41. PALYNOLOGICAL INVESTIGATION OF SAMPLES FROM SITES 259, 261, AND 263, LEG 27, DEEP SEA DRILLING PROJECT

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ABSTRACT

The occurrences of Mesozoic dinoflagellates, pollen, and spores from Sites 259, 261, and 263 are described, and from these descriptions the sediments studied are dated Early Cretaceous. The dinoflagellate stratigraphy is compared with a worldwide range chart compiled for this study; the spore and pollen stratigraphy is compared with previously described zonations. This is a preliminary study and, consequently, includes few taxonomic considerations.

The dinoflagellates were studied by Wiseman and the spores and pollen by Williams.

INTRODUCTION

Twenty-two samples were studied from Site 259, 11 from Site 261, and 24 from Site 263. Most samples yielded varied and well-preserved assemblages of palynomorphs. However, the upper samples from Sites 259 (Cores 10-17) and 261 (Cores 9-12) were barren, and Site 263, Core 3, was also barren. No obvious sedimentological differences were observed which would account for the lack of palynomorphs in these samples.

Virtually all of the samples with palynomorphs had predominantly marine assemblages. Percentages of marine palynomorphs in the total assemblages were counted and the results summarized in Figures 1, 2, and 3.



Figure 1. Percentage of marine (left side of graph) against land-derived (right side of graph) palynomorphs in samples from Site 259.





DISCUSSION

Dinoflagellates

The previous stratigraphical ranges of the dinoflagellates encountered in this study are summarized in Figure 4. The main sources of reference for this chart were Evans (1966), Eisenack (1967, 1971), Sarjeant (1967), Singh (1971), and Davey and Verdier (1971). The ranges of a number of species have been slightly modified in accordance with unpublished data from studies undertaken at West Australian Petroleum, notably by H. L. Ott, during the drilling of exploratory oil wells in Western Australia.

The ranges of 86 species are shown. The taxonomy employed is that of current usage and, where changes of generic assignments have been made, the author responsible for the reassignment is given together with the original author.

Several species have rather more restricted known stratigraphical ranges in Western Australia than those shown on the worldwide range chart. *Muderongia mcwhaei* Cookson and Eisenack, 1958 is usually



Figure 3. Percentage of marine (left side of graph) against land-derived (right side of graph) palynomorphs in samples from Site 263.

restricted to the Aptian. *M. tetracantha* (Gocht, 1957) Alberti, 1961 occurs in the late Aptian. *Muderongia* sp. nov. Evans, 1966 is normally confined to the late Barremian and early Aptian. *?Oligosphaeridium asterigerum* (Gocht, 1959) Davey and Williams, 1969 usually occurs in the early Aptian. *Dingodinium cerviculum* is generally restricted to the Barremian to Albian. *Phoberocysta neocomica* (Gocht, 1957) Millioud, 1967 is confined to the Barremian, whereas *P. neocomica* forma *dedecosa* (Gocht, 1957) usually occurs only in the early Aptian.

Site 259

Figure 5 shows the distribution of dinoflagellates in the samples examined from Site 259. It is considered that the assemblages recorded are all typical of the Aptian, since they include *Muderongia simplex* Alberti, 1961; *M. tetracantha* (Gocht, 1957) Alberti, 1961; *M. mcwhaei* Cookson and Eisenack, 1958; *Cyclonephelium ?attadalicum* Cookson and Eisenack, 1962; *Dingodinium cerviculum* Cookson and Eisenack, 1962; *Broomea micropoda* Eisenack and Cookson, 1960; *Gonyaulacysta muderongensis* Cookson and Eisenack, 1958; and *?Oligosphaeridium asterigerum* (Gocht, 1959) Davey and Williams, 1969.

The occurrence of ?Dingodinium albertii Sarjeant, 1966 in Cores 29-33 and ?Oligosphaeridium asterigerum

in Cores 25-27 would suggest an early Aptian age for these sediments. Also the occurrence of *Hystrichosphaera ramosa* var. *reticulata* Davey and Williams, 1966 in Cores 23-19 is suggestive of a late Aptian age. Therefore, it would appear that Cores 18-33 encompass almost the whole of the Aptian.

The consistent occurrence of *Canningia rotundata* Cookson and Eisenack, 1960 in these samples would indicate that the range of this species should be extended down into the Aptian. (Previous records have shown its range to be Santonian to Turonian.)

Cores 10-17 were found to be barren of palynomorphs. However, they can be inferred to be late Aptian or younger in age.

Site 261

Figure 6 shows the distribution of dinoflagellates in the samples examined from Site 261. Cores 21-26 have typical Aptian assemblages including *Pterodinium cornutum* Cookson and Eisenack, 1962; *Broomea micropoda* Eisenack and Cookson, 1960; *?Oligosphaeridium asterigerum* (Gocht, 1959) Davey and Williams, 1969; *Carpodinium granulatum* Cookson and Eisenack, 1962; *Muderongia simplex* Alberti, 1961; *M. mcwhaei* Cookson and Eisenack, 1958; *Dingodinium cerviculum* Cookson and Eisenack, 1958; *Gonyaulacysta episoma* Sarjeant, 1966; and *G. muderongensis* Cookson and Eisenack, 1958.

Cores 14-16 are rather more problematical with regard to their age. The occurrence of Odontochitina costata Alberti, 1961 and Cleistosphaeridium ancoriferum Cookson and Eisenack (1960) 1968 in Core 14 would suggest an Albian age, but Muderongia mcwhaei Cookson and Eisenack, 1958 in Cores 14 and 15 and M. tetracantha (Gocht, 1957) Alberti, 1961 in Core 16 are indicative of an Aptian age. Consequently, these cores may be assigned either a late Aptian or early Albian age.

Cores 9, 10, and 12 from Site 261 were found to be barren of palynomorphs.

Site 263

Figure 7 shows the distribution of dinoflagellates recorded from the samples studied from Site 263. Cores 19-29 are considered to be Barremian because of the occurrence of *?Cordosphaeridium fasciatum* Davey and Williams, 1966; *Senoniasphaera* sp. A (an undescribed species known to occur in the late Neocomian of Western Australia); *Muderongia* sp. nov. Evans, 1966; and *Phoberocysta neocomica* (Gocht, 1957) Millioud, 1967.

Cores 5-18 all have typical Aptian assemblages which include Muderongia tetracantha (Gocht, 1957) Alberti, 1961, M. mcwhaei Cookson and Eisenack, 1958; M. simplex Alberti, 1961; Gonyaulacysta episoma Sarjeant, 1966; G. muderongensis Cookson and Eisenack, 1958; Carpodinium granulatum Cookson and Eisenack, 1962; Pterodinium cornutum Cookson and Eisenack, 1962; Pterodinium cornutum Cookson and Eisenack, 1962; ?Oligosphaeridium asterigerum (Gocht, 1959) Davey and Williams, 1966; and Broomea micropoda Eisenack and Cookson, 1960.

PALYNOLOGICAL INVESTIGATION OF SAMPLES, SITES 259, 261, AND 263

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86 H speciosa Deflandre-1937	1							-	-							54 Broomea micropoda
74 Hystrichosphaeridium stellatum Maier, 1959 75 Minutinim stellatum Stationatt 1965	-									-						55 Canningia colliveri
41 Muderongia Crucis Neale and Sarjeant-1962	1															57 Carpodinium granulatum
23 M. mcwhaei Cookson and Eisenack 1958	1	1 8								-	-					58 Chlamydophorella nyei
24 M. simplex Alberti-1961 40 M. staurota Sarinant-1966	1										1					59 Cleistosphaeridium polypes 50 Cyclonechelium 2 attactations
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2 P. ceratophore Deflandre-1947	1										-			-		76 Odontochitina costata
34 Phoberocysta neocomica (Gocht.1957) Millioud.1967 35 P. neocomica Edederosa (Gocht.1957)	-													-		77 Tanyosphaeridium isocalamus
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3 S. crystallinum (Deltaodre-1938) Klement-1957	1								-		-		-			83 Hystrichosphaera ramosa var reticulata
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77 Tanyosphaeridium isocalamus (Deflandre and Cookson.1955) Davey et al.1966	1										-			_		86 Hystrichosphaera speciosa
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Figure 4. Compilation of previously described stratigraphical ranges in the Late Jurassic and Cretaceous of dinoflagellates recorded in this study. (*denotes a range beyond the limits of chart.)

	SITE 250	01-1-20	etium distinctum	(a)	ium albertii	. indet. 1	ia piscifornis	phaera cingulata var cingulata		P. A	i simplex	m enn	m granulatum	shum 2 attadalicum	m cerviculum	m granulatum	ium spp.	tetracantha	aera ramuittera	m reticulatum	ct. dysculum	cropoda	converi		214 4/1/113		às	inium voigti	phaera ramosa var ramosa	i mcwhaei	radium complex	tron strongvlum	cf. rotundata	elium distinctum vat brevispinosum	ysta muderongensis	intum pulchrum	m setosum	crucis	Trinetton	teratopriora 11. nadnoserratum	eridum isocalamus		elium paucimarginatum	cincta	iridium diastema	aeridium, parvispinum obiases starota	presse provota oneie enn	opera app.	aeridium asterigerum	inum	ita neocomica var dedecosa	ysta episoma		ina operculata	phaera ramosa var reticulata	elium membraninhorum
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Lower Aptian Upper Aptian	18 19 20 21 23 25 26 27 28 27 28 29 30 31 32 33	3 4 3 3 3 2 3 2 3 2 3 3 2 1	x x x x x x x x x	x x x x x x x x x x	K X X X	х х х х х х х		* * * * * * * * * * *		* * * * * *	х х х х х х х х х х х х х х х х х х х				х х х х х х х х х х х х х х х х х х х	х х х х	x x x	x x x x x x x	×	× ×	***	x x x	1 1 1 1 1 1 1 1	***	× × × × ×	*	×	x x x x	x x x x x x	x x x x x x	* * * * * * *		ĸ	x x x	x x x x x	* * * * * * * *	*	×	e ,	< ×	cf x x	x x x x x x x	×	×	× × × / /	× ×	× ×		*	×	ĸ	×	×	* * * *	×××	×

Figure 5. Range chart of dinoflagellates recovered from samples from Site 259.

	SITE 261		ridium parvispinum	ium distinctum	naera cingulata var, cingulata	dium complex	idium isocalamus	cornutum	f. dysculum	rotundata	ium distinctum var, brevispinosum	pisciformis	ium pulchrum	olliveri	rella nyei	opoda	trinetron	eratophora	eridium asterigerum	p.A	ta edwardsi	granulatum	simplex	cf granulatum	tundata	laera ramosa var ramosa		maculatum	ta episoma	taurota	cerviculum	dium profixopsinum	i neocomica f dedecosa	a operculata	ridium polypes var polypes	a costata	ta muderongensis	E	etracantha	ensis	reticulatum	ncwhaei	eridium ancoriferum
Age	Core	Section	Prolixosphae	Cyclonephel	Hystrichospl	Oligosphaer	Tanyosphaer	Pterodinium	Belodinium o	Canningia cl	Cyclonephel	Herendeenia	Hystrichodin	Canningia co	Chlamydopho	Broomea mic	Netrelytron	Pareodinia c	? Oligosphae	Druggidium s	Gonyaulacys	Carpodinium	Muderongia s	Carpodinium	Canninga ro	Hystrichosph	Tenua spA	Apteodinium	Gonyaulacys	Muderongia s	Dingodinium	Oligosphaeri	Phoberocysta	Odontochitin	Cleistospilat	Odontochitin	Gonyaulacys	Micrhystridit	Muderongia t	M. tomaszow	Apteodinium	Muderongia	Cleistosphae
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Figure 6. Range chart of dinoflagellates recovered from samples from Site 261.

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SITE 263		ella nyei edium fasciatum	im ? attadalicum	um distinctum cerviculum	lium complex	ra neptuni	um densebarbatum	dium macrotubulum	E	crystallinum	um areolatum a merforans	luridum	ra sp A return certeratubiterum	BF I	a apionis	m spp	p. ibv (Evans)	nsis is edwardsi		spp. um pulchrum	aera cingulata var cingulata	aeridium stellatum Maracantha	diur diastema	neoconutua	var dedecosa ta helicoidea	cwhaei		tundata	idium pervispinum naculatum		rotundata a muderongensis	ratophora	pi ciformis aeridium recurvatum		dysculum	ganuauun aera pterota	ramosa	ornorum		um amprecommun 1 operculata	ridrum asterigerum idium polypes var polypes	ncta	lium profixospinum ium isocalamus	apoda	let.1 aera ramosa var multibrevis	aera ramosa var reticulata	im distinctum var brevispinosum westhalium	iculata	abrose	ratum ancorretum um oligacanthum		aera speciosa is denticulata	idium striolatum var, truncatum	a cretacea s	sis spp.	
Age Core	Section	Chlamydophor 7 Cordoschae	Cyclonephelu	Cyclonepheliu	Oligosphaerid	Achomosphae	Cyclonephelii Gardodinium	Oligosphaeric	O perforatum O pulcherrimu	Scriniodinium	Cyclonephelii Gonvaulacyst	Scriniodinium	Senoniasphae Surculoschaer	Broomea jaeg	Gonyaulacyst G. orthoceras	Micrhystridiu	Muderongia s	Gonyaulacyst	G episoma	Hvstrichodini	Hystrichosphi	Hystrichosphi Mideonois 1	Oligosphaeric	Phoberocysta	P. neocomica Gonyaulacyst	Muderongia m	M. staurota	Canningia rol	Apteodinium r	A. reticulatur	Gonyaulacyst	Pareodinia ce	Herendeenia Hystrichospha	Druggidium sp	Belodinium cf	Hystrichosphi	H. ramosa var	P magnoserra	Tenua sp. A	Odontochitine	Cleistosphaer	Deflandrea ci	Oligosphaerid Tanyosphaerd	Broomea micro	Gen. et sp int Hystrichosphi	Hystrichosph	Cyclonephelu Dinogymnium	Canningia ret	Canningia sci	Hystrichodini	H voigti	Hystrichosphi Canninginops	Exochosphaer	Gonyaufacyst G. longicorni	Pterospermop	
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Figure 7. Range chart of dinoflagellates recovered from samples from Site 263.

These samples probably range into the late Aptian to early Albian. This is suggested by the occurrence in Cores 8 and 5 of *Cleistosphaeridium ancoriferum* Cookson and Eisenack, (1960) 1968; *Hystrichodinium oligacanthum* Deflandre and Cookson, 1955; *Hystrichosphaera speciosa* Deflandre, 1937; and *Exochosphaeridium striolatum* var. *truncatum* Davey, 1969.

Core 3 was barren of palynomorphs. Core 2 contained a poorly preserved, restricted assemblage of dinoflagellates of Early Cretaceous aspect. These are considered to be reworked and not indicative of the age of these sediments.

A number of reworked dinoflagellates were recognized in the Aptian assemblages. These include *Cyclonephelium densebarbatum* Cookson and Eisenack, 1960 (Oxfordian to Kimmeridgian) in Cores 28 and 26; *Scriniodinium crystallinum* (Deflandre, 1938) Klement, 1957 (Callovian to Kimmeridgian) in Core 28; *Cyclonephelium areolatum* Cookson and Eisenack, 1960 (Tithonian), *Gonyaulacysta perforans* Cookson and Eisenack, 1958 (Oxfordian to Tithonian), and Surculosphaeridium cribrotubigerum (Sarjeant, 1960) Davey et al., 1966 (Kimmeridgian to Tithonian) in Core 26; and *Gonyaulacysta cretacea* Neale and Sarjeant, 1962 (Hauterivian) and *G. longicornis* Downie, 1957 (Tithonian) in Core 7.

Spores and Pollen

Range charts of spores and pollen for Sites 259, 261, and 263 are given in Figures 8-10. Overall, spores and pollen comprise a minor part of the microfloral asemblages (see Figures 1-3), particularly in the samples studied from Site 261 and the upper part of Site 263. There is a rough correlation between a greater diversity of species recorded and samples with relatively high percentages of spores and pollen (e.g., at Site 259, contrast the assemblages recovered from Core 26 with Core 27, and Core 29 with Core 30); this is probably a function of the availability of spores and pollen, and their transport and sorting, partly by air but largely by water (Muller, 1959), into the marine environment indicated by the microplankton.

Balme's papers (1957, 1964) remain the main works on Early Cretaceous spores and pollen of Western Australia. Dettmann and Playford (1969) have reviewed the palynology of the Lower Cretaceous in Australia and compared it with extra-Australian records. The assemblages recorded here are of Late Jurassic to Early Cretaceous aspect, containing many bryophytic, pteridophytic, and gymnospermous elements reported previously from sediments of this age, (Dettmann and Playford, 1969) especially from Australia, India, and South America; no angiosperm pollen was recorded.

The zone ranges of the key species of Dettmann and Playford (1969) are not well verified in Western Australia, and some species (e.g., *C. stylosus*) are rarely recorded. The *C. stylosus* and *D. speciosus* zones are not precisely dated (Dettmann and Playford, 1969, p. 186-190), but probably fall, respectively, within the limits of Late Jurassic to Early Neocomian, and Late Neocomian to Late Aptian. The datings from spores and pollen are considered together with microplankton datings (see Conclusions).

At Site 259 the occurrence of Microcachryidites antarcticus Cookson, Podocarpidites ellipticus Cookson, and Inaperturopollenites limbatus Balme, frequently in some numbers, and Cicatricosisporites spp., Acanthotriletes levidensis Balme, and Concavisporites infirmus Balme, indicate a correlation with Balme's (1964) Microcachryidites Assemblage (Neocomian to Aptian), at least up to Core 20. Although the occurrence of Crybelosporites stylosus Dettmann in Core 31 suggests that the lower part of the interval examined may be assigned to the C. stylosus Zone of Dettmann and Playford (1969), in the light of evidence from the dinoflagellates, this probably represents reworking of older sediments. The upper limit of Contignisporites cooksonii (Balme) and the presence of Dictyotosporites filosus Dettmann indicate that most of the interval, at least up to Core 20, is in the Dictyotosporites speciosus Zone (Dettmann and Playford, 1969).

The samples up to Core 11 at Site 263 are assigned to the Microcachrvidites Assemblage; they yielded the same species as listed for the Microcachryidites Assemblage at Site 259 together with Murospora florida (Balme) and Reticuloidosporites arcus (Balme). The occurrence of Aequitriradites hispidus Dettmann and Playford implies assignment to the C. stylosus Zone for the assemblage from Core 29. However, in view of the Barremian age determined from the dinoflagellates present, this probably represents reworking. The occurrences of Murospora florida and Krauselisporites linearis (Cookson and Dettmann) and the top of the range of Contignisporites cooksonii indicate that the assemblages up to Core 12 correlate with the lower part of the D. speciosus Zone, and the occurrence of D. speciosus Cookson and Dettmann (D. speciosus Zone) in Core 11 is the highest occurrence of a key species.

Recovery of spores and pollen was low from the samples from Site 261. The assemblages are consistent with an Early Cretaceous age.

Reworked palynomorphs were recorded from some samples. They may give some clue to sediment source and are included on the range charts, together with their age ranges.

SYSTEMATIC PALEONTOLOGY

The taxa described are only those which differ markedly from previously described forms, either in morphologic or stratigraphic occurrence. New species are herein given informal designations.

Genus BELODINIUM Cookson and Eisenack, 1960

Belodinium sp. cf. B. dysculum

Remarks: This is most likely a separate species from *B. dysculum* Cookson and Eisenack, 1960, since there is a wide stratigraphic separation between the occurrence of the two forms, Cookson and Eisenack's species being restricted to the Late Jurassic. However, the only distinguishing morphological feature recognized is that *B. cf. dysculum* has a longer apical horn than *B. dysculum* s.s. In most observed specimens, this horn has been lost during archeopyle formation and is, therefore, not generally useful in distinguishing a separate species. Until other morphological differences are observed, it is considered unwise to erect a separate species for the Early Cretaceous forms.

Occurrence: Site 259, Cores 18, 19, 20, 21, 23, 25, 26, 27, 29, 30, 31. Site 261, Cores 21, 24, 26. Site 263, Cores 5, 6, 7, 9, 10, 11, 12, 14, 15. Inferred age: Aptian.

Neocom Aptian to Neocomian	AGE
18 19 20 21 23 25 26 27 28 28 29 30 31 32 33	CORE SITE 259
3 4 3 3 3 2 3 2 3 2 3 2 3 2 3 2 1	SECTION
***	Microcachryidites antarcticus Cookson
x x x x x x x x x x x x	Inaperturopollenites limbatus Baime
	Lycopodiumsporites dustractiveness (Lookaon /
	Podocaroidites ellipticus Cookson
	Alisporites grandis (Cookson)
×××× × ×××	Zonalapollenites dampieri Balme
****	Ctassopollis classoides (Pflug)
×× × × ×	Alisporites cf. bilateralis Rouse
x x x xxx	Duptexisporites mortoni (De Jersey)
x x x x	Zonalapollenites segmentatus Balme
×	Cicatricosisporites australiensis (Cookson)
× × × × × × × × × × × × × × × × × × ×	Gleicheniidites senonicus Ross
	Osmundacidites wellmanii Couper
	Caratosnorites adualis Conkson & Dettmann
	Vitraisnoritas Dollidus (Leschick)
	Cuthiditas minor Courses
	Continuites minor couper
K K X X X X	Duristiciantites auratus Plaufard & Deftmann (28-1 Reworking)
× 1	Duptexisponies grades righting determined to the second of the second second of the second se
	Podocornidites multesimus (Ap/khoviting)
	rouced plates mattering (Barnoring) Ciscutrilates clovic /Barne)
× ,,	Aminoriate co
x	Araucariacites sp.
××××××××××××××××××××××××××××××××××××××	Araucariacites australis Cookson
cf. X	Aconthotriletes levidensis Balme
×	Lycopodiumsporites aff. glebulentus Kemp
? ××× ×××××	Alisporites similis (Balme)
cf X X X	Zonalapollenites trilobatus Balme
x cf. X X X	Bocutatisporites comaumensis (Cookson)
×××	Contignisporites multimuratus Dettmann
X X	Lycopodiumsporites eminulus Dettmann
xx	l veonodiumsporites circolumenus Cookson & Dettmann
× × × × × ×	Dictvatasanarites comalex Conkson & Dettmann
	Neoraistrickia truncata (Cookson)
	Dedoerendites so
	Crubalgeneritae stylesus Dattman
< >	Trister of tuberculatue Contena (ac in Dattmann 1063)
×	Fritetes Ci. tuber cututus - cuuson us in ustimum, 1303 /
×	Samarosporites speciosus Goubin (R. Keworking)
×	Alisporites australis DeJersey (P-R.Reworking)
× × ×	Trisaccites microsaccatus (Couper)
x	Protohaploxypinus sp. (? P T. Reworking)
x	Striatopodocarpites fusus (Balme & Hennelly) (P-R. Reworking)
×××	?Cedrepites sp.
× × × × ×	Podocarpidites sp.1.
×××	Trisaccites variabilis (Dev)
×	Protohaploxypinus amplus (Balme & Hennelly) (P. Reworking)
×	Acanthotriletes dentatus Balme & Hennelly (P. Reworking)
×	Cyathidites australis Couper
?	Cicatricosisporites Ludbrooki Dettmann
×	Coronatispora telata (Balme)
×	2Tigrisporites so.
ct	Matonisporites crassiangulatus (Balme)
EX	Ischvosnorites ounctatus Cookson & Dettmann
x	Dadararnidites eximus Harrie
× × ×	Consultanties infirmus Brime
(() (Veloconstate trianature (Instr.)
< c	I unondinciditae constatue Dattmon
:£)	Lycopodiaciones appendias Defaurat & Command
×	Biretisporites dr. potonigei Uercourt à Sprumont
×	Dictyotosporites Tilosus Defimann
?	Protohaploxypinus limpidus (Baime & Hennelly) (?P. Reworking)
×	Monosulcites sp.
×	Lycopodiumsporites nodosus Dettmann

Figure 8. Range chart of spores and pollen recovered from samples from Site 259.

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AGE	CORE SITE 261	SECTION	Gleicheniidites senonicus. Ross.	Microcachryidites antarcticus. Cookson.	Padacarpidites sp.	? Cedrepites sp.	Classopoltis classoides. (P1/ug.)	Baculatisporites comaumensis. (Cookson.)	Alisporites similis. (Balme.)	Osmundacidites wellmanii. Couper	Araucariacites australis. Cookson.	Podocarpidites ellipticus. Cookson,	Zonalapollenites trilobatus. Balme.	Gleicheniidites sp. 1.	inaperturopolienites limbatus. Balme.	Podocarpidites multesimus. (Bolkhovitina.)	Concavisporites infirmus. Balme.	Podocarpidites sp.1.	Vitreisporites pallidus. (Leschik.)	Cyathidites minor. Couper	Trisaccites variabilis. (Dev.)	Araucariacites sp.	Zonalapollenites dampieri, Balme.	Ceratosporites equalis Cookson & Dettmann.	Podocarpidites exiguus. Harris.	Lycopodiumsporites circolumenus. Cookson & Dettmann.	Cicatricosisporites sp.	Lycopodiumsporites austroclavatidites. (Cookson.)
retaceous	16 24 25 26	1 2 3 2	××××	××××	××××	×	××××	cf.	X cf.	x x	×××	××××	×××	××××	×	x	××	x	x	×	×	x	x	x	x	x	×	×



Genus CANNINGIA Cookson and Eisenack 1960

Canningia sp. cf. C. rotundata Cookson and Eisenack, 1961

Remarks: C. cf. *rotundata* is reserved for those specimens of C. *rotundata* with thick walls $(\sim 5\mu)$ and a strongly vermiculate or reticulate ornamentation. These forms were included in Cookson and Eisenack's original description of the species but are readily distinguishable from the more typical thin-walled and indistinctly ornamented specimens.

Occurrence: Site 259, Cores 25, 30, Site 261, Cores 21, 22, 23, 24, 26. Site 263, Cores 6, 13, 15, 17, 18.

Inferred age: Aptian.

Genus DRUGGIDIUM Habib, 1973

Druggidium sp. A.

Description: Small, oval to spherical, proximate cysts with a tabulation of 4', 6", 6g, 6''', lp, 1''''. Plates smooth, bordered by low, simple ridges. Archeopyle precingular, formed by loss of plates 2'' and 3''.

Sizes of observed specimens range between 35 and 46 meters.

Remarks: This species most closely resembles *D. apicopaucicum* Habib 1973, described from Leg 11, Hole 105 (Valanginian-Tithonian). It differs in that the septa marking the plate boundaries are smooth, straight, and not crenulated. It differs from *D. rhabdoreticulatum* Habib, 1973 in that it does not possess the raised membrane described for that species.

are smooth, straight, and not crenulated. It differs from D. *rhabdoreticulatum* Habib, 1973 in that it does not possess the raised membrane described for that species.

Occurrence: Site 259, Cores 19, 20, 21, 23, 25, 26, 27, 38, 30, 31, 33. Site 261, Cores 14, 15, 16, 21, 22, 23, 24. Site 263, Cores 6, 7, 8, 9, 11, 15, 17.

Inferred age: Aptian.

Genus SENONIASPHAERA Clarke and Verdier, 1967

Senoniasphaera sp. A.

Description: A species of *Senoniasphaera* with pronounced antapical horns and lateral horns, the inner body protruding into the antapical horns. Apical horn not observed due to archeopyle formation.

Remarks: This species closely resembles *S. protrusa* Clarke and Verdier, 1967, described from the Senonian of the Isle of Wight. The antapical horns in *Senoniasphaera* sp. A are equal in length and more pronounced.

The size range observed is $93-125\mu$ for the overall length and $67-86\mu$ for the overall width.

Occurrence: Site 263, Cores 22, 25, 26.

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Genus TANYOSPHAERIDIUM Davey and Williams, 1966

Tanyosphaeridium sp. cf. T. isocalamus

Remarks: The specimens observed are very similar to *Tanyosphaeridium* sp. Singh, 1971 from the Albian of the Peace River Area, Alberta, in that they vary from *T. isocalamus* s.s. in having slightly buccinate extremities to the processes.

Occurrence: Site 259, Core 30. Site 261, Cores 24, 26. Site 263, Cores 12, 13.

Inferred age: Early Aptian.

Genus TENUA (Eisenack 1958) Sarjeant, 1968

Tenua sp. A.

Description: Relatively small, ovoidal species of *Tenua* with no indication of tabulation. The wall is thick $(\sim 5\mu)$ and possesses strong vermiculate ornamentation.

Remarks: *Tenua* sp. A is probably closely related to *Canningia* sp. cf. C. *rotundata* Cookson and Eisenack, 1961. However, the two species do occur in different samples, although they are not mutually exclusive and have similar stratigraphic ranges.

Occurrence: Site 259, Cores 20, 23, 25, 26, 27, 28, 30. Site 261, Cores 14, 16, 21, 22. Site 263, Cores 5, 6, 8, 13, 15.

Inferred age: Aptian to ?early Albian.

Genus et species indet. 1

Remarks: This genus is probably closely related to *Dichadogonyaulax* Sarjeant, 1966 since it is tabulate and has an epitractal archeopyle. It will be formally described at a latter date.

CONCLUSIONS

The ages obtained from study of the dinoflagellates from Sites 259, 261, and 263 agree well with the ages indicated by the pollen and spores present.

Site 259, Cores 18-33 are all considered to be Aptian and probably range from early to late Aptian. The age of Cores 10-17 could not be determined by palynological means.

Site 261, Cores 14-26 range from early Aptian to late Aptian or early Albian in age. The age of Cores 9-12 could not be determined by palynological means.

Site 263, Cores 5-29 range from Barremian to late Aptian or early Albian in age. The ages of Cores 2 and 3 are indeterminable by palynological means.

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Neod Upper Aptian to Upper Neocomian	AGE
5 7 9 111 12 14 17 18 19 20 21 23 26 29 29	CORE SITE 263
1 3 2 4 3 2 3 4 3 3 4 3 3 4 3 4 4	SECTION
****	Zonalapollenites trilobatus Baime
x x x x x x x x x x x x x x x x x x x	Araucariacites gustralis Cookson
* * * * * * * * * * * * * * * * * * * *	Padaocarpiantes etilipticus cookson Inaperturapollenites turbatus Baime
x x x	Zonalapollenites segmentatus Balme
***	Alisporites similis (Balme) Clossopollis classoides (Pflug)
x x x x x x x	Zonatapollenites dampieri Balme
x x x x x x x x x x x x x x x x x x x	Indperturopollenites limbatus Balme
	Leptorepiares major. Couper Contignisporites cooksonii (Balme)
* * ****	Cyathidites minor. Couper
x cf. x x x x x x	Contignisporites multimuratus Dettmann
x x x x x ?	Podocarpidites multesimus (Bokkhovitina) Tritetes of tuberculatus Contract (as in Cottacon 1962)
	Cicatricosisporites hughesi Dettmann, 1903 /
x x x x x x x x x x x x x x x x x x x x	Gleicheniidites senonicus Ross
ct	Foraminisporis asymmetricus (Cookson&Dettmann)
	Lycopodiumsporites austraciavatidites (Cookson)
	Ausportes granus (cooxson) Aequitriadites hispidus Dettmann & Plavford
x cf. x x x x x x x x x	Neoraistrickia truncata (Cookson)
x x x x x x x x x x x x x x x x x x x	Vitreisporites pallidus <i>(Leschik)</i>
	Lycopodiumsporites circolumenus Cookson & Deftmann Microsophruidites advertions Cookson & Deftmann
	Plicatipollenites andwanensis (Balme & Hennelly) (P Rewarking)
cf	Dictyophyllidites crenatus Deftmann
× × ×	Laevigatosporites sp. (as in Ingram, 1962, pl. 37, fig. 7)
× × ×	Osmundacidites wellmanii Couper
« ×	zonalapouente sp. Araucariacites so.
x x x x	Coronatispora perforata Dettmann
x	Ornamentifera sp.
x x	Staplinisporites caminus (Balme)
×>	Foveosporites canalis Balme
x x < x	vetosporites triguetrus (1.00/2.)
x x x	Ischyosparites punctatus Cookson & Dettmann
x x x x	Polypodiidites sp.
x x x x x x x x	Dictyophyllidites mortoni (De Jersey)
x x x	Foromisporis daily! (Cookson & Dettmann)
< , x	Andrustoria (darme / Andron & Dattman)
x	Aroucariacites sp.
x	Dulhuntyspora parvithola (Balme & Hennelly) (P. Reworkina)
x x x	Matonisporites crassiangulatus (Balme)
×××	Leptolepidites verrucatus Couper
x	Contignisporites fornicatus Dettmann
××××	Densoisporites velatus Weyland & Kreiger
× × × × × × × × × × × × × × × × × × ×	Ceratosporites equalis Cookson & Dettimann
x	Cyathidites australis Couper Detinitiducantites arrive (balvas 1
×××××	Activitation of the section of the s
cf	Trilabosporites tribatrys Deftmann
x	Kuylisporites lunaris Cookson & Dettmann
x x x	Cyathidites punctatus (Delcourt & Sprumont)
x x x	Klukisporites scaberis (Cookson & Dettmann)
) :f X X ? c	Contignisporites glebulentus (Deffmann)
	Cicotricosisponites autremucatus (Cooper)
× × × ×	Alisporites cf. bilateralis Rouse
****	Gleicheniidites sp.1.
x x x x	Bacutatisporites comaumensis (Cookson)
× ×	Lycopodiumsporites eminutus Dettmann
< x	Poveorritetes porviretus (Bdime / Polocionalitetes reduces (Bdime)
×	Concavisporites infirmus Baime
x	Alisporites australis De Jersey (P- R. Reworking)
x	Coronatispora telata (Baime)
×××	Cyathidites concavus. (Bolkhoviting)
x	Arguserisporties (inteoris) (Cookson & Defitmann) Lycopodiumsoorites reticulumsoorites (Rourse)
? x x	Podocarpidites sp.1.
×	Trisaccites variabilis (Dev)
x	Cingutriletes clovus (Balme)
	Dictyotosporites complex Cookson & Deftmann Aconthotrilates Lavidansis Balma
x	Dictvotosparites speciosus Cookson & Dettmann
x	Guthoertisporites cancellosus Playford & Dettmann (P & Reworking)
×	? Tigrisporites, sp.
(et	Podocorpidites exiguus Harris
-	Polycingularisporites densatus (ne Jersey)

Figure 10. Range chart of spores and pollen recovered from samples from Site 263.

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