



Micropalaeontological dating of the basal Cretaceous section of DSDP Site 249, Leg 25, Mozambique Ridge: implications for the timing of the southern Atlantic–Indian Ocean connection

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Abstract. Tectonic models suggest the absence of a deep water connection on the Mozambique Ridge during early Neocomian time. These models imply the initiation of a deep water connection between the southern Atlantic and Indian oceans formed during Barremian–earliest Aptian times. However, previous biostratigraphic studies of the earliest deep water sediments on the Mozambique Ridge suggest that the basal section is Neocomian in age. Here, we present a new biostratigraphic analysis undertaken to test this tectonic model and determine the earliest age of deep water sedimentation on the Mozambique Ridge. Core samples from the Cretaceous interval 222.05–406.32 m (Cores 19–32) of DSDP Site 249, Leg 25, were sampled for calcareous nannoplankton and palynological analysis. Most of the sampling was concentrated on the Lower Cretaceous interval below 294 m. Our results indicate that the lower sedimentary section is no older than Barremian and therefore provides support for the age proposed by the tectonic models.

1 Introduction

Site 249 of the DSDP Leg 25 was drilled in 1972 at a water depth of 2088 m on the Mozambique Ridge (Fig. 1). The total penetration of the borehole was 412, with 408 m of sedimentary section (Cores 1–32) overlying 3.1 m of highly vesicular theolithic basement basalt (Core 33). The borehole penetrated Miocene sediments unconformably overlying Upper Cretaceous. Shipboard biostratigraphic data identified the top Cenomanian/Lower Cretaceous section at 294 m (Core 24) with top Neocomian hypothesized at 313 m (Core 26).

Previous biostratigraphic analyses concentrated on calcareous nannoplankton (Shipboard Scientific Party, 1974a; Bukry, 1974), foraminifera (Shipboard Scientific Party, 1974a; Riegraf, 1989), and radiolaria (Sanfilippo and Riedel, 1974). Bukry (1974) describes a diverse Campanian assemblage (*E. augustus* Zone) at 263 m (Core 21) and proba-

ble early Aptian assemblages at 332–398 m (Cores 28–31), including *Micrantholithus obtusus*, *Vagalopilla matalosa*, and the ubiquitous *Watznaueria barnesiae*. An assemblage at 390 m (Core 31) contains abundant *W. barnesiae*, common *M. obtusus* and *V. matalosa*, as well as *C. crenulatus*, *M. hoschulzii*, *P. asper*, and *P. embergeri*, among others. Bukry (1974) suggests that his age determination is supported by the absence of Albian and younger taxa such as *Cribosphaera* and *Eiffellithus*, as well as the absence of *Crucilipsis cuvillieri*, which is indicative of Hauterivian. Lees (2002) re-analysed the Late Cretaceous section of Site 249. She assigned this section to the Campanian based on the presence of *Eiffellithus eximius* and *Eiffellithus sissinghii*. She considered that the Campanian sat unconformably on late Aptian and older based on an occurrence of *Farhania varolii*. A brief report indicates that radiolaria were recovered, but no firm stratigraphic conclusions were proposed although as-

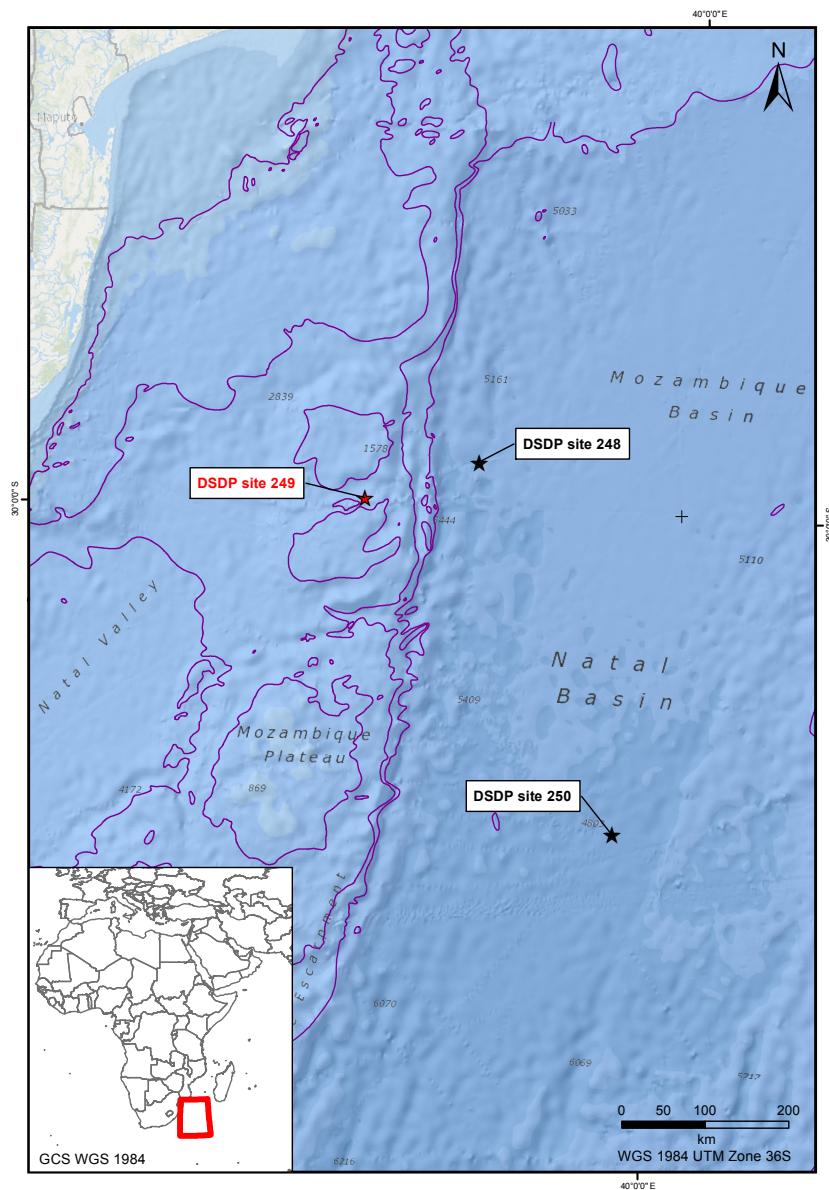


Figure 1. Location map of DSDP core holes on the Mozambique Ridge (DSDP 249) and Mozambique/Natal basins (DSDP 248, 250).

semblages from Cores 23-3 to 26-2 (287–315 m) appeared to be of “early Late Cretaceous” aspect (Sanfilippo and Riedel, 1974). Foraminiferal studies undertaken on board ship generally reported benthic forams (as well as some ostracods). Samples over the interval 294–313 m (Cores 24–26) contain small globigerinids of Aptian–Barremian aspect. Samples below 322 m contain ostracods and benthic forams. The authors suggest a Hauterivian–Valanginian age for the basal section. Riegraf (1989) in his study of 12 radiolarian-rich claystones from the interval 322–398 m (Cores 26-2 to 31-3) reaches a similar conclusion and assigns this interval to the Hauterivian–Valanginian. As abundant radiolaria are generally considered indicators of deep water, Riegraf considers

the benthic foraminifera assemblages, which are indicative of shelf habitats, to be reworked into deeper water.

The current study was undertaken to determine the earliest age of marine sedimentation on the Mozambique Ridge. Previous investigations, based principally on benthic foraminifera, proposed a Neocomian age (taken here and in the previous biostratigraphic studies to encompass the Berriasian–Hauterivian). Recent models for the Mozambique Ridge favour a magmatic origin (Koenig and Jockat, 2010; Maria et al., 1990), although a continental origin has been previously proposed (Tucholke et al., 1981). The ridge represents over-thickened oceanic crust generated during anomalous spreading activity at the complex triple junction between

Table 1. DSDP 249: list of samples with core numbers and depths (from sea floor) analysed for nannofossils and palynology.

ODP Core Sample	Top depth (m CSF-A)	Bottom depth (m CSF-A)	Top depth (m CSF-B)	Bottom depth (m CSF-B)	Palynology	Nannofossils
U0249Z-19R-3 W, 103.0–105.0 cm	222.03	222.05	222.03	222.05	×	×
U0249Z-22R-1 W, 70.0–72.0 cm	275.7	275.72	275.7	275.72		×
U0249Z-23R-4 W, 108.0–110.0 cm	289.58	289.6	289.58	289.6		×
U0249Z-23R-5 W, 106.5–108.5 cm	291.065	291.085	291.065	291.085	×	
U0249Z-24R-1 W, 88.0–90.0 cm	294.88	294.9	294.88	294.9	×	
U0249Z-24R-1 W, 135.0–137.0 cm	295.35	295.37	295.35	295.37		×
U0249Z-25R-1 W, 120.0–122.0 cm	304.2	304.22	304.2	304.22		×
U0249Z-25R-3 W, 22.5–25.0 cm	306.225	306.25	306.225	306.25	×	
U0249Z-25R-3 W, 83.5–85.0 cm	306.835	306.855	306.835	306.855		×
U0249Z-25R-3 W, 121.0–123.0 cm	307.21	307.23	307.21	307.23	×	×
U0249Z-26R-1 W, 62.0–64.0 cm	313.62	313.64	313.62	313.64	×	
U0249Z-26R-2 W, 110.0–112.0 cm	315.6	315.62	315.6	315.62		×
U0249Z-27R-1 W, 120.0–122.0 cm	323.2	323.22	323.2	323.22		×
U0249Z-27R-3 W, 121.0–123.0 cm	326.21	326.23	326.21	326.23	×	
U0249Z-28R-1 W, 21.0–23.0 cm	332.21	332.23	332.21	332.23		×
U0249Z-28R-1 W, 68.0–70.0 cm	332.68	332.7	332.68	332.7	×	×
U0249Z-29R-1 W, 53.0–55.0 cm	351.53	351.55	351.53	351.55		×
U0249Z-29R-1 W, 146.0–148.0 cm	352.46	352.48	352.46	352.48	×	
U0249Z-30R-1 W, 120.0–122.0 cm	371.2	371.22	371.2	371.22	×	×
U0249Z-30R-2 W, 24.0–26.0 cm	371.74	371.76	371.74	371.76	×	
U0249Z-31R-2 W, 30.0–31.0 cm	390.8	390.81	390.8	390.81	×	
U0249Z-31R-4 W, 34.0–35.0 cm	393.84	393.85	393.84	393.85		×
U0249Z-32R-1 W, 130.0–132.0 cm	406.3	406.32	406.3	406.32	×	×

Africa, Antarctica, and South America. Magmatic models are supported by recent refraction seismic observations (Koenig and Jokat, 2010; Maria et al., 1990), DSDP penetrations of basement at Sites 249 and 248, and numerous plate tectonic models.

Tectonic models by Koenig and Jokat (2006) suggest that the Mozambique Ridge was an effective barrier to deep water connection between the southern Atlantic and Indian oceans until at least the basal Barremian. By late Barremian/early Aptian time the tectonic models indicate deep water connectivity had been established. The objective of this biostratigraphic study at DSDP Site 249 was to establish the earliest age of the deep marine sedimentary package present on the Mozambique Ridge and therefore the timing of the southern Atlantic–Indian Ocean connection.

A total of 23 core samples were obtained from the ODP curator for palaeontological analysis over the interval 222.5–406.3 m (Cores 19-3 to 32-1). Calcareous nannofossils were re-examined in 15 samples in order to generate a quantitative dataset. Also, 13 samples were examined for palynology and a quantitative dataset was likewise generated. The sample and fossil group selection were made based on lithology. The three uppermost samples (222.05, 275.72, 289.6 m) were taken in overlying Upper Cretaceous Chalk. The remaining samples were taken from the generally Lower Cretaceous dark silty claystones and volcanic siltstones at and below 291.09 m (Core 23-5, 106.5–108.5 m). The sample and anal-

ysis listings with core depths from sea-bed and DSDP core notation are provided on Table 1.

2 Preparation techniques

Both suspended/pipette strew and centrifuge slides were produced for nannofossil examination. The suspended/pipette strew technique takes generally a teaspoon (less if there is small amount of sample) of washed sample. These are wrapped in a paper towel and crushed by a hammer. The powdered sediment is placed into a plastic cup/glass beaker and distilled water is added. Generally a deflocculant (sodium hexametaphosphate) is added to the distilled water. The sample is stirred and subjected to ultrasonication for 10 min and then left to disintegrate for several hours (generally overnight). A small amount of the suspension is decanted into a vial and diluted with distilled water. This is pipetted onto a glass slide and dried on a hotplate.

For the centrifuge slide the suspension in the beaker is left for several hours and then decanted into a test tube and centrifuged for 30 s at 350 rpm. The suspended liquid is decanted into a test tube and the residue sediment at the base of test tube is discarded. Distilled water is added and the sample is spun at 850 rpm for 30 s. The liquid is discarded and the residue sediment is retained. More distilled water is added and the sample is spun again at 850 rpm for 30 s. The suspended liquid is discarded and a small amount of distilled

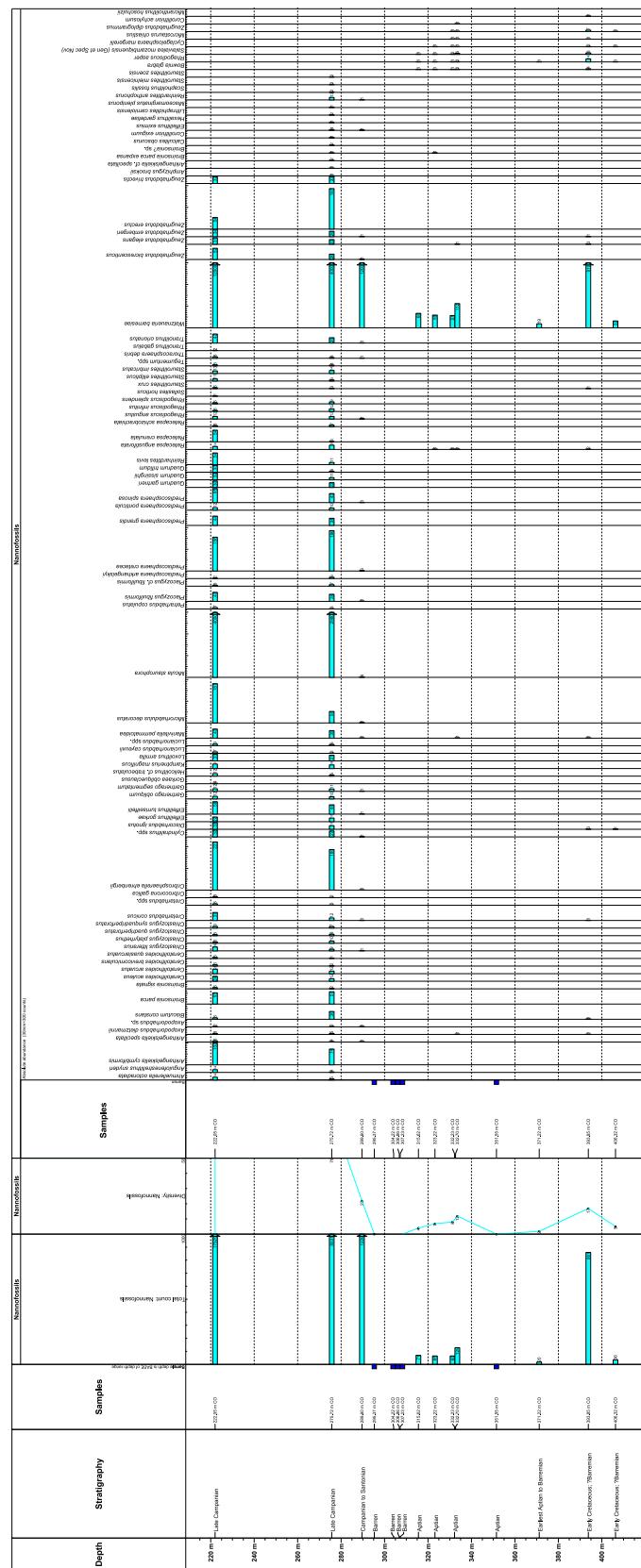
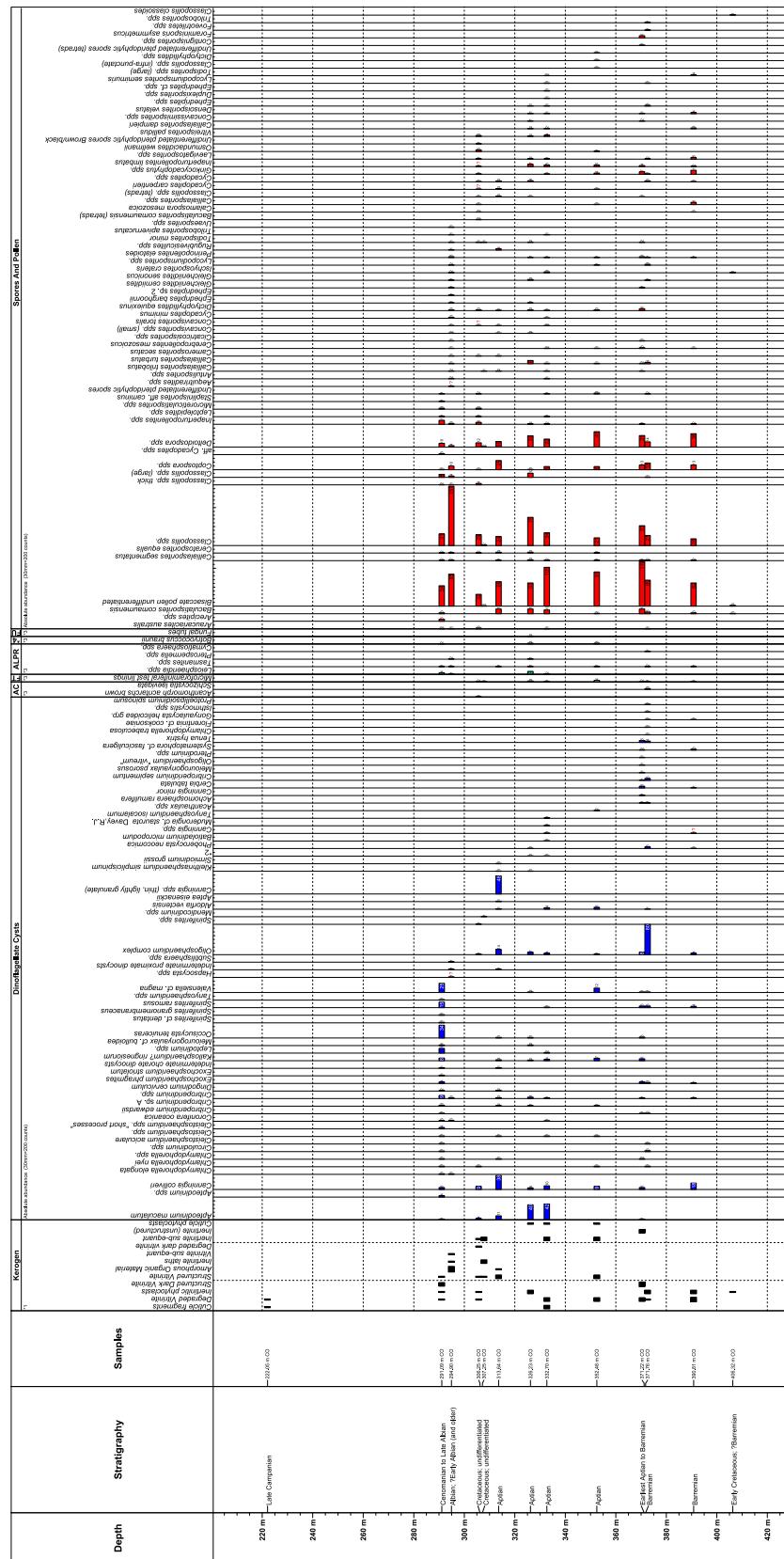


Figure 2. Calcareous nannoplankton fossil distribution chart. Total nannofossil count and species diversity per core (CO) sample.



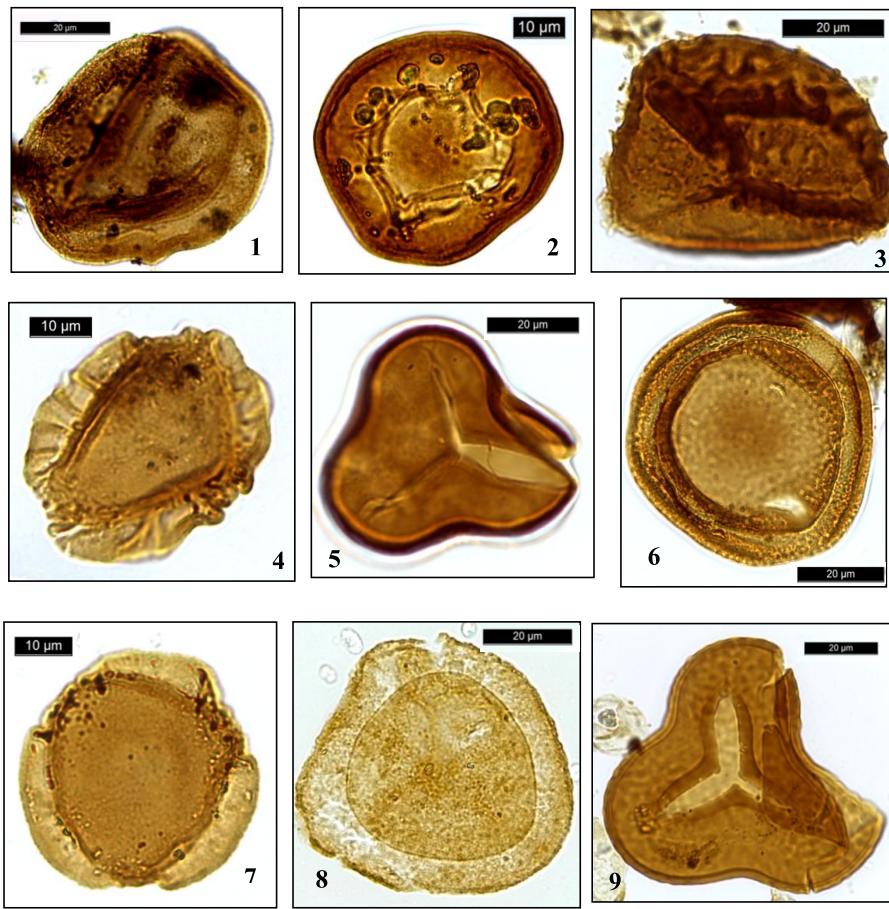


Plate 1. Dinocysts and palynomorphs. (1) *Callialasporites* spp., DSDP Site, depth 304.2 m; (2) *Classopollis* spp., DSDP Site 249, depth 371.7 m; (3) ?*Foraminisporis* spp., DSDP Site 249, depth 332.7 m; (4) *Callialasporites dampieri*, DSDP Site 249, depth 332.7 m; (5) *Cyathidites* spp., DSDP Site 249, depth 371.7 m; (6) *Callialasporites turbatus*, DSDP Site 249, depth 371.7 m; (7) *Callialasporites trilobatus*, DSDP Site 249, depth 332.7 m; (8) *Densosporites* spp., DSDP Site 249, depth 332.7 m; (9) *Concavissimisporites* spp., DSDP Site 249, depth 332.7 m.

water is added to the remaining sediment residue which is decanted into a vial. If the sample is judged to be too thick it is diluted with distilled water and then pipetted onto a glass slide and dried on a hotplate.

The nannofossil logging technique for each sample involved logging three traverses of the suspended/pipette strew slide. The sample is then counted using a cascading counting technique (Styzen, 1997) on 100 fields of view on the suspended/pipette strew slide.

The processing techniques for palynology slide preparation consisted of the following: core samples were scrubbed to remove surface contaminants and crushed. The samples were then immersed in 36% HCl to remove carbonates. After termination of any reaction the samples were treated with 48% HF for 3–4 days. After termination of reaction the samples were then sieved and 5 mL of sample was centrifuged in ZnCl (2.2 SG) to remove mineral matter. These samples were then mounted to produce kerogen slides. The remaining samples were oxidized utilizing 70% HNO₃. The samples were

centrifuged and sieved and after checking were mounted on slides.

The logging technique was to count a maximum of 200 specimens per slide and then re-examine the entire slide to log any sparse or single occurrences of other taxa.

3 Biostratigraphic results

All quantitative results are presented in Figs. 2 (calcareous nannofossils) and 3 (palynology). Key palynology taxa are illustrated on Plates 1–4 and calcareous nannofossil taxa are illustrated on Plate 5.

Late Campanian. The Chalk samples 222.05 m (Core 19-3, 103–105 cm) and 275.72 m (Core 22-1, 70–72 cm) contain rich calcareous nannofossil assemblages, including *Broinsonia parca*, *Quadrum trifidum*, *Eiffellithus eximus*, and *Reinhardtites anthophorus*, indicating a late Campanian age.

Plate Cretaceous indeterminate. The sample at 289.6 m (Core 23-4, 108–110 cm) contains a sparse and poorly pre-

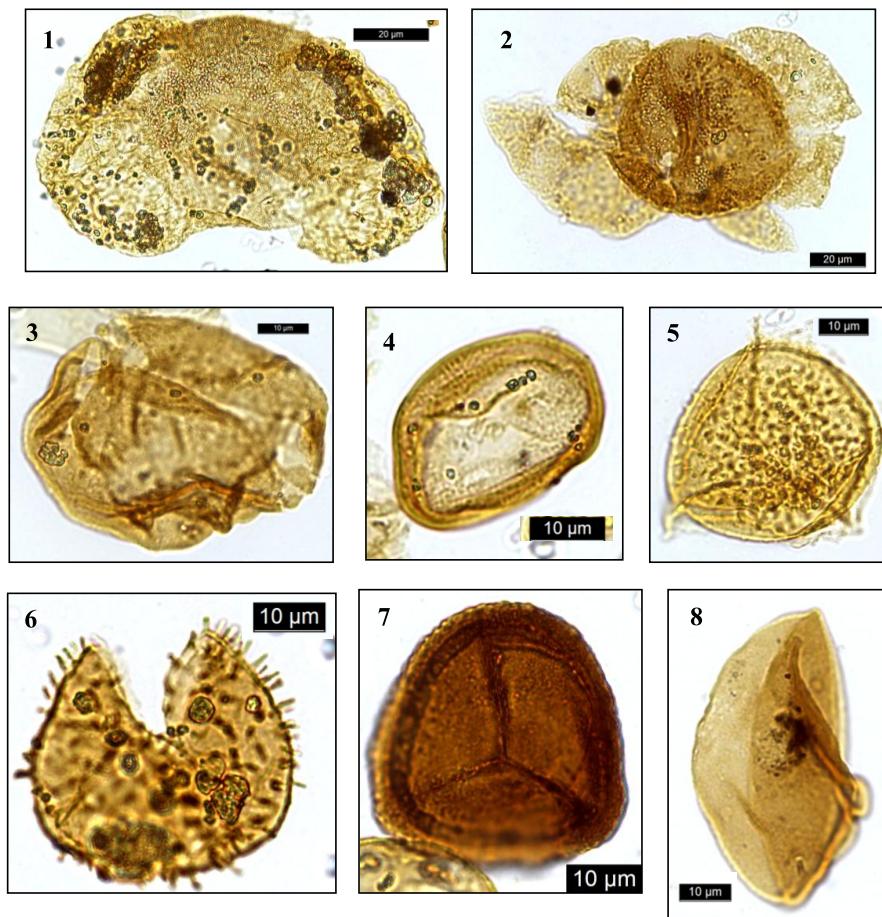


Plate 2. Dinocysts and palynomorphs. (1) Bisaccate pollen undifferentiated, DSDP Site 249, depth 332.7 m; (2) bisaccate pollen undifferentiated, DSDP Site 249, depth 332.7 m; (3) *Araucariacites australis*, DSDP Site 249, depth 332.7 m; (4) *Classopollis* spp., DSDP Site 249, depth 332.7 m; (5) aff *Aequitriradites* spp., DSDP Site 249, depth 294.9 m; (6) *Baculatisporites comaumensis*, DSDP Site 249, depth 352.4 m; (7) *Densiisporites velatus*, DSDP Site 249, depth 390.8 m; (8) *Cycadopites* spp., DSDP Site 249, depth 332.7 m.

served assemblage dominated by *Watznaueria barnesiae* with *Eiffellithus eximus* and *Arkhangelskiella specillata*. These are long-ranging Late Cretaceous taxa.

Cenomanian–late Albian. The claystone at 291.09 m (Core 23-5, 106.5–108.5 cm) was palynologically analysed. Dinocysts are common, with *Occisucysta tenuiceras*, *Canningia colliveri*, *Exochosphaeridium striatolatum*, *Coronifera oceanica*, and *Cribroperidinium* spp. as major constituents. *Classopollis torosus* is the dominant pollen species and occurs in strata no younger than Cenomanian (Herngreen, 1975; Morgan, 1978). No nannofossil analyses were undertaken on this sample. However, an associated sample at 288.4 m (Core 23-3, 3–6 cm) contained a planktonic foraminifera assemblage including *Ticinella* (aff *T. robertii*), *Rotalipora appenninica balernaensis* and *Praeglobotruncana delrioensis* (Shipboard Scientific Party, 1974a), suggesting a Cenomanian–late Albian age.

Early Albian to late Aptian (294.9–307.23 m). The age determination is based on sparse palynofloras with increased

numbers of *Callialasporites* at 294.9 (Core 24-1, 88–90 cm) associated with *Ephedripites* and *Classopollis torosus*. An increase in pteridophyte spores may argue for an early Aptian or older age (Morgan, 1978), although could be environmentally driven. Dinocysts are very rare at 294.9 m. The other samples in this interval contain dinocysts of early Albian–late Aptian aspect (e.g. *Apteodinium maculatum*). The interval is barren of calcareous nannofossils.

Early Aptian (313.64–352.48 m). The downhole appearance at 313.64 m (Core 26-1, 62–64 cm) of the dinocyst species *Kleithriaspheeridium simplicispinum* indicates an age no younger than Aptian although this species can range into the early Albian mammilatum ammonite zone (Costa and Davey, 1992). Other dinocyst taxa typical of the Aptian, such as *Aptea eisenacki* (313.64 m), *Batioladinium micropodium* (326.23 m; Core 27-3, 121–123 cm), and *Muderongia cf. staurota* (332.7 m; Core 28-1, 21–23 cm), appear in this interval. There is also an increase in *Oligosphaeridium* spp., *Canningia* spp., and *Apteodinium maculatum*. Other

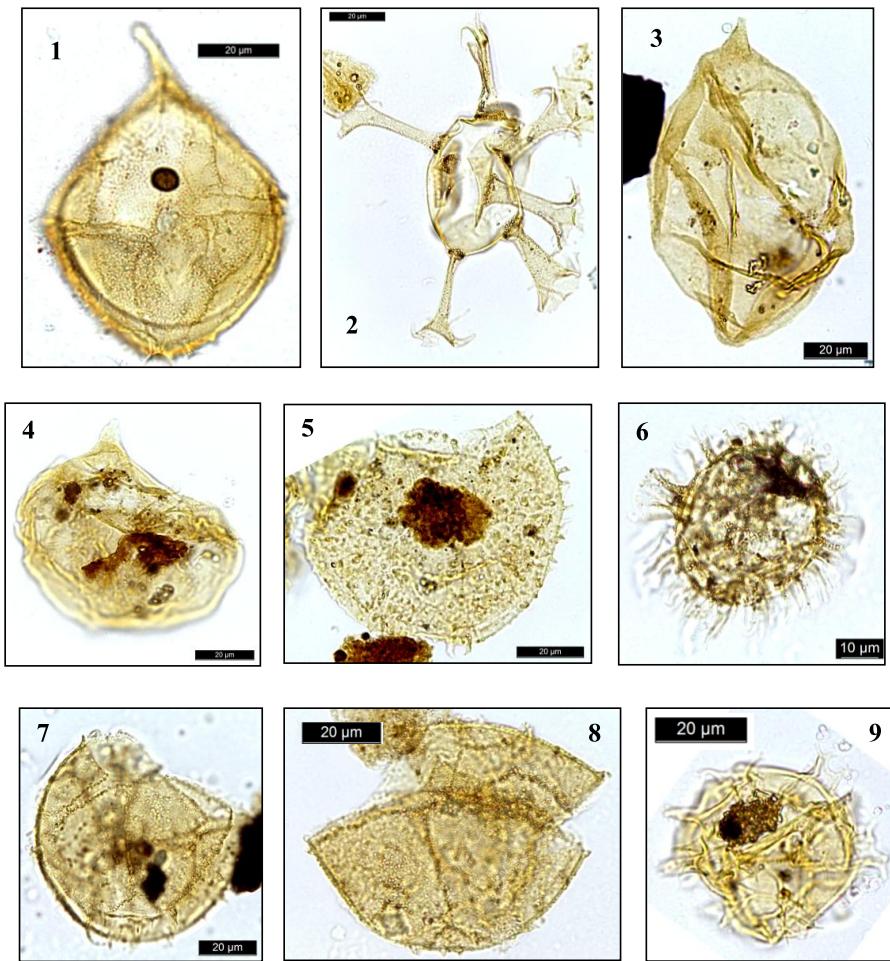


Plate 3. Dinocysts and palynomorphs. (1) *Cribroperidinium edwardsii*, DSDP Site 249, depth 371.7 m; (2) *Oligosphaeridium complex*, DSDP Site 249, depth 371.7 m; (3) *Apteodinium maculatum*, DSDP Site 249, depth 332.7 m; (4) *Apteodinium maculatum*, DSDP Site 249, depth 332.7 m; (5) *Canningia colliveri*, DSDP Site 249, depth 332.7 m; (6) *Cleistosphaeridium aciculare*, DSDP Site 249, depth 291.0 m; (7) *Cribroperidinium* spp., DSDP Site 249, depth 291.0 m; (8) *Occisucysta tenuiceras*, DSDP Site 249, depth 291.0 m; (9) *Spiniferites ramosus*, DSDP Site 249, depth 291.0 m.

dinocysts also appear which do not contradict an early Aptian age, such as *Sirmiodinium grossii* and *Phoberocysta neocomica*.

This is supported by the presence of the Turonian–Aptian nannofossil *C. achylosus* at 332.7 m, which indicates an age no older than Aptian. Furthermore, this species is considered to have its base towards the top of the early Aptian (Erba et al., 1999; Aguado et al., 2014). The absence here of nannofossils with stratigraphic bases in the Albian also supports a pre-Albian age. The assemblages are dominated by the long-ranging species *Watnaueria barnesiae*.

Earliest Aptian to Barremian (371.22 m). The last down-hole occurrence of the dinocyst *Occisucysta tenuiceras* and the presence of common *Cerbia tabulata* at 371.22 m (Core 30-1, 120–122 cm) indicate earliest Aptian to Barremian. According to Oosting (2004) *O. tenuiceras* indicates an age no older than earliest Aptian. However, common *C. tabulata* and

T. hystrix are generally indicative of Barremian assemblages. Only rare, long-ranging calcareous nannofossils (e.g. *W. barnesiae*) occur in this sample.

Barremian (371.76–393.85 m). The presence of common *Phoberocysta neocomica* and *Cribroperidinium sepimentum* suggests a Barremian age as it is associated with the occurrence of *Cerbia tabulata*. The first occurrence (inception) of *C. tabulata* occurs at 390.81 m (Core 31-2, 30–31 cm). The inception point of this species in Europe is considered by Heilmann-Clausen (1987) and others to be no older than early late Barremian (*elegans* ammonite zone).

The presence of *Bownia glabra* at 393.8 m, which has its lowest occurrence in the Aptian/late Barremian, supports an age no older than late Barremian at this depth. Although the FO (first occurrence) of *B. glabra* is considered to be at the Aptian–Barremian boundary, Cooper has found this species in the late Barremian in confidential commercial well sec-

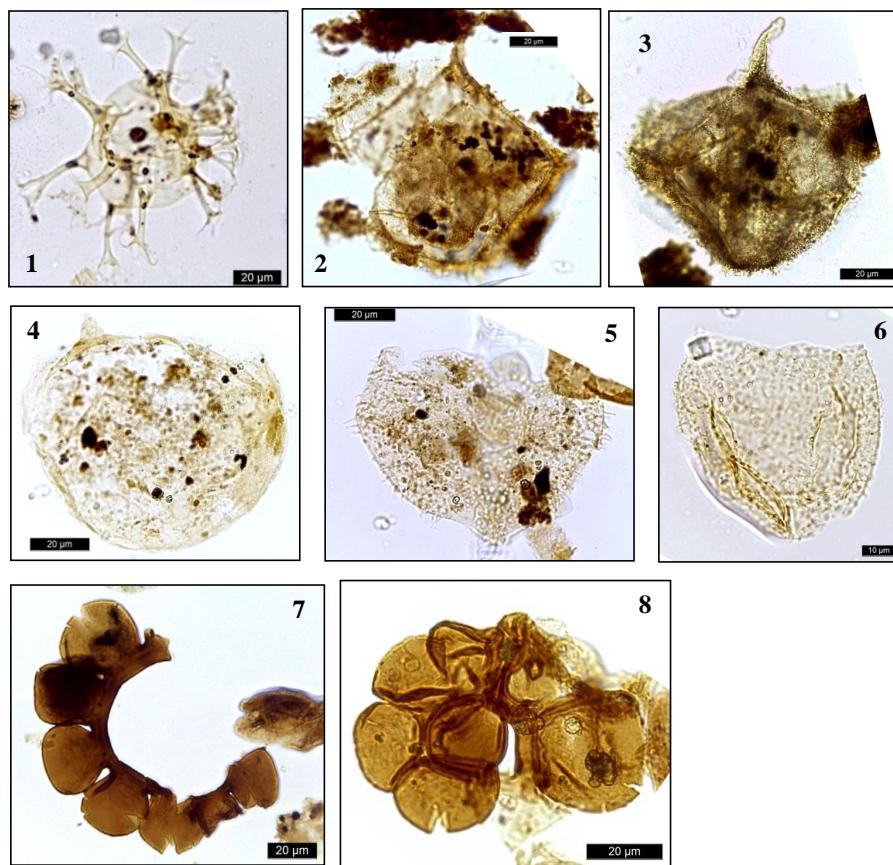


Plate 4. Dinocysts and palynomorphs. (1) *Oligosphaeridium complex*, DSDP Site 249, depth 326.2 m; (2) *Occysucysta tenuiceras*, DSDP Site 249, depth 304.2 m; (3) *Cribroperidinium edwardsii*, DSDP Site 249, depth 326.2 m; (4) *Aptedinium* spp., DSDP Site 249, depth 326.2 m; (5) *Canningia* spp., DSDP Site 249, depth 326.2 m; (6) *Cerbia tabulata*, DSDP Site 249, depth 371.7 m; (7) Microforaminiferal test lining, DSDP Site 249, depth 326.2 m; (8) Microforaminiferal test lining, DSDP Site 249, depth 326.2 m.

tions. Also, an image in Ruckheim et al. (2006) (Fig. 3c) which they recorded in the late Barremian and which was assigned to *Broinsonia galloisii* is most likely *B. glabra*. *W. barnesiae* remains a dominant constituent of the assemblage at 393.85 m. *Bownia glabra* is to be assigned to a new genus which will be formalized by Cooper in 2018.

Early Cretaceous indeterminate (406.32 m). A very sparse palynoflora containing exclusively pollen and spores of indeterminate age occurs at this bottommost sample (Core 32-1, 130–132 cm). A sparse nannoflora consisting of *W. barnesiae* and single specimens of *Rhagodiscus asper*, *Cyclagelosphaera margerelli*, and *Zeugrhabdotus diplogrammus* also occur and indicate a general Early Cretaceous age.

4 Biostratigraphic discussion

The age assignment of Campanian to 222.05 and 275.72 m is in agreement with the conclusions of the Shipboard Scientific Party (1974a), as is the late Albian–Cenomanian age assignment at 291.09 m. The early Albian to late Aptian interval

(294.9–307.23 m) is also consistent with the conclusions of the Shipboard Scientific Party (1974a) and later reports.

However the Aptian and Barremian age assignments of the interval below 313 m (Core 26) in the present analysis differs from the Neocomian age date proposed both in 1974 Shipboard Scientific Party reports and the Valanginian–Hauterivian age proposed by Riegraf (1989). The concept of the “Neocomian” is indistinct and differs with different authors. The shipboard reports exclude the Barremian stage as does Riegraf. However, Mutterlose (1992) in his nannofossil study of the Lower Cretaceous of ODP Leg 123 (off NW Australia) includes the Barremian in the Neocomian as major floral and faunal changes occur worldwide at the Barremian–Aptian boundary.

Riegraf (1989) described the foraminifera from 12 radiolarian-rich claystone samples over the depths 315–394 m (Cores 26–31), listing 38 species of calcareous benthic foraminifera dominated by nodosariids and 4 species of agglutinated forams, as well as 13 others in open nomenclature. No planktonic forams were described. The vast majority of the described species are considered endemic or

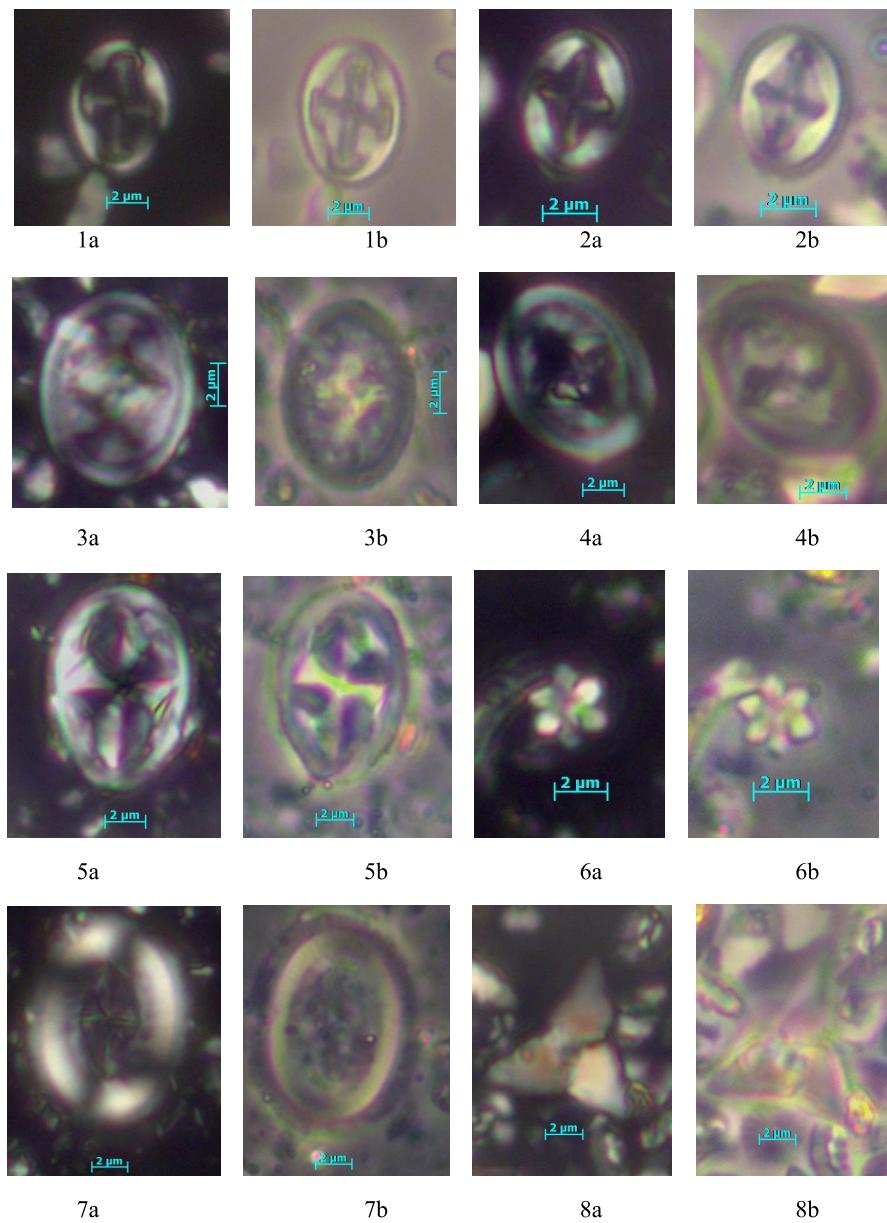


Plate 5. Calcareous Nannoplankton. (1a, b) *Salavialea mozambiquensis* (gen. et spec. nov., formal designation in press), (1a) crossed nicols, (1b) phase contrast, same specimen, DSDP Site 249, depth 393.8 m; (2a, b) *Bownia glabra*, (2a) crossed nicols, (2b) phase contrast, same specimen, DSDP Site 249, depth 393.8 m; (3a, b) *Reinhardtites levis*, (3a) crossed nicols, (3b) phase contrast, same specimen, DSDP Site 249, depth 222.0 m; (4a, b) *Reinhardtites anthophorus*, (4a) crossed nicols, (4b) phase contrast, same specimen, DSDP Site 249, depth 289.6 m; (5a, b) *Staurolithites integer*, (5b) phase contrast, same specimen, DSDP Site 249, depth 222.0 m; (6a, b) *Hexolithus gardetiae*, (6a) crossed nicols, (6b) phase contrast, same specimen, DSDP Site 249, depth 222.0 m; (7a, b) *Broinsonia parca*, (7a) crossed nicols, (7b) phase contrast, same specimen, DSDP Site 249, depth 222.0 m; (8a, b) *Quadrum trifidum*, (8a) crossed nicols, (8b) phase contrast, same specimen, DSDP Site 249, depth 222.0 m.

range throughout the Early Cretaceous with extinction points in Barremian or younger sections. Three of the described species are considered by the author to be restricted to sequences no younger than Hauterivian or Valanginian: *Marginulina caelata* with rare occurrences (1–5 individuals) at 393, 351, and 315 m; *Astacolus microdictyotus* with a rare

occurrence at 351 m; and *Paalzowella feifeli* also with a rare occurrence at 315 m.

The actual age range of these benthic forams is uncertain. *P. feifeli* has been described from the Bathonian to Valanginian at various sites, and *Marginulina caelata* is a generally Late Jurassic form. *Astracolus microdictyotus*,

which is described by Riegraf as having a Late Jurassic–Valanginian range in Madagascar, has been also described from the post-rift Barremian sequence in the neighbouring offshore basins of South Africa (McMillan, 2003). *Lenticulina nodosa*, another nodosariid encountered by Riegraf in the sample range 315–393 m, is also a common constituent of the early Aptian–Barremian post-rift faunal assemblages of the South African basins as described by McMillan (2003).

The biostratigraphic evidence for younger Early Cretaceous (i.e. Aptian and Barremian) ages for the section below 313 m is presented in this paper. The presence of the nannofossil species *Corollithion achylosus* at 332.7 m indicates an age no older than early Aptian at this level. This occurrence, associated with the absence of typical Albian forms, strongly suggests an Aptian age. Mutterlose (1992) reported first occurrences of *C. achylosus* in Core 27, ODP Leg 123, Site 766A, of NW Australia, which he dated as early Aptian. The first downhole appearance of the dinocyst *Phoberocystis neocomica* at 326.23 m, which has an early Aptian extinction level, further suggests an early Aptian age.

The Barremian age assignment for the section below 371.76 m is based on the occurrences of the dinocyst *Ceratia tabulata* at 390.81 m and its common occurrence at 371.76 m. *C. tabulata* is considered to be no older than late Barremian. The presence of the nannofossil species *Bownia glabra* at 393.85 m also indicates an age no older than the late Barremian.

5 Conclusions

Our biostratigraphic results indicate that the lower sedimentary section of DSDP Site 249 is no older than Barremian. Although 3.1 m of glassy vesicular basaltic material was recovered from the base of Site 249 (Shipboard Scientific Party, 1974b) no radiometric age dating was performed. K–Ar dating on three basalt samples at Site 248 (McKee, 1974) records a Late Cretaceous age of 72.3 ± 7 Ma, with reported late Palaeocene sediments overlying basalt. Although Site 248 is only 143 km ENE of Site 249 (Fig. 1), it is within the abyssal oceanic plain, rather than on the Mozambique Ridge. A tectonic explanation for the implied difference in the minimum age of the basalts is beyond the scope of this study. Tectonic models proposed by Koenig and Jokat (2006) suggest that the development of a deep water connection on the Mozambique Ridge did not occur until Barremian/Aptian time. The previous biostratigraphic studies, based primarily on benthic foraminifera assemblages, suggested a Hauterivian/Valanginian age for the oldest sediments at DSDP 249 (Shipboard Scientific Party, 1974a; Riegraf, 1989). The results of the current study, indicating a Barremian age for earliest sedimentation over the basement basalt, are consistent with the tectonic model.

Data availability. This micropalaeontological analysis was undertaken as part of a comprehensive geological study of the region which is commercially confidential. All of the raw palaeontological data relevant to this paper are contained in the figures and tables presented in the paper.

Competing interests. The authors declare that they have no conflict of interest.

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