No.2 Borehole is thus useful biostratigraphically.
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1 The upper part of the Gault in Ventnor No.2 Borehole is a siltstone. The lowest sample
2 examined contained only long ranging taxa, but *Gyroidinoides angulata* appeared at 55.1 m
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4 depth. Originally placed in the genus *Valvulineria*, this species shows an intermediate position
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6 between *Gyroidinoides praestans* and *Valvulina* aff. *loetterlei*, from which it apparently
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8 evolved in the *inflatum* Zone. *Gyroidinoides angulata* is confined to that zone judging from
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10 the information given by Jannin (1967) and Magniez-Jannin (1975), although zonal data are
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12 not abundant.
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17 Diminutive specimens of *Arenobulimina* cf. *sabulosa* appeared at 52.55 m, in the
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19 highest sample of Gault examined. Price (1977 a, b), Hart et al. (1990) and Hart (2000) placed
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21 its inception within the *inflatum* Zone, however its first appearance is at the base of Gault Bed
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23 XII according to Hart et al. (1989), i.e. within the *fallax/rostratum* zones. The rare specimens
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25 of *Arenobulimina sabulosa* recovered from the highest Gault, therefore, are stratigraphically
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27 useful.
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31 32 33 **4.2 Upper Greensand Formation (Fig. 5)**

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35 Despite the fact that the distribution of foraminifera through the Gault Formation of southern
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37 England has been studied in detail, faunas from the Upper Greensand are not as well known,
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39 the most detailed analysis being the BGS Selborne boreholes (Woods et al., 2001).
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43 "**Passage Beds**" (**Division A**): Foraminifera are generally less diverse than in the Gault and in
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45 general they are long-ranging. *Marssonella ozawai*, which was recovered from the basal
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47 "Passage Beds", at a depth of 51.05 m, is characteristic of the *fallax/rostratum* zones, its
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49 inception being in Bed XII of the Copt Point Gault succession (Hart et al., 1990; Hart, 2000)
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51 and then ranges up into the Cenomanian. *Gavelinella cenomanica* was recorded for the first
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53 time at 49.4 m, although it is rare and rather patchily distributed throughout the more
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55 arenaceous Upper Greensand of the Ventnor No. 2 Borehole. This species is rare in the upper
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57 part of the *varicosum* Zone of Europe, but becomes more frequent and consistently present in
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1 the *inflatum* Subzone and through into the Cenomanian (Price, 1977a,b). Hart et al. (1989,
2 1990) and Hart (2000) showed that in south-eastern England it first appeared in Foraminiferal
3 Subzone 6 (middle), at about the *rostratum/perinflatum* boundary interval. *Gavelinella*
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5 *cenomanica* becomes more numerous above 36.05m (where it accompanies *Hedbergella*
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7 *bentonensis*), possibly indicating Foraminiferal Subzone 6 (middle) at that level (see below).
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12 **“Malm Rock Bed” and “Chert Beds” (divisions B-F):** The five informal divisions recognised
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14 at Undercliff and Gore Cliff by Jukes Browne and Hill (1900) (see also Osborne White, 1921)
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16 appear to be represented in the Ventnor No.2 Borehole (Table 4).
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20 At 43.2 m, *Arenobulimina praefrankei*, *Tritaxia singularis* and *Valvulineria berthelini*
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22 appear for the first time in the borehole, although all are long ranging. *Arenobulimina*
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24 *praefrankei*, for example, first appears in the *inflatum* Zone and extends up to the top of the
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26 Albian (and into the Cenomanian according to some authors, see Friege and Price, 1982).
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28 *Valvulineria berthelini* evolved from *V. aff. loetterlei* within the *inflatum* Zone and then
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30 ranges through to the top of the Albian (Magniez-Jannin, 1975).
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35 The biostratigraphy of the lower part of the Upper Greensand (and "Passage Beds") is
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37 difficult to determine due to the dominance of long ranging taxa. However, at 38.85 the first
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39 specimens of planktonic foraminifera were found. They consisted entirely of *Hedbergella*
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41 *bentonensis*, a species that is particularly characteristic of Foraminiferal Zone 6 and which, in
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43 the Gault facies, may occur in flood proportions, particularly in Foraminiferal Subzone 6
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45 (middle) (Hart et al., 1990; Hart, 2000). Although not found in flood occurrences in the
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47 greensand facies as it does in the Gault, their sudden appearance is taken to reflect the zone 6
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49 incursion. Further north in the Selborne boreholes, planktonic foraminifera were not recorded
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51 in the Upper Greensand (Woods et al., 2001), although those boreholes yielded common
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53 radiolaria which were not encountered in the Ventnor No.2 Borehole. *Gyroidinoides*
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1 *praestans* entered the record at 30.9 m, although it appeared earlier in France (Jannin, 1967;
2 Magniez-Jannin, 1975).
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5 In the upper part of the Upper Greensand, *Arenobulimina frankei* makes its first
6 appearance at a depth of 21.55 m in Ventnor No. 2 Borehole. This species has been
7 misunderstood in the past, but Freig and Price (1982) clarified its taxonomic position. It
8 apparently evolved from *Arenobulimina prae فرانكي* in the late *perinflatum* Zone and Hart et
9 al. (1990) and Hart (2000) showed it to be a good marker for foraminiferal Subzone 6 (upper).
10 It is often accompanied by *Lingulogavelinella jarzevae*, a species that was present between
11 21.55 m and 17.70 m depth, a little below a bored and bioturbated surface at 17.17 m. The
12 latter species is known from Foraminiferal Subzone 6 (middle) of Hart et al. (1990), but is
13 more consistently present from the upper part of Foraminiferal Subzone 6 (upper) and through
14 to the Cenomanian. Its first up-hole appearance is a useful index for the upper part of the
15 *rostratum* zone.
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31 The presence of *Arenobulimina chapmani* in the sample from 17.70 m proves that the
32 biostratigraphical age is no younger than Foraminiferal Subzone 6 (upper). According to Hart
33 et al. (1989, 1990) it is not present in Foraminiferal Zone 6a, although Price (1977a,b) showed
34 that it ranged into the basal part of the zone, which he placed in his Foraminiferal Subzone
35 9(i). The fauna at a depth of 17.70 m also contained the first specimens of *Arenobulimina*
36 *advena*. This is essentially a Cenomanian species, but Hart et al. (1989, 1990) showed that its
37 first occurrence is within Foraminiferal Zone 6a and Price (1977a,b) shows it is a
38 characteristic element of his foraminiferal subzones 9(ii) and 9(iii). Foraminifera Zone 6a falls
39 within the *briacensis* Zone at the top of Gault Bed XIII. *Arenobulimina chapmani* and
40 *Arenobulimina advena* are believed to be mutually exclusive so that their co-occurrence in the
41 present sample may be the result of bioturbation.
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4.3 West Melbury Chalk Formation (Fig. 6)

The distribution of foraminifera in the Cenomanian of the Isle of Wight is poorly known compared to the higher chalks and depends primarily on the discussion of Carter and Hart (1977).

Glaconitic Marl Member: The foraminiferal faunas from the base of the Glaconitic Marl Member (at the base of the West Melbury Marly Chalk Formation) lack many of the characteristic species associated with Upper Cretaceous Foraminiferal Zone BGS1. However, *Arenobulimina anglica* is present in the sample from 17.1 m indicating the Cenomanian and *Rotalipora appeninica*, the first keeled planktonic species to enter the British area, was also recorded. The latter species appears later in the British succession compared to the Tethyan province, and although it is known to occur in the Cenomanian of south east England, where it is a useful local marker, there is a possibility that it first appeared during the latest Albian, in the upper part of Bed XIII of the Gault in Kent (Hart et al., 1989). The fauna at 16.6 m in Ventnor No. 2 Borehole is essentially similar to that at 17.1 m, and although diversity is increased at this depth, the additional taxa are generally long ranging Late Albian to Cenomanian species.

"Chalk Marl": The first specimens of *Pseudotextulariella cretosa* were encountered at a depth of 15.3 m. This species is characteristic of Foraminiferal Zone BGS2 (Zone 9 of Carter and Hart, 1977; UKB3 of Hart et al., 1989), the base of which is placed in the topmost *carcitanense* macrofaunal Subzone (Hart, 2000). Carter and Hart (1977) placed their Foraminiferal Zone 8/9 boundary in the upper part of their "Upper Greensand with Stone Bands" at Compton Bay and Culver Cliff (Isle of Wight) – at an erosion surface at the former locality and at a stone band at the latter. The stone horizon and erosion surface were not identified in Ventnor No.2 Borehole, although a marl seam was observed immediately below but the base of BGS2 at 15.40 m.

1 The upper 6 to 7 m of the borehole is difficult to date biostratigraphically, but the base
2 of Foraminifera Zone BGS3 in Ventnor No. 2 Borehole is tentatively placed at a depth of
3 circa 7.0 m, above the last specimens of *Marssonella ozawai*, although the absence of this
4 species in the highest levels may be the result of sample failure. Carter and Hart's (1977)
5 Foraminiferal Zone 9/10 boundary (which equates with UKB3/UKB4 boundary of Hart et al.,
6 1989) is above an interval with abundant sponges and immediately below a bed of phosphatic
7 nodules at Compton Bay and Culver Cliff (Isle of Wight). In Ventnor No.2 Borehole,
8 phosphatic nodules occur at about 5.6 m depth and sponges were observed from 4.75 m depth
9 through to the top of the core. Foraminiferal Zone BGS4 (defined by the inception of
10 *Flourensina mariae* and *Plectina cenomana*) was not recognised. Comparison with other Isle
11 of Wight successions shown in Table 5 indicates consistency with the interpretations for the
12 Culver Cliff and Compton Bay successions given by Carter and Hart (1977).
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31 5 Conclusions

32 Much of the Albian succession of the Ventnor No.2 Borehole was subdivided into the
33 foraminiferal zones recognised in the Gault of southern England and elsewhere in Europe.
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36 1. The Sandrock and Monks Bay Sandstone formations are barren of foraminifera and no
37 biostratigraphical conclusions are possible.
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39 2. The lower part of the Gault Formation yielded only long-ranging foraminifera but the
40 appearance of consistently occurring *Haplophragmium chapmani* suggests the base of the
41 Mid Albian and Foraminiferal Zone 3 (of Carter and Hart, 1977; Price, 1977a). The presence
42 of *Arenobulimina* cf. *macfadyeni* between 88.0 and 82m confirms foraminiferal zones 3 or 4.
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44 However, the absence of species of *Hoeglundina* precludes further subdivision of the lower
45 part of the Gault.
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3. The first evidence of Foraminiferal Zone 5 was at a depth of 70.6 m, with the inception of *Citharina pinnaeformis*. The top of the zone is placed at 61.65 m. In south eastern England, the top of Zone 5 equates with the top of Gault Bed XII.

4. The silty part of the Gault above 59.32 m is tentatively equated, at least in part, with Bed XII of Kent. This is based on the last appearance of *Citharina pinnaeformis* (Foraminiferal Zone 5) and the first appearance of *Arenobulimina sabulosa* (Foraminiferal Zone 6) towards the top of the unit, at a depth of 52.55 m.

5. 'The Passage Beds' fall within Foraminiferal Subzone 6 (lower). The remainder of the Upper Greensand is placed in Foraminiferal Subzone 6 (middle) and Subzone 6 (upper), Foraminiferal Zone 6a appears to be represented at 19.7 m with the appearance of *Arenobulimina advena*, although there is a possibility that bioturbation and burrowing is the cause for the apparent presence of zone 6a.

6. Foraminiferal Zone BGS 1, including *Arenobulimina anglica* and *Rotalipora appeninica* was found in the lower part of the Glauconitic Marl (17.1-15.40 m depth). The facies controlled foraminiferal subzone BGS 1i, which equates with UKB1 of Hart et al. (1989), was not recognised

7. Foraminiferal Zone BGS 2 faunas, including *Pseudotextulariella cretosa* and *Marssonella ozawai*, were encountered between 15.3 and 7.0 m depth. Although evidence is equivocal, the remainder of the borehole is tentatively assigned to Foraminiferal Zone BGS 3.

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Figure captions

Fig. 1. Geological Sketch map of the Isle of Wight showing the localities mentioned in the text.

Fig. 2. Albian- Lower Cenomanian stratigraphy of southern England. Macrofaunal zonation after Owen and Mutterlose (2006) and Kennedy, W.J. and Latil, J.-L. (2007).

Fig. 3. Stratigraphy of the Cenomanian Chalk in the Ventnor No. 2 Borehole and its suggested correlation with the Compton Bay Succession.

Fig. 4. The distribution of foraminifera through the Gault Formation of Ventnor No. 2 Borehole.

Fig. 5. The distribution of foraminifera through the Upper Greensand Formation of Ventnor No. 2 Borehole.

Fig. 6. The distribution of foraminifera through the West Melbury Chalk in the Ventnor No. 2 Borehole.

Table Captions

Table 1. The ‘traditional’ ammonite zonal scheme of the Upper Albian of England correlated with the modified scheme after Owen and Mutterlose (2006) and Kennedy and Latil (2007)

Table 2. The foraminiferal zonation scheme for the Albian of southern England.

Table 3. Foraminiferal zonal scheme in the lower Cenomanian of southern England (the UKB scheme is after Hart et al., 1989, and the BGS scheme follows Wilkinson, [herein](#)). GMM: Glauconitic Marl Member.

Table 4. Subdivision of the Upper Greensand in Ventnor No. 2 Borehole, based on definitions by Jukes-Browne and Hill (1900) and Osborne White (1921) and Insole et al, 1998.

Table 5. Comparison of the thickness of lower Cenomanian foraminiferal zones in three localities in the Isle of Wight (data for Compton Bay and Culver Cliff from Carter and Hart, 1977).

Table

‘Traditional’ macrofaunal biostratigraphy		Revised macrofaunal biostratigraphy	
Zones	Subzones	Zones	Subzones
S dispar	No macrofaunal subzone	A briacensis	
	M perinflatum	M perinflatum	
	M rostratum	M rostratum	
		M fallax	
M. inflatum	C auritus	M. inflatum	
	H varicosum	H varicosum	H choffati
			H binum
	H orbigny		H orbigny
	D cristatum	D cristatum	

Lithostratigraphy				Macrofaunal zonation		Foraminiferal zones and defining faunas	
				Zones	Subzones		
Late Albian	Gault Bed XII		Upper Greensand Formation	A		8a	Concurrent range of <i>Arenobulimina</i> (<i>Arenobulimina</i>) <i>sabulosa</i> and <i>Flourensina</i> (<i>Flourensina</i>) <i>intermedia</i> with typically Cenomanian <i>Arenobulimina</i> (<i>Voloshinoides</i>) <i>advena</i> . <i>Citharinella lafferi</i> is restricted to the zone. Known only in the English Channel and Surrey.
				M			
				M			
				M			
				M			
	Gault Bed IX			H	H choffati	5	Citharinella pinnaeformis Assemblage Zone. FAD of <i>Eggerellina marae</i> .
					H. sinum		
					H. ortignyi		
	VIII			D	D cratatum	4a	Concurrent range of <i>Epistominella spinulifera</i> and <i>Citharinella pinnaeformis</i> .
Gault Bed VII		E	A diversa	4	Concurrent range of <i>Hoeglundina carpenteri</i> and <i>Dorothyia filiformis</i> .		
			E. nodosa				
			E. maandhrus				
			M. subclavatus				
			D. noble				
			A. intermedius				
Gault Bed I		H	H. spathi	3a	Arenobulimina macdadyeni. FAD of <i>Conoroides lampughii</i> and <i>Gavelinella tomnensis</i> . This fauna is transitional to the more calcareous assemblages above and equates with the upper part of Zone 2, 3a and 3b of Price (1977).		
			L. lyelli				
			H. eodentatus				
O. aurifrons		P. steinmanni	2	FAD of <i>Arenobulimina macdadyeni</i> together with <i>Lingulogavelinella</i> spp. <i>Fabogaudryina moesiana</i> , <i>Psilochorina</i> spp and <i>Gavelinella intermedia</i> . Rare <i>Hedbergella</i> appear for the first time in the Albian. Known in Germany & France (Price, 1977), the Carlstone of Yorkshire (Dilley, 1999) and as Zone E in the Upper A Beds of the Speeton Clay Formation, Yorkshire (Underwood & Mitchell, 1999).			
		O. bullensis					
		P. putosianus					
		O. naulinarus					
		C. fontium					
S. chalcidus		S. Alchovi	1	FAD of <i>Rhipidomina cf. dichotoma</i> , with longer ranging <i>Rhipidomina minuta</i> , <i>Ammonitoceras gaultina</i> , <i>Gilmorella gaultina</i> , <i>Rhipidomina lagenarium</i> & <i>Textularia minuta</i> (Price, 1977). Zone D (Underwood & Mitchell, 1999) in the Lower A Beds of the Speeton Clay Formation, Yorkshire.			
		S. perforatum					
L. sandelcarata		L. regularis	1	FAD of <i>Rhipidomina cf. dichotoma</i> , with longer ranging <i>Rhipidomina minuta</i> , <i>Ammonitoceras gaultina</i> , <i>Gilmorella gaultina</i> , <i>Rhipidomina lagenarium</i> & <i>Textularia minuta</i> (Price, 1977). Zone D (Underwood & Mitchell, 1999) in the Lower A Beds of the Speeton Clay Formation, Yorkshire.			
		L. acuticostata					
		L. schrammii					

Table

	Stratigraphy	Standard zonal scheme		Foram Zonal scheme and defining indices	
Early Cenomanian	West Melbury Marly Chalk	<i>M. dixon</i> Zone		B.G.S. 3 (=UKB4)	'Interregnum zone' between the extinction of <i>Marssonella ozawai</i> and <i>Quinqueloculina antiqua</i> and the appearance of <i>Flourensina (Flourensina) mariae</i> and <i>Plectina cenomana</i> . The extinction of <i>Lingulogavelinella jarzevae</i> and inception of <i>Rotalipora reicheli</i> are within the zone.
				B.G.S. 2 (=UKB3)	Base: FAD of <i>Pseudotextulariella cretosa</i> & the LAD of <i>Flourensina (Flourensina) intermedia</i> . Top: LAD of <i>Marssonella ozawai</i> & <i>Quinqueloculina antiqua</i> .
	GMM	<i>M. mantelli</i> Zone	<i>M saxbii</i> Subzone	B.G.S. 1 (=UKB1-2 of Hart et al., 1989)	Base: FAD of <i>Plectina mariae</i> and <i>Hagenowina anglica</i> . <i>Flourensina (Flourensina) intermedia</i> , common <i>Hagenowina advena</i> & <i>Arenobulimina (Sabulina) sabulosa</i> also present. <i>Flourensina (Vialovella) praefrankei</i> becomes extinct in the lower <i>carcitanense</i> Subzone. BGS1i (=UKB1 of Hart et al., 1989) does not occur in the study area
			<i>S schlueteri</i> Subzone		
			<i>N carcitanense</i> Subzone		

Table 2. Foraminiferal zonal scheme in the lower Cenomanian of southern England.
(GMM: Glauconitic Marl Member)

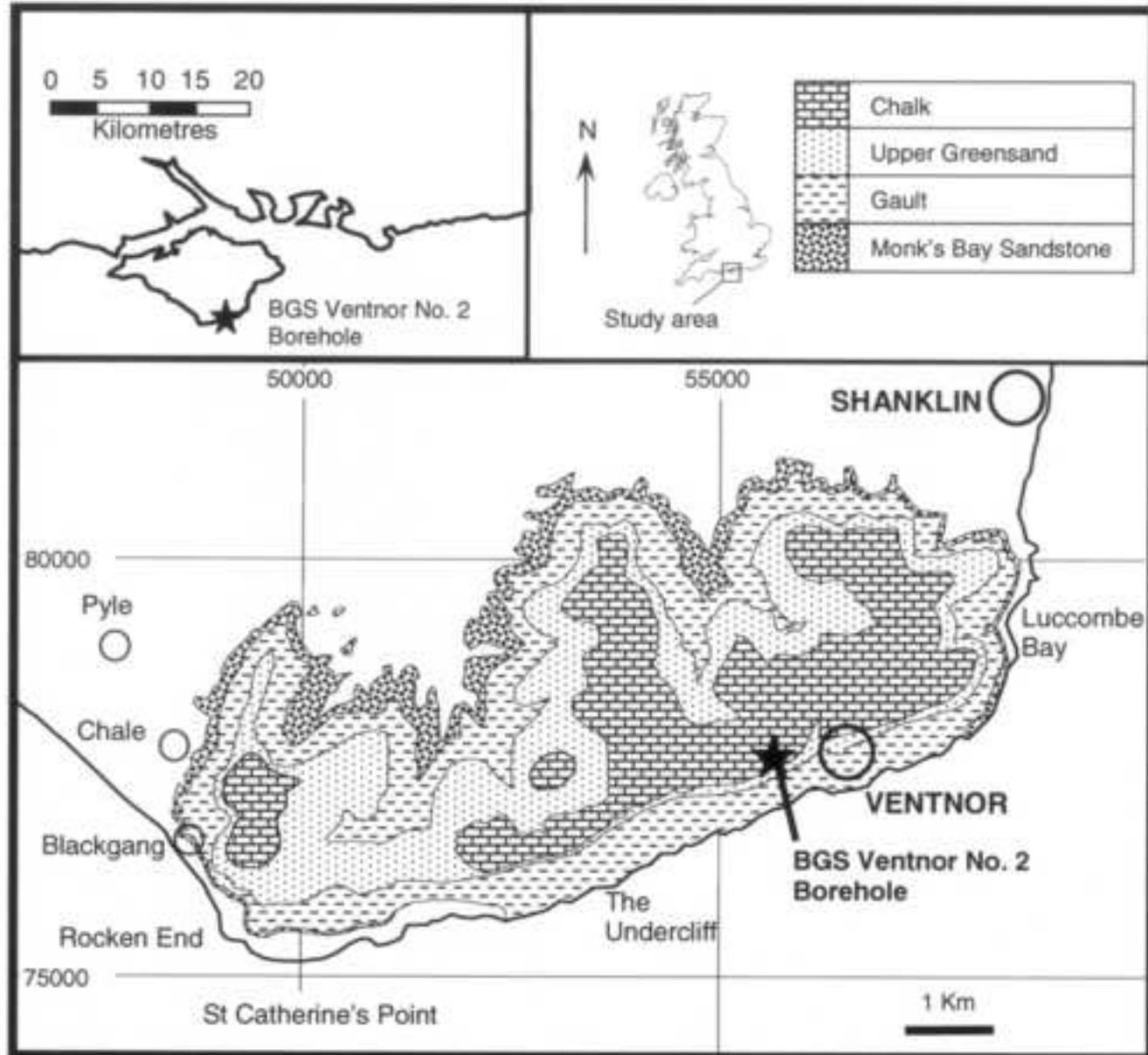
Subdivisions of Jukes-Browne & Hill, 1900; Osborne White, 1921	Insole et al., 1998	Ventnor No. 2 Borehole	
		Top	Base
F. Sands with layers of calciferous concretions, often partly phosphatised	Chert Bed: grey and buff, glauconitic siltstones and fine-grained sandstones with bands of grey, siliceous and calcareous concretions.	17.17	17.90
E. Chert Beds		17.90	23.97
D. Firestones & freestones	Malm Rock Bed: grey or buff, glauconitic, fine-grained sands and sandstones with irregular bands of large calcareous concretions and small phosphatic nodules.	23.97	27.73(?)
C. Sandstones with phosphatic nodules & courses of large calcareous doggers		27.73(?)	33.25
B. Rough Sandstone with irregular concretions		33.25	43.96
A. Grey sandy clay and micaceous silt ('Passage Beds')	Passage Bed: an alternation of grey and pale brown, micaceous sandy siltstones and fine-grained, argillaceous buff sands (the latter become thicker up sequence)	43.96	51.50

Table

Foraminiferal zones			Thicknesses (m) in the Isle of Wight		
Wilkinson (2000 and herein)	Hart et al. (1989)	Carter & Hart (1977)	Compton Bay	Culver Cliff	Ventnor No.2 Borehole
BGS3	UKB4	10	c. 10.4 m	c.8.8 m	6.40+ m (top not seen)
BGS2	UKB3	9	c. 5.75 m	c.7.0 m	c. 9.0 m
BGS1	UKB2	8	c. 1.5 m	c. 1.7 m	c. 1.77 m

Figure

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Stage/ Substage		Macrofossil zonation		Lithostratigraphy									
		zones	Subzones	Group	Subgroup	Formation		Member					
CENOMANIAN (part)	Lower	<i>M dixonii</i>		Chalk (part)	Grey Chalk (part)	West Melbury Marly Chalk		Glaucconitic Marl					
		<i>M mantelli</i>	<i>M saxbii</i>										
			<i>S schlueteri</i>										
			<i>N carcitanense</i>										
ALBIAN	Upper	<i>A. briacensis</i>		Selborne		Upper Greensand							
		<i>M. perinflatum</i>											
		<i>M. rostratum/ M. fallax</i>											
		<i>M inflatum</i>											
		<i>H varicosum</i>	<i>H choffati</i>						Gault				
			<i>H. binum</i>										
			<i>H orbigny</i>										
		<i>D cristatum</i>											
	Middle	<i>E lautus</i>	<i>A daviesi</i>			Lower Green-sand					Monks Bay Sandstone	Folkestone	
			<i>E. nitidus</i>										
		<i>E loricatus</i>	<i>E meandrinus</i>										
			<i>M subdelaruei</i>										
			<i>D niobe</i>										
			<i>A intermedius</i>										
		<i>H dentatus</i>	<i>H spathi</i>										
			<i>L lyelli</i>										
	Lower	<i>O. auriformis</i>	<i>H. eodentatus</i>	Sandrock (part)									
			<i>P steinmanni</i>										
			<i>O bulliensis</i>										
			<i>P puzosianus</i>										
			<i>O raulinianus</i>										
		<i>S chalcensis</i>	<i>C floridum</i>										
			<i>S kitchini</i>										
			<i>S perinflatum</i>										
		<i>L. tardefurcata</i>	<i>L regularis</i>										
			<i>L acuticostata</i>										
			<i>L. schrammeni</i>										

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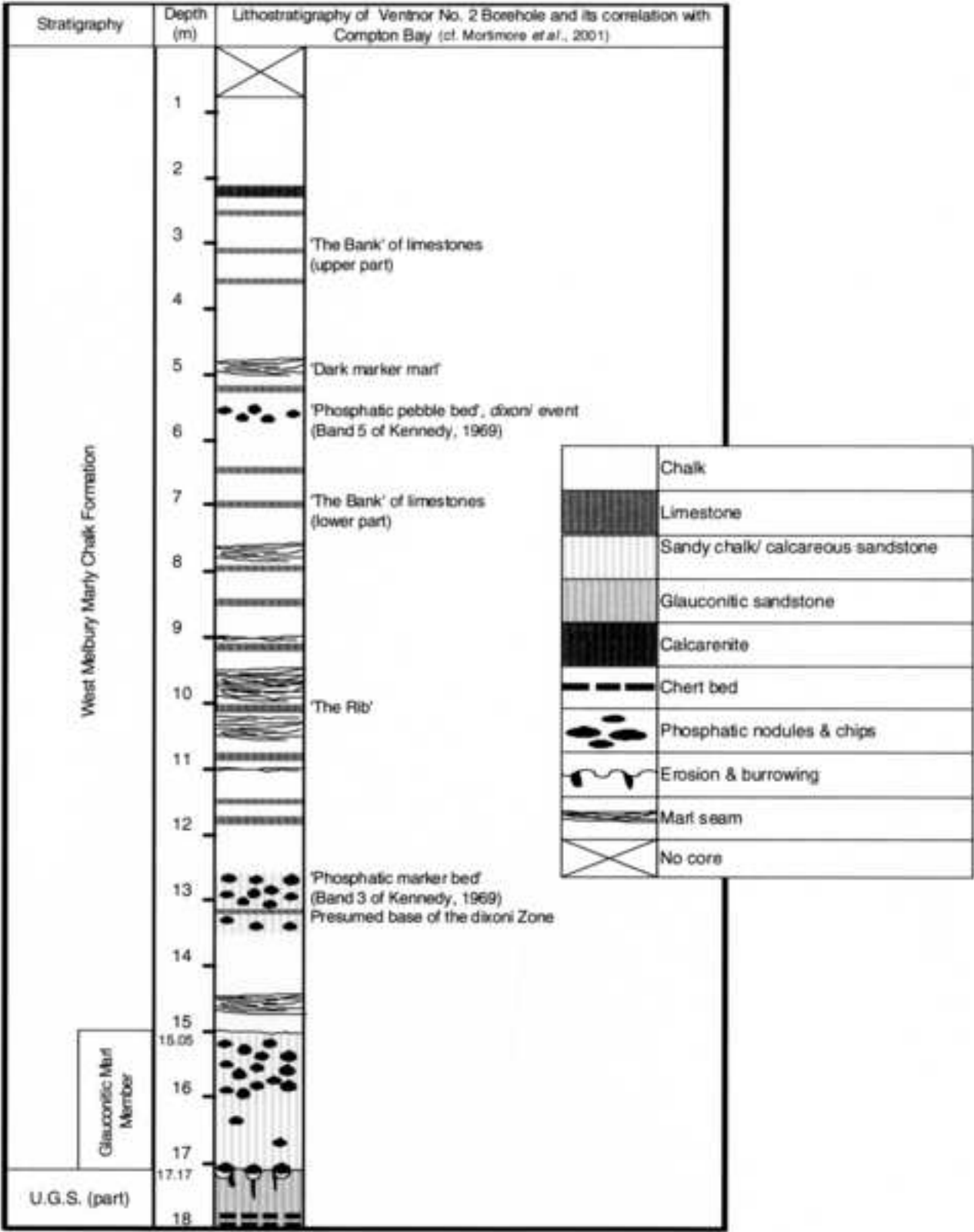


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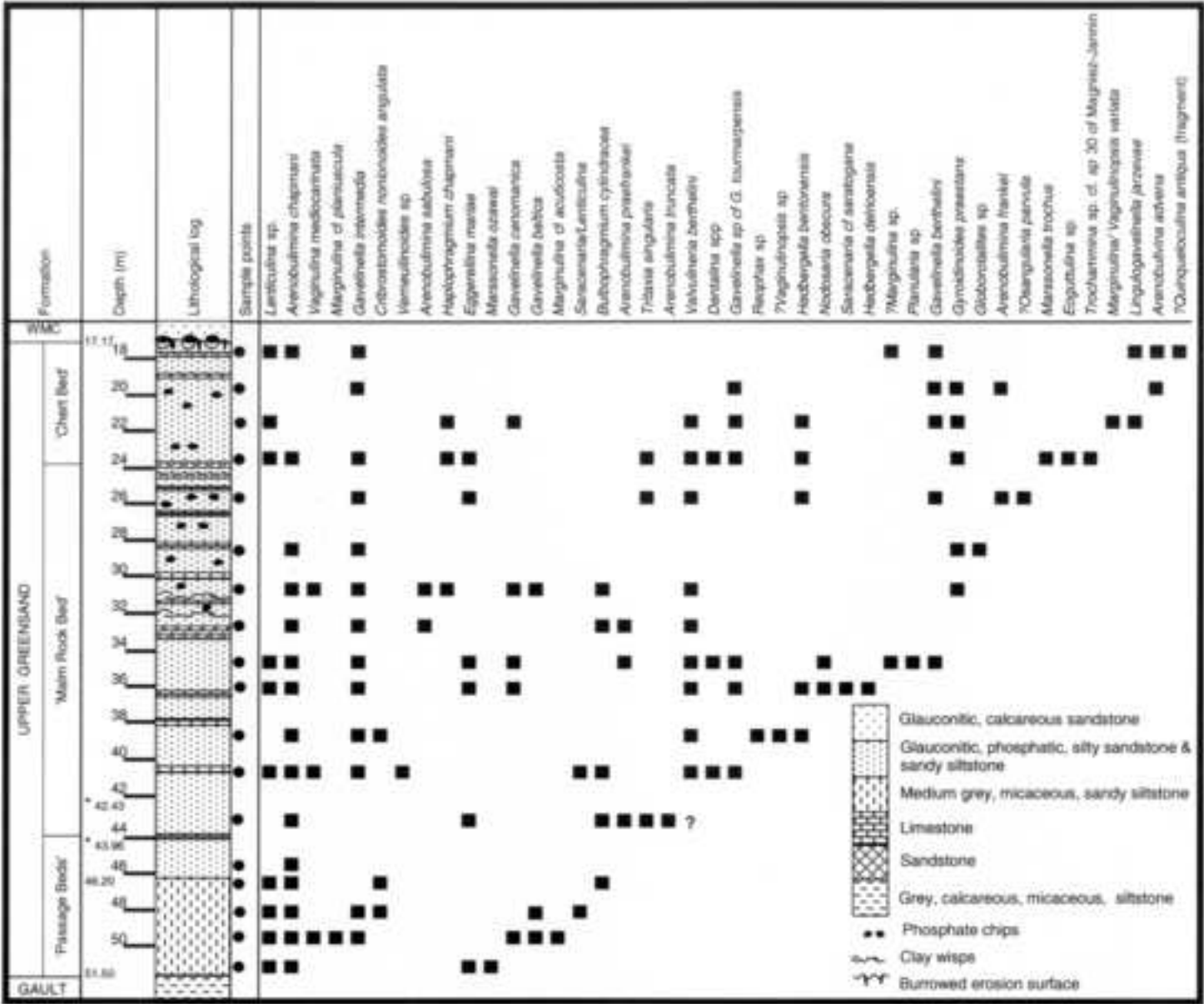
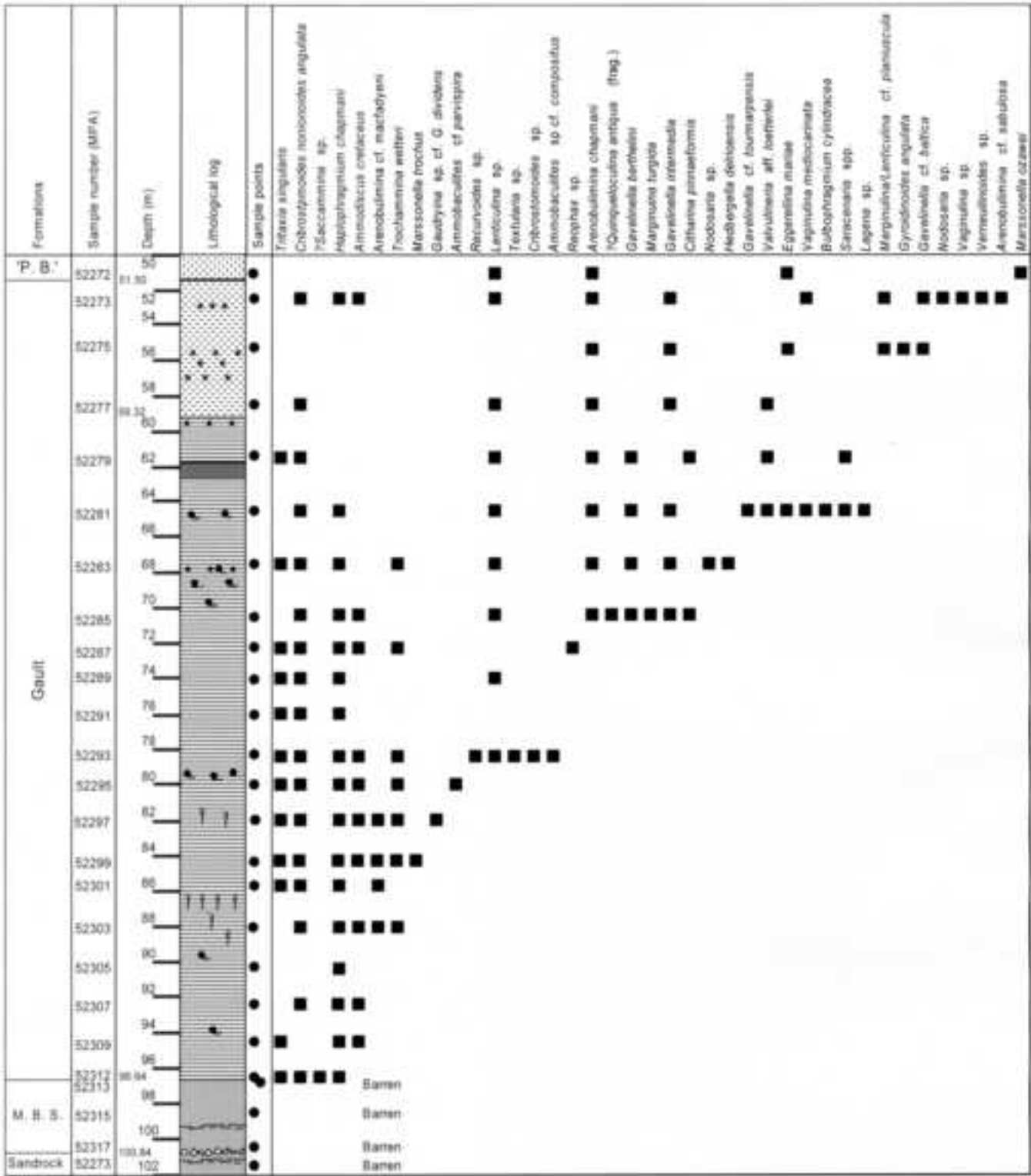


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P. B. = Passage Beds (part.)
M.B.S. = Monks Bay Sandstone Formation

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