BIOSTRATIGRAPHIC ZONATION

SHELL KUGPIK O-13

68° 52' 50" N. LAT., 135° 18' 15" W. LONG.
NORTHWEST TERRITORIES

AUSTIN & CUMMING EXPLORATION CONSULTANTS
CALGARY, ALBERTA
AUGUST, 1976.

C O N T E N T S

BIOSTRATIGRAPHIC ZONATION

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SUMMARY AND CONCLUSIONS

This study incorporates the data obtained from one hundred and three palynological samples and one hundred microfaunal samples obtained from both cuttings and cores from the subject well.

Microfloral examination yielded 51 terrestrial and 30 marine palynomorph species ranging in age from Neogene to Pennsylvanian or Mississippian.

Microfaunal examination identified 48 species of Foraminifera and Ostracods, plus a number of other fossil fragments, and characteristic minerals.

Following is a compilation of the results of the study utilizing zone designation for intervals where correlation to other wells permits.

Palynological analysis identifies eight zones that tentatively range through Neogene, Eocene, Paleocene, Maestrichtian or Campanian, Albian, Berriasian-Tithonian, Middle or lower Upper Jurassic to Pennsylvanian or Mississippian.

Micropaleontological analysis generally confirms the palynological zonation with the exception of the KP-2 zone, the lower portion of KP-4 and the upper portion of KP-8.

Revision of the Palynological Report was necessitated as a result of additional information acquired subsequent to the initial study. Zone numbering has been revised in this report, however bracketed numbers are carried throughout the report as reference has been made to these numbers in previous well reports.

A stratigraphic summary log at a scale of 1" = 100' (FIG. 3 in pocket) is included. This log incorporates microfaunal assemblages, microfloral zonation, lithological summary and the Dual Induction Laterolog. This log records our geological interpretation and notes significant lithological or mechanical log characteristics that may assist in correlation.

A summary of zonation and discussion of zonation is as follows.

Zonation Summary

Age	Palynological Well Zone	Correlative Palynological Zone	Micropaleontologi Zone
Neogene	-	-	Assemblage I (Surf.-900')
	KP-1 (943-1995)	Not Zoned	Ammobaculites 20((1600-1950)
Paleogene	KP-2 (2087-4795)	Not Zoned	
Paleocene?[1].			Cyclammina 71 (2200-4550)
Paleocene-Maestrichtian	KP-3 (4910-5954)	Leptolepidites cf. tenuis	
Maestrichtian-Campanian	KP-4 (KP-4A) (6056-6860)	Wodehousia	
Campanian-[2]. Santonian?			Bone Beds (6500-7000)
Albian (Middle-Upper)	KP-5 (KP-4B) (6930-7170)	Leptodinium-1	Radiolaria 1 to 3 (7000-7200)
Hauterivian-Tithonian	KP-6 (KP-5A) (7669-9150)	Trilobosporites	Haplophragmoides 217 & 219 (7900-9900)
Jurassic-(Middle-Upper) Cretaceous (Lowermost)	KP-7 (KP-5B) (9640-9687)	Not Zoned	
Pennsylvanian[3]. or Mississippian 10,140-12,103	KP-8 (KP-6) (9695-11,672) Mainly barren	Triquitrites	Arenoturrispirill 232 (9900-10,200)

1. Inferred by microfaunal correlations.
2. Based on micropaleontology, lithology and mechanical log correlations.
3. Based on lithology and mechanical log change and one indeterminate species of Triquitrites at 10,600 feet.

Discussion of Zonation

KP-2 Zone

Palynological correlations based on meager data indicate KP-2 to be a correlative of the *Lycopodium*-1 zone of Imp. Nuktak C-22 (NT-8). However, microfaunal examination identifies the Cyclammina 71 Fauna through most of this interval (2200-4550). Correlation of this Cyclammina fauna ("arctic-borealis") to Imp. Taglu C-42 and Gulf Imp. Shell Titalik K-26 indicates an association with beds of Lower Paleocene (TG-8, *Leptolepidites* cf.*tenuis*) and "Lower Paleogene" (TI-7, *Pesavis*-1) respectively. The transgression of this fauna from TG-8 to TI-7 and KP-2 is interpreted by Braun (Taglu C-42 report) as facies controlled. The interpretation of the one zone discrepancy between faunal and floral evidence is accepted for the Taglu and Titalik wells, but it is believed unlikely that the Cyclammina fauna is sufficiently long ranging to occur in beds of Upper Eocene age as in this well.

A direct correlation to the TI-7 (*Pesavis*-1) zone based on the presence of the Cyclammina 71 fauna is favoured. The absence of characteristic microflora for this interval may result from an impoverished sequence similar to the NI-9 zone of Shell Niglintgak H-30, with younger flora resulting from contamination.

KP-4 Zone

Microfaunal examination of the lower portion of this unit (6500-7000) identifies an interval containing teeth and bone fragments. Mechanical log radioactive markers coincide with this interval which can be correlated to Chamney's unit 8 of Early Campanian to Late Santonian age. This interval is tentatively correlated with the Boundary Creek Formation.

KP-8 Zone

Microfossil and lithological analysis of this zone indicate the upper portion (9687-10,140) of this interval to be of uppermost Jurassic and lowermost Cretaceous as evidenced by the Arenoturrispirillina 232 fauna. Lithological examination, supported by mechanical logs, places the contact between Jurassic and Pennsylvanian or Mississippian at 10,140 feet. The interval above this contact is considered a continuation of Middle-lower Upper Jurassic (not zoned). The lower portion (10,140-12,103') of the KP-8 zone is placed in the Pennsylvanian or Mississippian on the basis of an indeterminate species of Triquitrites.

A detailed discussion of the palynological and micropaleontological analysis follows.

TABLE 1

PALYNOLOGICAL ZONATION

DEPTH	ZONES (PALYNOLOGY)	ENVIROMENT	AGE	ORG. MAT.
0	943'	TERRESTRIAL	NEOGENE	1-2
2000'	KP-1 1995'			
4000'	KP-2 4795'	MARINE HORIZON TERRESTRIAL	PALEOGENE (PROBABLY UPPER EOCENE)	2-3 3-4
6000'	KP-3 5954'	NEARSHORE MARINE TERRESTRIAL	PALEOCENE-MAESTRICHTIAN	4-5
	KP-4 (KP-4A) 6930'	OFFSHORE MARINE	MAESTRICHTIAN OR CAMPANIAN	
	KP-5(KP-4B) 7170'		M-U ALBIAN	
8000'	KP-6 (KP-5A) 9640'	TERRESTRIAL WITH SPORADIC MARINE HORIZONS	BERRIASIAN-TITHONIAN	3-4
	KP-7(KP-5B) 9687'		M-LOWER UPPER JURASSIC	4-5
10,000'	KP-8 (KP-6) 11,672'	TERRESTRIAL	PENNSYLVANIAN OR MISSISSIPPIAN	5-6
12,000'	NO SAMPLES IN THIS INTERVAL			

SHELL KUGPIK 0-13

(INTEGRATING CORE MATERIAL)

Zone KP-3 (4910-5954 feet)

The following terrestrial species characterize this zone:

522 *Leptolepidites* cf. *tenuis*
4 *Cicatricosisporites hallei*
13 *Alisporites grandis*
5 *Alisporites bilateralis*
22 *Cyathidites minor*
24 *Podocarpidites multisimus*
77 *Contignisporites cooksoni*
31 *Lycopodiumsporites austroclavatidites*
38 *Aequitriradites spinulosus*

All but 522 *Leptolepidites* cf. *tenuis* are relatively long ranging Cretaceous species. *Leptolepidites tenuis* Stanley has been reported from the Maestrichtian and Paleocene of South Dakota.

Marine species in this zone comprise M36 *Odontochitina operculata*, M251 *Deflandrea* cf. *wetzeli*, and M240 *Deflandrea ditissima*.

Zone KP-4 (KP-4A) (6056-6860 feet)

This zone is characterized by the rare occurrence of these terrestrial species:

289 *Wodehousia spinata*
513 *Hamulatisporis* cf. *rugulatus*
52 *Biretisporites potoniei*
247 *Aquilapollenites attenuatus*

This zone also contains the following marine dinoflagellates:

M240 *Deflandrea ditissima*
M249 *Deflandrea biapertura*
M42 *Pterospermopsis australiensis*
M122 *Deflandrea cooksoni*
M252 *Deflandrea microgranulata*
M238 *Gonyaulacysta* cf. *orthoceras*

Zone KP-5 (KP-4B) (6930-7170 feet)

Characterized by the following species in cuttings and cores:

54 *Distaltriangulisporites perplexus*
M89 *Spinidinium vestitum*
M22 *Aptea* cf. *polymorpha*
M170 *Canningia* cf. *colliveri*
M253 *Leptodinium*-1
M1 *Oligosphaeridium complex*

Zone KP-6 (KP-5A) (7669-9150 feet)

Characterized by the following terrestrial and marine species:

20 *Cicatricosisporites australis*
3 *Classopollis torosus*
9 *Cerebropollenites mesozoicus*
40 *Sestrosporites pseudoalveolatus*
518 *Trilobosporites* cf. *bernissartensis*
M175 *Imbatodinium villosum*
M250 *Pareodinia osmingtonense*
M180 *Tubotuberella rhombiformis*
M54 *Pareodinia ceratophora*

Zone KP-7 (KP-5B) (9640-9687 feet)

Cored material from this interval has yielded the following species:

512 *Callialasporites* cf. *segmentatus*
M60 *Gonyaulacysta jurassica*

Zone KP-8 (KP-6) (9695-11,672 feet)

This part of the section is essentially barren except for the presence of an indeterminate species of 523 *Triquitrites* indicating a Mississippian or Pennsylvanian age at 10,600 feet.

PALEOENVIRONMENTS

Weak marine influence at 3,229 feet in Zone KP-2 is indicated by the presence of rare M220 *Lejeunia*-1.

A near-shore marine interval at the top of Zone KP-3 between 4,910 and 5,122 feet is indicated by the infrequent dinoflagellates and diverse terrestrial palynomorph assemblages.

A well-marked offshore marine interval occupies 6,229-7,070 feet in Zone KP-4 (KP-4A) indicated by 6 dinoflagellate species and less diverse spore-pollen floras compared with the superadjacent interval.

Marine conditions are also indicated in Zone KP-5 (KP-4B) by the presence of several dinoflagellate species in core material.

Sporadic marine conditions in Zone KP-6 (KP-5A) are indicated by the scattered occurrences of dinoflagellates at 7,876 feet, 8,025 feet, 8,532 feet, 8,830 feet, and 9,074 feet.

Zone KP-7 (KP-5B) is weakly marine to judge from the presence of two dinoflagellate species.

All other intervals apparently represent non-marine conditions of deposition.

AGE AND CORRELATION

Zone KP-1

This is a poorly characterized zone comprising 5 terrestrial species. Considering the general paucity of the flora and lack of abundant and diverse temperate elements, this zone is probably principally Neogene in age. No close correlation with other wells is possible on this poor palynoflora.

Zone KP-2

The presence of the following species suggests a correlation with Eocene or Oligocene assemblages in previously examined wells:

325 *Aquilapollenites* cf. *reticulatus*
395 *Corylus*-1
378 *Pluricellaesporites*-1
405 *Cicatricosisporites intersectus*
320 *Ulmus*-1
411 *Abies*-1
414 *Triatripollenites*-1
412 *Lycopodium*-1
415 *Aquilapollenites* cf. *murus*

No more precise correlation is possible. However, the presence of 325 *Aquilapollenites* cf. *reticulatus* at 2,087 feet and M220 *Lejeunia*-1 at 3,229 feet suggests a correlation with the Upper Eocene zones NT-8 and NI-2 and NI-3 of previously examined wells.

The possibility of recycling of Tertiary elements cannot, however, be ruled out.

Zone KP-3

522 *Leptolepidites* cf.*tenuis* compares with a Maestrichtian-Paleocene species but all other elements in this zone are long-ranging Cretaceous species.

Zone KP-4 (KP-4A)

This zone contains typical Maestrichtian species between 6,229 feet and 6,860 feet:

289 *Wodehousia spinata*
513 *Hamulatisporis* cf. *rugulatus*
247 *Aquilapollenites attenuatus*

However, the following marine dinoflagellates between 6,056 feet and 6,450 feet suggest Campanian or Maestrichtian (McIntyre, 1975):

M240 *Deflandrea ditissima*
M249 *Deflandrea biapertura*
M122 *Deflandrea cooksoni*

M252 *Deflandrea microgranulata* at 6820-6860 feet has previously been reported from Paleocene strata.

The balance of evidence suggests a Maestrichtian age for Zone KP-4.

Zone KP-5 (KP-4B)

Several species in this interval have restricted ranges as indicated:

54 *Distaltriangulisporites perplexus*, Middle-Upper Albian
M89 *Spinidinium vestitum*, Middle-Upper Albian
M22 *Aptea* cf. *polymorpha*, Aptian-Upper Albian
M170 *Canningia* cf. *colliveri*, Aptian-Upper Albian

Furthermore, M253 *Leptodinium*-1 resembles the species recently described by Brideaux and McIntyre (1975) from the Middle Albian of the Horton River, District of Mackenzie.

A Middle or Late Albian age is indicated for this interval.

Zone KP-6 (KP-5A)

This zone contains a characteristic uppermost Jurassic or lowermost Cretaceous assemblage with the following important index species as indicated:

M175 *Imbatodinium villosum*, Upper Jurassic-Hauterivian
M250 *Pareodinia osmingtonense*, Upper Jurassic-Valanginian
M180 *Tubotuborella rhombiformis*, Upper Tithonian-Berriasian
M54 *Pareodinia ceratophora*, Upper Jurassic
518 *Trilobosporites* cf. *bernissartensis*, lowest Cretaceous

Some of the above species have recently been reported from the Upper Jurassic and Lower Cretaceous of the North Slope of Alaska (Wiggins, 1975).

Zone KP-7 (KP-5B)

The following species of restricted range indicate a Middle or early Late Jurassic age:

M60 *Gonyaulacysta jurassica*
M254 *Cannosphaeropsis* sp. indet.
512 *Callialasporites* cf. *segmentatus*

Zone KP-8 (KP-6)

This is essentially a barren interval but a rare species of *Triquitrites* suggests a Pennsylvanian or Mississippian age.

ORGANIC MATURATION

Grades of organic maturation are indicated on the accompanying chart using colours of indigenous palynomorphs as follows:

1 light yellow
2 yellow
3 dark yellow
4 amber
5 brown
6 black-brown
7 black

Maturation increases progressively from 1 to 5 in the Tertiary-Upper Cretaceous interval down to 7,070 feet.

Maturation grade decreases to 3 at 7,669 feet and then progressively increases to 6 at 10,660 feet. No indigenous palynomorphs are present below this depth.

Reasons for decrease in organic maturation rank between 7,170 feet and 7,669 feet are not known but could be due to one or more of the following:

1. Change in processing technique.
2. Change in lithology.
3. Paleo-weathering horizons.
4. Tectonic superposition of high-rank on low-rank strata.

No information on any of the above is presently available to the writer.

REFERENCES

Brideaux, W.W. and McIntyre, D.J., 1975. Miospores and microplankton from Aptian-Albian rocks along Horton River, District of Mackenzie. Geol. Surv. Can. Bull. 252, 1-85.

McIntyre, D.J., 1975. Morphologic changes in Deflandrea from a Campanian section, District of Mackenzie, N.W.T., Canada. Geoscience and Man, 11, 61-76.

Wiggins, V.D., 1975. The dinoflagellate family Pareodiniaceae: a discussion. Geoscience and Man, 11, 95-116.

MICROPALEONTOLOGICAL STUDY

BY

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ASSEMBLAGE I

Unlike Assemblage I of Adgo, Niglintgak and Nuktak where it is richly diversified, only a few ostracods and some possible reworked Foraminifera were found in the upper 900 feet of the Kugpik borehole. This impoverished fauna resembles that of Taglu C-42, and the presence of some freshwater and shallow-marine ostracods permit to place the fauna into Assemblage I, although no environmental assessment can be made. The lower boundary is tentatively drawn along the top of Norris's KP-1 zone.

AMMOBACULITES 200 - FAUNA

A new fauna, hitherto unrecognized in Adgo-Niglintgak-Nuktak-Titalik- and Taglu appears from about the 1600 to the 1950 foot level. It is monotpyic (the associated forms are considered contaminants), indicating weak, marine influences, and the fossiliferous interval spans approximately the lower half of Norris' KP-1 zone of Neogene age. Assuming this age assignment to be correct, the Ammobaculites 200-Fauna should be considered the "restricted" counterpart of the lower sequence of Assemblage I.

CYCLAMMINA 71 - FAUNA

After about 200 feet of section without a diagnostic microfossil, the characteristic "Cyclammina" 71 appears at about the 2200 foot level; it becomes abundant to very abundant between the 2500 to 3500 foot interval, and continues downwards to at least 4500 feet although scattered specimens were detected to a depth of more than 7,000 feet. The fauna is monotypic from 2200 to about 3,000 feet, and again from 4,000 to about 4600 feet; in between and from 3,000 to 3800 feet, however, there are a few other Foraminifera associated, both calcareous and agglutinated forms, indicating more open-marine influences (provided that the associated forms are not all contaminants).

The "Cyclammina" 71-Fauna or "arctica-borealis" complex is well known and relatively widespread in the Delta region. It was found in this study at Taglu C-42 and Titalik K-26 so far, but Chamney reports the same fauna from other wells also (his units 6 and 7).

At Kugpik O-13, "Cyclammina" 71 spans nearly the full sequence of Norris' KP-2 zone of Paleogene (probably Upper Eocene) age, a placement compatible in general with the age placement of this fauna in other wells. Problems, however, may arise when the Upper Eocene age is substantiated, for the "Cyclammina" 71-Fauna appears at Taglu and Titalik in sequences considered by Norris as a Middle Eocene to older Paleogene age. Another minor discrepancy surfaces with respect to the paleo-environmental assessment, for the Foraminifera would indicate longer-lasting and stronger marine influences in this zone as Norris' flora indicates.

TABLE 2

SHELL KUGPIK O-13

INTERPRETATION OF

MICROPALEONTOLOGY AND PALEONTOLOGY

PALYNOLOGY After Norris 1976		MICROPALEONTOLOGY After Braun & Brook 1976
NEOGENE	943'	ASSEMBLAGE I 900
	KP-1 1965'	NOT DIAGNOSITC 1600
		AMMOBACULITIES 200 FAUNA 1950
		NOT DIAGNOSTIC 2200
PALEOGENE Probably UPPER EOCENE	KP-2 4795'	CYCLAMMINA 71 FAUNA 4550
PALEOCENE - MAESTRICHTIAN	KP-3 5954'	NOT DIAGNOSTIC 6500
MAESTRICHTIAN - CAMPANIAN	KP-4 6930'	BONE BED 7000
M-U ALBIAN	KP-5 7170'	RADIOLARIA 1 to 3 7200
		NOT DIAGNOSTIC 7900
BERRIASIAN- TITHONIAN	KP-6 9640'	HAPLOPHRAGMOIDES 217 & 219 FAUNA RECURVOIDES 218 FAUNA 9900
M-UPPER JURASSIC	9687'	
		ARENOTURRISPIRILLINA 10,200
PENNSYLVANIAN or MISSISSIPPIAN	KP-8 11,672'	232 FAUNA NOT DIAGNOSTIC 12,103
NO SAMPLES		

Norris suggests a possible correlation of his KP-2 zone with the Upper Eocene zones of NT-8 and NI-2 and 3, but no Cyclamminas were found in these boreholes. At Nuktak, a peculiar Haplophragmoides 53-Bathysiphon 52 fauna extends into the NT-8 zone followed by the rather undiagnostic astrorhyzid? - Fauna for the rest of the interval. No diagnostic microfossils were found either in the corresponding intervals at Niglintgak. Should this correlation be confirmed, the Haplophragmoides 53 and Bathysiphon 52-Fauna then is to be considered a "restricted" counterpart to the Cyclammina 71-Fauna, and the latter to extend into the Upper Eocene. However, in view of the tentative nature of the correlations and the age assignments, further and more precise data are required to resolve these questions.

From 4600 to about 6500 feet of the borehole, only a few undiagnostic fossil fragments and some "Cyclammina" 71 were found, possibly all contaminants.

BONE BED INTERVAL

A distinct microfaunal marker of teeth and bone fragments occurs between 6500 to 7000 feet. These fragments seem to come from certain layers within two black shales that can be readily identified as individual markers on the gamma ray-neutron logs. From 6980 to 7150 feet, radiolarians are associated which might be useful in separating the lower and upper black shale, with the lower one characterized mainly by the Radiolaria.

Chamney reports a bone bed and radiolarians from his unit 8 of Early Campanian to Late Santonian age - a unit that seems to be equivalent to the upper black shale of Kugpik. However, no radiolarians were found in this study in these upper horizons.

RADIOLARIA 1 to 3 - FAUNA

The influx of the radiolarians allows to discriminate another faunal unit, the Radiolaria 1 to 3 - Fauna equivalent to Norris' KP-5 zone of Middle-Upper Albian age. Bone fragments and teeth are still associated (unless they are all contaminants) but the radiolarian horizons seem to be equivalent to Chamney's Radiolaria 9 unit of Middle Albian age, and the upper part of his Bentonite shale zone (unit 10) of the Reindeer D-27 well.

HAPLOPHRAGMOIDES 217 and 219 - RECURVOIDES 218 - FAUNA

After about 800 feet of section without diagnostic or any microfossils, this new fauna appears at about the 7900 foot level. It is characteristic of the lower parts of the Lower Cretaceous sequences of the northern Richardson Mountains and the adjoining Delta region, and the fauna is composed of agglutinated and calcareous forms, indicating relatively open-marine influences.

ARENOTURRISPIRILLINA 232 - FAUNA

From about 9900 to 10,200 feet, this new and quite characteristic Foraminifera appears among many other forms of the overlying and younger assemblage. It is an important element of the upper parts of the Husky Formation of the northern Richardson Mountains and useful as an index species for the uppermost Jurassic and lowermost Cretaceous sequences of this region.

No diagnostic microfossils were recovered from 10,200 feet to 12,103 feet total depth.

REFERENCES CITED:

Chamney, T.P., 1973: Tuktoyaktuk Peninsula Tertiary and Mesozoic Biostratigraphy Correlations: Geol. Surv. Can., Paper 73-1, part B, p. 171-179, 3 figs., 1 table.

APPENDIX

PALYNOLOGICAL PHOTOGRAPHS

APPENDIX

PALYNOLOGICAL PHOTOGRAPHS

(Plate numbering corresponds
to sequential numbering of
Austin & Cumming Arctic Flora
Photographic Library)

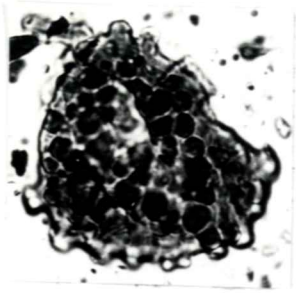
EXPLANATION OF PLATES 17-19

SHELL KUGPIK 0-13

All figures approximately 750x (scale in top left represents 750u). All species new to this study are illustrated, excepted some recycled elements. In addition, extra photographs are provided of some species that have not been adequately illustrated in previous reports.

Plate 17

269-272.	522	*Leptolepidites* cf. *tenuis*
273-274.	513	*Hamulatisporis* cf. *rugulatus*
275.	405	*Cicatricosisporites* cf. *intersectus*
276.	77	*Contignisporites cooksoni*
277.	38	*Aequitriradites spinulosus*
278.	518	*Trilobosporites* cf. *bernissartensis*
279.	40	*Sestrosporites* cf. *pseudoalveolatus*
280.	325	*Aquilapollenites* cf. *reticulatus*
281.	289	*Wodehousia spinata*
282.	523	*Triquitrites* sp. indet.
283.	414	*Triatriopollenites*-1
284.	415	*Aquilapollenites* cf. *murus*
285-287.	M252	*Deflandrea microgranulata*



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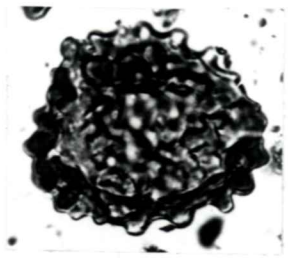

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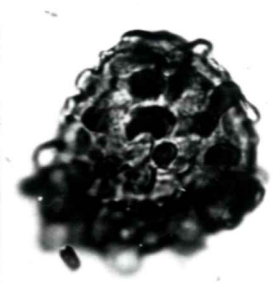

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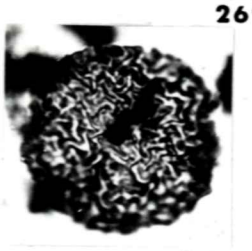

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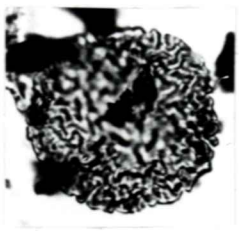

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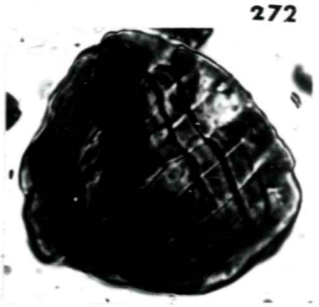

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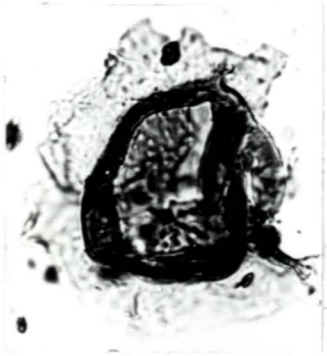

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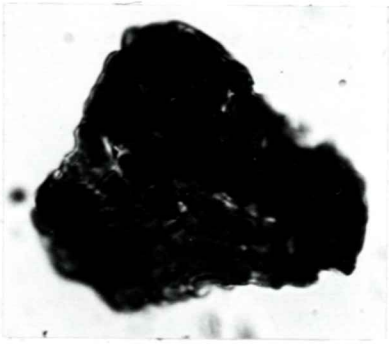

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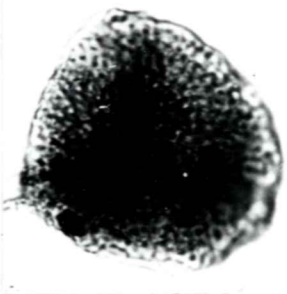

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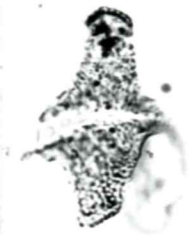

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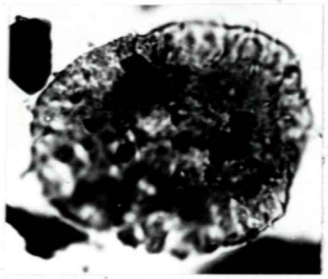

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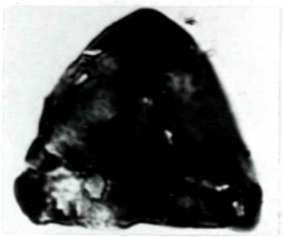

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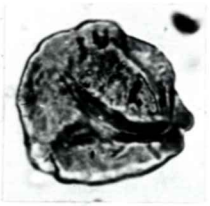

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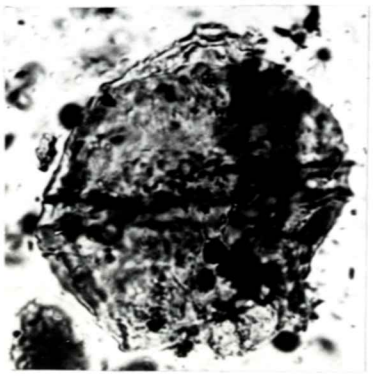

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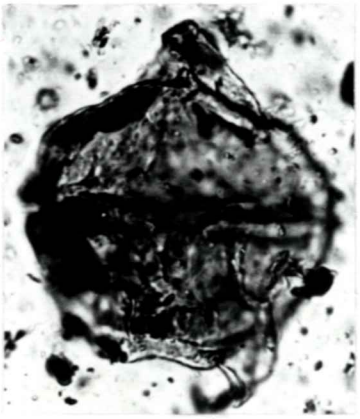

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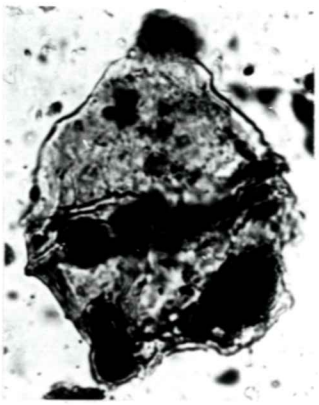


287

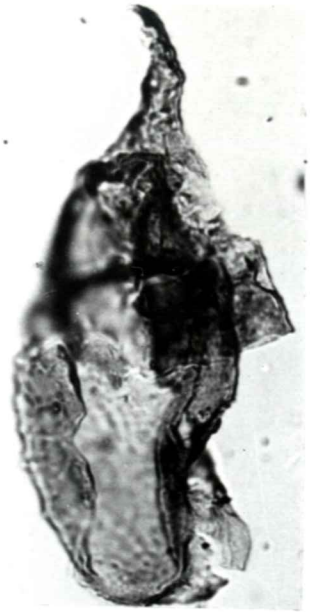
EXPLANATION OF PLATES 17-19

SHELL KUGPIK O-13

All figures approximately 750x (scale in top left represents 750u). All species new to this study are illustrated, excepted some recycled elements. In addition, extra photographs are provided of some species that have not been adequately illustrated in previous reports.

Plate 18

288-289. M250 *Pareodinia osmingtonense*
290. M54 *Pareodinia ceratophora*
291-293. M175 *Imbatodinium villosum*
294. M254 *Cannosphaeropsis* sp. indet.
295. M175 *Imbatodinium villosum*
296. M180 *Tubotuborella rhombiformis*



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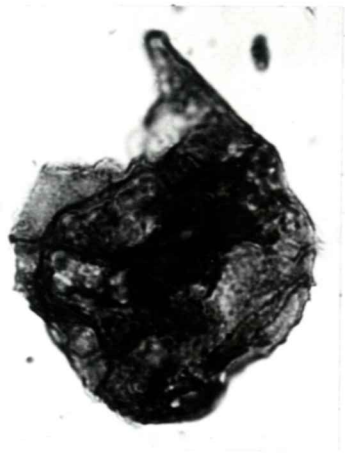

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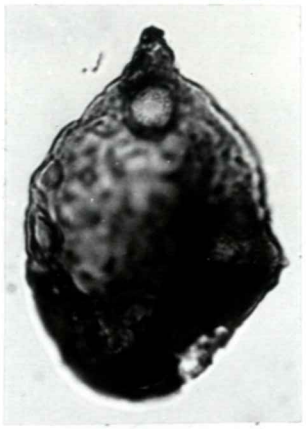

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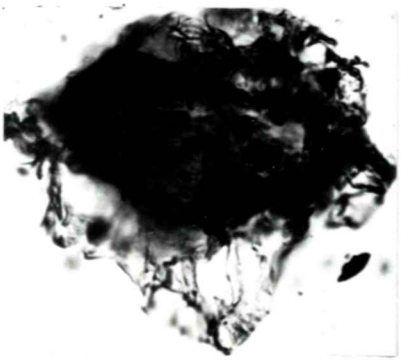

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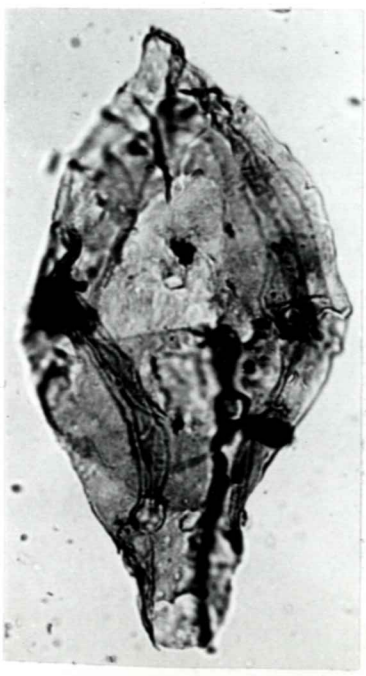


296

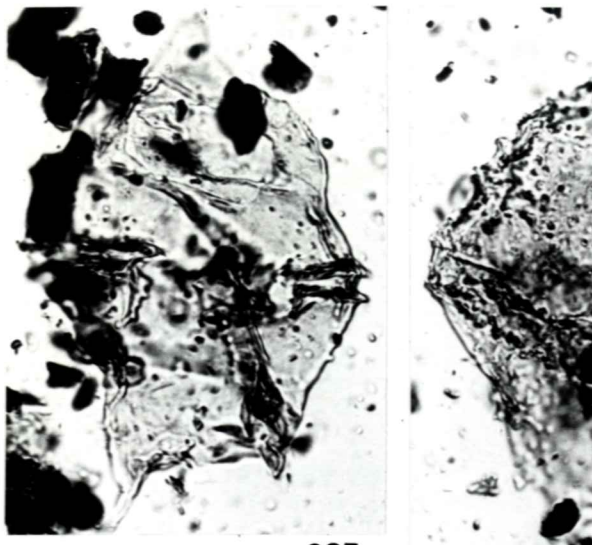
EXPLANATION OF PLATES 17-19

SHELL KUGPIK O-13

All figures approximately 750x (scale in top left represents 750u). All species new to this study are illustrated, excepted some recycled elements. In addition, extra photographs are provided of some species that have not been adequately illustrated in previous reports.

Plate 19

297. M240 *Deflandrea ditissima*
298. M251 *Deflandrea* cf. *wetzeli*
299. M249 *Deflandrea biapertura*
300. M240 *Deflandrea ditissima*
301. M253 *Leptodinium*-1
302. M122 *Deflandrea cooksoni*
303. M253 *Leptodinium*-1
304. M220 *Lejeunia*-1



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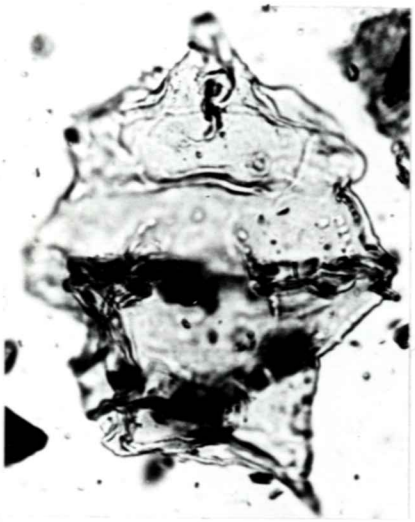

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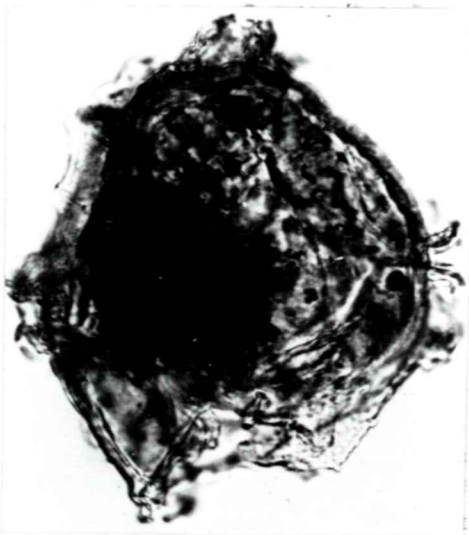

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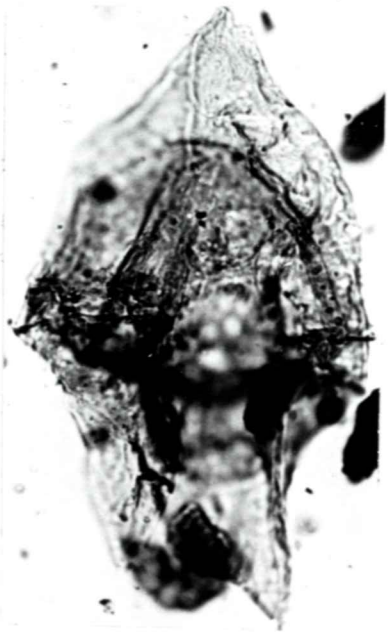

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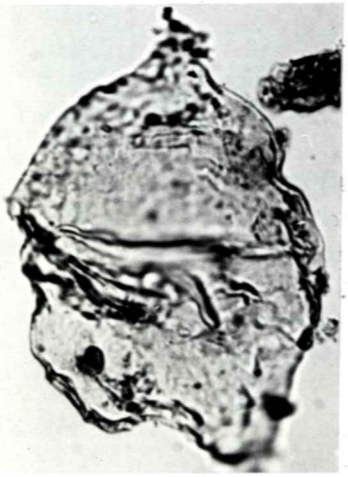

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