Ostracoda during the early Aptian greenhouse period in the Isle of Wight, England

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ABSTRACT

The earliest Aptian marine transgression across southern England resulted in the collapse of the generally freshwater Barremian environment and the initiation of marine mileux. Salinities passed from fresh-oligohaline to meso- and pliohaline, reaching fully marine conditions during the *obsoletum* Subzone (*P. fissicostus* Zone). Newly formed environmental niches were rapidly occupied by ostracod associations. In the Isle of Wight, freshwater *Cypridea*-rich assemblages in the lower Shepherd's Chine Member (Vectis Formation) were gradually replaced by faunas dominated by *Sternbergella cornigera*, *Mantelliana mantelli* and *Theriosynoecum fittoni*. Marine taxa recorded from the Atherfield Clay Formation migrated predominantly from the Paris Basin and include *Asciocythere albae*, *Schuleridea derooi*, *Neocythere gottisi*, *N. bordeti*, *Cythereis geometrica*, *Cytheropteron stchepinskyi* and *Protocythere croutesensis*.

Key words: early Aptian, Ostracoda, Isle of Wight.

1. Introduction

The earliest Aptian was a time of major change in the Wealden and Vectis provinces of the Wessex Basin (Fig. 1) with the return of marine conditions after about 20-25 million years dominated by paralic deposition. Rapid palaeoenvironmental change profoundly affected the ostracod community; fresh and brackish water faunas of the late Barremian were replaced by marine taxa during the early Aptian. In terms of the ostracod communities, the *Cypridea*-rich associations of the Barremian and earliest Aptian (Anderson, 1985 and references; Horne, 1995, 2009) were progressively replaced by more saline tolerant taxa such as *Theriosynoecum, Sternbergella, Mantelliana*, then by *Schuleridea* and *Asciocythere* and fully marine taxa including *Cythereis, Neocythere* and *Protocythere*.

Previous work on the early Aptian marine ostracod faunas of the Isle of Wight is limited. Kaye (1965) concentrated on taxonomic descriptions in the Atherfield Clay of Chale Bay and Wilkinson (1996, 2008) included data from the Isle of Wight in a broader consideration of stratigraphical and palaeoecological relationships in the Wessex Basin. The aim of the present work is to examine the earliest Aptian ostracod faunas of the Isle of Wight in order to determine detailed relationships between temporal change, facies and palaeoenvironmental variability preserved in their spatial distribution and faunal structure.

2. Stratigraphy

The lithostratigraphy adopted in the present discussion follows that of Hopson et al. (2008).

2.1. Vectis Formation

The Vectis Formation (Fig. 2), which comprises mainly dark grey mudstones, is divided into three members (e.g. Hopson et al., 2008 and references therein), although only the highest of these, the Shepherd's Chine Member, is considered here.

The Shepherd's Chine Member consists of up to 45m of rhythmic grey, fine-grained sands and silts passing up into dark grey clay in thin, upwardly fining units; the base of each unit is generally erosional (Insole et al., 1998). Towards the top of the member, thin, shelly, argillaceous limestones contain the molluscs *Filosina* and *Ostrea*. The member has traditionally been placed into the Upper Barremian, but, the highest part is younger than the earliest Aptian magnetostratigraphic chron CM-0 (Kerth & Hailwood, 1988), suggesting a position within the *bodei* Subzone of the *fissicostatus* ammonite Zone (Fig. 2). The overlying Perna Member has a *fissicostatus* Zone, *obsoletus* Subzone macrofauna, so that the deposits of *bodei* Subzonal age must fall within the non-marine facies. Thus, the stratigraphical gap between the Vectis Formation and overlying Atherfield Bone Bed, at the base of the Perna Member, represents a very short period of time.

2.2. Atherfield Clay Formation (part)

The Atherfield Clay Formation, although predominantly a mudstone unit, contains grits, sandstones and limestones.

The Perna Member comprises a basal grit (the Atherfield Bone Bed of Simpson, 1985), a transgressive lag consisting of small pebbles, phosphatic nodules (some containing Kimmeridgian ammonites) and fish and reptile debris (Simpson, 1985, Hart et al., 1991). Overlying the bone bed are shelly, dark greenish-grey, fine-grained clayey sand and sandy clay, containing Early Aptian microfaunas, including rare, generally agglutinated foraminifera and very rare dinoflagellate cysts (Hart et al., 1991) suggesting accumulation took place in a shallow marine environment. Shelly microfossils have not been recorded from the more indurated, glauconite-rich, highly bioturbated medium- to coarse-grained, calcareous sandstone of the upper Perna Member. Casey (1961) placed the Perna Member in the *Prodeshayesites obsoletus* Subzone, but hinted that, although evidence is lacking, the Atherfield Bone Bed might be of *Prodeshayesites bodei* subzonal age.

The Chale Bay Member (of Simpson, 1985, formerly called the Atherfield Clay) comprises up to 21 m of brown-weathering, dark grey, silty clay, with red nodules in the lower part. On sedimentological grounds the unit accumulated in shallow marine conditions with storm events resulting in silty lags (Insole et al., 1998). Although poorly fossiliferous, bivalves occur and the ammonites place the unit within the *Deshayesites fittoni* Subzone.

3. Results

Atherfield Bay. Slumping prevents high resolution sampling of the section, but those data available show that ostracod assemblages from the Shepherd’s Chine Member contain several species of *Cypridea* (Fig. 3). The specimen of *C. pseudomarina* at 38 m below the base of the Atherfield Clay appears to be close to its upper limit in the "C. pseudomarina Beds" of Anderson (1971). Higher in the succession, 25 m below the base of the Atherfield Clay, the highest zonal index of the Weald Clay, *Theriosynoecum fittoni*, occurs in large numbers, accompanied by *Cypridea tenuis, C. cuckmerensis* and *C fasciata* (the subzonal index species of Horne, 1995. 2009). Within the upper part of the Shepherd's Chine Member less common, non-*Cypridea* taxa, such as *Sternbergella cornigera* and *Mantelliana mantelli* appear for the first time (Anderson, 1971). At the top of the section (between 6 and 0.3 m below the Perna Member) *Cypridea* becomes rare, replaced by more numerous "S-phase" species (sensu Anderson, 1985 and references) and the appearance of rare *Paranotacythere* (*Paranotacythere*) *inversa*, a species that occurs in the marine deposits of the North Sea Basin and Germany, points to a short lived phase of higher salinities. Although *Cypridea fasciata* was present 3m below the top of the Shepherd Chine Member near Atherfield Point, the fauna recovered between 6m and 0.3 m below the base of the Perna Member are characterised by *Sternbergella cornigera, Mantelliana mantelli* and *Theriosynoecum fittoni*.

Sandown Bay. Stewart et al. (1991) indicated that 'C-phase' ostracods are not found in the highest part of the Vectis Formation (highest Shepherds Chine Member), the fauna being entirely 'S-phase, although no details were given. However this statement is supported by the examination of two samples 0.20 and 0.25m below the contact with the Atherfield Bone Bed, where only very rare specimens of *Sternbergella cornigera* and *Mantelliana mantelli* were found (Fig. 4).

The earliest marine ostracod faunas to enter the Wessex Basin were recorded from the basal Perna Member, which were examined at Sandown Bay, Isle of Wight (Fig. 4). The more successful species include abundant *Asciocythere albae* and frequent to common *Asciocythere* sp., *Schuleridea derooi, Neocythere* (*Centrocythere*) *gottisi, N.* (*C.*) *bordeti* and *Cytherelloidea* sp. Other species include rare *Cythereis geometrica, Eocytheropteron stchepinskyi* and *Protocythere croutesensis*. There is little difference in the faunas throughout the Lower Perna Member, except that *Cythereis* tends to become more common up-sequence, at the expense of *Neocythere* and *Cytherelloidea*.

BGS Borehole 75/35 (Fig. 5). A sparse fauna was recovered in a borehole (British Geological Survey borehole 75/35) to the east of Sandown, Isle of Wight (Latitude

50° 37.81’ N Longitude 1° 5.54’W) (Dingwall & Lott, 1979). Within the borehole the Chale Bay Member was represented by 29.35m of brown-grey, fossiliferous mudstone with occasional calcareous and phosphatic nodules (base not seen).

Ostracods were less diverse in the Chale Bay Member (*D. forbesi* Zone, *D. fittoni* Subzone) of borehole 75/35 compared to the onshore section described by Kaye (1965). However, the fauna is characterised by *Schuleridea derooi, S. sulcata, Neocythere* (*Centrocythere*) *bordeti* and *Cythereis geometrica*, together with occasional *Dolocytheridea intermedia* at the base and *Paranotacythere inversa tuberculata* and *Protocythere mertensi langtonensis* in the upper part (Fig. 5).

4. Ostracod distribution across the Vectis-Atherfield Clay formational boundary

4.1 Temporal distribution of Ostracoda

The Aptian succession of England was subdivided into two zones and four subzones by Casey (1961), based on the distribution of ammonites (Fig. 2). However, the *bodei* Subzone at the base of the *fissicostus* Zone cannot be recognised in the Isle of Wight due to the low salinities in which the Shepherd’s Chine Member accumulated. It is suggested that its chronostratigraphical position of the *bodei* Subzone is within that part of the Aptian below the first ammonite-bearing strata, but above the magnetostratigraphic chron CM-0 recognised by Kerth & Hailwood (1988) (Fig. 2).

Although slumping at Brighstone Bay precludes the possibility of regular sampling, those samples from the Shepherd’s Chine Member are characterised by the indices of the *Theriosynoecum fittoni* Zone, *Cypridea fasciata* Subzone of Horne (1995, 2009), and the *Cypridea valdensis* Zone, assemblages 14 and 15, of Anderson (1985). The succession straddles the Barremian/Aptian boundary, although the coarse sampling intervals reduce the usefulness of the ostracod assemblage to pick out the boundary.

The ostracods from the lower Atherfield Clay Formation of the Isle of Wight can be divided into two characteristic assemblages. The older assemblage from the Perna and Chale Bay members (contemporaneous with the *P. obsoletus* and *D. fittoni* subzones of the standard macrofaunal scheme) is recognised by the appearance of *Neocythere gottisi* with *Eocytheroptern stchepinskyi* and *Schuleridea derooi*. The younger assemblage in the Upper and Lower Lobster and Crackers members (in the *D. kiliana* and *D. callidiscus* standard macrofaunal subzones) is characterised by sparse assemblages that include *Cythereis geometrica* and *Veeniacythereis* cf. *blanda* (Wilkinson, 2008) and *Schuleridea sulcata* (Kaye, 1965).

4.2. Spatial distribution of Ostracoda

With the opening of the sea-way at the beginning of the Aptian, the Isle of Wight became connected with the Celtic Sea Basin to the west and the Paris Basin to the south-east. Ostracod migration began with development of this connection, especially from the Paris Basin, where ostracods of *D. deshayesi* zonal age have been recognised (Deroo, 1956; Damotte & Grosdidier, 1963; Damotte, 1971; Damotte & Magniez-Jannin, 1973; Babinot et al., 1985). In northern France, *Neocythere* (*Centrocythere*) *bordeti* and *Eocytheropteron stchepinskyi* continue through from the highest Barremian, but many species appear for the first time at the base of the zone, including *Cythereis* (*Rehacythereis*) *geometrica*, *Neocythere* (*Centrocythere*) *gottisi*, *Protocythere croutesensis*, *Asciocythere albae* and *Schuleridea derooi*.

Ostracods in the earliest Aptian deposits of the Isle of Wight bear a close resemblance to faunas of the Paris Basin. *Asciocythere albae albae* is particularly common in the Vectian province of the Wessex Basin as well as the Paris Basin, and appears to have been a successful opportunist. Others, such as *Eocytheropteron stchepinskyi*, *Protocythere croutesensis* and *Cythereis* (*Rehacythereis*) *geometrica*, are not common in southern England, although the last named species ranges up into the higher parts of the Atherfield Clay Formation of the Isle of Wight and Wilkinson (2008) recorded it in the *bowerbanki* Zone (*transitoria* Subzone) of Sussex.

Bedoulian ostracod assemblages of the Jura and Alps are characterised by a diverse fauna, including species of *Asciocythere*, *Schuleridea*, *Paracypris*, *Protocythere* and *Cythereis* (Sauvagnat, 1999; Sauvagnat *et al*., 2001), the last two genera being particularly useful biostratigraphically in the Mesogean region of France (Babinot et al., 1985 and references therein). Several species have a wide geographical distribution, extending as far north as the Isle of Wight, e.g. *Neocythere* (*C.*) *gottisi*, *Protocythere croutesensis*, *Eocytheropteron stchepinskyi* and *Schuleridea* cf. *derooi*. Very rare specimens tentatively assigned to ‘*Protocythere*’ sp. 3 (of Babinot et al., 1985), and originally found in the Bedoulian of Mesogean France

(Oertli, 1958; Babinot et al., 1985) are present in the Perna Member at Sandown. *Strigocythere*? *reticulata*, which was first described from the Gargasian of Apt as '*Cythereis*' sp 307 of Oertli (1958), has a widespread distribution in south-eastern France (Sauvagnat, 1999; Sauvagnat et al., 2001) and ranges as far north as the Celtic Sea Basin (Colin et al., 1981). In the Isle of Wight, it was confined to the *P. obsoletus* Subzone (*P. fissicostatus* Zone).

Despite the fact that a diverse ostracod population has been recovered from the Aptian of the Celtic Sea (Colin et al., 1981; Ainsworth, 1985, 1986, 1987; Ainsworth et al., 1985, 1987), few species migrated into the Wessex Basin in general and the Vectis province in particular. Only five species are common to both the Celtic Basin and Wessex Basin (although several others show close affinities). One example, is a single fragment of *Quasihermanites* sp. cf. *bicarinata* at the top of the lower Perna Member at Sandown Bay, which is similar to that figured by Hart & Crittenden (1985) (as *Eucythere ornata*) from the latest Barremian of the Goban Spur.

Earliest Aptian (*P. fissicostus* Zone, *P. bodei* Subzone) ostracod assemblages from the East Midlands Shelf of eastern England (Wilkinson, 1996) and the southern North Sea Basin (Lott et al., 1985) differ markedly from contemporaneous faunas of the Isle of Wight. This was due to the palaeogeography at that time, the North Sea and Wessex basins being separated prior to the opening of the Bedfordshire Straits during the mid and late Aptian.

It seems clear, therefore, that despite the fact that a few species may have been derived from the west, implying a physical, oceanographical or biological barrier, by far the largest number of species in the Isle of Wight originated in the Paris Basin. Geologically instantaneous palaeoenvironmental evolution and migration of brackish marine and marine taxa took place with the opening of the seaway during the earliest Aptian.

5. Palaeoenvironmental controls

The Cretaceous period can be considered an example of a 'greenhouse' world, although there is evidence for several periods of climatic fluctuation during that time (Fig 7). In high palaeolatitude regions, cooling events are preserved as ice transported clasts (e.g. Kemper, 1983; Frakes & Francis, 1988 Frakes & Krassay, 1992), glacio-marine pebble beds (e.g. Frakes & Francis, 1988), glendonite (e.g. Kemper, 1983, 1987; Sheard, 1990; De Lurio & Frakes, 1999) and expansion and collapse of carbonate platform communities in low palaeolatitudes (e.g. Skelton, 2003). The earliest Aptian is characterised by rising sea level, increased marine productivity and excursions in the δ^{13}C signature and δ^{18}O suggesting fluctuations in climate (e.g. Jenkyns, 1995; Menegatti *et al*., 1998; Bralower, *et al*., 1999; Jones & Jenkyns, 2001; Erba *et al*., 1999; Luciani *et al.*, 2001; Bellanca *et al*., 2002). The cause is not clear, but may be due to the release of gas hydrates associated with the Ontong Java Manihiki Large Igneous Province and increased sea floor spreading (Larson, 1991a, b; Larson & Erba, 1999).

Ostracod populations are controlled essentially by local palaeoenvironmental condition, such as salinity, facies, substrate and water temperature, but during the earliest Aptian, climatic oscillations appear to have played an overarching role in controllingpopulation structure. The earliest major marine transgression in the Vectis Province of the Wessex Basin saw Tethyan associations established, including species of *Cythereis, Cytherelloidea*, *Asciocythere*, *Protocythere* and *Strigocythere*.

During the *P. fissicostus* Zone the Shepherd’s Chine Member accumulated in shallow, storm influenced lagoonal conditions (Stewart, et al 1991), with intermittent, possibly climatically controlled fluctuations in fluvial input and flooding events (Insole et al., 1998) and gradually increasing salinity (Ruffell, 1988; Radley, 1995). Changes in the ostracod assemblages reflect variability in environmental conditions, particularly salinity (Fig. 6), but also permanency of the water body and perhaps climate. Ephemeral fresh and oligohaline water (<3 ‰) with *Cypridea* evolved into oligohaline and miohaline (possibly ranging up to the lower part of the mesohaline) permanent water bodies colonised by *Theriosynoecum. Sternbergella* and *Mantelliana* probably colonised the Vectis Province only when miohaline salinities had been reached. Late in the zone there is some evidence for short lived oscillations in salinity. A short-lived phase of elevated salinity is suggested by the appearance of *Paranotacythere* (*Paranotacythere*) *inversa (Fig. 3)*, a species that is interpreted to be essentially euhaline, but perhaps tolerating a high brachyhaline salinity. This is followed by a return to oligohaline conditions (and the last appearance of *Cypridea*) before a final increase to miohaline-mesohaline before the start of the *P. obsoletus* Subzone.

The lower boundary of the *P. fissicostus* Zone, *P. obsoletus* Subzone can be placed at the base of the Atherfield Bone Bed and the Perna Member (Simpson, 1985). The marine incursion into the region took place at this time, and brought with it both macro- and microfaunas, which rapidly occupied the newly formed environmental niches. The typical Wealden assemblages were replaced by associations employing new strategies. The bone bed represents a transgressive lag but the remainder of the Perna Member contains evidence of shallow lagoonal and interdistributary bays (Kerth & Hailwood, 1988; Stewart et al., 1991; Hart et al., 1991). The increasing salinity had risen from miohaline to at least pliohaline and probably brachyhaline by the start of the deposition of the lower Perna Member, as suggested by the colonisation of genera such as *Schuleridea, Asciocythere, Protocythere, Cythereis* and *Cytherelloidea* just 10 cm above its base.

It seems probable that the increasing water temperatures associated with climate change favoured migration from the south-east and Paris Basin rather than the the west. The earliest Aptian populations at Sandown Bay, Isle of Wight, compare closely with those of the Paris Basin (Damotte & Grosdidier, 1963; Damotte & Magniez-Jannin, 1973; Babinot *et al*., 1985). However, there appears to be little in common with faunas recorded from south-eastern France, with the possible exception of a single specimen of a species very closely related to *Protocythere* sp.3 (Babinot et al., 1985) known in the Bédoulien of Ardèche. This shallow, near-shore, warm water fauna reached the Isle of Wight very quickly after the opening of the marine connection during the earliest Aptian, when salinities had edged towards the upper part of the brachyhaline range and fully marine conditions.

The Chale Bay Member is of *D. fittoni* Subzone age *(D. forbesi* Zone). It accumulated in a shallow marine environment that suffered from occasional storm events, resulting in the formation of thin silty lags (e.g. Insole et al., 1998). Ostracods include *Neocythere (C.) gottisi, Neocythere (C.) bordeti, Protocythere croutesensis, Cythereis geometrica, Eocytheropteron stchepinskyi, Schuleridea derooi, Dolocytheridea* cf. *intermedia* and species of *Paranotacythere* including *P. (P.) oertlii*. The assemblage is similar to the faunas recovered from the lower Perna Member, although *Paranotacythere* is present.

Of those taxa found in the Chale Bay Member, *Schuleridea* is a euryhaline genus that apparently tolerated pliohaline to fully marine salinities and

Dolocytheridea could tolerate reduced salinities down to the higher part of the brachyhaline salinity range (Fig. 6). The remaining species, however, are restricted to fully or near marine brachyhaline salinities. *Paranotacythere (P.) oertlii* and *Protocythere mertensi langtonensis*, which are found towards the upper part of the member, are restricted to the shallow marine milieu.

6. Conclusions

The Early Aptian global climatic amelioration and sea level rise appears to have played a fundamental role in determining the composition of the shallow water ostracod assemblages of the Isle of Wight. During the earliest Aptian, the rapid marine transgression resulted in oligohaline and miohaline ostracod populations being replaced by brachyhaline and fully marine assemblages. Species of genera such as *Cypridea* were replaced by *Mantelliana* and *Sternbergella*, and, by the *obsoletus* Subzone, *Asciocythere*, *Schuleridea*, *Neocythere* and *Cytherelloidea* dominated the faunas. Populations in the Isle of Wight were similar to those of the Paris Basin, but showed only slight similarity with the Celtic Sea faunas to the west. With the opening of the earliest Aptian seaways and elevated global temperatures, Tethyan ostracods successfully colonised the Vectis Province of the Wessex Basin.

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References

Ainsworth N.R. 1986. Upper Jurassic and Lower Cretaceous Ostracoda from the Fastnet Basin, offshore southwest Ireland. Irish Journal of Earth Sciences 7, 145-168.

Ainsworth N.R., Horton, N.F., Penney, R.A. 1985. Lower Cretaceous micropalaeontology of the Fastnet Basin, offshore southwest Ireland. Marine Petroleum Geology 2, 341-349.

Ainsworth, N.R. 1985 Upper Jurassic and Lower Cretaceous Ostracoda from the Fastnet Basin, offshore southwest Ireland. Irish Journal of Earth Sciences 7, 15-33.

Ainsworth, N.R., 1987. Upper Jurassic and Lower Cretaceous Ostracoda from the Fastnet Basin, offshore southwest Ireland. Irish Journal of Earth Sciences 8, 139-153.

Ainsworth, N.R., O'Neill, M., Rutherford, M.M., Clayton, G., Horton, N.F., Penney, R.A. 1987. Biostratigraphy of the Lower Cretaceous, Jurassic and uppermost Triassic of the North Celtic Sea and Fastnet basins. In: Brooks, J. & Glennie, K. (eds), Petroleum Geology of North West Europe, 611-622. [Graham & Troutman].

Anderson, F.W. 1971. The sequence of ostracod faunas in the Wealden and Purbeck of the Warlingham borehole. In: Worssam, B. C. & Ivimey-Cook, H. C. The stratigraphy of the Geological Survey borehole at Warlingham, Surrey. Bulletin of the Geological Survey of Great Britain No.36, Appendix B, 122-138.

Anderson, F.W. 1985. Ostracod faunas in the Purbeck and Wealden of England. Journal of Micropalaeontology 4, 1-68.

Babinot, J-F., Damotte, R., Donze, P., Grosdidier, E., Oertli, H.J., Scarenzi-Caroni, G. 1985 Crétacé infèrieur. In: Oertli, H.J. (ed.), Atlas des ostracodes de France (Paléozoic-Actuel). Bulletin des Centres de Recherches Exploration-Production Elf-Aquitaine, Mémoires 9, 163-209.

Bellanca, A., Erba, E., Neri, R., Premoli Silva, I., Sprovieri, M., Tremolada, F., Verga, D. 2002 Palaeoceanographic significance of the Tethyan `Livello Selli’ (Early Aptian) from the Hybla Formation, northwestern Sicily: biostratigraphy and high-resolution chemostratigraphic records. Palaeogeography, Palaeoclimatology Palaeoecology, 185, 175-196.

Bralower, T.J., Cobabe, E., Clement, B., Sliter, W.V., Osburn, C.L., Longoria, J. 1999. The record of global change in mid-Cretaceous (Barremian-Albian) sections from the Sierra Madre, Northeastern Mexico. Journal of Foraminiferal Research 29, 418-437.

Bralower, T. J., Fullagar, P. D., Paull, C. K., Dwyer, G. S., Leckie, R. M. 1997. Mid-Cretaceous strontium-isotope stratigraphy of deep-sea sections. Geological Society of America Bulletin 109, 1421-1442.

Casey, R. 1961. The stratigraphical palaeontology of the Lower Greensand. Palaeontology 3, 487-621.

Colin, J.-P., Lehmann, R.A., Morgan, B.E. 1981.Cretaceous and Late Jurassic biostratigraphyof the North Celtic Sea Basin, offshore southern Ireland. In: Neale, J.W., Brasier, M.D. (eds) Microfossils from Recent and fossil shelf seas. 122-155. [Ellis Horwood, Chichester].

Damotte R., Grosdidier, E. 1963. Quelques ostracodes du Crétacé infèrieur de la Champagne Humide. 2: Aptien. Revue de Micropaléontologie 6, 153-168.

Damotte R., Magniez-Jannin, F. 1973. Ostracodes et foraminifères de l'Aptien infèrieur du Sondage du Bois du Perchois (Aube). Bulletin d' Information des Géologues du Bassin de Paris 36, 3-47.

Damotte, R. 1971. Contribution à l'étude des Ostracodes marins dans le Crétacé du Bassin de Paris. Memoire de la Société géologiques de la France 50, 152pp.

De Lurio, J.L., Frakes, L.A. 1999. Glendonites as a paleoenvironmental tool: implications for early Cretaceous high latitude climates in Australia. Geochim Cosmochim Acta, 63, 1039-1048.

Deroo, G. 1956. Etude critique au sujet des Ostracodes marins du Crétacé inférieur et moyen de la Champagne Humide et du Boulonnais. Revue de l' Institut français du Pétrole 11, 1499-1545.

Dingwall, R.G., Lott, G.K 1979. IGS Boreholes drilled from MV Whitehorn in the English Channel 1973-75. Report of the Institute of Geological Sciences 79/5, 45pp.

Erba, E., Channell, J.E.T., Claps, M. 1999. Integrated stratigraphy of the Cismon APTICORE (Southern Alps, Italy): a 'reference section' for the Barremian-Aptian interval at low latitudes. Journal of Foraminiferal Research 29, 371-391.

Frakes, L.A., Francis, J.E. 1988. A guide to Phanerozoic cold polar climates from high latitude ice-rafting in the Cretaceous. Nature 333, 547-549.

Frakes, L.A., Krassay, A.A., 1992. Discovery of probable ice-rafting in the late Mesozoic of the Northern Territory and Queensland. Australian Journal of Earth Sciences 39, 115–119.

Haq, B.U., Hardenbol, J., Vail, P.R. 1987. Chronology of fluctuating sea levels since the Triassic. Science 235, 1156-1167.

Hart, M.B., Crittenden, S. 1985. Early Cretaceous Ostracoda from the Goban Spur; D.S.D.P. Leg 80, Site 549. Cretaceous Resea*rch* 6**,** 219-233.

Hart, M.B., Rajshekhar, C., Fitzpatrick, M., Milton, J.A., Wadsworth, A.J. 1991. The early Aptian transgression event in the United Kingdom. Historical Biology 5, 309-319.

Hopson, P. M., Wilkinson, I.P., Woods, M. A. 2008. A stratigraphical framework for the Lower Cretaceous of England. British Geological Survey. *British Geological Survey Research Report*, RR/08/03. 308 [Geological Society, London].

http://nora.nerc.ac.uk/3236/1/Lower_Cretaceous_Strat_Framework_Report%5B1%5D.pdf

Horne, D.J. 1995. A revised ostracod biostratigraphy for the Purbeck-Wealden of England. *Cretaceous Research* 16, 639-663.

Horne, D.J. 2009. Purbeck-Wealden. In: Whittaker, J.E. & Hart, M.B. (eds) Ostracods in British Stratigraphy. The Micropalaeontological Society Special Publications, 289-

Insole, A., Daley, B., Gale, A. 1998. The Isle of Wight. Geologists' Association Guide no. 60, 132pp.

Jenkyns, H.C. 1995. Carbon-isotope stratigraphy and palaeoceanographic significance of the lower Cretaceous shallow water carbonates of Resolution Guyot. In: Winterer, E.L., Sager, W.W., Firth, J.V., Sinton, J.M. (Eds) Proceedings of the Ocean Drilling Program. Scientific Results 143. Ocean Drilling Program, College Station, 99-104.

Jones, C.E., Jenkyns, H.C. 2001. Seawater strontium isotopes, oceanic anoxic events and sea-floor hydrothermal activity in the Jurassic and Cretaceous. American Journal of Science 301, 112-149.

Kaye P. 1965. Ostracoda from the Aptian of the Isle of Wight, England. Paläontologische Zeitschrift 39, 33-50.

Kemper, E. 1983, Uber Kalt und Warmzeiten der Unterkreide. Zitteliana 10, 359–369.

Kemper, E. 1987 Das Klima der Kreidezeit. Geologisches Jahrbuch A96, 5-185.

Kerth, M., Hailwood, E.A. 1988. Magnetostratigraphy of the Lower Cretaceous Vectis Formation (Wealden Group) on the Isle of Wight, southern England. Journal of the Geological Society, London 145, 351-360.

Larson, R.L., Erba, E. 1999. Onset of the mid-Cretaceous greenhouse in the Barremian-Aptian: igneous events and the biological, sedimentary, and geochemical responses. Paleoceanography 14, 663-678.

Larson, R.L. 1991a. Geological consequences of superplumes. Geology 19, 963-966.

Larson, R.L. 1991b. Latest pulse of Earth: Evidence for a mid-Cretaceous superplume. Geology 19, 547-550.

Lott, G.K., Ball, K C. & Wilkinson, l.P. 1985. Mid-Cretaceous stratigraphy of a cored borehole in the western part of the Central North Sea Basin. Proceedings of the Yorkshire Geological Society 45, 235-248.

Luciani, V., Cobianchi, M., Jenkyns, H. C. 2001 Biotic and geochemical response to anoxic events: the Aptian pelagic succession of the Gargano Promontory (southern Italy). Geological Magazine 137, 277-298

Menegatti, A.P., Weissert, H., Brown, R.S., Tyson, R.V., Farrimond, P., Strasser, A., Caron, M. 1998. High-resolution [delta] ^{13}C stratigraphy through the Early Aptian 'Livello Selli' of the Alpine Tethys. Paleoceanography 13, 530-545.

Oertli, H.J. 1958. Ostracodes du Jurrasique supérieur du Bassin de Paris (Sondage-Vernon 1). Revue de l' Institut Français du Pétrole 12, 647-695.

Price, G.D. 1999. The evidence and implications of polar ice during the Mesozoic. Earth-Science Reviews 48, 183-210.

Radley J. D.. 1995. Foraminifera from the Vectis Formation (Wealden Group, Lower Cretaceous) of the Wessex Sub-basin, southern England: a preliminary account. Cretaceous Research 16, 717-726.

Ruffell, A. H. 1988. Palaeoecology and event stratigraphy of the Wealden-Lower Greensand transition in the Isle of Wight. Proceedings of the Geologists ' Association 99, 133-140.

Sauvagnat, J. 1999. Les Ostracodes aptiens et albiens du Jura. Publications du Déparement de Géologie et Paléontologie, Université de Genève 24, 264pp.

Sauvagnat, J., Clavel, B., Charollais, J., Schroeder, R. 2001. Ostracodes barrémo-aptiens de quelques vires marneuses de l’Urgonien Jurassien, Pré-Subalpin et

Subalpin SE de France)- inventaire préliminaire et systématique. Archives de Science, Genève 54, 83-98.

Sheard, M.J., 1990. Glendonites from southern Eromanga Basin in South Australia: palaeoclimatic indicators for Cretaceous ice. Geological Survey of Southern Australia Q. Notes 114, 17–23.

Simpson, M.I. 1985. The stratigraphy of the Atherfield Clay Formation (Lower Aptian; Lower Cretaceous) at the type and other localities in southern England. Proceedings of the Geologists' Association 96, 23-45.

Skelton, P. W. (Ed.) 2003. The Cretaceous World. Cambridge University Press, Cambridge; Open University, Milton Keynes. 360pp.

Stewart, D.J., Ruffell, A.H., Wach, G.D., Goldring, R. 1991. Lagoonal sedimentation and fluctuating salinities in the Vectis Formation (Wealden Group, Lower Cretaceous) of the Isle of Wight, southern England. Sedimentary Geology 72, 117-134.

Weissert, H., Erba, E. 2004. Volcanism, CO_2 and palaeoclimate: a late Jurassic-early Cretaceous carbon and oxygen isotope record. Journal of the Geological Society, London 161, 695-702.

Wilkinson, I.P. 1996. Palaeoenvironmental controls on British Ostracoda between 112.5 and 108 Ma (Aptian). 21-28. In: Keen, M.C. (Ed.) Proceedings of the 2nd European Ostracodologists meeting, University of Glasgow, Scotland, 23rd-27th July 1993.

Wilkinson, I.P. 2008. The effect of environmental change on early Aptian ostracod faunas in the Wessex Basin, southern England. Revue de micropaléontologie 51 (2008) 259–272.

Figure Captions

Fig. 1. Sketch map of the Isle of Wight to show localities discussed in the text.

Fig. 2. Early Aptian stratigraphy in the Wessex Basin together with the ranges of selected, biostratigraphically useful ostracod species. (D.d. *Deshayesites deshayesi* Zone; ABB Atherfield Bone Bed)

Fig. 3. Distribution of ostracods in the earliest Aptian at Atherfield, Isle of Wight (together with a single sample from Sandown). The approximate position of Magnetochron CM-0 is shown (for details see Kerth & Hailwood, 1988). For key, see Fig. 5.

Fig. 4. Distribution of ostracods in the earliest Aptian Shepherd's Chine and Perna members at Sandown, Isle of Wight. ABB: Atherfield Bone Bed. The 'Upper Perna Bed' is barren of ostracods. For key, see Fig. 5.

Fig. 5. Distribution of ostracods in the Chale Bay Member (Atherfield Clay Formation) in BGS borehole 75/35.

Fig. 6. The relationship between ostracod genera and salinity in the early Aptian of the Wessex Basin.

Fig. 7 Evidence of environmental variability across the Barremian/Aptian boundary: isotopic variability, large scale volcanism, distribution of climatically controlled glendonite and drop stones, fluctuations in aridity/humidity and sea level change (modified from Haq et al, 1987; Bralower et al., 1997, 1999; Price, 1999; Weissert & Erba, 2004). The early Aptian warm climatic event is shown in grey. fiss = *Prodeshayesites fissicostus* ammonite Zone; forb = *Deshayesites forbesi* ammonite Zone; des = *Deshayesites deshayesi* ammonite Zone; bow = *Tropaeum bowerbanki* ammonite Zone.

Figure

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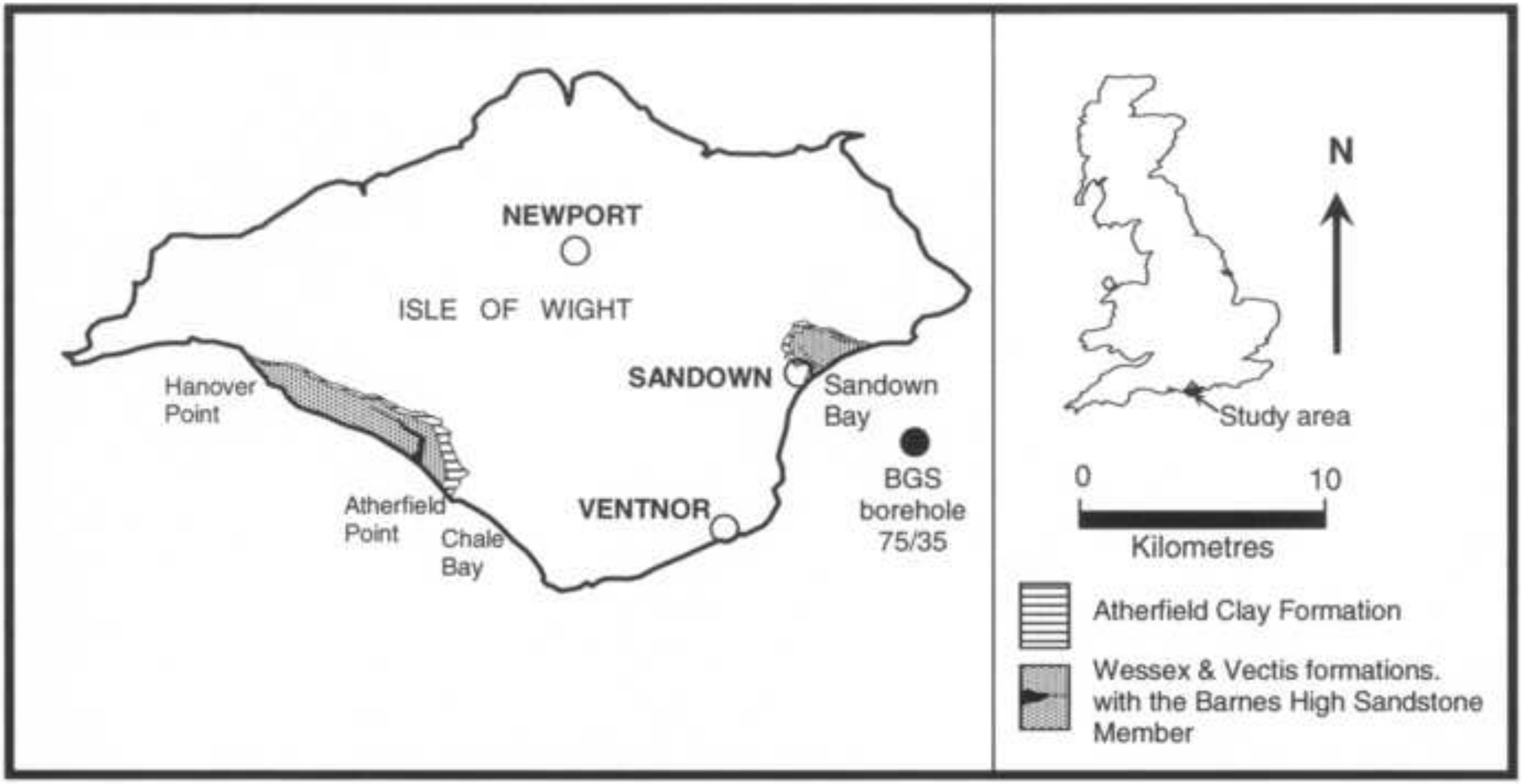

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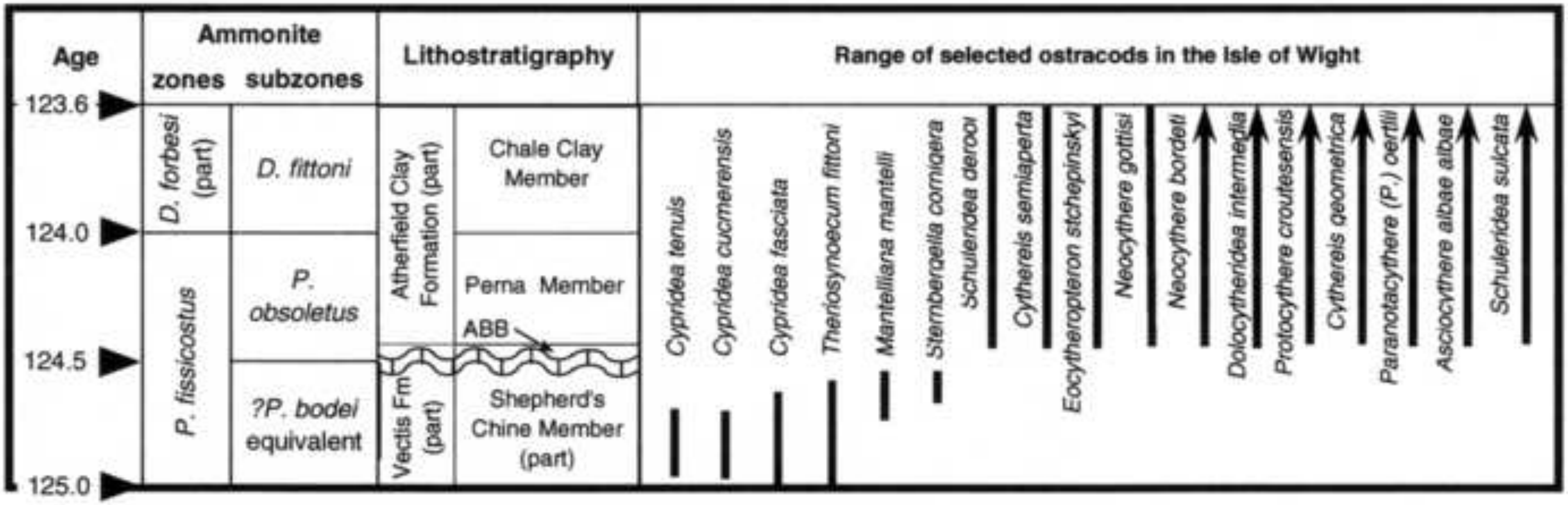
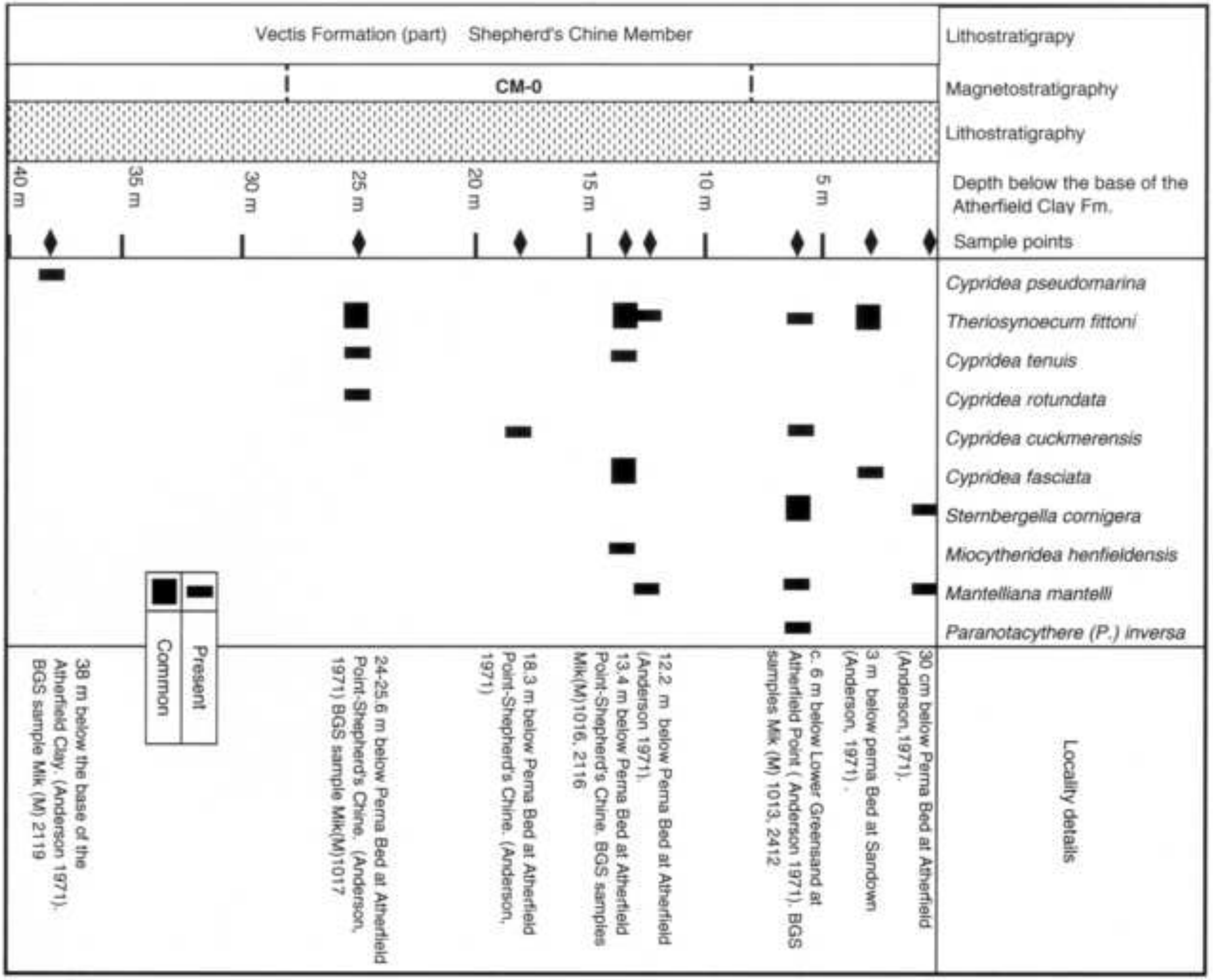
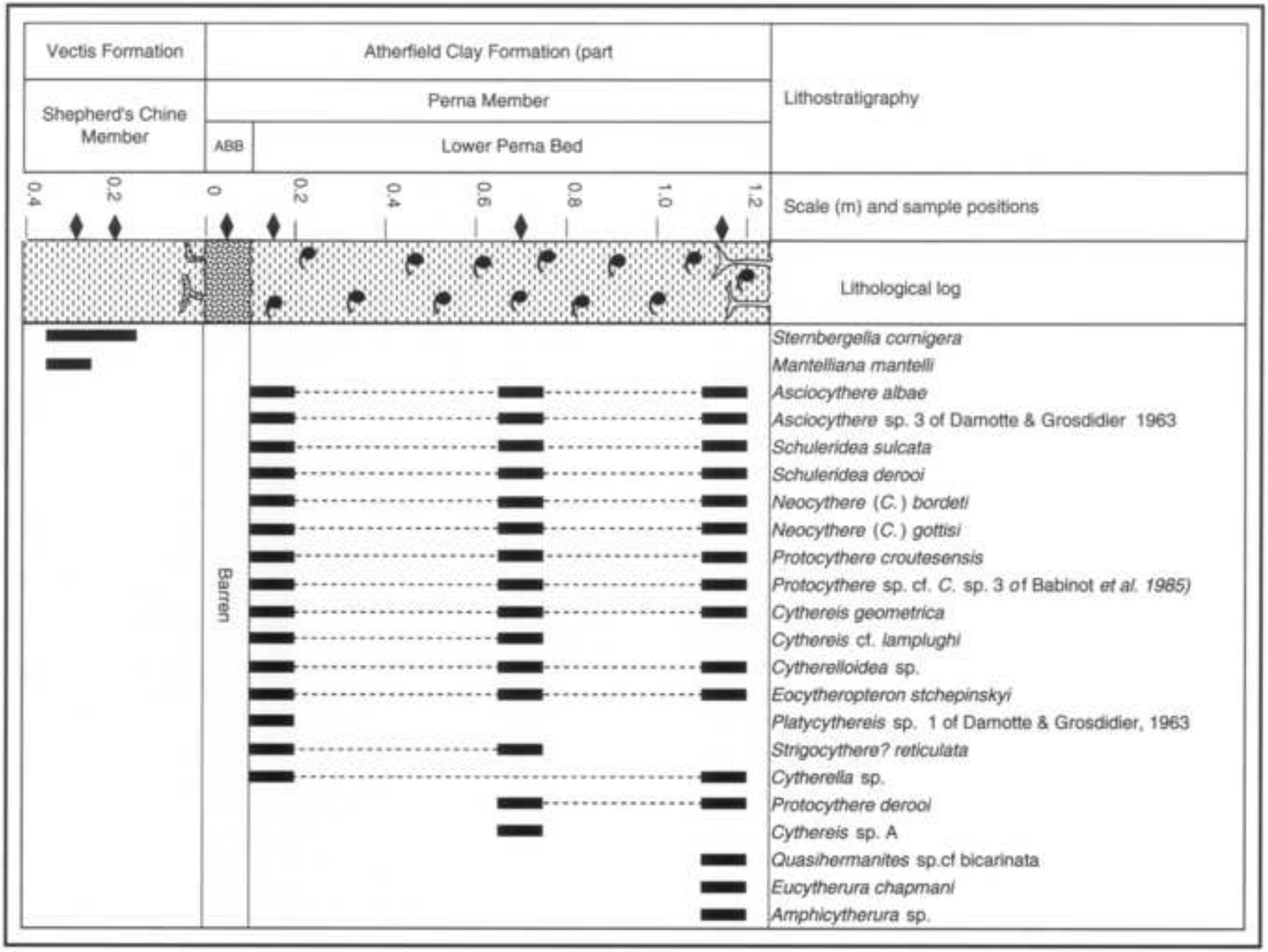
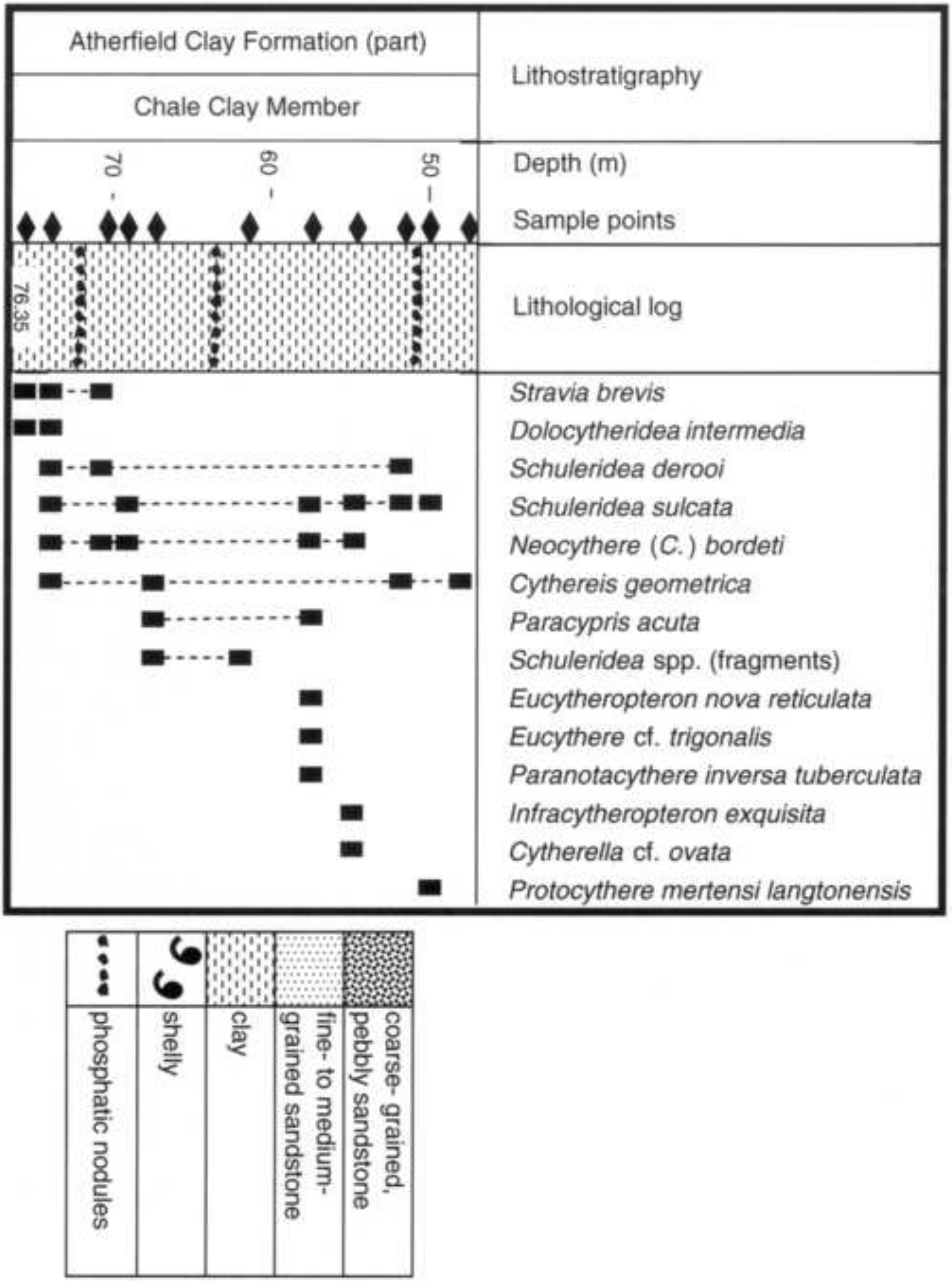



Vectis Formation (part) Shepherd's Chine Member
Lithostratigrapy
CM-0
Magnetostratigraphy
Lithostratigraphy
40 m
35 m
30 m
25 m
20 m
15 m
10 m
5 m
Depth below the base of the Atherfield Clay Fm.
Sample points
Cypridea pseudomarina
Theriosynoecum fittoni
Cypridea tenuis
Cypridea rotundata
Cypridea cuckmerensis
Cypridea fasciata
Sternbergella cornigera
Miocytheridea henfieldensis
Mantelliana mantelli
Paranotacythere (P.) inversa
Common
Present
Locality details
38 m below the base of the Atherfield Clay. (Anderson 1971). BGS sample Mik (M) 2119
24-25.6 m below Perna Bed at Atherfield Point-Shepherd's Chine. (Anderson, 1971) BGS sample Mik(M)1017
18.3 m below Perna Bed at Atherfield Point-Shepherd's Chine. (Anderson, 1971)
13.4 m below Perna Bed at Atherfield Point-Shepherd's Chine. BGS samples Mik(M)1016, 2116
12.2 m below Perna Bed at Atherfield (Anderson 1971).
c. 6 m below Lower Greensand at Atherfield Point (Anderson 1971). BGS samples Mik (M) 1013, 2412
3 m below perna Bed at Sandown (Anderson, 1971).
30 cm below Perna Bed at Atherfield (Anderson,1971).


Vectis Formation
Atherfield Clay Formation (part
Shepherd's Chine Member
Perna Member
ABB
Lower Perna Bed
Lithostratigraphy
0.4
0.2
0
0.2
0.4
0.6
0.8
1.0
1.2
Scale (m) and sample positions
Lithological log
Barren
Sternbergella cornigera
Mantelliana mantelli
Asciocythere albae
Asciocythere sp. 3 of Damotte & Grosdidier 1963
Schuleridea sulcata
Schuleridea derooi
Neocythere (C.) bordeti
Neocythere (C.) gottisi
Protocythere croutesensis
Protocythere sp. cf. C. sp. 3 of Babinot et al. 1985)
Cythereis geometrica
Cythereis cf. lamplughi
Cytherelloidea sp.
Eocytheropteron stchepinskyi
Platycythereis sp. 1 of Damotte & Grosdidier, 1963
Strigocythere? reticulata
Cytherella sp.
Protocythere derooi
Cythereis sp. A
Quasihermanites sp.cf bicarinata
Eucytherura chapmani
Amphicytherura sp.


Atherfield Clay Formation (part)
Chale Clay Member
Lithostratigraphy
70
60
50
Depth (m)
Sample points
76.35
Lithological log
Stravia brevis
Dolocytheridea intermedia
Schuleridea derooi
Schuleridea sulcata
Neocythere (C.) bordeti
Cythereis geometrica
Paracypris acuta
Schuleridea spp. (fragments)
Eucytheropteron nova reticulata
Eucythere cf. trigonalis
Paranotacythere inversa tuberculata
Infracytheropteron exquisita
Cytherella cf. ovata
Protocythere mertensi langtonensis
phosphatic nodules
shelly
clay
fine- to medium-grained sandstone
coarse- grained, pebbly sandstone

Figure

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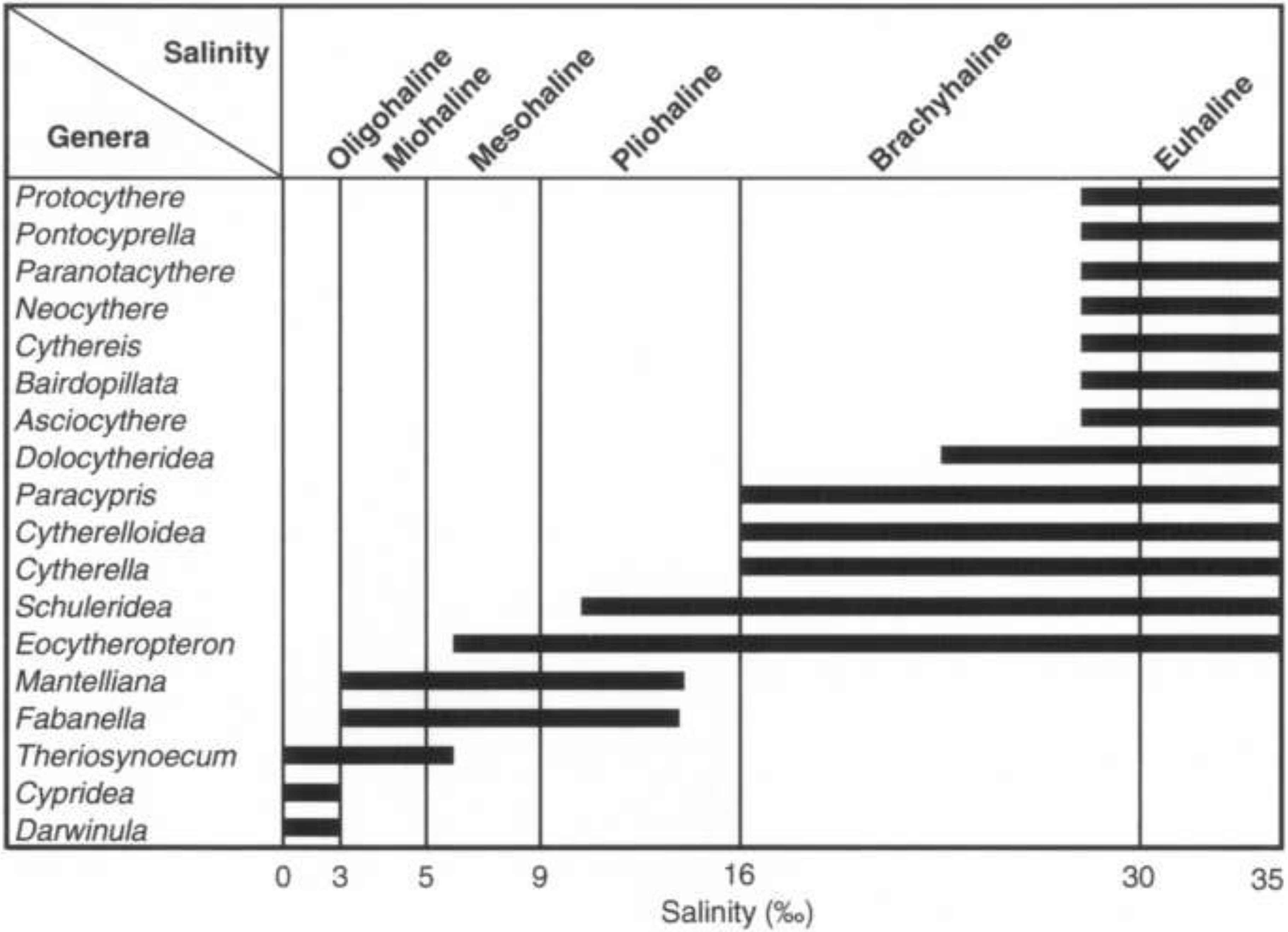

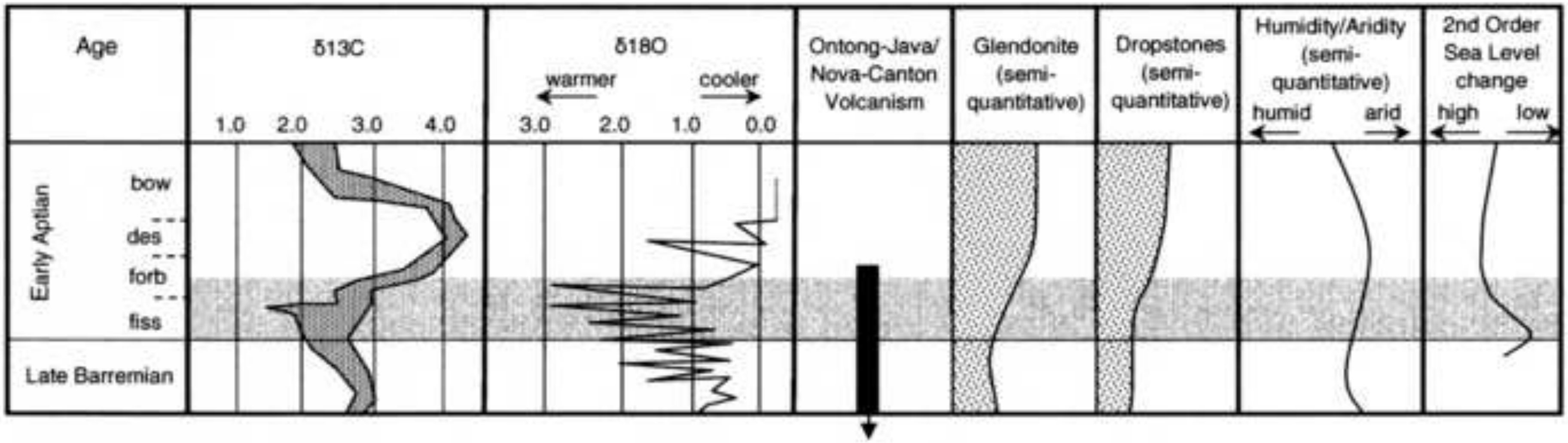
Age
δ13C
1.0
2.0
3.0
4.0
δ18O
warmer
cooler
3.0
2.0
1.0
0.0
Ontong-Java/
Nova-Canton
Volcanism
Glendonite
(semi-
quantitative)
Dropstones
(semi-
quantitative)
Humidity/Aridity
(semi-
quantitative)
humid
arid
2nd Order
Sea Level
change
high
low
Early Aptian
bow
des
forb
fiss
Late Barremian