

P 3-217

*Confidential to Aug. 28/79*

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STRATIGRAPHIC CORRELATION  
BIOSTRATIGRAPHIC ZONATION

SUN BVX UNARK L-24

69° 33' 30.2" N. LAT.; 134° 37' 00.1" W. LONG.  
NORTHWEST TERRITORIES

AUSTIN & CUMMING EXPLORATION CONSULTANTS  
CALGARY, ALBERTA  
NOVEMBER, 1977

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SUMMARY AND CONCLUSIONS  
Discussion of Zonation

BY

L. W. CUMMING, P. GEOL.

SUN BVX UNARK L-24SUMMARY AND CONCLUSIONS

Biostratigraphic analysis of Sun BVX Unark L-24 is comprised of a palynological analysis and zonation by Dr. G. Norris and a micropaleontological study carried out by Drs. W. Braun and M. Brooke.

One hundred twenty five (125) palynological slides, 13 of which were obtained from cores and 102 from ditch cuttings, were provided by the Operator and analysed in detail for palynological material. One hundred and fifty eight (158) micropaleontological slides, also provided by the Operator, were examined for microfossil content.

Following is a summary of zonation (Table 1) that integrates the palynological and micropaleontological zonation. Correlation of Sun BVX Unark L-24 with Imp. Pullen E-17 is illustrated by Table 2.

Palynological and micropaleontological species distribution are recorded by Figures 1 and 2 respectively.

A summary log (Figure 3) relates palynological and micropaleontological zonation to mechanical logs and lithology at normal reduced log scale of 1 inch = 100 feet.

TABLE 1  
SUN BVX UNARK L-24  
SUMMARY OF ZONATION

<u>AGE</u>	<u>PALYNOLOGICAL ZONE</u>	<u>LITHOLOGY</u>	<u>MICROFOSSIL ASSEMBLAGE</u>
<u>NEOGENE</u>			
U. Miocene- Pliocene	<i>Laevigatosporites</i> -1 (0-1260')	Mudstone (0-470') Sandstone (470-1260')	Assemblage I (100-1150')
<u>PALEOGENE</u>			
Oligocene	<i>Ericaceae</i> -1 (1260-4920')	Coarse gravelly Sandstone, minor Mudstone (1260-4920')	
U. Eocene- Oligocene	<i>Lycopodiumsporites</i> -1 (4920-8070')	Mudstone and fine grained Sandstone (4920-9000')	
U. Eocene	<i>tetrad</i> -1 ( <i>Parviprojectus</i> -1) (8070-12,320')	Mudstone (9000-12,350')	Alveophragmium? 154 (8350-12,510')
Middle Eocene	<i>Pesavis tagluensis</i> (12,320-12,510')	Sandstone (12,350-12,510')	

## DISCUSSION OF ZONATION

(Tables 1 & 2)

Palynological analysis of Sun BVX Unark L-24 identifies a single Neogene zone (0-1260 feet) overlying a thick Paleogene series (1260-12,510 feet). Paleogene beds can be divided palynologically into 4 faunal zones ranging in age from Middle Eocene at the base to Oligocene at the top.

Microfaunal analysis identifies an impoverished Assemblage I Fauna through the upper 1150 feet. This widespread faunal unit appears generally to support the Upper Miocene-Pliocene placement suggested palynologically. No diagnostic fauna was recovered between 1150 and 8350 feet, an interval indicated by palynological material to be of primarily non-marine origin. The lack of faunal material, other than reworks, tends to support this interpretation.

The Alveophragmium? 154 fauna, encountered below 8350 feet, supports a range of Middle to Upper Eocene for the interval 8350-12,510. However, at Imp. Netserk B-44, Imp. Ivik K-54 and Imp. Umiak J-37, this fauna appears to range into the lowermost portion of the Upper Eocene-Oligocene (*Lycopodiumsporites*-*Osmundacidites* zones).

### NEOGENE

#### Upper Miocene-Pliocene

##### *Laevigatosporites*-1 (Surface-1260 feet)

This palynozone consists of two distinctive lithologies. The upper unit (80-470 feet) is composed predominantly of unconsolidated clays with occasional thin fine grained unconsolidated sandstones and siltstones scattered throughout. Plant, wood and coal is common. The lower interval consists of vari-coloured fine to medium grained quartz sandstone with abundant plant and wood material scattered throughout. A sharp increase in grain size at 1250 feet may mark the base of this palynozone.

The presence of *Laevigatosporites*-1 and associated flora in combination with Assemblage I microfauna indicates an Upper Miocene-Pliocene age.

Beds equivalent to the Upper Miocene-Pliocene *periporate*-1 and Miocene *Tsuga*-1 palynozones appear to be absent at this location, suggesting a considerable period of hiatus or erosion prior to deposition of the *Laevigatosporites*-1 zone. This interpretation is supported lithologically by the absence of mudstones associated with the *Tsuga*-1 zone present in other wells in this stratigraphic position.

PALEOGENEOligocene*Ericaceae*-1 (1260-4920 feet)

The upper limit of this palynozone (1260 feet) essentially coincides with the top of a lithological unit that contains primarily coarse-grained, vari-coloured, unconsolidated gravelly sandstone passing gradually toward the base to a mixed facies of unconsolidated mudstone (claystone) and gravelly sandstone. The base of this palynozone is placed at 4920 feet at the uppermost appearance of *Osmundacidites wellmanii* followed by *Lycopodiumsporites*-1. This complete sequence appears non-marine in origin and is devoid of micro-faunal material, other than reworks.

Upper Eocene-Oligocene*Lycopodiumsporites*-1 (4920-8070 feet)

The presence of *Lycopodiumsporites*-1 and associated flora through this interval indicates beds equivalent to those assigned to the Upper Eocene-Oligocene section in other wells (Imp. Netserk B-44, Imp. Pullen E-17, etc.).

Lithologically, this unit consists of poorly consolidated mudstones (claystones) with fine grained sandstone scattered throughout. This characteristic lithology continues, below where the base of the *Lycopodiumsporites* zone is picked palynologically, to 9,000 feet. A fairly well defined sandstone unit (logs and lithology) developed through the interval 8915-9,000 feet appears to mark the base of the overlying stratigraphic unit. The single occurrence of *tetrad*-1 at 8870 feet may represent reworked material, consequently, the base of the palynozone might be better placed to coincide with an influx of new species at 9120 feet immediately below the lithological change at 9,000 feet.

The presence of the *Alveophragmium*? 154 microfauna within the lower portion of this lithological unit is consistent with findings at Imp. Netserk B-44 and other wells.

The absence of the *Osmundacidites* flora toward the base of the *Lycopodiumsporites*-1 zone is problematic. Possibly this species was facies sensitive and not present at all locations. Alternatively, beds containing this flora may be absent at this location.

The former interpretation is presently preferred.

Upper Eocene*tetrad*-1 (8070-12,320 feet)

This unit consists of a monotonous sequence of soft, grey-dark grey micromicaceous, shales with occasional thin stringers of very fine grained sandstone. The upper contact is placed palynologically



at 8070 feet at the appearance of the *tetrad*-1 species. As discussed above, this boundary might alternatively be placed at 9,000 feet on the basis of lithology. The base of this zone is placed at 12,320 feet at the uppermost occurrence of *Wetzeliella* cf. *hampdenensis*.

Common occurrences of *Astrocysta*-1 throughout the interval 10,830-12,320 strongly indicate a correlation of this shale unit to the *tetrad* (*Parviprojectus*-1) palynozone of numerous other wells.

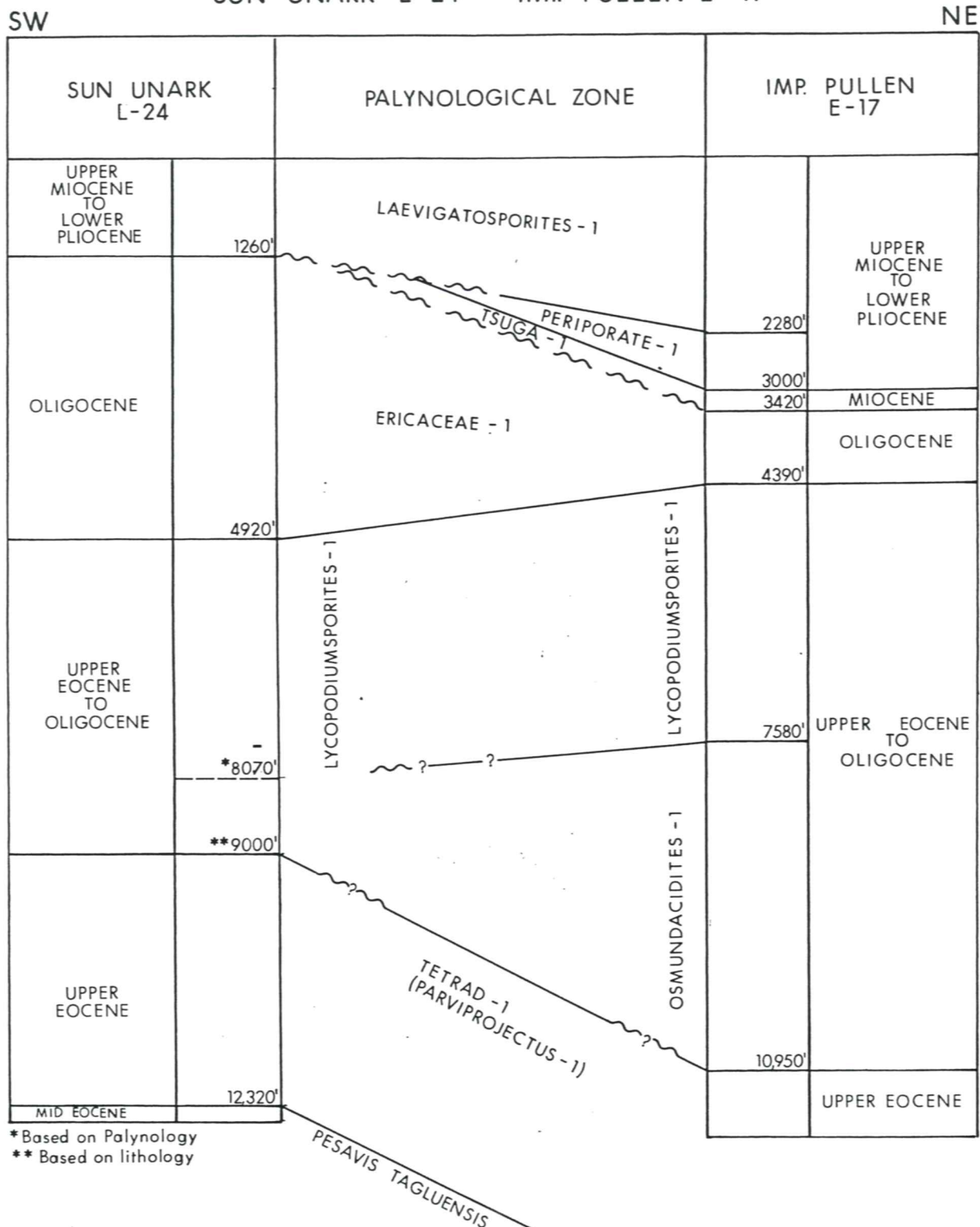
#### Middle Eocene

*Pesavis tagluensis* (12,320-12,510 feet)

The presence of the marine dinoflagellate *Wetzeliella* cf. *hampdenensis* below 12,320 feet marks the top of the *Pesavis tagluensis* palynozone. This species is commonly found in a marine shale interval directly overlying sandstone beds previously referred to as the Taglu Sandstone unit. Sandstone beds encountered through the interval 12,320-12,450 feet are thus equated to the uppermost portion of the Taglu Sandstone Unit of the Taglu field (Imp. Taglu C-42).



TABLE 2  
PALYNOSTRATIGRAPHIC CORRELATION  
SUN UNARK L-24 - IMP. PULLEN E-17



PALYNOSTRATIGRAPHIC STUDY

BY

G. NORRIS, PH.D.

TABLE 3  
SUN BVX UNARK L - 24  
PALYNOLOGICAL ZONATION

TERTIARY STRATIGRAPHY						
DEPTH	WELL ZONE	DEFINITIVE PALYNOMORPHS	ENVIRONMENT	AGE	MAT.	
1000	UR-1 284m 1260'	LAEVIGATOSPORITES-1	NON - MARINE	UPPER MIOCENE TO PLIOCENE	1-2	
2000	UR-2	ERICACEAE -1	640m 2100'	OLIGOCENE		
3000			MARINE			
4000			1198m 3930'			
5000	1500m 4920'	LYCOPODIUMSPORITES-1	NON - MARINE	UPPER EOCENE TO OLIGOCENE	2-3	
6000	UR-3				NON - MARINE	UPPER EOCENE TO OLIGOCENE
7000						
8000	2460m 8070'	TETRAD-1 (PARViprojectus-1)	BRACKISH	UPPER EOCENE	NO RELIABLE INFORMATION	
9000	UR-4					
10,000						
11,000						
12,000	3825m 12,350'	UR-5	MARINE	MID. EOCENE		

SUN UNARK L-24SUMMARY

One hundred and twenty five samples from the subject well yielded 71 terrestrial and 11 marine palynomorph species. Thin Neogene rests on thick Paleogene at 1,260 feet, as indicated by 5 palynozones. Marine influence is indicated between 2100 feet and 3930 feet, and a pronounced marine interval also occurs between 12,350 feet and 12,503 feet. Organic maturation based on spore colours increases from light yellow at the top of the well to amber at 6,720 feet (no reliable information on spore colours is available below this depth). Zones, possible ages, correlations, and paleo-environments are summarized in the accompanying figures.

ZONATION

The following zones are characterized by extinction of the species indicated:

UR-1 - 60-1,260 feet (*Laevigatosporites*-1 zone)

- 2 *Taxodiaceapollenites hiatus*
- 229 *Sigmopollis hispidus*
- 1 *Stereisporites antiquasporites*
- 409 *Steriesporites*-2
- 407 *Laevigatosporites*-1
- 326 *Pinus*-1
- 324 *Carpinus subtriangula*

UR-2 - 1,260-4,920 feet (*Ericaceae*-1 zone)

- 220 *Betulaceoipollenites*-1 (recycled above this)
- 287 *Alnipollenites*-1 (recycled above this)
- 395 *Corylus*-1 (recycled above this)
- 401 *Picea*-1 (recycled above this)
- 617 *Lacrimasporonites*-2
- 371 *Tsuga*-1
- 377 *Ericaceae*-1
- 411 *Abies*-1
- 394 *Corylus granilabrata*
- 612 *Corylus*-2
- 320 *Ulmus*-1
- 619 *Compositae*-2
- 332 *Pediastrum*
- 183 *Baculatisporites comaumensis*
- 408 *periporate*-1
- M242 *Korojonia*-1 (common in the interval 2100-3930 feet)

UR-3 - 4,920-8,070 feet (*Lycopodiumsporites*-1 zone)

- 19 *Osmundacidites wellmanii*
- 370 *Tiliapollenites*-1 (recycled above this)
- 615 *Selaginella*-1
- 412 *Lycopodiumsporites*-1
- 36 *Lycopodiumsporites reticulumsporites*
- 52 *Biretisporites potoniae*
- 586 *Multicellaesporites*-3
- 282 *Caryapollenites paleocenicus*
- 22 *Cyathidites minor*
- 34 *Laevigatosporites ovatus*
- 16 *Deltoidospora hallei*
- 378 *Pluricellaesporites*-1 (recycled above this)
- 323 *Pterocarya levis*
- 602 *Multicellaesporites*-2
- 291 *Tricolpites hians* (recycled above this)
- M233 *Horologinella*-1

UR-4 - 8,070-12,350 feet (tetrad-1 zone)

- 419 tetrad-1
- 384 *Retitricolpites*-1
- 418 *Polypodiisporites*-1
- 584 *Polypodiisporites*-2
- 382 *Tricolporopollenites*-5
- 614 *periporate*-4
- 525 *Typha*-1 (recycled above this)
- 620 *Retitricolpites*-2
- 621 *Psilatricolpites*-2
- 622 *Triatriopollenites*-2
- 527 *Liliacidites*-1
- 530 *Pachysandra*-1 (probably recycled)
- 381 *Psilatricolpites*-1
- 399 *Castanea*-1 (recycled above this)
- 373 *Tricolporopollenites*-3
- 388 *Tricolporopollenites*-7
- 385 *Rhoiipites*-1
- 372 *Granatitricolpites*-1
- 597 *Tsuga igniculus*
- 397 *Tiliapollenites*-3
- 623 *Syncolpites*-1
- 531 *Momipities tenuipollis*
- 524 *Ilexpollenites*-1
- 624 *Tricolporopollenites*-10
- M295 *Aptoomorphidium*-1
- M244 *Astrocysta*-1

UR-5 - 12,350-12,503 feet (*Pesavis tagluensis* zone)

- 529 *Tiliapollenites*-4
- 396 *Tiliapollenites*-2
- 367 *Azolla*
- 552 *Stephanocolporopollenites*-1

M229 *Wetzeliella* cf. *hampdenensis*  
M292 *Tanyosphaeridium*-2  
M222 *Ceratiopsis*-1  
M245 *Cordosphaeridium* cf. *diktyoplokus*  
M259 *Wetzeliella* *homomorpha*  
M256 *Ceratiopsis*-2

#### PALEOENVIRONMENTS

A marine interval occurs in UR-2 *Ericaceae*-1 zone between 2,100 feet and 3,930 feet, although the presence of only two species suggests weak influence. A stronger marine interval is present between 12,350 feet and 12,503 feet with brackish conditions extending up to 10,830 feet in the overlying *tetrad*-1 zone. The remaining portions of the section appear to be non-marine.

#### AGE AND CORRELATION

A correlation with previously established zones is indicated in Table 1. No new information on ages is available for this well. A significant hiatus is indicated at 1,260 feet, with Pliocene resting on Oligocene. The top of the Eocene *Pesavis tagluensis* zone is clearly indicated at 12,350 feet by a well-defined marine assemblage and a few characteristic spore species, although the nominal species is absent.

#### ORGANIC MATURATION

Light yellow colours characterize spore-pollen extines at the top of the well, increasing to amber at 6,720 feet as indicated on the paleo log. Maceration techniques below this depth have obscured natural spore colours.

MICROPALAEONTOLOGICAL STUDY

BY

DR. W. BRAUN

DR. M. BROOKE



TABLE 4  
SUN BVX UNARK L-24

DEPTH	PALYNOLOGICAL ZONATION NORRIS, 1977		MICROPALEONTOLOGY BRAUN, BROOKE, 1977
	ZONE	AGE	
1000	UR-1 LAEVIGATO- SPORITES 1260'	UPPER MIOCENE TO PLIOCENE	100'----- ASSEMBLAGE I 1150'-----
2000			
3000	ERICACEAE	OLIGOCENE	
4000			NOT DIAGNOSTIC
5000	4920'		
6000			
7000	LYCOPOD-1	UPPER EOCENE TO OLIGOCENE	
8000	8070'		8350'-----
9000			
10,000			
11,000	TETRAD-1	UPPER EOCENE	ALVEOPHRAGMIUM ? 154
12,000	12,350'		
	/	M. EOCENE	
	PESAVIS TAGLUENSIS		

SUN UNARK E-24SUMMARY OF MICROPALAEONTOLOGICAL STUDY

## GENERAL REMARKS

One hundred and fifty-eight (158) micropaleontological slides were submitted for study. In comparison to the microfossil sequences of other Mackenzie Delta wells, the recovery of microfossils in the Unark E-24 borehole proved to be disappointingly low both in terms of number of species and abundance of specimens. For this reason, an additional 86 samples were prepared and their microfossils picked in the hope of obtaining more specimens. Although some were found, the microfossil sequence nevertheless remains one of the poorest encountered to date in our studies of Mackenzie Delta boreholes, reflecting on marginal living conditions at the time of deposition and the presence of a thickly developed, non-marine sequence within the section penetrated.

## NEOGENE ASSEMBLAGE I

(150' to approx. 1150')

An impoverished Assemblage I - fauna was encountered between 150 feet and approximately 1150 feet of the borehole which spans Norris' UR-1 or Laevigatosporites zone of Neogene age. The fauna is composed of some shallow-water, marine foraminiferal and ostracode species of the inner to middle neritic zone, with a few specimens of freshwater ostracodes associated. The latter most likely represent ostracode remains transported from adjoining freshwater bodies.

The relative paucity of microfauna within this interval, in contrast to the much richer sequences in equivalent horizons of other boreholes, attests to marginal living conditions at the time and site of deposition.

Assemblage I is identical to Staplins' et al. "Sigmopolis-Ostracode-Elphidium Assemblage" of late Neogene age. Chamney shows the same fauna to be present in many boreholes, and the fauna is without doubt one of the most widespread in the Mackenzie Delta region. Generally, it has been recovered from sequences dated on palynological evidence to be of an undifferentiated "Neogene" age, or more specifically from some sequences considered to be Upper Miocene (?), Pliocene to Pleistocene age. However, many of the Assemblage I - Foraminifera still flourish in the boreal waters off the northern coast of the North American continent, and it is assumed therefore that Assemblage I indicates approximately a Pliocene to Recent age.

UNDIAGNOSTIC INTERVAL  
(1150' to 8350' approx.)

No diagnostic microfossils were recovered from more than 7,000 feet of section and between level 1,150 and 8,350 feet (approximately) of the borehole. Some of the specimens present in this part are either uphole contaminants or reworked forms. Only Haplophragmoides sp. 1 seems to be indigenous to the upper few hundred feet of the interval. This Foraminifera is not an index fossil but indicates the presence of some weak marine influences. The remaining and major portion of the undiagnostic interval seems to be of terrestrial origin as the virtual absence of microfauna indicates.

ALVEOPHRAGMIUM? 154 - FAUNA  
(8350' to 12,000' approx.)

At about 8,350 feet, the first unmistakable specimens of Alveophragmium? 154 appear, continuing nearly to the base of the borehole and of the section penetrated. Associated with this large-sized and characteristic species are a few other foraminiferal species, mainly of the agglutinated-arenaceous group forming altogether a low-diversity assemblage.

The microfaunal assemblage most closely resembles that of Nuktak C-22 (6960-11,600 feet) and Ivik K-54 (7400-10,320 feet). At Unark E-24, the Alveophragmium? 154-Fauna occurs throughout Norris' tetrad-1 or UR-4 zone of supposedly Upper Eocene age. At Nuktak, it was found in the lowermost part of Norris' Lycopodiumsporites-1 zone, throughout his Osmundacidites and tetrad-1 zones, and in the upper part of his Pesavis tagluensis zone spanning a time interval from the Middle Eocene, the Upper Eocene, and the early parts of an Upper Eocene-Lower Oligocene interval. At Ivik, the Alveophragmium? 154-Fauna occurs within Norris' tetrad-1 zone of Upper Eocene age. Its overall range, therefore, seems to be mainly concentrated in the Upper Eocene, extending downwards into the Middle Eocene and upwards into the Upper Eocene-Lower Oligocene.

With respect to paleoenvironments, the low-diversity nature of the Alveophragmium-fauna points to restrictive conditions. However, the question if this fauna is of a more shallow or more deeper marine origin cannot be answered on the basis of the microfauna composition alone.

The occurrence of a few specimens of Cyclammina 71 within the Alveophragmium? 154 assemblage also is a recurrent problem. This latter species was found to date mainly in Paleocene sequences (dated on palynological evidence), but it keeps appearing in younger sequences too. Admittedly, some of the specimens in Unark E-24 are too badly preserved to be identified positively, and some specimens may be reworked. Still, we have to keep an open mind as to the overall range of this species, and use it only within the context of the fauna associated.

APPENDIX

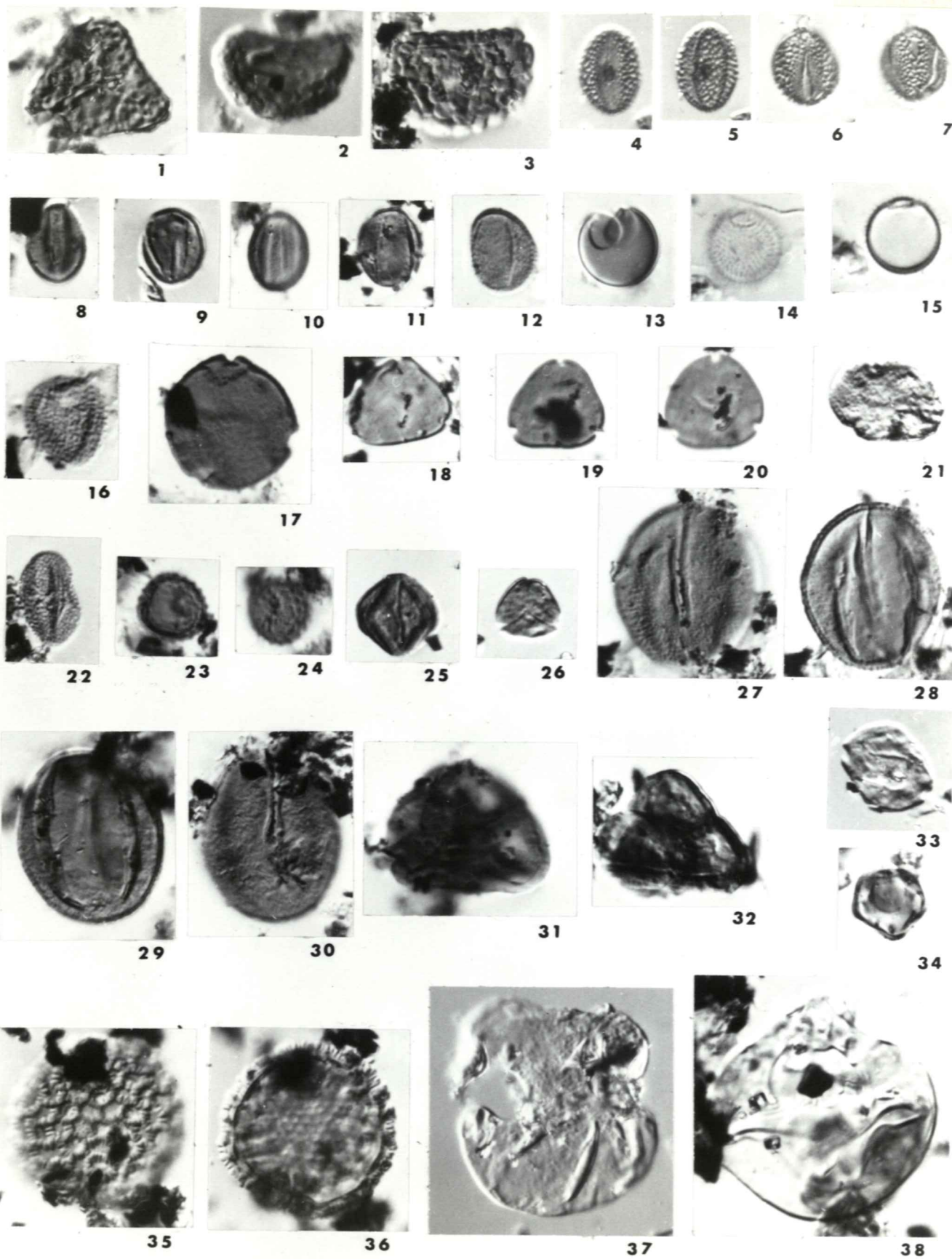
PALYNOLOGICAL  
PHOTOGRAPHS

All photographs on same scale - 100 micron scale in top left.

PLATE 1

1	586	<i>Leptolepidites</i> -2
2-3	584	<i>Polypodiisporites</i> -2
4-7	620	<i>Retitricolpites</i> -2
8-11	621	<i>Psilatricolpites</i> -2
12	527	<i>Liliacidites</i> -1
13-15	229	<i>Sigmopollis hispidus</i>
16	525	<i>Typha</i> -1
17	612	<i>Corylus</i> -2
18-20	622	<i>Triatriopollenites</i> -2
21	529	<i>Tiliapollenites</i> -4
22	384	<i>Retitricolpites</i> -1
23-24	619	<i>Compositae</i> -2
25	552	<i>Stephanocolpites</i> -1
26	623	<i>Syncolpites</i> -1
27-30	624	<i>Tricolporopollenites</i> -10
31-32	419	<i>tetrad</i> -1
33-34	614	<i>periporate</i> -4
35-36	530	<i>Pachysandra</i> -1 (recycled)
37	M233	<i>Horologinella</i> -1
38	M295	<i>Aptoomorphidium</i> -1





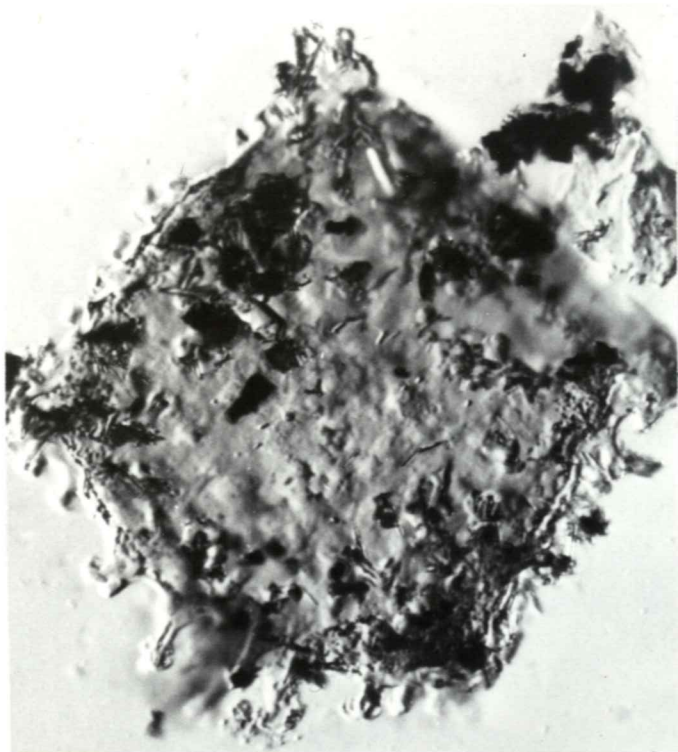
SUN UNARK E-24

All photographs on same scale - 100 micron scale in top left.

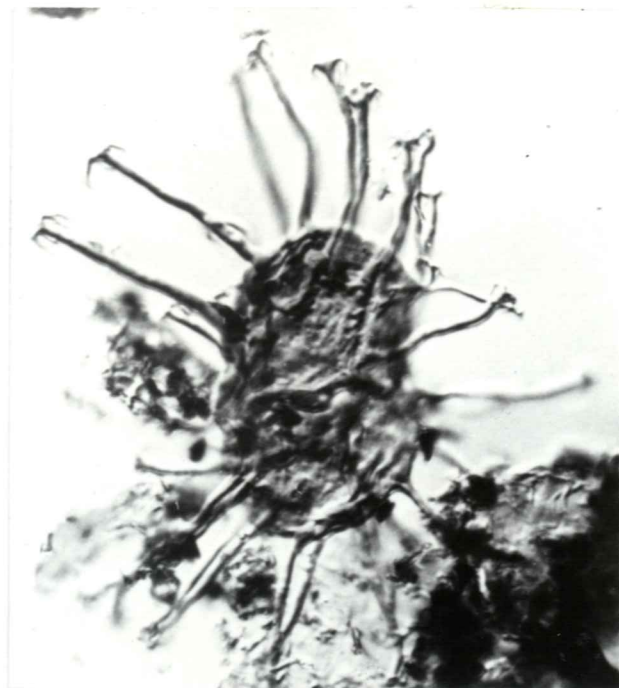
PLATE 2

39-40	M229	<i>Wetzeliiella</i> cf. <i>hampdenensis</i>
41	M292	<i>Tanyosphaeridium</i> -2
42	M222	<i>Ceratiopsis</i> -1
43	M244	<i>Astrocysta</i> -1





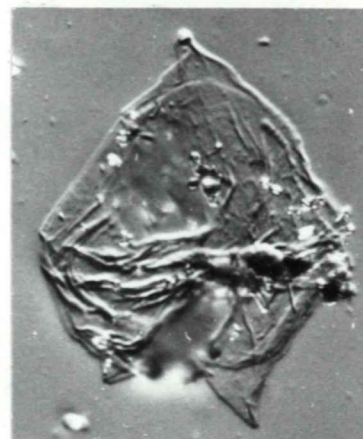
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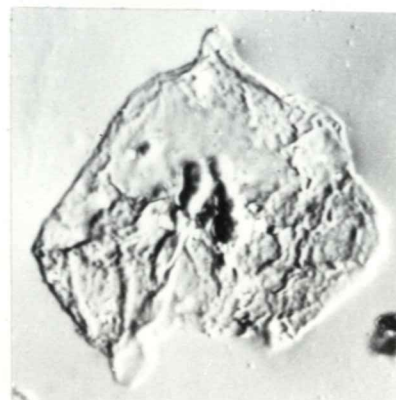
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SUN UNARK E-24

All photographs on same scale - 100 micron scale in top left.

PLATE 3

44-46	M242	<i>Korojonia</i> -1
47-48	M295	<i>Aptoomorphidium</i> -1
49	M244	<i>Astrocysta</i> -1



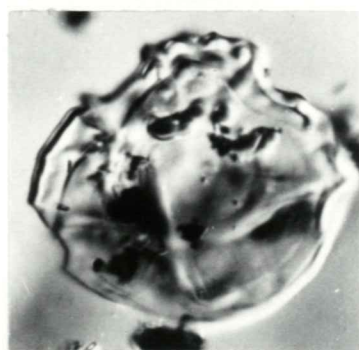
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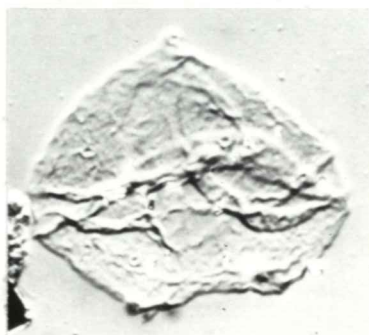
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