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Provenance of chalk tesserae from Brading Roman Villa, Isle of Wight, UK

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ABSTRACT

Thin section petrographical analysis of chalk tesserae at Brading Roman Villa, Isle of Wight, England, identifies a range of planktonic foraminifera and the calcareous algal cyst *Pithonella* that identify the Late Cenomanian *Rotalipora cushmani* Biozone (BGS Foraminiferal Biozones 4iii to 7). The local chalk crop to the north of the villa includes rocks of *R. cushmani* Biozone age, and indicates a likely local, rather than long distance, source for the tesserae. Microfossils provide a powerful tool for identifying the provenance of artefacts in Roman Britain.

Keywords: Roman mosaics; chalk tesserae; foraminifera; *Rotalipora cushmani* Biozone; provenance

1. Introduction

It has been recognised for some time that establishing the provenance of the materials used to manufacture mosaics in Roman Britain has the potential to improve our understanding of how raw mosaic materials were sourced and transported and how the trade itself might have been organised. However, as recently as 2002, the authors of a corpus of Roman mosaics of Britain were able to note how little research had been carried out into the composition of the materials from which the tesserae (small stone cubes) used to construct the mosaics were manufactured (Neal and Cosh, 2002:19).

Since then the field has advanced considerably. Studies of stone materials dating to the Roman period, including tesserae, have been carried out using microfacies classification (Flügel and Flügel, 1997; Flügel, 1999, 2004), petrology (Allen and Fulford, 2004; Allen et al., 2007), an integrated approach including geochemistry (Hayward, 2009), and microfossil analysis (Wilkinson et al., 2008). The results have been informative. We know now, for instance, that boulders and pebbles of Mesozoic carbonates and sandstones found locally in Pleistocene and Holocene glacial sediments provided the raw material for mosaic tesserae from two villas close to Augsburg (*Augusta Vindelicum*) in Bavaria (Flügel, 1999); that dolomitic cementstone and burned clay sourced from the Upper Jurassic Kimmeridge Clay Formation in Dorset contributed the raw material for mosaics found at Silchester (Allen and Fulford, 2004); and that Caen limestone and similar freestones from the Jurassic, Upper Cretaceous and Tertiary periods were imported from widely separate outcrops in northern and central France during the first century AD (Hayward, 2009). This paper examines the contribution that microfossil analysis can make to the question of materials provenance, using as an example chalk tesserae from mosaics at Brading Roman Villa in the Isle of Wight, UK.

Chalk was widely used in Roman mosaics to provide white backgrounds for figured mosaics and to provide contrast to darker lithologies in bichrome and polychrome geometric patterns. The rock itself is composed almost entirely of microfossils (principally foraminifera, ostracods and nannofossils). Microfossils are particularly useful tools with which to provenance stone mosaic materials. They are very small (ostracods being typically 1-2 mm in length, foraminifera being generally <1mm in diameter and nannofossils being measured in microns) and so can be recovered from small samples such as tesserae, which are typically only about 1.5 cm^3 in size and often smaller; the groups of organisms preserved as microfossils generally evolved rapidly and were often extremely abundant; and they were also geographically widespread and occur in a wide variety of sedimentary rock types. These qualities have enabled successions of rock strata to be characterised on the basis of their microfossil content (biostratigraphy).

Biostratigraphic units can be correlated between regions to form biozones based on the presence or absence of particular species or assemblages. This has enabled the Chalk Group to be characterised by a succession of foraminiferal biozones (Wilkinson, 2000). These foraminiferal biozones, together with the spatial distribution of rocks of that biostratigraphic age, provide the basis for the determination of provenance of the chalk tesserae.

2. Archaeological background

Archaeological evidence suggests that the Isle of Wight was well populated during the Roman occupation (Tomalin, 1987; Lyne, 2007). Farm and villa sites, domestic artefacts, coin hoards and evidence of industrial activity all point to a relatively prosperous community on the island. Industrial activities included iron, lead and copper working at Yaverland; stone quarrying for Bembridge Limestone and 'Quarr Stone' at Quarr; and salt production at Barnes Chine, Grange Chine, Fishbourne and Redcliff (Trott, 2002; Pearson, 2006; Tomalin, 1990). Local industries included the production of Vectis Ware during the second and third centuries AD, which does not seem ever to have become large scale; tile manufacture at Combley; and a possible winery at Rock, suggesting that viticulture as well as agriculture may have been practised at the villas and farmsteads (Lyne, 2007). Between AD 250 and 270 a phase of newly built and expanded villas and farmsteads reflects a period of increased prosperity: substantial Roman stone-built farmsteads or villas are known at Bowcombe (Sydenham, 1945); Brading (Price and Price, 1881; 1890); Carisbrooke (Spickernell, 1859; Rigold, 1969); Clatterford (Kell, 1856; Busby et al,. 2001); Combley (Sydenham, 1945; Fennelly, 1969, 1971); Gurnard (Kell, 1866); Rock (Goodburn et al., 1976; Tomalin, 2006) and Shide, at Newport (Sherwin, 1929; Stone, 1929). There is another possible villa site at Watergate Newport (Frere and Tomalin, 1991).

Brading is one of four Roman villas on the island known to have installed mosaics. The villa is sited on the Ferruginous Sandstone Formation (part of the Lower Greensand Group), a few hundred metres south of Brading Down, the local section of the Chalk ridge that runs across the island from The Needles in the west to Culver Cliff in the east (Figure 1). The main building faces east and overlooks an alluvial plain that once formed a small harbour (Brading Haven) at the mouth of the East Yar; the harbour is now silted up and the villa is about 1.5 km from the coast. The site was first excavated in the late nineteenth century, but it was poorly understood and a definitive history was never determined. The fine figured mosaics in the west range of the villa are normally dated to around the mid-fourth century AD, but the results of a recent excavation by Kevin Trott suggested the possibility of an earlier, late third century date (Neal and Cosh 2009: 262-280, especially 263). This excavation will be re-evaluated in the context of the results of further excavation and research on the villa and its development currently being undertaken by Professor Sir Barry Cunliffe. Interim reports on the first two seasons' work on the north and south ranges have already been published (Cunliffe 2009; 2010).

3. Analysis of material

Both stratified and unstratified chalk tesserae were obtained from Brading Roman Villa. Stratified material is traceable to a particular archaeological context, as its reference number records the level in the excavation at which it was found. All the chalk tesserae examined in this study appeared to be unaltered (i.e. country rock). Five unstratified chalk tesserae were chosen initially for processing. These were very hard and neither of the methods described by Slipper (1997) for processing hard chalks (using white spirit and sodium hexametaphosphate or the freeze-thaw technique using sodium sulphate decahydrate) succeeded in disaggregating the chalk sufficiently to release microfossils. Five stratified tesserae were therefore thin sectioned; two thin sections were cut at right angles from each tessera. Microfossils found in the thin sections were photographed using a petrological microscope equipped with a JVC KYF55B digital camera and imaged using a Hitachi 3200N scanning electron microscope. All but two of the thin sections revealed foraminifera, although only in three thin sections were these relatively common. The results are summarised in Table 1.

4. Biostratigraphical analysis of tesserae

The microfossils identified in thin section from the chalk tesserae from Brading Roman Villa (Table 1) include, in one tessera (MPA 61053), the index species *Rotalipora cushmani* (Figure 2.1). It is reasonable therefore to assign the chalk from which this tessera was made to the *Rotalipora cushmani* planktonic foraminiferal biozone of the Mid-to-Late Cenomanian (Hart et al., 1989). This biozone corresponds to BGS Foraminiferal Biozones 4iii to 7 (s*ensu* Wilkinson, 2000) which are shown in Figure 3. The abundance of the calcareous algal cyst *Pithonella sphaerica* and the occasional appearance of *Pithonella ovalis* in several of the Brading thin sections also strongly support a Late Cenomanian date, as *P. sphaerica* dramatically increased in abundance during the *Calyoceras guerangeri* macrofaunal Biozone and reached flood proportions in the early Turonian (Wilkinson, 2011, in this issue). Data on the frequency and abundance of Pithonellid blooms in Upper Cretaceous strata are also shown in Figure 3. Foraminifera found in other Brading thin sections include long-ranging planktonic species such as *Hedbergella brittonensis*, *H. delrioensis* and cf *Heterohelix.* Examples of the pithonellid bloom and a planktonic (*Hedbergella* sp) and benthonic (*Arenobulimina* sp) foraminiferid from the Brading thin sections are illustrated in Figure 2.

Five samples collected by the British Geological Survey (BGS) from the chalk outcrop of Brading Down were studied in order to compare local chalks with those used to manufacture the tesserae found at the villa. The locations of the five BGS sampling points and their respective grid references are shown on Figure 2. The chalk outcrop is relatively narrow in this part of the Isle of Wight, but the West Melbury Chalk to Culver Chalk formations (Figure 3) can be observed over a relatively short distance before the Chalk Group disappears below the Palaeogene. The Chalk Group to the north of the villa forms the near vertical northern limb of the Sandown Monocline and structural induration of the chalk made it impossible to disaggregate the BGS samples for micropalaeontological studies. All conclusions therefore are based on the analysis of thin sections.

Microfossil analysis suggests that the five BGS samples all represent chalk of the Cenomanian or Early Turonian stages of the Upper Cretaceous. The thin section from Locality 2 contained only a sparse foraminiferal assemblage, comprising predominantly simple unkeeled, planktonic species such as common *Hedbergella delrioensis,* together with *Hedbergella brittonensis* and *Heterohelix* sp. cf. *moremani;* this is interpreted as representing the Cenomanian West Melbury Chalk Formation. A little higher in the succession, at Locality 3, benthonic taxa were more numerous, including *Arenobulimina* cf. *anglica, Gavelinella cenomanica, Plectina* cf. *cenomanica* and *Lenticulina rotula,* suggesting Foraminiferal Subzones BGS4i-BGS4ii (*sensu* Wilkinson, 2000). It is probable therefore that Locality 3 represents the Mid-Cenomanian West Melbury/ZigZag formational boundary.

Foraminifera at Locality 1 were sparse and again comprised mainly simple, non-keeled planktonics (*Hedbergella delrioensis, H. brittonensis*) together with rare benthonic species (*Gavelinella* sp.). At Locality 4, planktonic species such as *Hedbergella brittonensis* and *H. delrioensis* were also observed, together with a moderately diverse benthonic assemblage including *Arenobulimina advena, Gyroidinoides praestans, Valvulineria* sp., *Marsonella* sp., *Tritaxia* sp. and a questionable specimen of *Spiroloculina papyracea*. Locality

5 contained sparse, simple planktonic foraminifera, none of them keeled, including rare *Hedbergella delrioensis* together with rare *Gavelinella intermedia*, a species that disappears from the record at the top of the Cenomanian. However, the biotic characteristic unifying the samples from these last three localities is the bloom of the calcareous algal cyst, *Pithonella*. In all three samples, *Pithonella sphaerica* occurs in flood proportions, together with rare *P. ovalis*. The stratigraphical significance of *Pithonella* blooms in the Late Cretaceous of the Isle of Wight has been considered further elsewhere in this volume (Wilkinson, 2011; and Figure 3), but this event can be correlated to other sites in southern England and places localities 1, 4, and 5 into the *Calyoceras guerangeri* to *Mytiloides* spp. macrofaunal zones between the Late Cenomanian and Early Turonian. These correspond to BGS Foraminiferal Biozones 4iii to 7 shown in Figure 3.

5. Provenance of tesserae

Previous analysis of chalk tesserae from Roman mosaics at *Calleva Atrebatum* (modern Silchester in Hampshire) demonstrated that the chalk material had been transported from Dorset, 100 km to the south west (Wilkinson et al., 2008), raising the possibility that the chalk from Dorset had been selected in preference to the local chalks outcropping in northern Hampshire. Proximity to the sea for the Isle of Wight in general and Brading Roman Villa in particular (via the harbour at Brading Haven) suggests that importation of chalk material might also have been a possibility in this case. However, the microfossil evidence shows that the chalk samples taken by the BGS from the five localities on Brading Down close to the villa straddle the *Rotalipora cushmani* Foraminiferal Biozone to which the chalk tesserae from the villa can be biostratigraphically dated by the presence of the index microfossil, with the chalk from Localities 1, 4 and 5 being closest in biostratigraphical age to that of the chalk used at Brading. A parsimonious interpretation of this evidence would suggest therefore that one of these three localities was the most likely source of the raw material used to manufacture the tesserae found at Brading Roman Villa, rather than material sourced over long distance as at Silchester.

6. Conclusions

Thin-section microfossil analysis of chalk tesserae at Brading Villa, Isle of Wight:

1) identifies a range of planktonic foraminifera and the calcareous algal cyst *Pithonella;*

2) provides a biostratigraphical age of the *Rotalipora cushmani* Biozone (BGS Foraminiferal Biozones 4iii to 7);

3) suggests a local source for building materials in the chalk outcrop to the north of the villa;

4) demonstrates that microfossils provide a powerful 'forensic tool' that can be applied to the identification of building material provenance in Roman Britain.

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References

Allen, J.R.L., Fulford, M.G., 2004. Early Roman mosaic materials in southern Britain, with particular reference to Silchester (Calleva Atrebatum): a regional geological perspective. Britannia 35, 9-38.

Allen, J.R.L., Fulford, M.G., Todd, J., 2007. Burnt Kimmeridgian shale at Early Roman Silchester, south-east England, and the Roman Poole–Purbeck complex-agglomerated Geomaterials Industry. Oxford Journal of Archaeology 26, 167-191.

Busby, P., de Moulins, D., Lyne, M., McPhillips, S., Scaife, R. 2001. Excavations at Clatterford Roman villa, Isle of Wight. Proceedings of the Hampshire Field Club and Archaeological Society 56, 95-128.

Cunliffe, B., 2009. The Brading Roman Villa, Isle of Wight. Excavations 2009. Interim Report. University of Oxford, Institute of Archaeology, Oxford.

Cunliffe, B., 2010. The Brading Roman Villa, Isle of Wight. Excavations 2010. Interim Report. University of Oxford, Institute of Archaeology, Oxford.

Fennelly, L., 1969. Excavations of the Roman villa at Combley, Arreton, I. W., 1968-1969. Proceedings of the Isle of Wight Natural History and Archaeology Society 6, 271-282.

Fennelly, L., 1971. Combley Villa, Arreton: Second Report. Proceedings of the Isle of Wight

Natural History and Archaeology Society 6, 420-430.

Flügel, E., Flügel, C., 1997. Applied microfacies analysis: Provenance studies of Roman mosaic stones. Facies 37, 1–48.

Flügel, E., 1999. Microfacies-based provenance analysis of Roman imperial mosaic and sculpture materials from Bavaria (Southern Germany). Facies 41, 197–208.

Flügel, E., 2004. Microfacies of carbonate rocks: analysis, interpretation and application. Springer-Verlag, Stuttgart.

Frere, S., Tomalin, R., 1991. Roman Britain in 1990. Britannia 12, 303-304.

Goodburn, R., Wright, R.P., Hassall, M.W.C., & Tomlin, R.S.O., 1976. Roman Britain in 1975. Britannia 7, 367-8, 369 (plan).

Hart, M., Bailey, H.W., Crittendon, S., Fletcher, B.N., Price, R.J., Swiecicki, A., 1989. Cretaceous. In: Jenkins, D.G., Murray, J.W. (Eds.), Stratigraphical Atlas of Fossil Foraminifera. Ellis Horwood, Chichester, British Micropalaeontological Society Series, 273-371.

Hayward, K.M., 2009. Roman Quarrying and Stone Supply on the Periphery - Southern England. A geological study of first century funeral monuments and monumental architecture. British Archaeological Report, British Series 500 . Archaeopress, Oxford.

Kell, E., 1856. Notices of Sites of Roman Villas at Brixton and Clatterford on the Isle of Wight. Journal of the British Archaeological Association 12, 159-162.

Kell, E., 1866. An account of the Discovery of a Roman building in Gurnard Bay, Isle of Wight and its relation to the ancient British tin trade in the Island. Journal of the British Archaeological Association 22, 351-368.

Lyne, M., 2007. Roman Wight. Available at: http://oxfordarch.co.uk/pdf_store/sthames/iow%20Roman.pdf. [Accessed 15 December, 2010].

Neal, D.S., Cosh, S.R., 2002. Roman Mosaics of Britain. Volume I: Northern Britain. Illuminata Press with the Society of Antiquaries of London, London.

Neal, D.S., Cosh, S.R., 2009. Roman Mosaics of Britain. Volume III: South-East Britain. Part 1. The Society of Antiquaries of London, London.

Pearson, A.F., 2006. The Work of Giants. Stone and quarrying in Roman Britain. Tempus, Stroud.

Price, J.E., Price, F.G.H., 1881. A Description of the Remains of Roman Buildings at Morton near Brading, Isle of Wight. J. Davey and Sons, London.

Price, J.E., Price, F.G.H., 1890. A Guide to the Roman Villa recently discovered at Morton between Sandown and Brading, Isle of Wight. 14th ed. Briddon Bros., Ventnor.

Rigold, S., 1969. Recent investigations into the earliest defences of Carisbrooke Castle, Isle of Wight. In: Taylor, A.J.P. (Ed.), Chateau Gaillard III; European Castle Studies, (Conference at Battle, Sussex, September 1966), 128-138. Philimore, Chichester.

Sherwin, G.A., 1929. A Roman Villa at Newport, Isle of Wight, Part II. Antiquaries Journal 9, 354-371.

Slipper, I.J., 1997. Turonian (Late Cretaceous) Ostracoda from Dover, south-east England. Unpublished PhD thesis. University of Greenwich.

Spickernell, W., 1859. The Roman Villa, Carisbrooke, Isle of Wight; with Ground Plan. Kentfield, Newport.

Stone, P.G., 1929. A Roman Villa at Newport, Isle of Wight. Antiquaries Journal 9, 141-151.

Sydenham, E., 1945. Roman times in the Isle of Wight. Proceedings of the Isle of Wight Natural History and Archaeological Society 3, 413-434.

Tomalin, D.J., 1987. Roman Wight. A Guide Catalogue to “The Island of Vectis, very near to Britannia”. Isle of Wight County Council, Newport.

Tomalin, D.J., 1990. An Early Roman Cliff-top Salt-working site at Redcliff Battery, Sandown, Isle of Wight. Proceedings of the Isle of Wight Natural History and Archaeological Society 9, 91-120.

Tomalin, D.J., 2006. Coastal villas, maritime villas; a perspective from Southern Britain. Journal of Maritime Archaeology 1, 29-84.

Trott, K., 2002. Archaeological Investigations at Yaverland and Ninham's Withybed and along the Ventnor to Sandown and Bembridge to Sandown Waste Water Pipelines. Archaeological Investigations Project 2002. South Wight 3/859 (E.28.K002). RPS Planning, Transport and Environment, Abingdon.

Wilkinson, I.P., 2000. A preliminary foraminiferal biozonation of the Chalk Group (in preparation for the Holostrat Project: Upper Cretaceous). British Geological Survey Report IR/00/013, 21pp. Natural Environment Research Council (NERC) Open Research Archive (NORA), http://nora.nerc.ac.uk/2598/.

Wilkinson, I.P., 2011. Pithonellid blooms in the Chalk of the Isle of Wight and their biostratigraphical potential. Proceedings of the Geologists' Association (this issue).

Wilkinson, I.P., Williams, M., Young, J.R., Cook, S.R., Fulford, M.G., Lott, G.K., 2008. The application of microfossils in assessing the provenance of chalk used in the manufacture of Roman mosaics at Silchester. Journal of Archaeological Science 35, 2415-2422.

Explanation of Figures

Figure 1. Geological and geographical context of Brading Roman Villa. Top: Map of the Isle of Wight showing the outcrop of the Chalk Group. Bottom: position of the BGS sample localities for microfossil analysis in relation to the local geology and the Roman villa. Grid references for BGS sample localities 1 to 5. 1: SZ 59828 86703; 2: SZ 59920 867053; 3: SZ 60319 86428; 4: SZ 61035 86224; 5: SZ 61583 86163.

Figure 2. Thin section images of microfossils found in tesserae from Brading Roman Villa. 1: *Rotalipora cushmani* (MPK 14107); 2: *Hedbergella* sp., (MPK 14108); 3: *Arenobulimina* sp., (MPK 14109); 4: overview of thin section MPA 61053, showing low-porosity chalk containing planktonic foraminifera and large numbers of the calcareous algal cyst *Pithonella sphaerica* (MPK 14110).

Figure 3. Upper Cretaceous chalk lithostratigraphy and biostratigraphy, showing the frequency and abundance of pithonellid blooms. The faunal biozones follow those of Wilkinson (2000). The *Rotalipora cushmani* biozone comprises BGS Foraminiferal Biozones 4iii to 7.

Table 1. Microfossil analysis of chalk tesserae from Brading Roman Villa, Isle of Wight, UK.

Figure 1

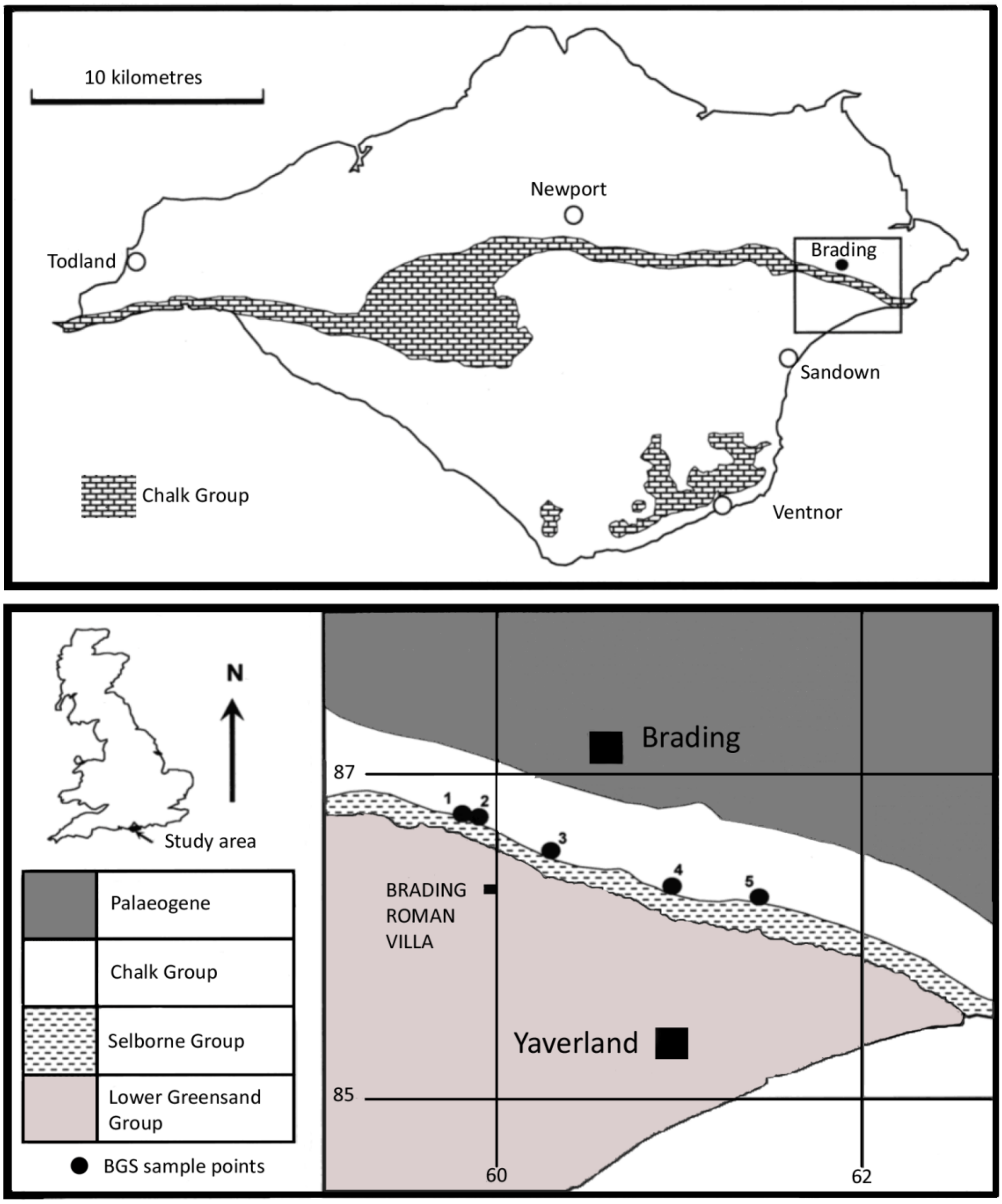

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Figure 2

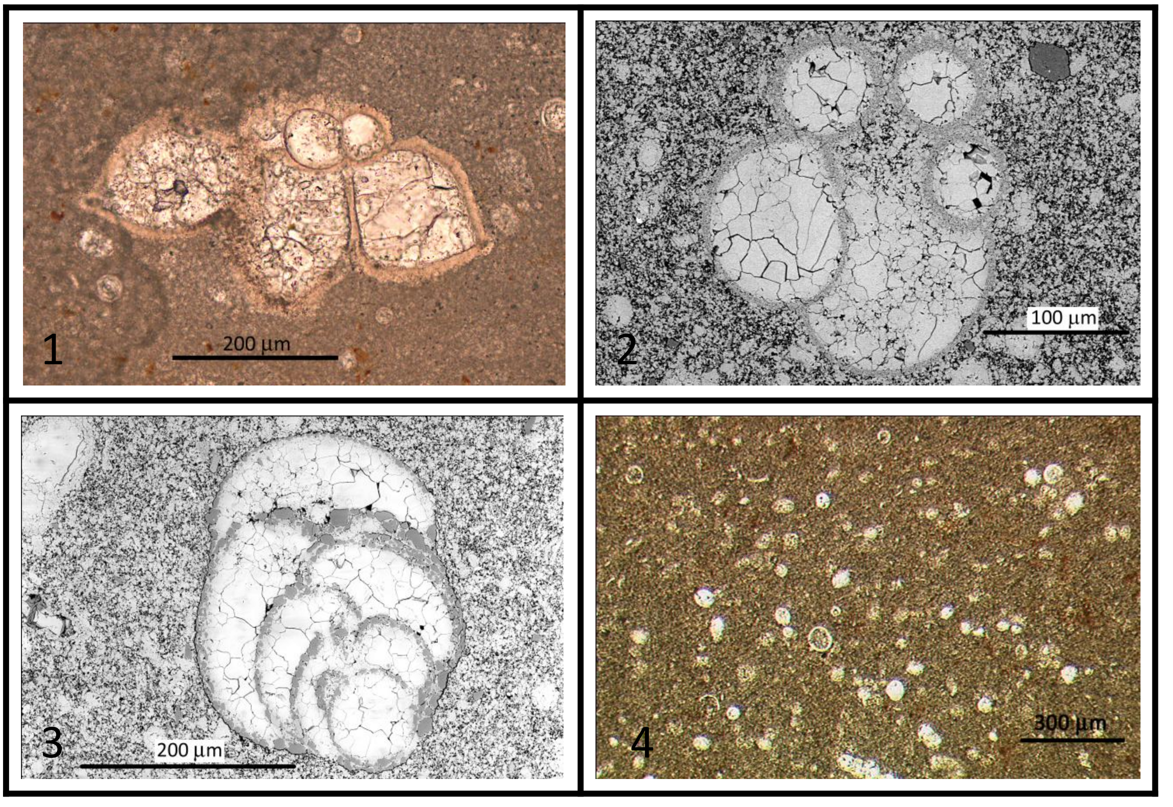

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Figure 3

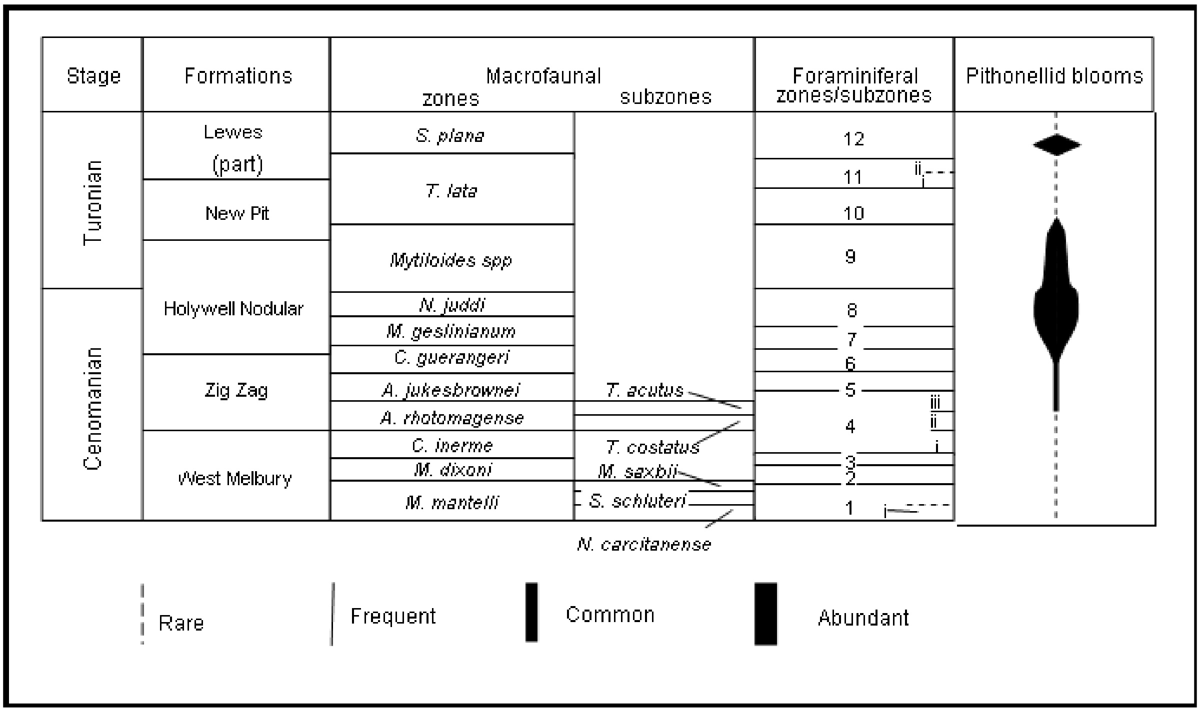

Figure 3. Upper Cretaceous chalk lithostratigraphy and biostratigraphy, showing the frequency and abundance of pithonellid blooms. The faunal biozones follow those of Wilkinson (2000). The *Rotalipora cushmani* planktonic foraminiferal Biozone is equivalent to BGS Foraminiferal Biozones 4iii to 7.

Table 1

Microfossils in chalk tesserae from Brading Roman Villa, Isle of Wight.					
Sample reference number	BGS number (MPA)	Archaeological reference number	National Grid Reference (approx)	Location	Palaeontology
IOW_BRV_B03	61053	BRV.EX03-Zone 7-758	SZ 599 862	Brading Roman Villa, IoW.	*Pithonella sphaerica (abundant), P. ovalis. Dentalina sp.*, cf. *Eoguttulina*, cf. *Frondicularia*, *Hedbergella delrioensis*, *H. brittonensis*, *Heterohelix* sp., *Marginulina* sp., *Rotalipora cushmani, Rotalipora* sp., *Gavelinella berthelini*, cf. *Gavelinella*, *Lenticulina rotula.*
IOW_BRV_B04	61054	BRV.EX03-Zone 7-758	SZ 599 862	Brading Roman Villa, IoW.	*Pithonella sphaerica (abundant), Hedbergella* sp.*, Heterohelix* sp.

Table 1: Microfossil analysis of chalk tesserae from Brading Roman Villa, Isle of Wight, UK.