21. MARINE CRETACEOUS PALYNOLOGY OF HOLES 549 AND 550, DEEP SEA DRILLING PROJECT LEG 80, NORTHERN BAY OF BISCAY[1]

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ABSTRACT

Marine palynomorph assemblages occurring in 71 Cretaceous samples from DSDP Holes 549 and 550 are described in the present study. Owing to the relative scarcity of the palynomorphs recovered, the ages assigned are based more on individual occurrences than on assemblages.

In Hole 549, Barremian and Cenomanian forms were positively identified; the identification of Albian strata is based on the occurrence of a single species. Aptian forms could not be identified. In the uppermost Albian (Vraconian) of Hole 550, palynomorph recovery was poor, but it improved in the Cenomanian, where the assemblages are characteristic. The post-Cenomanian Upper Cretaceous also contains diagnostic species, but cannot be subdivided to the stage level.

Palynofacies variations suggest that the Barremian and the Albian were deposited in a coastal marine environment and that the lower Upper Cretaceous accumulated farther offshore under a much reduced terrigenous influence.

INTRODUCTION

Leg 80 of the Deep Sea Drilling Project was a concerted effort to study the geologic history of the North Atlantic Ocean before, during, and after the rifting that opened the ocean and separated Europe from North America. The coring program concentrated on four closely spaced sites on the continental margin seaward of the Western Approaches Basin. They are situated on Goban Spur about 250 km southwest of Ireland. This area was selected because the sedimentary section there is thin but is relatively complete.

Hole 549

Site 549 is above the seaward tip of a tilted basement high (water depth 2533 m) near the Pendragon Escarpment, which truncates the westward slope of Goban Spur (Fig. 1). Hole 549 penetrated a 290-m sequence of Barremian sedimentary rocks that accumulated rapidly during a marine transgression over the upraised basement rock. The succession consists principally of 150 m of noncalcareous terrigenous mudstones, interbedded with calcareous mudstones, overlain by 40 m of vuggy, diagenetically recrystallized, skeletal packstones and wackestones and 120 m of calcareous sandy mudstones.

A postrift unconformity separates the upper Barremian from the lower Albian. At the contact, an undated 7-m bed of hard dolosparite is overlain by 185 m of gray calcareous lower and middle Albian siltstones. In the upper part, calcareous beds (as much as 83% carbonate) alternate irregularly with clayrich beds (as little as 5% carbonate). The Upper Cretaceous is dominated by white chalks, but Turonian black shales are present in the lower part.

Hole 550

Site 550 is on the abyssal plain (water depth 4432 m), 10 km southwest of the seaward edge of Goban Spur, above a high structural block of the oceanic basement (Fig. 1). Above the oceanic basement, the sedimentary sequence in Hole 550 begins with uppermost Albian (Vraconian) chalks at 685 m. Overlying lower and middle Cenomanian sediments, consisting of interbedded light and dark mudstones, complete the sequence.

A disconformity occurs at 594.8 m, and is indicated by a sharp contact between calcareous and noncalcareous sediments. The overlying interval consists of dark, massive, carbonate-free claystone (Santonian–Coniacian). Lower Maestrichtian (and late Campanian?) strata, from 575 to 426.5 m, consist of interbedded calcareous turbiditic and mudflow deposits.

Figure 1. Locations of DSDP Holes 549 and 550. Contour depths in meters.

[1] Graciansky, P. C. de, Poag, C. W., et al., *Init. Repts. DSDP*, 80: Washington (U.S. Govt. Printing Office).

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PALYNOLOGIC RESULTS

Palynologic slides were prepared from 25 samples (17 cores) from Hole 549 and from 46 samples (34 cores) from Hole 550, and were studied for their marine palynomorph content.

Hole 549

In the Lower Cretaceous samples (Barremian and Albian), palynologic preparations are dominated by land-derived plant debris and sporomorphs. Marine palynomorphs usually represent between 5 and 30% of the total palynomorph assemblage, although this figure may be as high as 45% (Sections 549-76-1 and 549-60-3). In the Cenomanian palynologic residue (Core 27), the marine palynomorph assemblage makes up a lower percentage, and sapropelic organic matter is abundant.

The stratigraphic distribution of palynomorphs from Hole 549 is plotted in Figure 2. In most cases, the species are represented by few specimens, and their preservation is relatively poor; most are transparent, and are often obscured by organic matter. For these reasons, the dinocysts present are difficult to use for precise stratigraphic interpretations; detailed correlations with other areas have not been attempted.

All the recovered dinocysts have been previously reported from samples from coeval sediments in northwest Europe (Davey, 1979a, Apto-Albian; Duxbury, 1980, Barremian) and in the western North Atlantic (Habib, 1977, Neocomian).

Cores 79 to 53: Barremian

Four long-ranging species, *Spiniferites ramosus, Oligosphaeridium complex, Cyclonephelium distinctum*, and *C. brevispinatum*, dominate the marine palynomorphs. Specimens of the genus *Cyclonephelium* are particularly abundant.

Some species are restricted to the Lower Cretaceous, notably *Gonyaulacysta confossa, Dingodinium ?albertii, Meiourogonyaulax pertusa, Phoberocysta neocomica, Muderongia simplex microperforata*, and *Aprobolocysta neistosa*, which are also present in the Lower Cretaceous Speeton Clay of England (Davey, 1974; Duxbury, 1977) and in Denmark (Davey, 1982). One other species, *Druggidium deflandrei*, is known only from the Barremian section, and occurs also in coeval sediments of southeast France (Millioud, 1969), and in the western North Atlantic (Habib, 1977).

Two stratigraphically important species found here are used in the dinocyst zonation (Davey, 1979b) of northwest Europe. The first is *Odontochitina operculata*, the base of which defines the zone of that name and encompasses most of the Barremian and more recent stages in the Cretaceous. The second is *Palaeoperidinium cretaceum*, which first occurs near the base of the mid-Barremian. So, in spite of low species diversity, the dinocysts confirm that this interval is Barremian.

Cores 49 to 32: Albian

The assemblages obtained from these cores are restricted: most of the samples are barren or contain only rare specimens. Most of the dinocyst species recovered in these cores were also present in the Barremian. Only four species first appear in this interval. Of these, *Batioladinium* sp. is characteristic of the Lower Cretaceous, *Hystrichodinium pulchrum* and *Sensutidinium* sp. are long-ranging forms, and *Systematophora cretacea* appears to be diagnostic for the middle and lower upper Albian (Davey, 1979a). The Albian cannot be well documented by means of dinocysts in these cores.

Cores 28 through 27: Cenomanian

In spite of a poor assemblage, the appearance of the two characteristic species, *Palaeohystrichophora infusorioides* and *Epelidosphaeridia spinosa*, in Section 27-1, indicates that these cores are uppermost Albian to Cenomanian.

Upper Cretaceous Cores (25 to 19)

All analyzed samples from these cores are completely barren of marine palynomorphs.

Cretaceous Palynofacies in Hole 549

The relative proportions of marine palynomorphs, spores, and pollen grains present in the palynologic residues of the samples studied are shown in Figure 3. This figure shows that spores and pollen grains are predominant in the Barremian and especially common in the Albian (85–95%). This association, together with abundant terrestrial plant debris, suggests that the sediments were deposted not far from land.

Core 27, upper Cenomanian, is characterized by an abundance of amorphous palynodebris and a higher proportion of microplankton (40%). This assemblage reflects a decreasing continental influence and a marine depositional environment.

PALYNOMORPH SPECIES IN HOLE 549[3]

Aprobolocysta neistosa Duxbury, 1980 (Plate 1, Figs. 5 and 6)
Batioladinium sp.
Callaiosphaeridium asymmetricum (Deflandre and Courteville, 1939) Davey and Williams, 1966
Cassiculosphaeridia reticulata Davey, 1969
Coronifera oceanica Cookson and Eisenack, 1958 (Plate 2, Fig. 7)
Cribroperidinium edwardsii (Cookson and Eisenack, 1958) Davey, 1969
Cyclonephelium brevispinatum (Millioud, 1969) Below, 1981 (Plate 2, Fig. 1)
Cyclonephelium distinctum Deflandre and Cookson, 1955
Dingodinium ?albertii Sarjeant, 1966 (Plate 2, Fig. 8)
Druggidium deflandrei (Millioud, 1969) Habib, 1973 (Plate 2, Figs. 2 and 3)
Epelidosphaeridia spinosa (Cookson and Hughes, 1964) Davey, 1969
Exochosphaeridium phragmites Davey et al., 1966
Florentinia mantellii (Davey and Williams, 1966) Davey and Verdier, 1973
Gardodinium trabeculosum (Gocht 1959) Alberti, 1961
Gonyaulacysta aptiana (Deflandre, 1935) Sarjeant, 1966 (Plate 1, Fig. 4)
Gonyaulacysta confossa Duxbury, 1977
Gonyaulacysta helicoidea (Eisenack and Cookson, 1960) Sarjeant, 1966
Hystrichodinium pulchrum Deflandre, 1935 (Plate 2, Fig. 6)
Hystrichosphaerina schindewolfii Alberti, 1961
Kiokansium polypes (Cookson and Eisenack, 1962) Davey, 1983
Meiourogonyaulax pertusa (Duxbury, 1977) Below, 1981 (Plate 1, Fig. 7)
Muderongia simplex (Alberti, 1961) subsp. *microperforata* Davey, 1982 (Plate 1, Fig. 8)

[3] In alphabetic order by genus and species. Plate and figure numbers indicate species illustrated in this chapter.

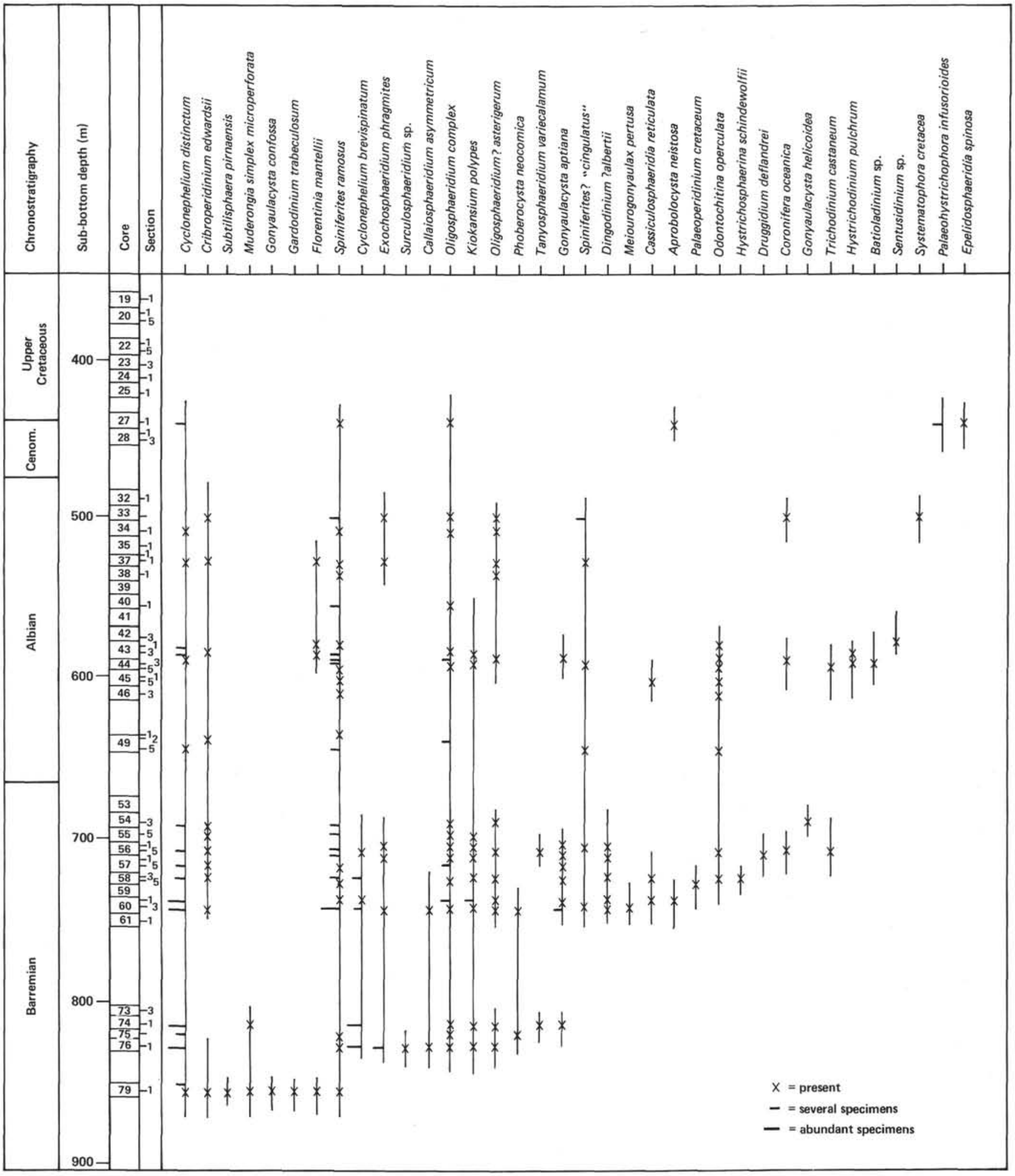

Figure 2. Distribution of Cretaceous marine palynomorphs, Hole 549.

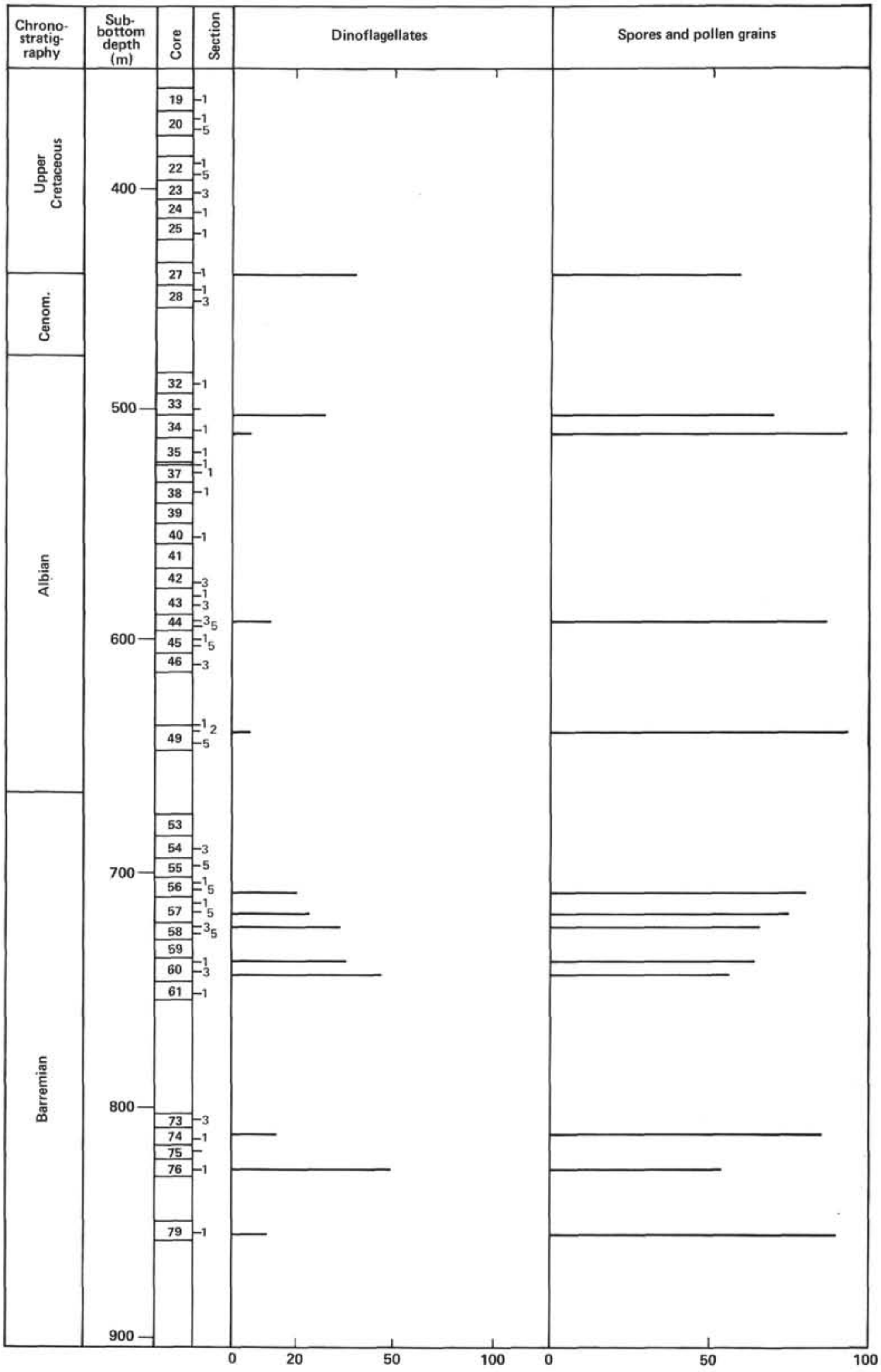

Figure 3. Relative abundances (%) of dinoflagellates, spores, and pollen grains, Hole 549.

Odontochitina operculata (Wetzel, 1933) Deflandre and Cookson, 1955 (Plate 1, Fig. 2)
Oligosphaeridium ?asterigerum (Gocht, 1959) Davey and Williams, 1969
Oligosphaeridium complex (White, 1942) Davey and Williams, 1966
Palaeohystrichophora infusorioides Deflandre, 1935
Palaeoperidinium cretaceum Pocock, 1962
Phoberocysta neocomica (Gocht, 1957) Millioud, 1969
Pterodinium cingulatum (Wetzel, 1933) Below, 1981
Sentusidinium sp.
Spiniferites? "cingulatus" (Wetzel, 1933) Sarjeant, 1970
Spiniferites ramosus (Ehrenberg, 1838) Loeblich and Loeblich, 1966
Subtilisphaera pirnaensis (Alberti, 1959) Jain and Millepied, 1973 (Plate 1, Fig. 3)
Surculosphaeridium sp.
Systematophora cretacea Davey, 1979 (Plate 2, Figs. 4 and 5)
Tanyosphaeridium variecalamum Davey and Williams, 1966
Trichodinium castaneum (Deflandre, 1935) Clarke and Verdier, 1967

Hole 550B

The analyzed palynologic slides analyzed from the upper Albian samples (Cores 25 to 22) contain dark sapropelic organic matter, rare terrestrial plant debris, and rare marine species. Sapropelic organic matter and sporomorphs become abundant in the middle Cenomanian samples; marine palynomorphs represent less than 15% of the palynomorph assemblage. Above this level, in Cores 14 and 13, amorphous organic matter, continental plant debris, and dinocysts are more abundant, and sporomorphs decrease markedly. From Core 12 upward, the samples are barren and contain little organic matter.

The stratigraphic distribution of the marine palynomorphs from Hole 550 is plotted in Figure 4. The occurrence of microplankton is very limited in the lower part of the sequence (Cores 25 to 18). In the middle part (Cores 17 to 13) dinocysts are more abundant, and 41 species were recovered. In the upper part (Cores 12 to 6), only two species were encountered, in Section 10-4. All dinocyst species present at this hole are known to occur in northwest Europe and/or in Canada (Manun and Cookson, 1964; McIntyre, 1975) and in California (Drugg, 1967).

Cores 25 to 22: Uppermost Albian (Vraconian)

The assemblages from these cores contain only seven taxa, and thus show relatively little diversity. No detailed stratigraphic conclusions can be drawn.

Cores 21 to 15: Cenomanian

The following three long-ranging species dominate the marine palynomorph assemblages: *Cyclonephelium distinctum, Spiniferites ramosus*, and *Odontochitina operculata*. In spite of the limited diversity of the microplankton (22 species in 10 samples), the five species *Palaeohystrichophora infusorioides, Leberidocysta chlamydata, Epelidosphaeridia spinosa, Litosphaeridium siphoniphorum,* and *Florentinia deanei* indicate that the sediments from Core 17 upward are uppermost Albian to Cenomanian.

Cores 14 to 6: Upper Cretaceous

Cores 14 and 13 are the most palyniferous of the samples analyzed. The same species as in the lower cores already discussed are usually present, and dominate some assemblages. These are *Cyclonephelium distinctum, Odontochitina operculata, Spiniferites ramosus*, and *Palaeohystrichophora infusorioides*. However, *Litosphaeridium siphoniphorum*, limited to the uppermost Albian to Cenomanian, is no longer present.

In addition, 18 species appear in these cores, six of which characterize the Upper Cretaceous: *Chatangiella victoriensis, C. granulifera, Laciniadinium arcticum*, and *Isabelidinium* cf. *acuminatum* occur in the Upper Cretaceous of Arctic Canada (Manum and Cookson, 1964); *Elytrocysta druggii* and *Palaeoperidinium pyrophorum*, are present in the Upper Cretaceous of California (Drugg, 1967). *C. victoriensis* has also been found in the Turonian of France (Foucher, 1982) and in the Santonian of England (Clarke and Verdier, 1967). The other species found in these cores have also been previously reported for samples predating the Upper Cretaceous.

With the exception of the two species found in Core 10, the samples from Cores 12 to 6 are barren.

Cretaceous Palynofacies in Hole 550

Figure 5 presents the relative proportions of dinoflagellates, spores, and pollen grains determined in the palynologic residues of the samples studied. In the Vraconian (uppermost Albian), the microplankton assemblages are too limited to be represented on the figure, and the paleoenvironment cannot be determined precisely, though it was certainly marine. In the Cenomanian, Cores 17 and 16 contain a mixture of sapropelic organic matter, abundant sporomorphs (80–85%), and terrestrial plant debris. These characteristics suggest marine sedimentation influenced by terrestrial sources. Higher in the Upper Cretaceous, Cores 14 and 13, microplankton and amorphous organic matter dominate the assemblages, whereas sporomorphs decrease. I interpret this to mean that neighboring land-masses had less influence during this period of deposition.

PALYNOMORPH SPECIES IN HOLE 550[4]

Achomosphaera ramulifera (Deflandre, 1937) Evitt, 1963
Apteodinium cf. *maculatum* Eisenack and Cookson, 1960
Callaiosphaeridium asymmetricum (Deflandre and Courteville, 1939) Davey and Williams, 1966
Canningia ?ringnesiorum Manum and Cookson, 1964
Chatangiella victoriensis (Cookson and Manum, 1964) Lentin and Williams, 1976 (Plate 3, Fig. 5)
Chatangiella granulifera (Manum, 1963) Lentin and Williams, 1976 (Plate 3, Fig. 6)
Chlamydophorella nyei Cookson and Eisenack, 1958
Cleistosphaeridium huguoniotii (Valensi, 1955) Davey, 1969
Coronifera oceanica Cookson and Eisenack, 1958
Coronifera striolata (Deflandre, 1937) Stover and Evitt, 1978
Cribroperidinium edwardsii (Cookson and Eisenack, 1958) Davey, 1969
Cyclonephelium distinctum Deflandre and Cookson, 1955
Elytrocysta druggii Stover and Evitt, 1978 (Plate 3, Fig. 4)
Epelidosphaeridia spinosa (Cookson and Hughes, 1964) Davey, 1969
Exochosphaeridium phragmites Davey et al., 1966
Florentinia deanei (Davey and Williams, 1966) Davey and Verdier, 1973
Hystiocysta palla Davey, 1969 (Plate 3, Fig. 2)

[4] In alphabetic order by genus and species. Plate and figure numbers indicate species illustrated in this chapter.

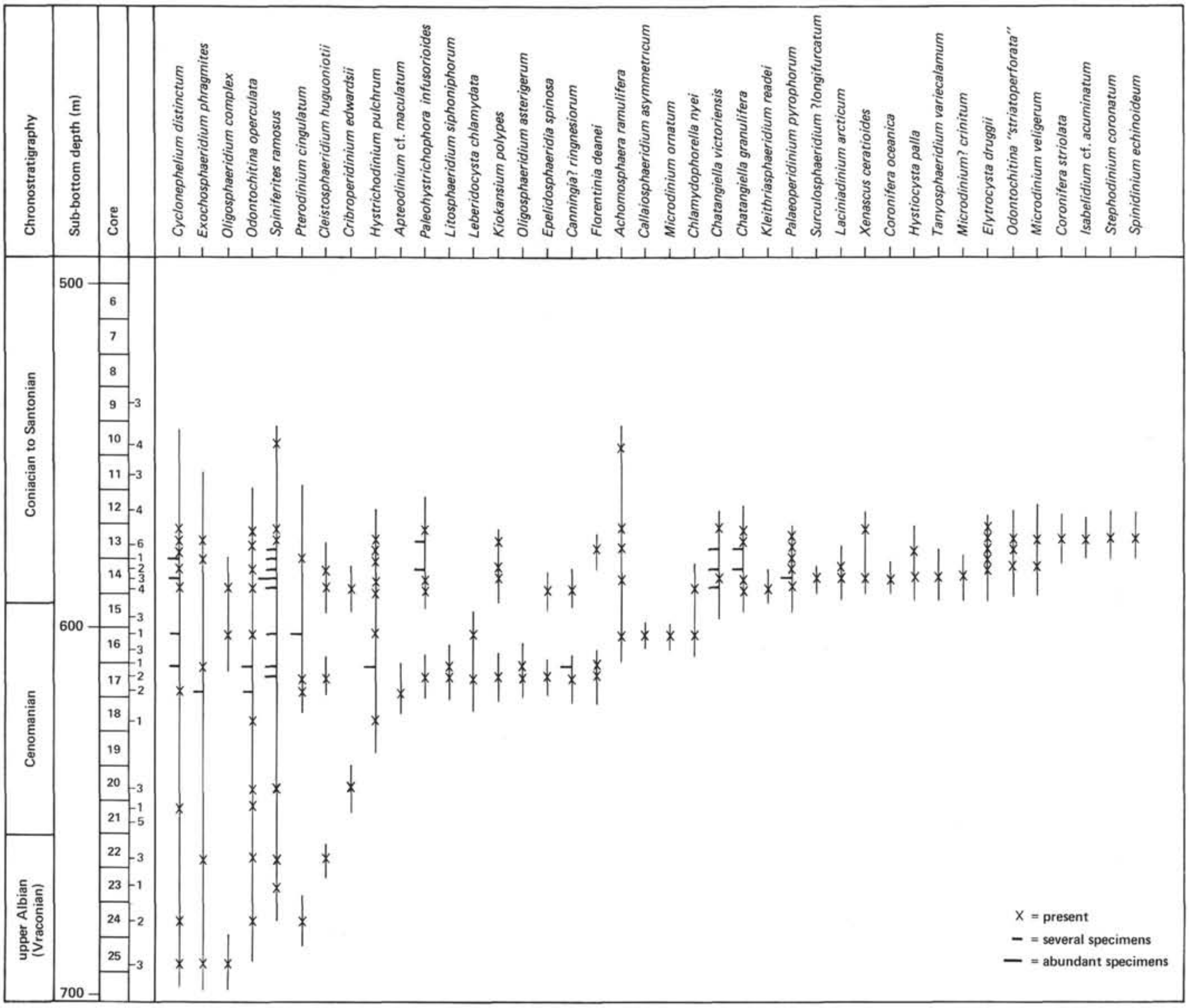

Figure 4. Distribution of marine palynomorphs, Hole 550.

Hystrichodinium pulchrum Deflandre, 1935

Isabelidinium cf. *acuminatum* (Cookson and Eisenack, 1958) Stover and Evitt, 1978

Kleithriasphaeridium readei (Davey and Williams, 1966) Davey and Verdier, 1976

Kiokansium polypes (Cookson and Eisenack, 1962) Davey, 1983

Laciniadinium arcticum (Manum and Cookson, 1964) Lentin and Williams, 1980 (Plate 3, Fig. 3)

Leberidocysta chlamydata (Cookson and Eisenack, 1962) Stover and Evitt, 1978 (Plate 3, Fig. 7)

Litosphaeridium siphoniphorum (Cookson and Eisenack, 1958) Davey and Williams, 1966

Microdinium? crinitum Davey, 1969

Microdinium cf. *ornatum* Cookson and Eisenack, 1960

Microdinium veligerum (Deflandre, 1937) Davey, 1969 (Plate 3, Fig. 1)

Odontochitina operculata (Wetzel, 1933) Deflandre and Cookson, 1955

Odontochitina "striatoperforata" Cookson and Eisenack, 1962 (Plate 3, Fig. 10)

Oligosphaeridium ?asterigerum (Gocht, 1959) Davey and Williams, 1969

Oligosphaeridium complex (White, 1842) Davey and Williams, 1966

Palaeohystrichophora infusorioides Deflandre, 1935

Palaeoperidinium pyrophorum (Ehrenberg, 1838) Sarjeant, 1967 (Plate 3, Figs. 8 and 9)

Pterodinium cingulatum (Wetzel, 1933) Below, 1981

Spinidinium echinoideum (Cookson and Eisenack, 1960) Lentin and Williams, 1976

Spiniferites ramosus (Ehrenberg, 1938) Loeblich and Loeblich, 1966

Stephodinium coronatum Deflandre, 1936

Surculosphaeridium ?longifurcatum (Firtion, 1952) Davey et al., 1966

Tanyosphaeridium variecalamum Davey and Williams, 1966

Xenascus ceratioides (Deflandre, 1937) Lentin and Williams, 1973

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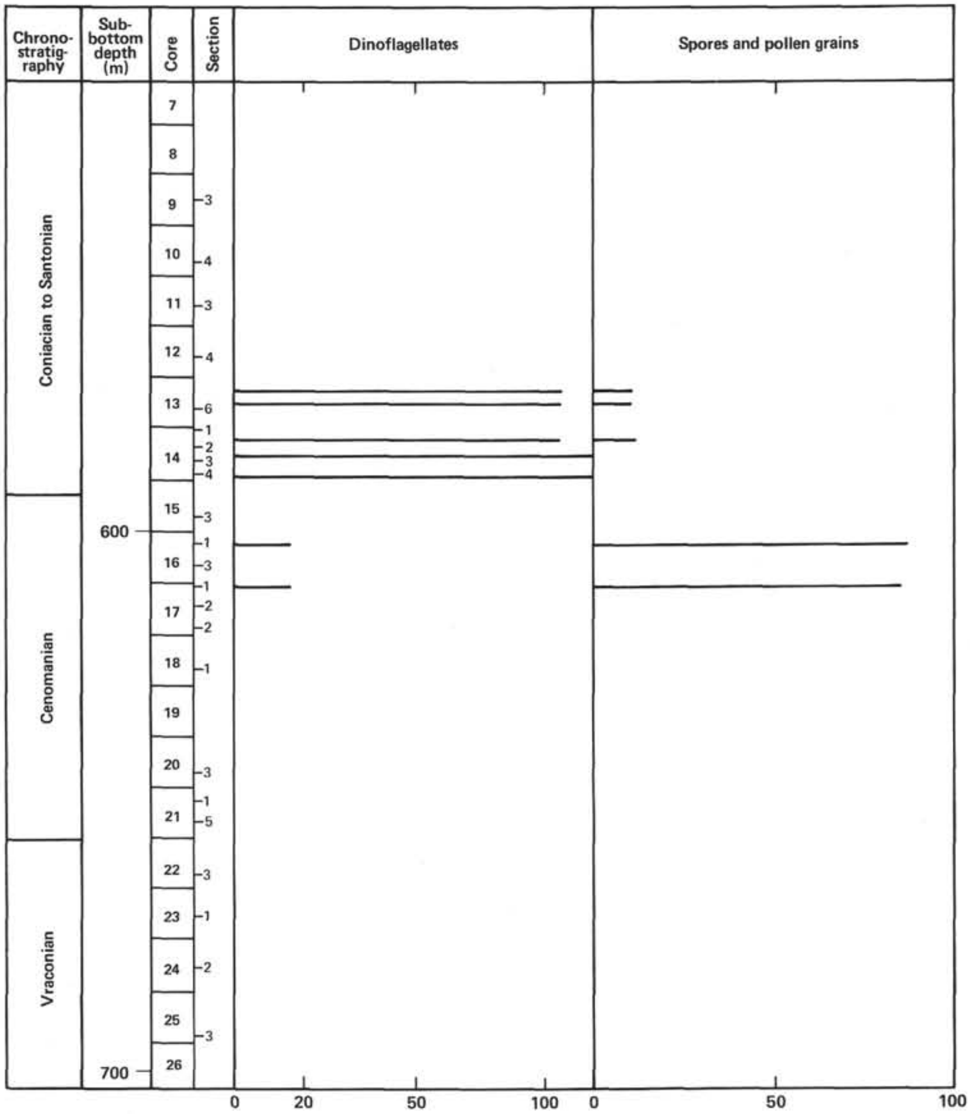

Figure 5. Relative abundances (%) of dinoflagellates, spores, and pollen grains, Hole 550.

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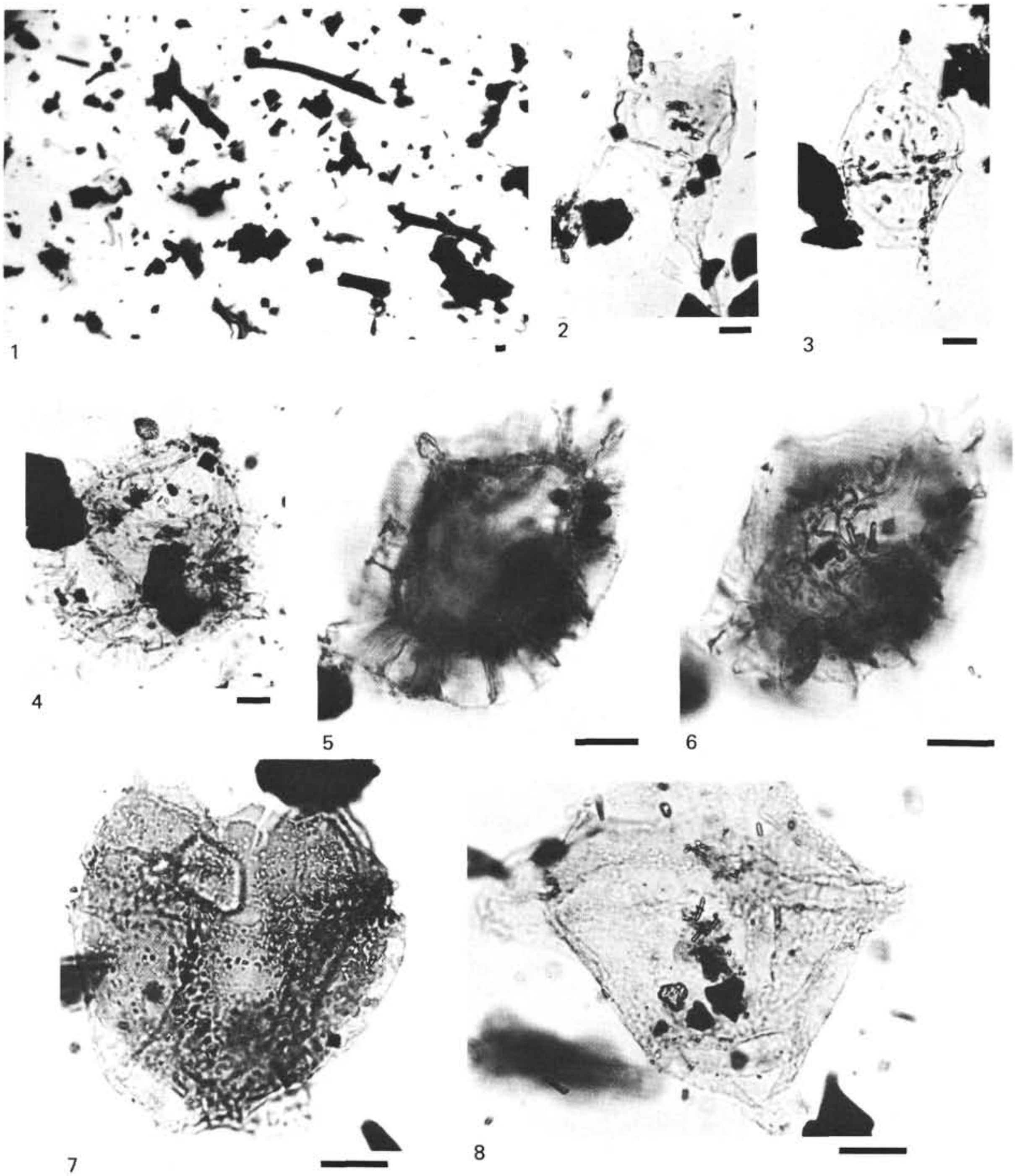

Plate 1. Hole 549; scale bar = 10 μm. **1.** Palynofacies (terrestrial plant debris) (× 100), Section 549-76-1. **2.** *Odontochitina operculata* (Wetzel) Deflandre and Cookson, 1955 (× 500), Section 549-58-3. **3.** *Subtilisphaera pirnaensis* (Alberti) Jain and Millepied, 1973 (× 500), Section 549-79-1. **4.** *Gonyaulacysta aptiana* (Deflandre) Sarjeant, 1966 (× 500), Section 549-58-3. **5, 6.** *Aprobolocysta neistosa* Duxbury, 1980 (× 1000), Section 549-60-1, (5) dorsal view, apical archaeopyle, (6) ventral view, ornamentation. **7.** *Meiourogonyaulax pertusa* (Duxbury) Below, 1981 (× 1000), Section 549-60-3. **8.** *Muderongia simplex* subsp. *microperforata* (Alberti) Davey, 1982 (× 1000), Section 549-74-1.

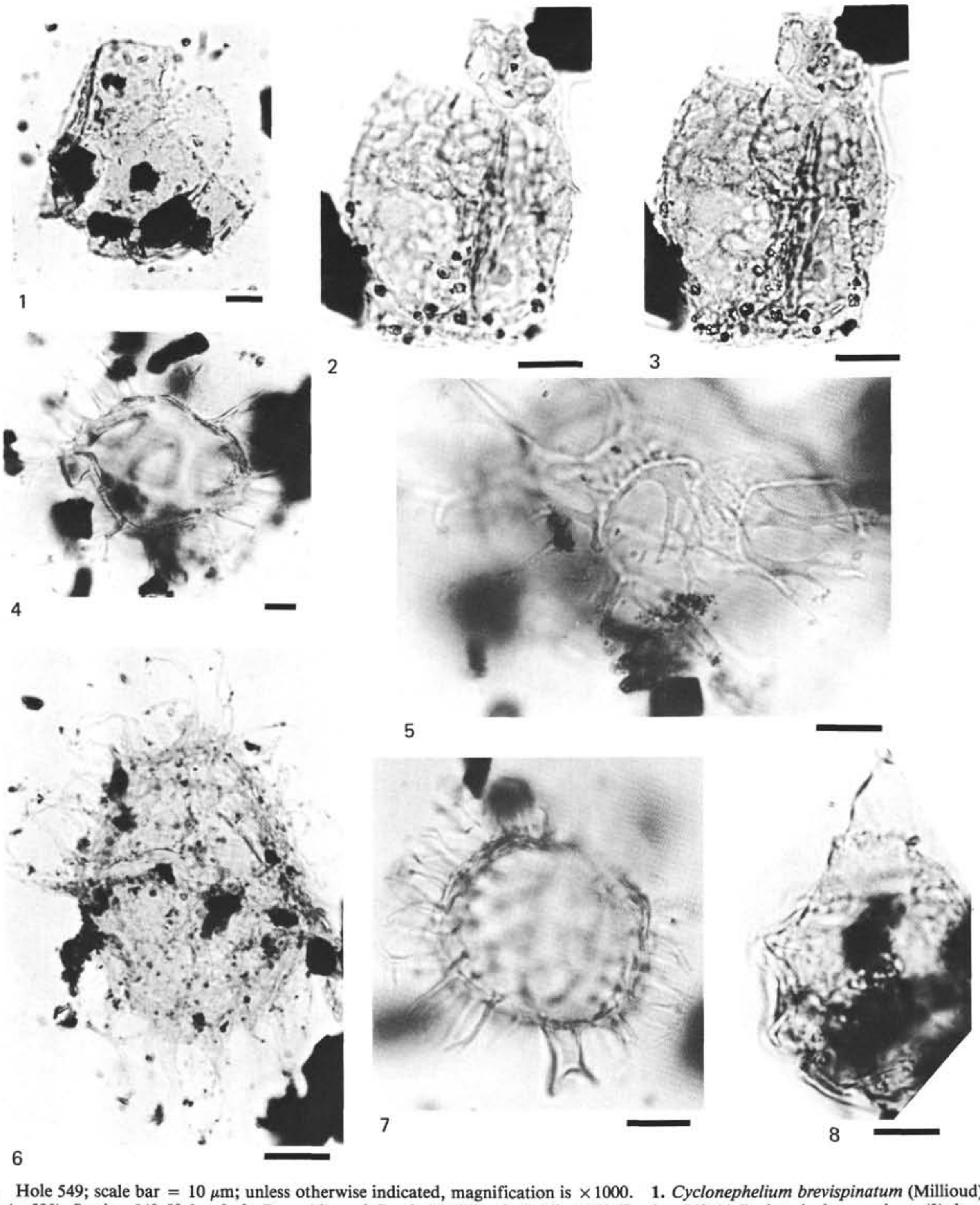

Plate 2. Hole 549; scale bar = 10 μm; unless otherwise indicated, magnification is $\times 1000$. **1.** *Cyclonephelium brevispinatum* (Millioud) Below, 1981 ($\times 500$), Section 549-58-3. **2, 3.** *Druggidium deflandrei* (Millioud) Habib, 1973 (Section 549-44-5), detached operculum, (2) dorsal view, (3) ventral view. **4, 5.** *Systematophora cretacea* Davey, 1979 (Section 549-33,CC), (4) $\times 500$ dorsal view apical archaeopyle, (5) detail, ornamentation of processus. **6.** *Hystrichodinium pulchrum* Deflandre, 1935 (Section 549-44-3). **7.** *Coronifera oceanica* Cookson and Eisenack, 1958 (Section 549-56-5). **8.** *Dingodinium ?albertii* Sarjeant, 1966 (Section 549-60-1).

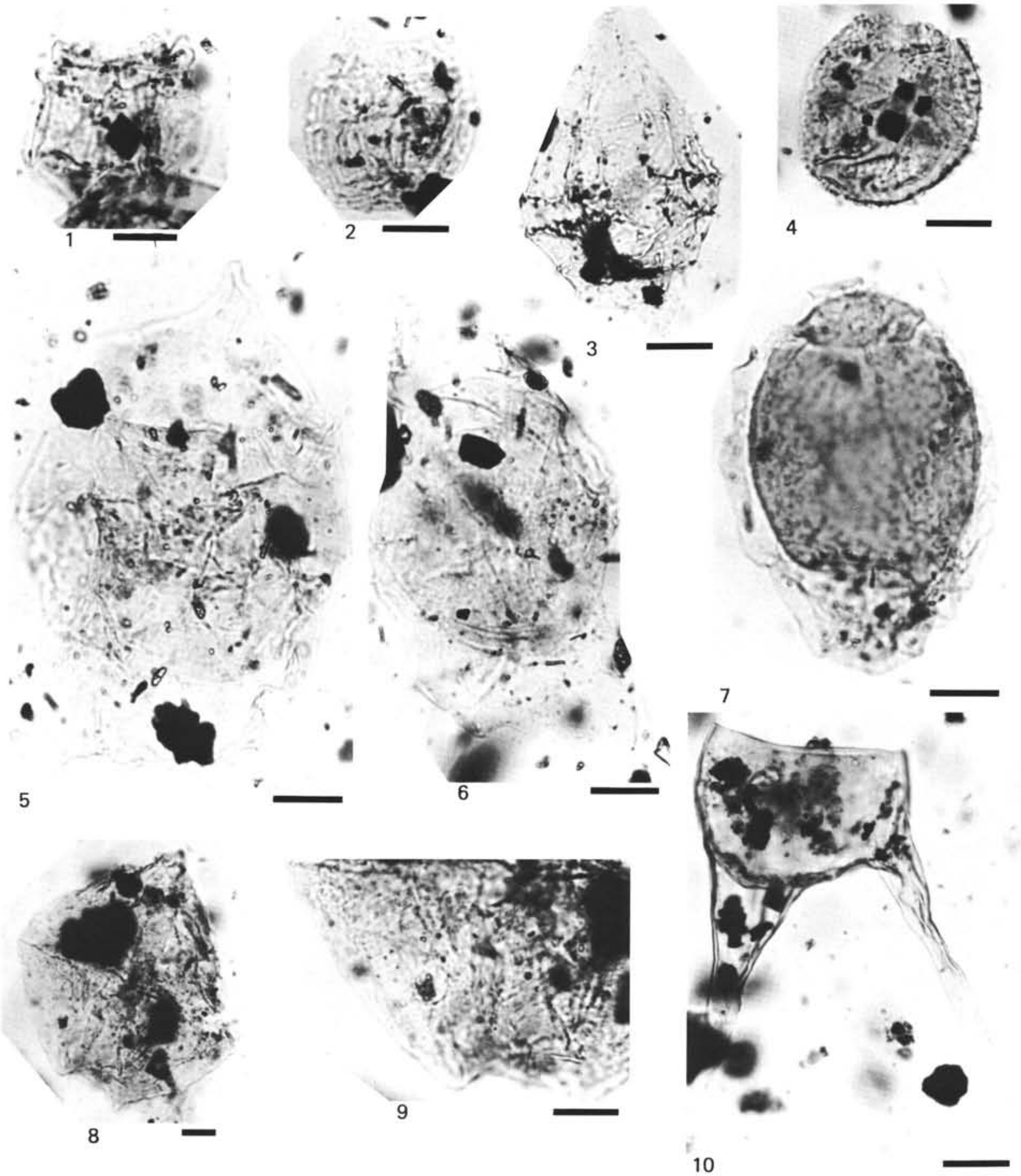

Plate 3. Hole 550; scale bar = 10 μm; unless otherwise indicated, magnification is $\times$1000. **1.** *Microdinium veligerum* (Deflandre) Davey, 1969 (Section 550-13-6). **2.** *Hystiocysta palla* Davey, 1969 (Section 550-13-6). **3.** *Laciniadinium arcticum* (Manum and Cookson) Lentin and Williams, 1980 (Section 550-14-2). **4.** *Elytrocysta druggii* Stover and Evitt, 1978 (Section 550-13-6). **5.** *Chatangiella victoriensis* (Cookson and Manum) Lentin and Williams, 1976 (Section 550-14-4). **6.** *Chatangiella granulifera* (Manum) Lentin and Williams, 1976 (Section 550-14-4). **7.** *Leberidocysta chlamydata* (Cookson and Eisenack) Stover and Evitt, 1978 (Section 550-17-2). **8, 9.** *Palaeoperidinium pyrophorum* (Ehrenberg, 1838) Sarjeant, 1967, (8) $\times$500, (9) detail of ornamentation. **10.** *Odontochitina "striatoperforata"* Cookson and Eisenack, 1962 ($\times$500), Section 550-13-6.