NEW PALYNOLOGY OF PRETTY HILL-1,

ONSHORE OTWAY BASIN, VICTORIA

BY

ROGER MORGAN

for MINORA RESOURCES

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CONTENTS

I SUMMARY

2928-40 ft. (CORE) : P. pannosus Zone : late Albian : non-marine : usually flat sonic response topmost Eumeralla

3340-3830 ft. (CORE) : upper C. paradoxa Zone : mid Albian : non-marine : usually flat response Eumeralla

4150 (cutts)-4940 ft. (CORE) : upper or lower C. paradoxa Zone : mid Albian : non-marine to slightly brackish

4961-5424 ft. (CORE) : lower C. paradoxa Zone : mid Albian : non-marine : usually spiky response Eumeralla

C. striatus and upper C. hughesi Zones apparently missing : usually spiky response Eumeralla

5935-5947 ft (CORE) or ?6010 ft. (cutts) : lower C. hughesi Zone : early Aptian : slightly brackish : usually very spiky response bottom Eumeralla and sometimes topmost Pretty Hill

6110-7660 ft. (CORE and cutts) : no reliable datings - all very lean with much Albian caving : no Aptian forms seen below 6110 ft. (cuttings)

7883 (CORE)-8124 ft. (CORE) : virtually barren : no dates possible

II INTRODUCTION

Ed Kopson of Minora Resources submitted 26 samples (18 cores and 8 cuttings samples) from the Early Cretaceous of Pretty Hill-1 for palynostratigraphy. This was on behalf of the PEP III operating group, as part of regional appraisal of the area. No raw data from earlier work on the well was available, although a report by Wilschut (1974) on the North Eumeralla-1 well, contained a tabular breakdown for Pretty Hill-1. This report details the final interpretation of results of these samples, with some consideration of the Wilschut report.

Palynomorph occurrence data are shown as Appendix I and form the basis for the assignment of the samples to seven spore-pollen units of late Neocomian to late Albian age. The Cretaceous spore-pollen zonation is essentially that of Dettmann and Playford (1969), but has been significantly modified and improved by various authors since, and most recently discussed in Helby et al. (1987), as shown on figure 1. As discussed in Morgan (1986) (Appendix to the Connard report), I have found the Dettmann and Douglas (1976) subdivision unworkable in some respects. The zonation used herein is that of Helby et al (1987) as discussed by Morgan (1986). The C. hughesi Zone of Dettmann and Douglas (1976) is therefore not the same as that herein.

	AGE		SPORE – POLLEN ZONES	DINOFLAGELLATE ZONES
Early Tertiary	Early Oligocene		P. tuberculatus	
	Late Eocene		upper N. asperus	P. comatum
			middle N. asperus	V. extensa
	Middle Eocene		lower N. asperus	D. heterophlycta
				W. echinosuturata
			P. asperopolus	W. edwardsii
				W. thompsonae
	Early Eocene		upper M. diversus	W. ornata
				W. waipawaensis
			middle M. diversus	
			lower M. diversus	W. hyperacantha
	Paleocene		upper L. balmei	A. homomorpha
			lower L. balmei	E. crassitabulata
				T. evittii
Late Cretaceous	Maastrichtian		T. longus	M. druggii
	Campanian		T. lilliei	I. korojonense
			N. senectus	X. australis
	Santonian		T. pachyexinus	N. aceras
				I. cretaceum
				O. porifera
	Coniacian		C. triplex	
	Turonian			C. striatoconus
	Cenomanian		A. distocarinatus	P. infusorioides
Early Cretaceous	Albian	Late	P. pannosus	
		Middle	upper C. paradoxa	
		Early	lower C. paradoxa	
			C. striatus	
	Aptian		upper C. hughesi	
			lower C. hughesi	
	Barremian		F. wonthaggiensis	
	Hauterivian			
	Valanginian		upper C. australiensis	
	Berriasian		lower C. australiensis	
Juras	Tithonian		R. watherooensis	

FIGURE 1 ZONATION FRAMEWORK

III PALYNOSTRATIGRAPHY

A. 2928-40 ft. (CORE) : P. pannosus Zone

Assignment to the Phimopollenites pannosus Zone is clearly indicated at the top by youngest Coptospora paradoxa and at the base by oldest P. pannosus, coincident with oldest Cupuliferoidaepollenites parvulus. Falcisporites spp. are quite common, and rare Permian reworking was noted.

Wilschut (1974) also assigned this core to the P. pannosus Zone.

Non-marine environments were indicated by the common and diverse spores and pollen. Slightly lacustrine influence is suggest by scarce algal acritarchs (Schizosporis spp.).

These features are normally seen at the top of the Eumeralla Formation. Sonic log response in some locations is extremely spiky with coals, but in some other localities is quite flat.

B. 3340-3830 ft. (both CORES) : upper C. paradoxa Zone

Assignment is indicated at the top by the absence of younger indicators (coincident with youngest Pilosisporites grandis) and at the base by oldest Perotriletes jubatus, an event which occurs near the top of the subzone. In this case, the specimen of Dictyotosporites speciosus (normally restricted to the lower C. paradoxa Zone and older), must be reworked. Falcisporites similis, Stereisporites antiquasporites and Cicatricosisporites australiensis are frequent and typical of the Otway Basin Albian. Minor Triassic and

Pemrian reworking were seen.

Wilschut (1974) also assigned this interval to the upper C. paradoxa Zone.

Spores and pollen are common and diverse and indicate non-marine environments at 3340-60 ft. At 3810-20 ft., very scarce spiny acritarchs were seen, indicating slightly brackish influence.

These features are normally seen near the top of the Eumeralla Formation, associated with flat sonic response.

C. 4150 (cutts)-4940 (CORE) : upper or lower C. paradoxa Zone

Assignment of this interval is highly problematic. Indicators of the lower C. paradoxa Zone include Coptospora striata (4150 ft. cutts, 4315-28 CORE) and D. speciosus (4625-40 ft. CORE). Indicators of the upper C. paradoxa Zone are more scarce, and in core comprise only Perotriletes majus at 4940-61 ft. Both P. majus and Pilosisporites grandis occur in cuttings at 4850 ft., but could be caved. Thus the interval may belong to the upper C. paradoxa Zone (with scarce indicators, and more common reworking), or belong to the lower C. paradoxa Zone (with a few caved/contaminated specimens). The two cannot be resolved on palynological criterea. Cyathidites, Cicatricosisporites australiensis and Stereisporites antiquasporites are frequent. Minor Permian and Triassic reworking were seen, most common at 4640-55 ft.

Wilschut (1974) assigned this interval down to 4655 ft.

to the upper *C. paradoxa* Zone, and 4950 ft. to the lower *C. paradoxa* Zone.

Environments are mostly non-marine, shown by the common and diverse spores and pollen. Minor lacustrine influence is shown by the presence of rare algal acritarchs in most samples. Slight brackish influence is shown by the very rare spiny acritarchs at 4315-28 ft. (CORE) and 4850 ft. (cutts).

These features are usually seen in the upper half of the Eumeralla Formation.

D. 4961-5424 ft. (CORE) : lower *C. paradoxa* Zone

The presence of multiple specimens of *Coptospora striata* in the core from 4940-61 ft. with *C. paradoxa* indicates a lower *C. paradoxa* Zone assignment. The presence also of *P. majus* (discussed above) suggests the upper *C. paradoxa* Zone. This core lies right on the subzonal boundary, and so is partly assigned to the overlying, and partly to the underlying zones.

The assemblage at 5150 ft. (cuttings) also contains *C. striata* and *C. paradoxa*, but could be caved. A lower *C. paradoxa* assignment is mostly likely, and is supported by frequent *Cyathidites* and *C. australiensis*.

The assemblage at 5400-20 ft. (CORE) is very lean, but contains two specimens of *Cooksonites variabilis* (suggesting a lower *C. hughesi* Zone assignment). Nothing in the scanty assemblage suggests a younger age, and the presence of frequent *Cyathidites*, *F. similis* and *O. wellmannii* may support the Aptian age. The assemblage is too lean to be pedantic about it, but if it is Aptian, then it and/or the assemblage beneath are out of place. If the well interects a fault or fault zone, such mixing up of blocks in the fault zone is entirely possible.

The assemblage at 5420-24 ft. (CORE) is rich and diverse and undoubtedly belongs to the lower C. paradoxa Zone as it contains C. paradoxa with D. speciosus. It also contains Trilobosporites tribotrys and T. trioreticulosus, and features relatively frequent Cicatricosisporites. As discussed above, if the section is shattered by faulting, this assemblage could be out of place.

Wilschut (1974) assigned 4940 ft. uncertainly to the lower C. paradoxa Zone, but assigned 5420 ft. with certainty to the upper part of the C. hughesi Zone. This lower assignment is totally at variance with that herein, and may lend credence to the idea that the section is confused and mixed up by fault shattering. He may have studied a different rock block. Alternatively, my sample may comprise drilling mud, or represent mixed up core.

Non-marine environments are indicated by the common and diverse spores and pollen and absence of spiny acritarchs. Minor lacustrine influence is suggested by the rare algal acritarchs (Schizosporis spp.).

These features are usually seen in spiky sonic response Eumeralla Formation.

E. C. striatus and upper C. hughesi Zones : apparently missing

These zones cannot be identified in the available samples in this section, and they are presumed to be absent due to unconformity or faulting. Notably, Wilschut (1974) also failed to locate the C. striatus Zone. The C. striatus Zone is normally associated with very spiky response mid Eumeralla, while the upper C. hughesi Zone tends to be fairly flat response lower Eumeralla Formation.

F. 5700 ft. (cutts) : indeterminate

This sample is dominated by inertinite and cuticle with too few palynomorphs being present for confident Zonal assignment or environmental interpretation. Young caving is not present.

G. 5935-47 ft. (CORE) to ?6010 ft. (cuttings) : lower C. hughesi Zone

Assignment of the core at 5935-97 ft. is straightforward as Cooksonites variabilis co-occurs with Pilosisporites notensis and Foraminisporis asymmetricus. Cyathidites and Falcisporites similis dominate the assemblage. Inertinite is very common, and minor Triassic reworking was noted. The cuttings at 6010 ft. also contain both F. asymmetricus and P. notensis. Although their spore colours suggest that they are in place, they could be caved a short distance, and Albian caving is quite prominent in the sample. The 6010 ft. sample is thus only tentatively assigned, and minor Permian reworking was seen.

Wilschut (1974) assigned 5947 ft. to the F. asymmetricus subzone of Dettmann's C. hughesi Zone. He therefore presumably saw F. asymmetricus, as herein. The raw data is therefore presumably compatible, although I differ on its interpretation.

Spores and pollen are common and diverse and indicate strong non-marine influence. Minor lacustrine input is suggested by very rare algal species (Schizosporis spp.), while a single spiny acritarch at 5935-47 ft. (CORE) indicates slight brackish input.

These features are normally seen in the basal Eumeralla Formation, associated with a very spiky sonic response.

H. 6070 ft. (CORE)-7660 ft. (cuttings) or 7597 ft. (CORE) : indeterminate

These samples are all lean to extremely lean. The core samples and most of the cuttings samples contain very small assemblages comprising long-ranging taxa. The cuttings sample at 6110 ft. is dominated by obviously caved Albian taxa, with few species convincingly in place on spore colour criterea. No Aptian restricted species were seen, nor were any Neocomian restricted species. The entire section is therefore indeterminate.

Wilschut (1974) assigned 6070 ft. to 6388 ft. with certainty to Dettmann's hughesi Zone, and 6690-7214 ft. with uncertainty to Dettmann's stylosus Zone. Without his raw data, I cannot evaluate this. He did note a base to Cicatricosisporites spp. in Pretty Hill-1 between 6070 ft. and 6370 ft. This suggests a base to the hughesi Zone as used herein at that point.

Non-marine environments are probable. No brackish indicators were seen, but this may be partly a consequence of the poor assemblages. Rare freshwater algal types (Schizosporis spp.) indicate minor lacustrine influence.

I. 7883-8124 ft. (both CORES) : indeterminate/barren

These two core samples are extremely lean of organic matter, in contrast to the overlying samples which at least have some inertinite and a low diversity assemblage. A trace of inertinite was seen in each, and an obviously caved Late Cretaceous Phyllocladidites mawsonii at 8107-24 ft. Clearly, these samples are barren and indeterminate.

IV CONCLUSIONS

A. The section is clearly incomplete and most unusual. At the base, the sandstone is too clean to contain diagnostic microfloras. In the centre, the apparent absence of two zones is most unusual. Near the top, only poor precision in paradoxa subzone definition is possible. Only at the top is the section relatively normal.

B. The lack of good data at the base makes it impossible to locate the hughesi/wonthaggiensis boundary, which is usually near the "top Pretty Hill unconformity". The passing comment of Wilschut (1974) suggests that it might lie in the gap 6070 to 6370 ft. The gamma and sonic change near 6230 ft. might be a candidate, but in the absence of good data, this is no more than a guess. Resampling holds little chance of better data, as earlier sampling appears to have removed the best lithologies. Studies of the Shell preparations would be valuable, but these cannot be located.

C. The early Aptian lower C. hughesi Zone is associated with spiky Eumeralla in the interval 5500-5964 ft., as usual.

D. The possibly mixed or confused samples assigned here to the lower C. paradoxa Zone, and the apparent absence of the C. striatus and upper C. hughesi Zones is most confusing. The suggestion that this section is confused by faulting is quite plausible. The very spiky C. striatus Zone sonic response is not obviously present in the well.

E. The long upper or lower *C. paradoxa* Zone section is also most confusing. The weight of palynolgical evidence suggests that a lower *C. paradoxa* Zone assignment is more likely, but the logs and regional experience suggest otherwise. It would be unheard of to date for the lower *C. paradoxa* Zone to be so thick, without artificial thickening by fault repeated section, or high dip angles. Given the geological data, this section probably belongs to the upper *C. paradoxa* Zone, with rare index species and frequent reworking. The palynology along cannot resolve this uncertainty.

F. At the top, a normal topmost *paradoxa*/*pannosus* section appears to be present.

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APPENDIX I

COMPOSITE PALYNOMORPH RANGE DATA

PRETTY HILL-1 COMPOSITE PALYNOLOGICAL DATA

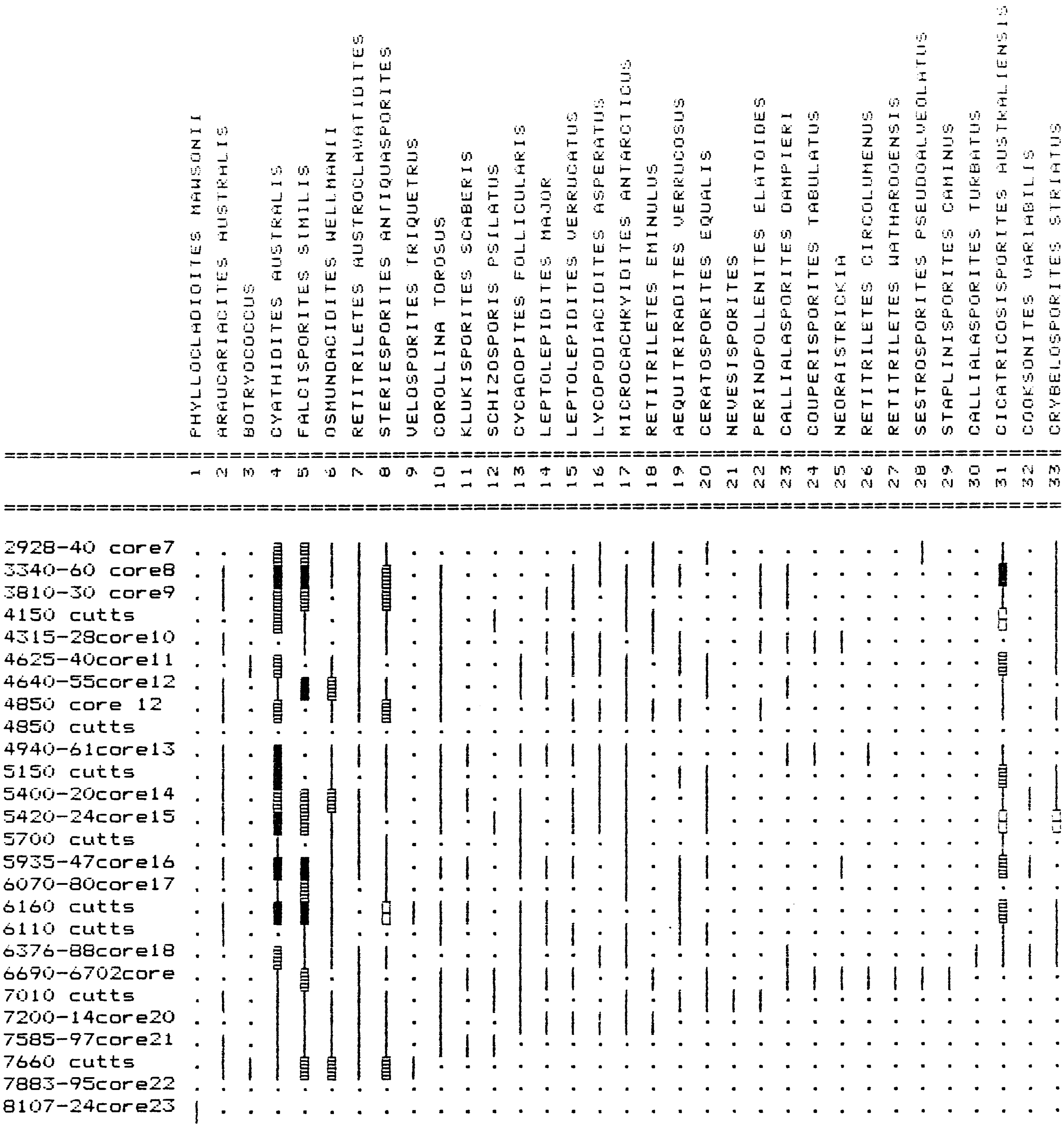
YOUR COMPANY NAME HERE
Street Address
City, State

CLIENT: MINORA RESOURCES NL
WELL: PRETTY HILL - 1
FIELD/AREA: OTWAY
SECTION: ________ TOWNSHIP: ______ RANGE: ______
COUNTY: ____________________ STATE: __________
KB ELEVATION: __________ TOTAL DEPTH: 8107-24'
ANALYST: ROGER MORGAN DATE: 29.9.88
NOTES: ALL SAMPLE DEPTHS IN FEET

RANGE CHART OF GRAPHIC ABUNDANCES BY LOWEST APPEARANCE

Key to Symbols

= Very Rare
= Rare
= Few
= Common
= Abundant
? = Questionably Present
. = Not Present



	34 DICTYOTOSPORITES SPECIOSUS	35 FALCISPORITES GRANDIS	36 FORAMINISPORIS ASYMMETRICUS	37 FORAMINISPORIS DAILYI	38 FOVEOTRILETES PARVIRETUS	39 GLEICHENIIDITES	40 AEQUITRIRADITES TILCHAENESIS	41 BALMEISPORITES HOLODICTYUS	42 BALMEISPORITES TRIDICTYUS	43 COPTOSPORA PARADOXA	44 DICTYOTOSPORITES FILOSUS	45 FORAMINISPORIS CAELATUS	46 FORAMINISPORIS WONTHAGGIENSIS	47 ISCHYOSPORITES PUNCTATUS	48 PILOSISPORITES GRANDIS	49 PILOSISPORITES NOTENSIS	50 SCHIZOSPORIS RETICULATUS	51 TRILOBOSPORITES TRIBOTRYS	52 TRILOBOSPORITES TRIORETICULOSUS	53 TRIPOROLETES RADIATUS	54 TRIPOROLETES RETICULATUS	55 TRIPOROLETES SIMPLEX	56 CINGUTRILETES CLAVUS	57 CONTIGNISPORITES COOKSONIAE	58 DICTYOTOSPORITES COMPLEX	59 JANUASPORITES SPINULOSUS	60 PILOSISPORITES PARVISPINOSUS	61 RETITRILETES FACETUS	62 AEQUITRIRADITES SPINULOSUS	63 BIRETRISPORITES	64 CYCLOSPORITES HUGHESI	65 MICRHYSTRIDIUM	66 PEROTRILETES WHITFORDENSIS
2928-40 core7	.	.	|	|	.	|	.	|	.	|	.	.	.	.	.	.	|	.	.	.	|	.	|	.	.	.	.	.	|	.	.	.	.
3340-60 core8	.	.	.	.	.	|	|	.	.	|	.	.	.	|	|	.	.	.	|	|	|	|	|	.	.	.	.	.	.	.	.	.	.
3810-30 core9	|	|	|	|	|	|	.	.	.	.	.	.	|	|	.	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.	.	.	.
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4315-28core10	.	.	|	|	|	.	|	|	.	|	.	.	|	|	.	.	.	.	.	.	|	|	|	.	|	.	.	.	|	.	.	|	.
4625-40core11	|	.	|	.	.	|	.	|	.	|	.	.	.	|	.	.	.	.	|	|	|	|	.	.	.	.	.	.	|	.	.	.	.
4640-55core12	.	|	.	.	.	|	.	.	.	.	.	.	.	|	.	.	.	.	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.
4850 core 12	.	.	|	.	|	|	|	|	.	|	.	.	.	|	.	|	|	|	|	|	.	.	.	.	.	.	.	.	.	.	.	|	.
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4940-61core13	.	.	|	.	|	.	.	|	|	|	.	.	.	.	.	.	.	.	.	|	.	|	|	.	.	.	.	.	|	.	?	.	|
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5400-20core14	|	.	.	.	.	|	.	.	.	.	.	|	.	|	.	.	|	.	.	.	|	.	|	.	.	.	.	.	|	.	.	.	.
5420-24core15	|	.	|	|	.	|	.	.	.	|	.	.	.	|	.	|	.	|	|	.	.	.	|	.	|	.	.	.	.	.	.	.	.
5700 cutts	.	.	.	|	.	|	.	.	.	.	.	.	.	.	.	.	|	.	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.
5935-47core16	.	.	□	|	.	|	.	.	.	.	.	.	|	|	.	|	.	.	.	|	|	.	|	.	.	.	.	|	|	|	|	|	|
6070-80core17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.	.
6160 cutts	.	.	|	|	|	.	|	.	.	|	.	.	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	.	.	.	.	.
6110 cutts	.	.	.	|	□	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	.	.	.	.	.	.	.	.	.	.	.
6376-88core18	|	|	|	|	|	|	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6690-6702core	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7010 cutts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7200-14core20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7585-97core21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7660 cutts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7883-95core22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8107-24core23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Sample	67 SCHIZOSPORIS PARVUS	68 DICTYOPHYLLIDITES	69 ANNULISPORITES	70 CICATRICOSISPORITES LUDBROOKIAE	71 RETITRILETES NODOSUS	72 CICATRICOSISPORITES HUGHESI	73 CONCAVISSIMISPORITES PENOLAENSIS	74 CONTIGNISPORITES GLEBULENTUS	75 COPTOSPORA STRIATA	76 ARCELLISPORITES	77 PEROTRILETES MAJUS	78 POLYCINGULATISPORITES	79 COPTOSPORA WRINKLY	80 ELATEROPLICITES AFRICAENSIS	81 LILIACIDITES PERORETICULOSUS	82 VITREISPORITES PALLIDUS	83 HOEGISPORIS	84 PEROTRILETES JUBATUS/MORGANII	85 EPHEDRIPITES	86 CUPULIFEROIDAEPOLLENITES PARVULUS	87 PHIMOPOLLENITES PANNOSUS	Sample
2928-40 core7	|	.	.	.	.	|	|	.	.	.	.	.	.	.	.	.	.	.	.	|	|	2928-40 core7
3340-60 core8	|	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.	.	.	|	.	.	3340-60 core8
3810-30 core9	.	.	|	|	.	|	.	.	.	.	.	.	.	.	.	.	|	|	.	.	.	3810-30 core9
4150 cutts	|	.	.	|	.	|	|	.	|	.	.	.	|	.	|	|	.	.	.	.	.	4150 cutts
4315-28core10	.	|	.	.	.	.	.	.	|	.	.	.	|	|	.	.	.	.	.	.	.	4315-28core10
4625-40core11	|	.	.	.	.	.	|	.	.	.	.	.	|	.	.	.	.	.	.	.	.	4625-40core11
4640-55core12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4640-55core12
4850 core 12	.	.	.	.	.	|	|	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4850 core 12
4850 cutts	.	.	.	.	.	.	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.	4850 cutts
4940-61core13	.	.	.	.	.	.	.	.	|	|	|	|	.	.	.	.	.	.	.	.	.	4940-61core13
5150 cutts	.	.	.	.	.	|	|	|	|	.	.	.	.	.	.	.	.	.	.	.	.	5150 cutts
5400-20core14	.	.	.	.	|	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5400-20core14
5420-24core15	.	|	|	|	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5420-24core15
5700 cutts	.	|	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5700 cutts
5935-47core16	|	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5935-47core16
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