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PALYNOLOGY OF MINORA WINDERMERE-2

ONSHORE OTWAY BASIN, VICTORIA

BY

ROGER MORGAN
Box 161
MAITLAND 5573
(088) 322795
Fax (088) 322658

for MINORA RESOURCES

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CONTENTS

I SUMMARY

1000-20m (cutts) : upper T.pachyexinus Zone : Santonian: nearshore marine (I.cretaceum Zone) : immature (minor Otway Group components at 1010-20m presumed reworked)

1090-1200m (cutts) : P.pannosus Zone : Late Albian: probably non-marine : marginally mature

1290-1490m (cutts) : upper C.paradoxa Zone : mid Albian : non-marine : marginally mature

1650m (cutts)-1748 (core) : lower C.paradoxa Zone : mid Albian : non-marine : early mature

1825m (cutts)-2007m (swc) : C.striatus Zone : early Albian : non-marine : early mature

2240m (swc)-3290m (cutts)(3200m swc) : C.hughesi Zone : Aptian : non-marine : mature 2240-3200m, peak mature 3245-3290m

3335m (cutts)-3570m (cutts) : F.wonthaggiensis Zone : late Neocomian : non-marine, some lacustrine influence : peak mature.

Breakdown is fairly straight forward; cuttings are generally fairly clean of downhole contamination. Sampled section comprised a condensed Sherbrook Group, normal Eumeralla Formation and a thin section of Crayfish Formation. Top Crayfish unconformity is expected in or near the gap 3290 to 3335m. The intra Eumeralla unconformity is expected in or near the gap 1748-1825m.

II INTRODUCTION

Ed Kopson of Minora Resources submitted 25 samples (14 cuttings, 10 swcs and 1 conventional core) after well completion. These were in addition to 7 "hot" cuttings samples submitted in 3 groups during drilling, to help locate top Crayfish Formation and therefore TD, ahead of the logs. Results were submitted as available and this report details the final interpretation of results from these samples.

Palynomorph occurrence date are shown as Appendix I and form the basis for the assignment of the samples to seven spore-pollen units of Santonian to late Neocomian age. The Cretaceous spore-pollen zonation is essentially that of Playford and Dettmann (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.

Cretaceous dinoflagellates are seen in only a few samples, and are discussed within the recent zonation framework of Helby et al. (1987), as on figure 1.

Maturity data are generated in the form of Spore Colour Index and plotted in figure 2. The oil window corresponds to spore colours of light-mid brown (2.7) to dark brown (3.6) and vitrinite reflectances of 0.6% to 1.3% respectively. Geological factors and kerogen factors can modify this window in a minor way, and instrumental geochemistry offers more quantitative and repentable measurements.

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

FIGURE 1 ZONATION FRAMEWORK

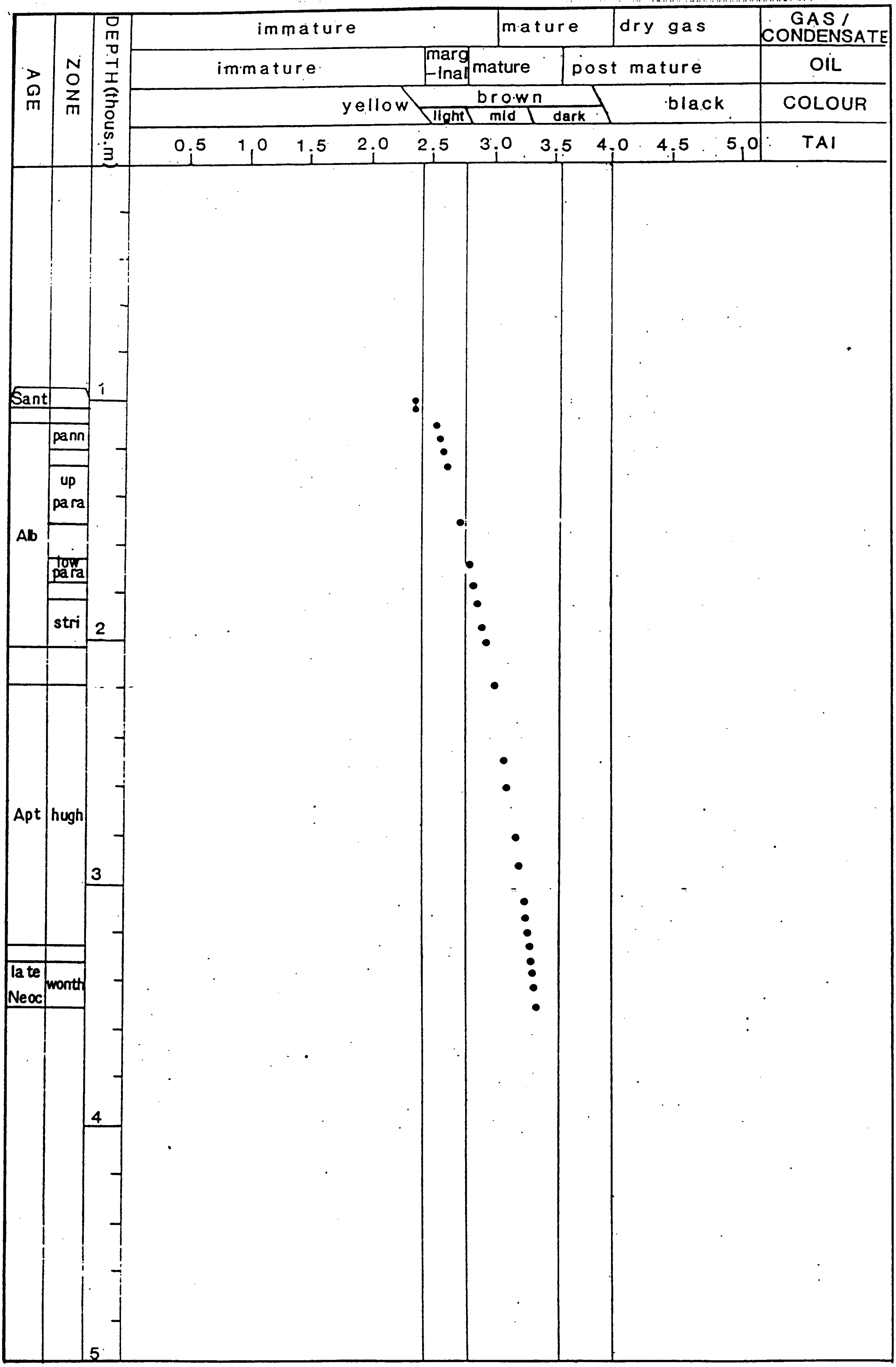

FIGURE 2 MATURITY PROFILE, WINDERMERE 2

III PALYNOSTRATIGRAPHY

A. 1000-20m (cutts) : upper T.pachyexinus Zone (I.cretaceum Zone)

These two cuttings samples are assigned to the Tricolporites pachyexinus Zone of Santonian age on the presence of T.pachyexinus (=T.apoxyexinus) without younger indicators. The upper half of the zone is clearly indicated by the scarcity of Amosopollis cruciformis and the dinoflagellate data. Cuticle and inertinite dominate the residues and Proteacidites spp. are the dominant spore-pollen taxa. Age significant taxa include Australopollis obscuris, Clavifera triplex, Ornamentifera sentosa, Phyllocladidites mawsonii and Tricolpites confessus. Minor Paleogene caving (Nothofagidites emarcidus) is seen in both samples. Minor Albian Otway Group reworking (A.spinulosus, C.paradoxa) and minor Permian and Triassic reworking are seen at 1010-20m only.

Dinoflagellates comprise 50 % of palynomorphs and are quite diverse (15-20) species). Nearshore environments are therefore indicated. Heterosphaeridium heteracanthum is dominant, but the co-occurence of Isabelidinium belfastense with I.cretaceum, Odontochitina porifera and Hexagonifera glabra indicates the upper part of the I.cretaceum Dinoflagellate Zone.

Palynomorphs are colourless, indicating immaturity for hydrocarbon generation.

These features are normally seen in the marine Sherbrook Group.

B. 1090-1200m (cutts) : P.pannosus Zone

Assignment to the Phimopollenites pannosus Zone is indicated at the top by youngest Coptospora paradoxa in situ and Pilosisporites grandis, along with a vast influx of spores and pollen. At the base, oldest P.pannosus indicates the assignment, but this may be slightly too low, if caving has occurred, Caving in these 3 cuttings samples appears to be minor, with caved Late Cretaceous taxa comprising only about 2% of the assemblage. The assemblage is dominated by Cyathidites and Stereisporites with high diversity. Trace Triassic reworking was seen at 1150-60m only.

Non-marine environments are considered most likely, as all of the marine elements are probably caved from the late Cretaceous. The abundant and diverse spores and pollen, and high cuticle and tracheid contents also support a non-marine provenance.

Light brown spore colours indicate marginal maturity for oil, but immaturity for gas/condensate. N.P. These features are normally seen in the topmost Eumeralla Formation.

C. 1290-1490m (cutts) : upper C.paradoxa Zone

Assignment to the upper Coptospora paradoxa Zone is indicated at the top by the absence of P.pannosus and youngest consistent P.grandis. The base is defined by oldest P.grandis and the absence of older markers. Common taxa are Cyathidites and Stereisporites antiquasporites. Foraminisporis *asymmetricus* and *Crybelosporites striatus* are consistent at 1290-1300m (cutts), and *Triporoletes radiatus* is consistent at 1480-90m (cutts). Late Cretaceous caving is minor, less than 1%.

Non-marine environments are indicated by the dominant cuticle and tracheid, common and diverse spores and pollen, and absence of in situ marine indicators. Minor lacustrine influence is suggested by the freshwater algal forms *Botryococcus* at 1480-90m and *Schizosporis* at 1290-1300m.

Light brown spore colours indicate marginal maturity for oil, and immaturity for gas/condensate.

These features are usually seen in the mid Eumeralla Formation.

D. 1650 (cutts)-1748m (core) : lower *C.paradoxa* Zone

Assignment to the lower *Coptospora paradoxa* Zone is indicated at the top by youngest *Coptospora striata* (1650-60m, cutts) and youngest *Dictyotosporites speciosus* (1748m, core 1). *Cyathidites* and *Falcisporites* are common in both samples, with *Cicatricosisporites australiensis* and *Triporoletes radiatus* consistent at 1650-60m (cutts). Only a trace of Late Cretaceous caving was seen.

Non-marine environments are indicated by the dominant cuticle and tracheid fragments, the common and diverse spores and pollen, and the absence of in situ marine indicators.

Light to mid brown spore colours indicate early maturity for oil generation and early marginal maturity for gas/condensate.

These features are normally seen at the base of the mid Eumeralla Formation, directly above the mid Eumeralla unconformity.

E. 1825m (Cutts)-2007m (swc) : C.striatus Zone

These three samples are assigned to the Crybelosporites striatus Zone at the top on the absence of younger indicators and at the base on oldest C.striatus. Youngest consistent Pilosisporites spp. (P.notensis and P.parvispinosus) occur at 1825-30m (cutts). Cyathidites spp. and Cicatricosisporites spp. are common throughout, with Stereisporites antiquasporites also common at 1825-30m. Cuticle and spores and pollen dominate the residues, and amorphous sapropel at 1825-30m suggests good source potential. Trace quantities of Late Cretaceous forms are caved into the cuttings.

Non-marine environments are indicated by the lack of marine taxa, the common and diverse spores and pollen, and common plant debris.

Light to mid brown spore colours indicate early maturity for oil generation and early marginal maturity for gas/condensate.

These features are normally seen in the mid Eumeralla Formation.

F. 2240m (swc)-3290m (cutts) : C.hughesi Zone

These ten samples (3 cuttings and 7 swcs) are assigned to the Cyclosporites hughesi Zone at the top on youngest C.hughesi and at the base on the lack of older indicators. Assignment to 3200m at least is confirmed by oldest P.notensis in the deepest swc. Within the interval, youngest Cooksonites variabilis at 2526m (swc) implies that 2240m belongs to the upper C.hughesi Zone and 2526-3290 to the lower C.hughesi Zone. These thicknesses appear unusual, and reworking of C.variabilis may be responsible, causing an apparently thicker lower C.hughesi Zone at the expense of the upper C.hughesi Zone. Alternatively, the subdivision may be valid : log correlation may throw light on the matter. Also within the interval, oldest consistent F.asymmetricus (2240m) and acmes of P.notensis (2930 m and 3167-3200m) may have correlative potential. Cyathidites, and Falcisporites tend to be the most common taxa throughout.

Non-marine environments are indicated by the absence of saline indicators, dominant spore/pollen with subordinate plant debris (tracheid and cuticle).

Mid brown spore colours indicate maturity for oil throughout, with mid to dark brown colours below 3200m indicating peak maturity for oil generation. The section 2240 to 2800m is marginally mature for gas/condensate, with 2800m-3200m mature for gas/condensate.

These features are normally seen in the lower Eumeralla Formation including any basal Eumeralla sands.

G. 3335m (cutts)-3570m (cutts) : F.wonthaggiensis Zone

Assignment to the Foraminisporis wonthaggiensis Zone is indicated at the top by youngest Microfasta evansii. The usual base range criteria cannot be used since no sidewall cores were recovered below 3200m. The younger taxa are seen in these cuttings but are presumed caved. At least some specimens are obviously caved, due to their lighter spore colours. The base of the interval is not clearly defined, but M.evansii is consistent to the base. Regionally, M.evansii is very rarely seen in the next older zone, the C.australiensis Zone. The whole interval is therefore assigned to the F.wonthaggiensis Zone.

Non-marine environments with some lacustrine influence is indicated by the common and diverse spores and pollen, abundant plant debris, and lack of saline indicators.

Peak maturity for oil is indicated by the mid-dark brown spore colours, which also indicate maturity for gas/condensate generation.

These features are usually seen in the Crayfish or Pretty Hill Formation.

IV CONCLUSIONS

A. The sampled section appears to consist of an incomplete and condensed Sherbrook Group, a thick and complete Eumeralla Formation, and a short drilled section of Crayfish Formation. Three major regional unconformities appear to be present at the mid Cretaceous (in the gap 1020 to 1090m), intra Eumeralla (in the gap 1748 to 1825m) and top Crayfish (in the gap 3290 to 3335m. Caving or reworking may have confused interpretation somewhat, and these unconformities may be nearby and not exactly in these gaps.

B. The section appears to be peak mature for oil below about 3200m.

V REFERENCES

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Helby, R.J., Morgan, R.P. and Partridge, A.D. (1987) A palynological zonation of the Australian Mesozoic Ass. Australas. Palaeontols. Mem 4, 1-94.

WINDERMERE#2

ROGER MORGAN, BOX 161,
MAITLAND, S.A., 5573,
PH (088) 322795 FAX (088) 322658

CLIENT: MINORA RESOURCES
WELL: WINDERMERE#2
FIELD/AREA: OTWAY BASIN

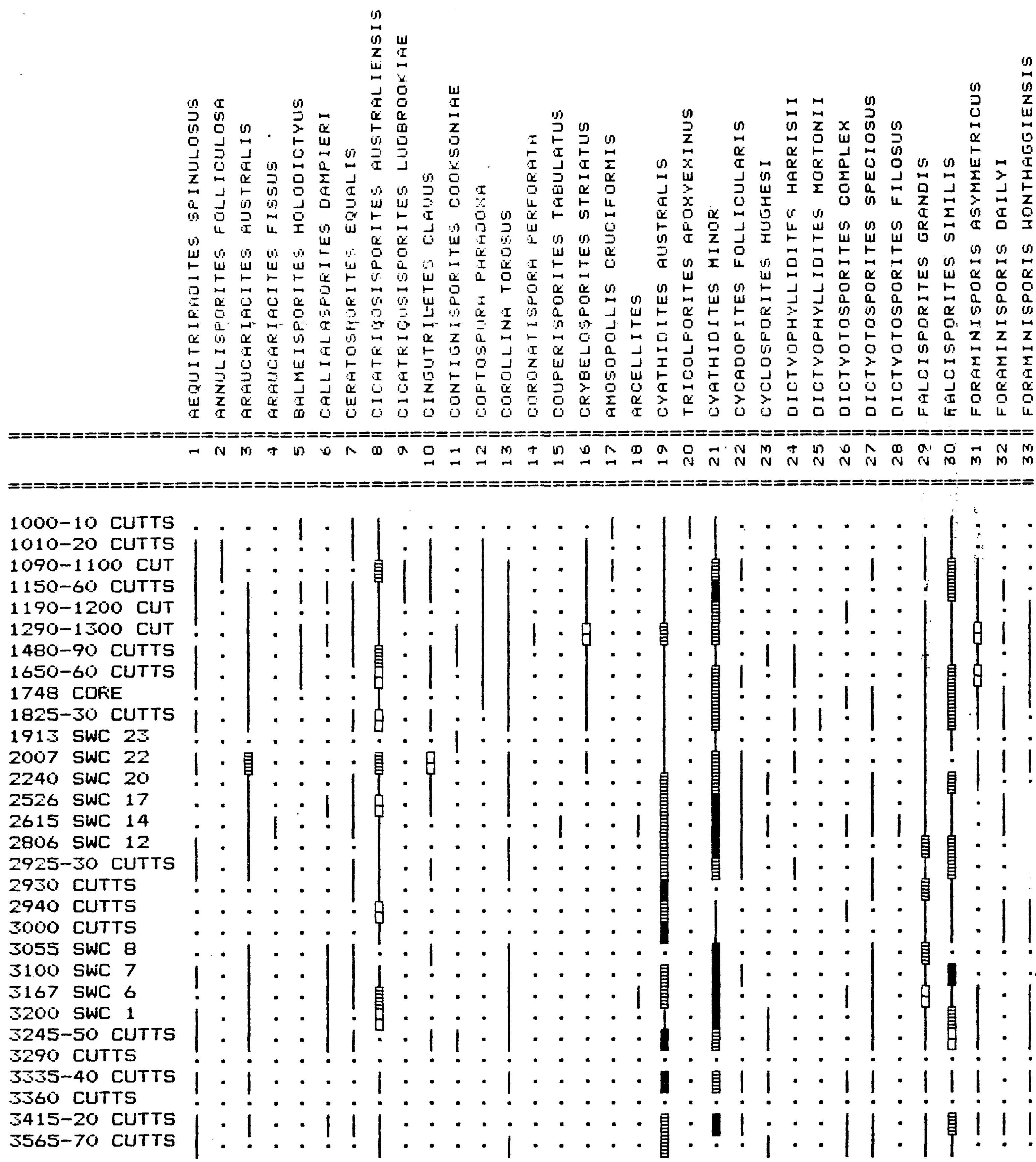
STATE: VICTORIA

ANALYST: ROGER MORGAN DATE: JUNE 1989
NOTES: ALL DEPTHS IN METRES

RANGE CHART OF GRAPHIC ABUNDANCES BY LOWEST APPEARANCE (By Group)

Key to Symbols

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



1 AEQUITRIRADITES SPINULOSUS
2 ANNULISPORITES FOLLICULOSA
3 ARAUCARIACITES AUSTRALIS
4 ARAUCARIACITES FISSUS
5 BALMEISPORITES HOLODICTYUS
6 CALLIALASPORITES DAMPIERI
7 CERATOSPORITES EQUALIS
8 CICATRICOSISPORITES AUSTRALIENSIS
9 CICATRICOSISPORITES LUDBROOKIAE
10 CINGUTRILETES CLAVUS
11 CONTIGNISPORITES COOKSONIAE
12 COPTOSPORA PARADOXA
13 COROLLINA TOROSUS
14 CORONATISPORA PERFORATA
15 COUPERISPORITES TABULATUS
16 CRYBELOSPORITES STRIATUS
17 AMOSOPOLLIS CRUCIFORMIS
18 ARCELLITES
19 CYATHIDITES AUSTRALIS
20 TRICOLPORITES APOXYEXINUS
21 CYATHIDITES MINOR
22 CYCADOPITES FOLLICULARIS
23 CYCLOSPORITES HUGHESI
24 DICTYOPHYLLIDITES HARRISII
25 DICTYOPHYLLIDITES MORTONII
26 DICTYOTOSPORITES COMPLEX
27 DICTYOTOSPORITES SPECIOSUS
28 DICTYOTOSPORITES FILOSUS
29 FALCISPORITES GRANDIS
30 FALCISPORITES SIMILIS
31 FORAMINISPORIS ASYMMETRICUS
32 FORAMINISPORIS DAILYI
33 FORAMINISPORIS WONTHAGGIENSIS
1000-10 CUTTS
1010-20 CUTTS
1090-1100 CUT
1150-60 CUTTS
1190-1200 CUT
1290-1300 CUT
1480-90 CUTTS
1650-60 CUTTS
1748 CORE
1825-30 CUTTS
1913 SWC 23
2007 SWC 22
2240 SWC 20
2526 SWC 17
2615 SWC 14
2806 SWC 12
2925-30 CUTTS
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3000 CUTTS
3055 SWC 8
3100 SWC 7
3167 SWC 6
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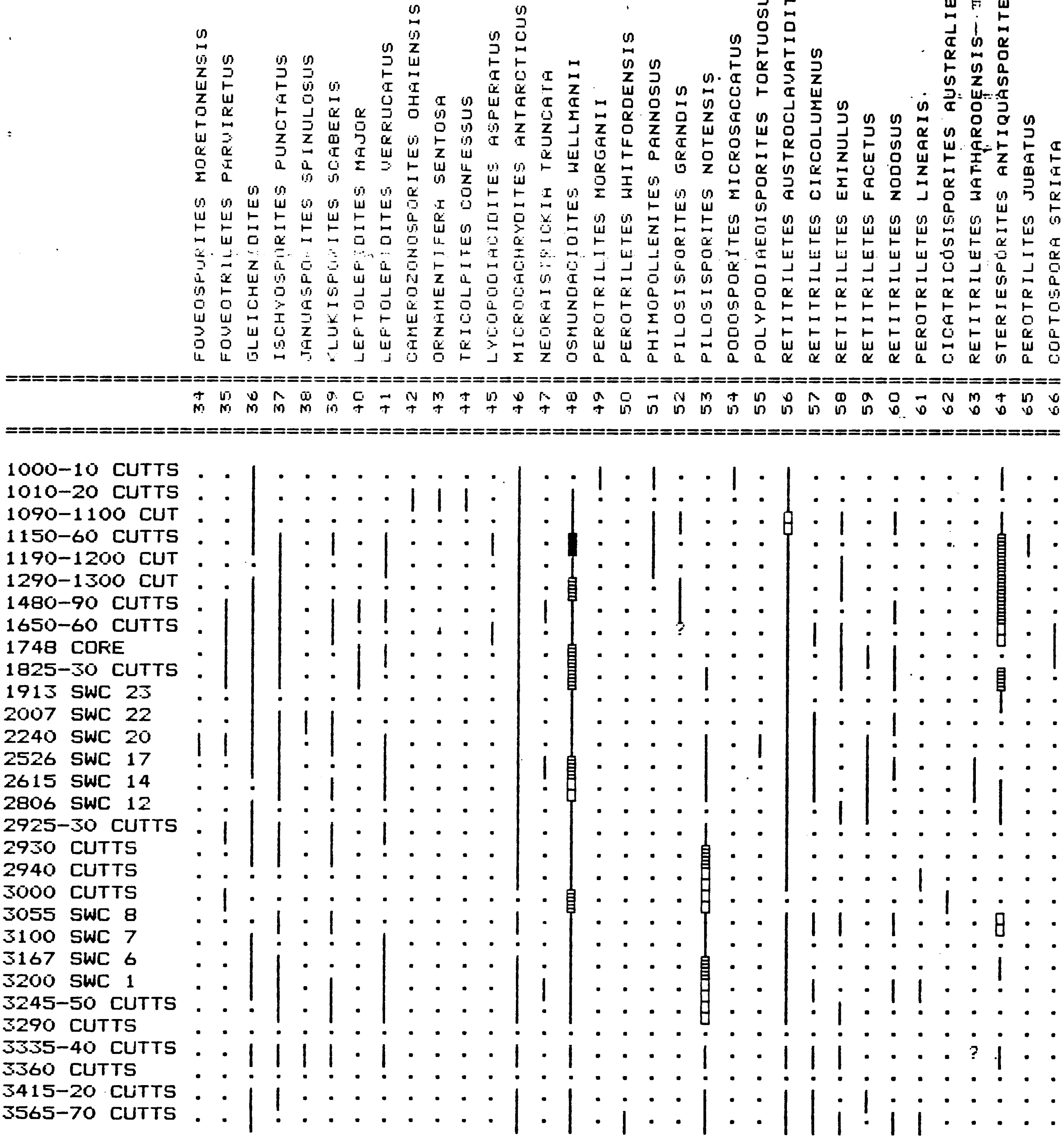

34 FOVEOSPORITES MORETONENSIS
35 FOVEOTRILETES PARVIRETUS
36 GLEICHENIIDITES
37 ISCHYOSPORITES PUNCTATUS
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44 TRICOLPITES CONFESSUS
45 LYCOPODIACIDITES ASPERATUS
46 MICROCACHRYIDITES ANTARCTICUS
47 NEORAISTRICKIA TRUNCATA
48 OSMUNDACIDITES WELLMANII
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51 PHIMOPOLLENITES PANNOSUS
52 PILOSISPORITES GRANDIS
53 PILOSISPORITES NOTENSIS
54 PODOSPORITES MICROSACCATUS
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56 RETITRILETES AUSTROCLAVATIDITES
57 RETITRILETES CIRCOLUMENUS
58 RETITRILETES EMINULUS
59 RETITRILETES FACETUS
60 RETITRILETES NODOSUS
61 PEROTRILETES LINEARIS
62 CICATRICOSISPORITES AUSTRALIENSIS MEGA
63 RETITRILETES WATHAROOENSIS
64 STERIESPORITES ANTIQUASPORITES
65 PEROTRILITES JUBATUS
66 COPTOSPORA STRIATA
1000-10 CUTTS
1010-20 CUTTS
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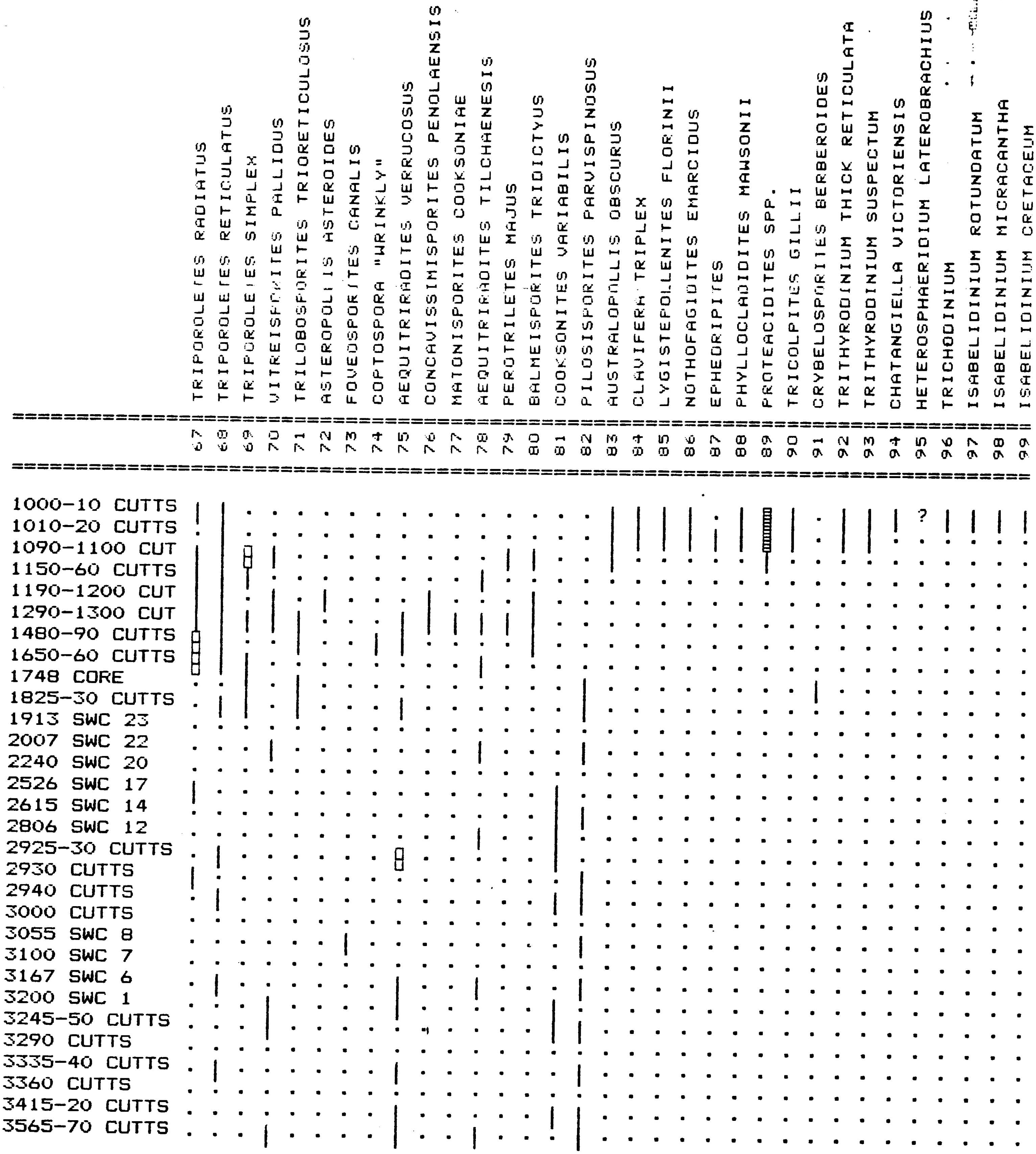

67 TRIPOROLETES RADIATUS
68 TRIPOROLETES RETICULATUS
69 TRIPOROLETES SIMPLEX
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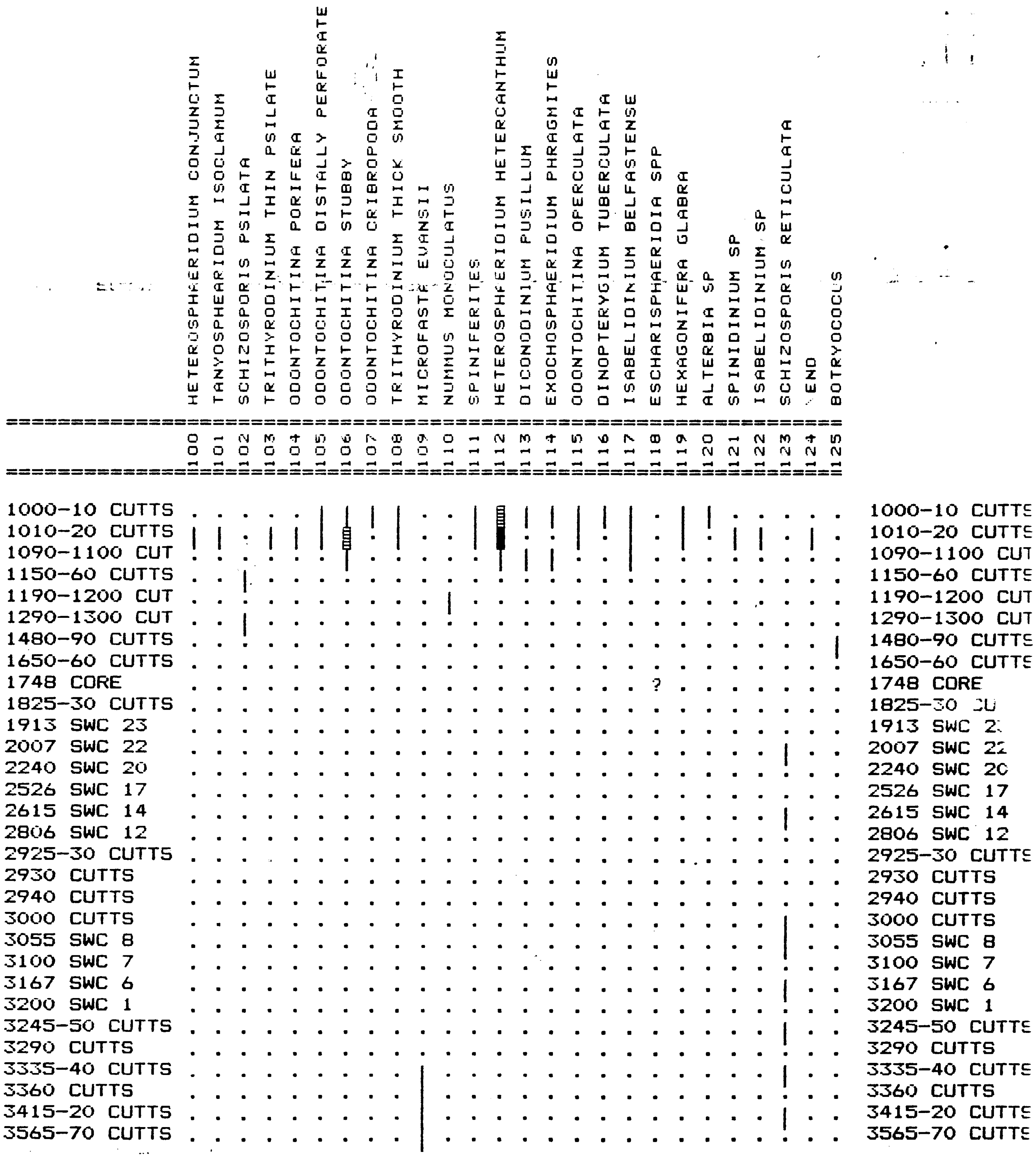

100 HETEROSPHAERIDIUM CONJUNCTUM
101 TANYOSPHEARIDUM ISOCLAMUM
102 SCHIZOSPORIS PSILATA
103 TRITHYRODINIUM THIN PSILATE
104 ODONTOCHITINA PORIFERA
105 ODONTOCHITINA DISTALLY PERFORATE
106 ODONTOCHITINA STUBBY
107 ODONTOCHITINA CRIBROPODA
108 TRITHYRODINIUM THICK SMOOTH
109 MICROFASTA EVANSII
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111 SPINIFERITES
112 HETEROSPHAERIDIUM HETERCANTHUM
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3565-70 CUTTS

SPECIES LOCATION INDEX
Index numbers are the columns in which species appear.

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75	AEQUITRIRADITES VERRUCOSUS
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