

RELEASED

OF 640

STRATIGRAPHIC CORRELATION
BIOSTRATIGRAPHIC ZONATION

IOE TAGLU C-42

69° 21' 0.5" N. LAT., 134° 56' 50" W. LONG.
NORTHWEST TERRITORIES

AUSTIN & CUMMING EXPLORATION CONSULTANTS
CALGARY, ALBERTA
MARCH, 1978

1599

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SUMMARY

IOE TAGLU C-42

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SUMMARY

Biostratigraphic analysis of the Imp. Taglu C-42 well consists of a palynostratigraphic study carried out by Dr. Geoffrey Norris and a micropaleontological analysis by Drs. W. Braun and M. Brooke.

One hundred fifty-eight (158) palynological samples provided by the operator were examined in detail. Conventional cores, sampled by Austin & Cumming, provide nine palynological slides representative of all conventionally cored intervals. One hundred fifty-eight samples (112 ditch, 46 conventional core) were used in the micropaleontological analysis.

Continuous zonation, correlatable with other wells in the area, is based on microfloral assemblages. Due to the paucity of marine intervals, continuous zonation cannot be arrived at through microfauna analysis. However, microfossils where present generally provide support for the palynological analysis.

A summary of the zonation for this well is shown in Table 1.

Palynological analysis over the interval 110-15,510 feet recognizes eight formal zones that are correlatable with other wells in the area. A lowermost interval, 15,510-16,010 feet is not recognized as a zone as no characteristic microflora is present.

TABLE 1
 SUMMARY OF ZONATION
 AUGUST 1976

IOE TAGLU C-42

<u>AGE</u>	<u>WELL ZONE</u>	<u>CORRELATIVE PALYNOLOGICAL ZONE</u>	<u>MICROPALAEONTOLOGICAL ASSEMBLAGES</u>
Neogene (Surf.-1110')	TG-1 (110-1110')	<i>Laevigatosporites</i> -1	Assemblage I (Surf.-1110')
Oligocene (1110-1710')	TG-2 (1110-1710')	<i>Ericaceae</i> -1	Assemblage II (1110-1800')
Upper Eocene (1710-10,610')	TG-3 (1710-9210')	<i>tetrad</i> -1	"Cyclammina" 7 Fauna (7,000-9,000')
	TG-4 (9310-10,610')	<i>Pesavis tagluensis</i>	
Middle Eocene & Lower Paleogene (10,610-15,110')	TG-5 (10,610-12,210')	<i>Punctodiporites</i> -1	"Astrorhyzid" Fauna (11,500-13,200')
	TG-6 (12,210-12,610')	<i>Striadiporites</i> -1	"Haplophragmoides" 67 Fauna (13,200-15,300')
	TG-7 (12,610-15,110')	<i>Pesavis</i> -1	
Lower Paleocene (15,110-15,510')	TG-8 (15,110-15,510')	<i>Leptolepidites</i> cf. <i>tenuis</i>	"Cyclammina" 71 Fauna (15,300-16,000')
Lower Paleocene or Older (15,510-16,010')	15,510-16,010' (Not formal zone)		

Palynological analysis over the interval 110-15,510 feet recognizes eight formal zones that are correlatable with other wells in the area. A lowermost interval, 15,510-16,010 feet is not recognized as a zone as no characteristic micorflora is present. A revised interpretation of the palynological data and age designation is presented in Table 2 following.

Microfaunal analysis of the lowermost interval (15,300-16,000 feet) indicates the presence of the Cyclammina 71 (arctica-borealis) fauna to a depth of 16,000 feet. This fauna has been encountered in other wells and is associated with Middle Eocene and Lower Paleogene (Titalik K-26). This transgression of palynological zones may result from an earlier establishment of the marine facies, represented by this fauna, in the Taglu area, with later development in the Titalik area and possibly Shell Kugpik O-13. Similarly, a discrepancy occurs when correlating the overlying "Haplophragmoides" 67 fauna (TG-7). Again this transgression of the palynological zones by the "Haplophragmoides" 67 fauna is interpreted as an earlier presence of this fauna in the Taglu area as a result of facies control. A more complete analysis of this zonation is presented on page 14 of the paleontological portion of this study.

Table 1A (page 4) is a revised interpretation of the zonation of this well based on correlations with subsequently zoned wells from the area and lithological considerations.

The Biostratigraphic Summary Log (Fig. 3 in pocket) shows the original palynozonation by Norris (1st column) and the revised palynostratigraphic zonation by Cumming (2nd column).

TABLE 1A

REVISED INTERPRETATION OF ZONATION
 BASED ON CORRELATION WITH SUBSEQUENT WELLS
 INTERPRETATION BY: L. W. CUMMING, P. GEOL.
 MARCH, 1978

IOE TAGLU C-42

AGE	WELL ZONE	PALYNOLOGICAL ZONE	MICROPALAEONTOLOGICAL ASSEMBLAGES
U. Miocene- Pliocene		<i>Laevigatosporites</i> -1 (110-1110')	Assemblage I (0-1110')
Mid-Upper Miocene		(1) <i>periporate</i> -1 (1110-1710')	Assemblage II (1110-1800')
Lower-Mid Miocene		(2) <i>Tsuga</i> -1 (1710-2500±)	
U. Eocene- Oligocene		(3) <i>Lycopodiumsporites</i> -1 to <i>Osmundacidites</i> -1 (2500-4800')	
U. Eocene		(4) <i>tetrad</i> -1 (4800-9210')	Cyclammina 7 (7,000-9,000')
Middle Eocene	(5) TG-4 (9210-10,610')	<i>Pesavis tagluensis</i>	
Lower Eocene	TG-5 (10,610-12,210')	<i>Punctodiporites</i> -1	Astrorhyzid Fauna (11,500-13,200')
Paleocene?	TG-6 (12,210-12,610')	<i>Striadiporites</i> -1	
	TG-7 (12,610-15,110')	<i>Pesavis</i> -1	Haplophragmoides 67 (13,200-15,300')
	TG-8 (15,110-15,510')	<i>Leptolepidites</i> cf. <i>tenuis</i>	Cyclammina 71 (15,300-16,000')
Lower Paleocene or Older	Not Zoned (15,510-16,010')		

(1) *periporate-1* (1110-1710')

The presence of Assemblage II microfauna through the interval 1110-1800 feet indicates a correlation of this interval with beds of the *periporate-1* palynozone of subsequent wells.

(2) *Tsuga-1* (1710-2500')

Common *Tsuga-1* and associated flora through the interval 1710-2500 feet is essentially coincident with a predominantly mudstone unit. Regional correlations suggest this interval is equivalent to the *Tsuga-1* palynozone of other wells. *Ericaceae-1* flora occurring through this interval is believed to be the result of recycling.

(3) *Lycopodiumsporites-1 - Osmundacidites-1* (2500-4800')

The presence of *Lycopodiumsporites-1*, *Osmundacidites wellmannii*, *Steriesporites-3*, *Cyathidites minor* and *Lycopodiumsporites reticulumsporites* indicates the presence of the combined *Lycopodiumsporites-1* and *Osmundacidites-1* zones through the interval 2500-5310. The *tetrad-1* flora commonly associated with the underlying beds is found to range to the top of the *Lycopodiumsporites-1* zone at some locations. An age of Upper Eocene-Oligocene is indicated for this zone.

The base of this zone is placed at 4800 feet to coincide with a lithological change from sandstones and mudstones of the *Lycopodiumsporites* zone to mudstones (shales?) of the underlying *tetrad-1* zone.

(4) *tetrad-1* (4800-9210')

A major lithological break at 4800 is used as the criteria for establishing the revised top of this unit. The presence of *tetrad-1* flora above this top is believed to result from recycling.

(5) *Pesavis tagluensis* (7210-10,610')

A thin marine bed, 9200-9310, contains the *Wetzeliella* cf. *hampdenensis* which is included by Norris in the *Pesavis tagluensis* zone. A Middle Eocene age is indicated for this *Wetzeliella* assemblage.

PALYNOSTRATIGRAPHIC STUDY

IOE TAGLU C-42

By

Dr. Geoffrey Norris

SUMMARY

158 samples from the subject well yielded 87 terrestrial and 11 marine palynomorph species. Zones, ages, and environments are summarized in the accompanying figure.

One Neogene and 7 Paleogene zones are recognized resting on possible high rank basement at 15,510 feet. Palynostratigraphic breaks occur between the Neogene, Oligocene, and Eocene and at horizons within and at the base of the Paleogene. The entire section is non-marine except for two near-shore marine horizons near the Middle/Upper Eocene boundary. Organic maturation increases from light yellow at the top of the well to brown immediately above a black zone at 15,510 feet that may be high rank basement or possibly a facies change in continuous sequence with the overlying Tertiary.

ZONATION

Zone TG-1 (110-1110 feet)

Apart from obviously reworked material, the following species occur in this zone:

- 1 *Stereisporites antiquasporites*
- 2 *Taxodiaceapollenites hiatus*
- 220 *Betulaceoipollenites-1*
- 229 *Sigmopollis hispidus*
- 326 *Pinus-1*
- 401 *Picea-1*
- 407 *Laevigatosporites-1*
- 7 *Gleicheniidites senonicus*

The following temperate species occur in this zone and may be reworked from older Tertiary:

- 287 *Alnipollenites-1*
- 323 *Pterocarya levis*
- 409 *Stereisporites-2*

Zone TG-2 (1200-1710 feet)

Characterized by:

- 324 *Carpinus subtriangula*
- 377 *Ericaceae-1*
- 34 *Laevigatosporites ovatus*
- 371 *Tsuga-1*
- 183 *Baculatisporites comaumensis*
- 287 *Alnipollenites-1*

The following may be reworked from older Tertiary:

- 282 *Caryapollenites paleocenicus*
- 395 *Corylus-1*

Zone TG-3 (1810-9210 feet)

Characterized by the frequent recurrence of:

- 374 *Granatisporites*-1
- 419 *tetrad*-1
- 395 *Corylus*-1
- 412 *Lycopodiumsporites*-1
- 19 *Osmundacidites wellmanii*
- 373 *Tricolporopollenites*-3
- 391 *Striadiporites sanctaeburberae* (lower part of zone)
- 399 *Castanea*-1 (lower part)
- 418 *Polypodiisporites*-1 (middle part of zone)
- 36 *Lycopodiumsporites reticulumsporites* (middle part)

A marine horizon is clearly differentiated in the lower part of this zone (at 8110 feet) by the following dinoflagellates and acritarchs:

- M220 *Lejeunia*-1
- M134 *Micrhystridium* cf. *deflandrei*
- M172 *Micrhystridium stellatum*
- M214 *Achomosphaera* cf. *ramulifera*
- M226 *Diconodinium*-6

Other less frequent terrestrial species in this thick zone include the following:

- 378 *Pluricellaesporites*-1
- 383 *Laricoidites*-1
- 394 *Corylus granilabrata*
- 525 *Typha*-1
- 384 *Retitricolpites*-1
- 362 *epiphyllous fungi*
- 320 *Ulmus*-1
- 22 *Cyathidites minor*
- 52 *Biretisporites potonieii*
- 380 *Tricolporopollenites*-4
- 543 *periporate*-2
- 413 *Stereisporites*-3
- 410 *Engelhardtia*-1
- 327 *Podocarpidites maximus*
- 323 *Pterocarya levis*
- 31 *Lycopodiumsporites austroclavatidites*
- 524 *Ilexpollenites*-1
- 411 *Abies*-1
- 370 *Tiliapollenites*-1
- 381 *Psilatricolpites*-1
- 405 *Cicatricosisporites intersectus*
- 531 *Momipites tenuipollis*
- 386 *Rhoipites*-2
- 422 *Parviprojectus*-1
- 387 *Tricolporopollenites*-6
- 396 *Tiliapollenites*-2
- 421 *Leptolepidites*-1

- 284 *Cupuliferoipollenites*-1
- 360 *Alnus trina*
- 330 *Pistillipollenites mcgregori*
- 6 *Cingutriteles clavus*
- 13 *Alisporites grandis*
- 239 *Sequoiapollenites paleocenicus*
- 382 *Tricolporopollenites*-5
- 385 *Rhoipites*-1
- 392 *Granatisporites cotalis*
- 26 *Vitreisporites pallidus* (probably recycled)
- 397 *Tiliapollenites*-3
- 537 *Polygoniaceae*-1
- 325 *Aquilapollenites cf. reticulatus*
- 367 *Azolla*
- 291 *Tricolpites hians*
- 372 *Granatitricolpites*-1
- 388 *Tricolporopollenites*-7

Zone TG-4 (9310-10,610 feet)

Characterized by the frequency of:

- 400 *Pesavis tagluensis*
- 392 *Granatisporites cotalis* (also ranges higher)
- 533 *Pluricellaesporites*-2 (also ranges higher)
- 529 *Tiliapollenites*-4
- 367 *Azolla* (also ranges higher)

The following occur less frequently:

- 389 *Nyssapollenites*-1
- 415 *Aquilapollenites cf. murus*
- 549 *Pluricellaesporites*-3

A marine interval occurs in this zone at 9210-9310 feet marked by:

- M226 *Diconodinium*-6
- M244 *Astrocyta*-1
- M229 *Wetzeliella cf. hampdenensis*
- M222 *Ceratiopsis*-1

The enigmatic M233 *Horologinella*-1 occurs 200 feet below this interval but its significance as an environmental indicator is uncertain. The possibility that it is recycled also cannot be ignored.

Zone TG-5 (10,710-12,210 feet)

Sparse but characteristic distribution of the following occurs in this zone:

- 546 *Punctodiporites*-1
- 390 *Salix*-1

Zone TG-6 (12,310-12,610 feet)

The following fungal spores occur sporadically in this zone:

- 550 *Striadiporites*-1
- 528 *Fusiformisporites*-1
- 551 *Striadiporites*-2

Zone TG-7 (12,710-15,110 feet)

556 *Pesavis*-1 occurs relatively frequently in this zone with a less frequent recurrence of

- 548 *Fusiformisporites*-2

Zone TG-8 (15,210-15,510 feet)

Poorly characterized by a single occurrence at the top of:

- 522 *Leptolepidites* cf. *tenuis*

15,610-16,010 feet (not a formal zone)

No new species occur in this interval. An abundance of high rank organic matter suggests possible penetration of basement.

PALEOENVIRONMENTS

The only clearly defined marine intervals occur at the bottom of Zone TG-3 and the top of TG-4, (8110-8504 feet and 9210-9310 feet). Both these intervals contain diverse terrestrial assemblages indicating near-shore conditions of deposition.

AGE AND CORRELATION

TG-1

The presence of 407 *Laevigatosporites*-1 and 229 *Sigmopollis hispidus* suggest a correlation with NT-1, AD-1, and TI-2 (Neogene).

TG-2

The co-occurrence of 377 *Ericaceae*-1 and 371 *Tsuga*-1 indicates a correlation with NT-4, AD-3, and NI-2 (Lower Oligocene). Presumably truncation has occurred of higher zones equivalent to e.g. NT-2 and NT-3.

TG-3

The clearly defined range zone of 419 *tetrad*-1 together with the co-occurrence of, for example, 418 *Polypodisporites*-1, 421 *Leptolepidites*-1, and 378 *Pluricellaesporites*-1 indicates a correlation with AD-4, NT-7, and NI-4 (Upper Eocene). The marine interval near the bottom of TG-3 is characterized by M220 *Lejeunia*-1, M226 *Diconodinium*-6, and M244 *Astrocysta*-1, some or all of which occur at the bottom of the correlative zones (AD-4, NT-7, NI-4) or top of the subjacent ones.

TG-4

Clearly this zone correlates with AD-5, NT-8, and NI-4 (Upper Eocene) on the basis of similar distributions of 400 *Pesavis tagluensis*, 392 *Granatisporites cotalis*, and 367 *Azolla* plus several rarer but characteristic elements. Similar marine dinoflagellates occur (those in Zone TG-3 plus M229 *Wetzeliella* cf. *hampdenensis* and M222 *Ceratiopsis*-1) in this and correlative zones.

TG-5

546 *Punctodiporites*-1 indicates a correlation with AD-7, NI-6 (4c), and TI-4 (Middle Eocene or older). No equivalents of AD-6 were found in Taglu.

TG-6

A correlation with AD-8 is indicated by the restricted ranges of 550 *Striadiporites*-1, 528 *Fusiformisporites*-1, and 551 *Striadiporites*-2.

TG-7

556 *Pesavis*-1 is restricted to this zone and correlates with TI-7.

TG-8

A single specimen of 522 *Leptolepidites* cf. *tenuis* indicates a correlation with TI-8 and KP-3.

15,610-16,010 feet

This is not recognized as a formal zone, but the interval contains a considerable amount of black organic matter. No spores of similar organic maturation rank are known from this interval.

The interval can be interpreted in two ways:

- (i) A downward continuation of the Tertiary sequence, the black matter coming from a distinctive lithology.
- (ii) Metamorphosed basement with spores derived by caving from higher horizons.

The former interpretation is used here, but requires confirmation from lithologic or geophysical data.

ORGANIC MATURATION

A gradual increase in colour from light yellow to brown occurs from 100 feet to 15,510 feet. A possible sudden increase to black may occur at 15,610 feet to T.D. (see comments in previous paragraph above).

MICROPALEONTOLOGY STUDY

IOE TAGLU C-42

By

Dr. W. Braun and Dr. M. Brooke

TABLE 2

Imperial Taglu C-42

PALYNOLOGY Norris, 1976			MICROPALAEONTOLOGY Brooke & Braun, 1976			
Zones	Environment	Age				
TG-1 1110'	Terrestrial	NEO-GENE	ASSEMBLAGE I	freshwater ostracods		
TG-2 1710'			ASSEMBLAGE II	open-marine with minor restrictions		
2000		UPPER EOCENE	OLIGO-CENE	1800'		
4000				terrestrial		
TG-3						
6000						
8000				"CYCLAMMINA" 7 FAUNA		
9210'	Near-shore					
	Terrestrial					
10,000						
TG-4 10,610'	Near-shore marine				not diagnostic	
12,000	LOWER PALEOGENE			MIDDLE EOCENE TO OLDER PALEOGENE	11,500'	
TG-5 12,210'			"ASTRORHYZID" FAUNA			
TG-6 12,610'		Terrestrial				
14,000						
TG-7 15,110'					HAPLOPHRAGMOIDES 67 FAUNA	
16,000			15,300'			
TG-8 15,510'	?		"CYCLAMMINA" 71 FAUNA			
16,000 T.D.						

restricted-marine
"landward" part of
estuarine - deltaic sequences
and terrestrial

SUMMARY OF MICROPALAEONTOLOGICAL STUDY

GENERAL REMARKS

One hundred and twelve (112) samples from cuttings and 46 core samples were submitted for study and analyzed for their microfaunal content. Only those intervals that offered any hope for recovery of microfossils were collected in some detail; the other intervals were "scanned" only with a few samples.

One sample (100-150 feet) only was available from the uppermost 1,000 feet of the section, four samples (1,000-1050, 1200-1250, 1500-1600, 1750-1800) from the following 1,000 feet, and one sample each from the following levels: 2500, 3700, 4200, 4300-4350, 5700-5750, and 6,000-6100 feet. From 6550 feet to total depth at 16,050 feet, samples were taken more or less continuously and in 50-foot intervals. The core samples started at 8400 feet to 11,500 feet.

All microfossils that could be identified, including certain characteristic fragments were provided with species numbers, and their sequence is shown on the chart. Whenever possible, the forms were identified to generic rank or as close as possible, but no attempt has been made to search the "international" literature for identical or closely related forms. Only a thorough paleontological study, based on extensive collections would do justice to such an attempt. It would require also an intimate knowledge of the paleontological and stratigraphical problems, and bias, contained "in between the lines" in any published account. There is no obvious similarity to any fauna published from North America, except for the fauna of the youngest and pre-Recent assemblage in the uppermost part of this borehole. Faunas from Siberia, however, show closer relationship but literature search is made difficult for many reasons. The microfauna of the Delta region, therefore, has to be evaluated on its own merits first and for the time being.

One of the most critical requirements in any paleontological study is consistency in identification. This consistency is best achieved by giving an adequate, visual impression of the taxa recovered, and document in detail their occurrences and distribution in individual distribution charts, summary range-charts, etc. Charts are usually given in reports or publications, but rarely are good photographs included. For this reason, emphasis was placed on photographic documentation for the key species. Such documentation, it is hoped, will serve to unify the many existing number codes used by other investigators in speciation and which are at times hard to translate into one's own work, and which make even detailed studies rather confusing to interpret.

The micropaleontological data are plotted from "top to bottom", a standard procedure in subsurface studies. First occurrences are used to delineate the upper boundary of a faunal complex although, in reality, these are last occurrences. Lower boundaries are hard to define without results from core samples, but the "trailing" of specimens through the Taglu C-42 borehole seem to be minimal.

The usefulness as time indicators of the microfauna recovered is very limited, in fact it is non-existent. The lack of planktonic forms, the endemic nature of many of the benthonic forms discovered, the sporadic and erratic occurrence of the fauna being restricted essentially to a few more "marinish" horizons in an essentially terrestrial-deltaic sequence make it extremely hazardous to tie the microfauna into a proper time framework. The microfaunal assemblages are for this reason simply traced by number or name, without any age connotation attached. They can be used as such readily in correlating from one borehole to the other, provided the fauna, or part of it, is the same. Any references to stage and ages that are used are those adopted from palynological studies, and the micropaleontological data are summarized in a table with the palynological ones shown alongside. (Table 3).

MICROFAUNAL ASSEMBLAGES

ASSEMBLAGE I

The only sample available from the uppermost 1,000 feet of the section yielded a few representatives only of a microfauna that is typical for the upper part of the Neogene and pre-Recent deposits of the entire Delta region. It is referred to as Assemblage I. The ostracods in the sample studied are dominated by freshwater forms (Iliocypris, Limnocythere), and the associated agglutinated Foraminifera may be contaminants. The rich, open-marine and shallow-water ostracod and foraminiferal faunas that form the second, major component of Assemblage I in other boreholes were not present in the sampled interval. There is no doubt, however, that the fauna recovered belongs to this assemblage.

Assemblage I is equivalent to a fauna that Staplin et al. refer to as the Sigmopollis-Ostracod-Elphidium-Assemblage in the same well. It occupies the highest part of the Neogene section and their Zone T4c. Chamney shows the same Pleistocene to Recent section with an ostracod and chara fauna that seems to be particularly thick in the Tuk F-18 borehole and widespread throughout the Delta region, according to his cross-section.

ASSEMBLAGE II ?

Staplin and co-workers show and discuss an Asterigerina 5122-501 marker that occurs about in the middle part of their Neogene section, and that characterizes the upper part of their T4 a-Zone in the Taglu C-42 borehole. The same, or closely related forms were recovered in this study from the 1500 to 1800-foot level. The specimens are badly preserved, distinctly rusty coloured, and they are tentatively referred to the genus Epistomina, for it is doubtful that representatives of the genus Asterigerina are present in the Delta region. These latter forms occur in warm to temperate waters only, and in combination with completely different genera as is the case with regard to Assemblage II.

Assemblage II of Adgo F-28, moderately diversified, was interpreted to indicate relatively open-marine waters and "farther off-shore" conditions. At Taglu C-42, only a few species, represented by relatively few specimens were found in the two samples available for study. Such evidence is not sufficient to make a valid environmental assessment. However, the few species found belong to Assemblage II but the zone is only tentatively recognized in view of the paucity of the fauna.

At Taglu C-42, Assemblage II spans Norris' TG-2 zone of Oligocene age, a placement compatible with that of Adgo F-28 but slightly differing from Staplin's placement in the lower part of the Neogene succession.

"CYCLAMMINA" 7 - FAUNA

A large gap (2,000 to 7,000 feet) in the microfaunal succession confirms Norris' findings that major parts of the Upper Eocene sequences at Taglu C-42 are terrestrial in origin. At approximately 7,000 feet, there appears a nearly monotypic foraminiferal fauna, the "Cyclammina" 7-Fauna which indicates the presence of marine influences, however, weak.

This fauna occurs more or less continuously between 7,000 and 9,000 feet, with a few isolated specimens also from 10,500 feet which are considered contaminants.

"Cyclammina" 7 is identical to Staplin's et al. Haplophragmoides 504 marker. However, they show the first occurrence of this characteristic species at about the 6200-foot level in Taglu C-42 which either is a misplot, for no specimens were found in this study in the higher intervals, or the few samples studied were "accidentally" barren.

The specimens recovered of "Cyclammina" 7, although numerous, were all badly preserved, and they show certain similarities to the Cyclammina arctica-borealis species that appear at the base of this borehole. If species 7 is a true Cyclammina is highly questionable and it could be accommodated equally well in the genus Haplophragmoides.

According to Staplin, Haplophragmoides 504 is a useful marker within the Paleogene sequences, spanning an interval equivalent to part of their upper T2-Zone. This age assignment is compatible with Norris' interpretation, for the "Cyclammina" 7-Fauna occurs over the lower third of his TG-3 zone of Late Eocene age.

"ASTRORHYZID" FAUNA

After a poorly fossiliferous (terrestrial ?) interval from about 9500 to 11,500 feet of the Taglu C-42 section, some agglutinated Foraminifera appear more consistently from about 11,500 to 13,000 feet and lower. This fauna, referred to as the "astrorhyzid" - Fauna after a peculiar foraminiferal (?) species, is not diagnostic to be placed properly within the zonal scheme, but its components are generally associated with the Haplophragmoides 67-Fauna that follows below.

HAPLOPHRAGMOIDES 67 - FAUNA

At about the 13,200-foot level, the distinctive Haplophragmoides 67 - Fauna appears, continuing to the base of the Taglu C-42 borehole. This fauna, relatively widespread in the Delta region, is equivalent to the Haplophragmoides 4160 marker that Staplin traces from Taglu C-42 to Ya Ya P-53, and which was found also in the Adgo-Niglintgak and Titalik sections.

The Haplophragmoides 67 faunal interval spans Norris' TG-7 zone of Middle Eocene to older Paleogene age, a placement compatible with Staplin's interpretation, and the placement of this fauna in the three wells mentioned above (see base AD-8 to AD-9, NI-5, TI-5 to top TI-6). However, when an attempt is made to "finely tune" the micro-paleontological and palynological correlations, a discrepancy emerges.

Norris considers his Pesavis-1 marker to characterize his TG-7 and TI-7 zones, both considered correlatives for this reason. But, whereas the Haplophragmoides 67 - Fauna occurs within the TG-7 zone at Taglu C-42, it does not occur in the supposedly equivalent TI-7 zone at Titalik K-26, but rather in the lower part of the TI-5 zone. Being "out of phase" with respect to at least one floral zone could be interpreted in two ways. The one interpretation, that the palynological correlation is open to question, is not considered seriously for the older Cyclammina arctica-borealis fauna that underlies the Haplophragmoides 67 complex is equally out of phase with respect to the palynological correlation. Therefore, the second and alternative interpretation is more appealing: that facies and environmental differences are responsible for the discrepancy in correlation using terrestrial palynomorphs and marine microfossils. The implications of this interpretation will be discussed below.

"CYCLAMMINA" 71 - FAUNA (Cyclammina arctic-borealis complex)

In the lowermost section of the borehole starting at about 15,300 feet, the drill barely penetrated the "Cyclammina" 71-bearing sequences, a faunal complex widespread in the Delta region. This complex is referred to as the arctica-borealis fauna by Staplin et al. who traced it on their cross-section from the base of the Taglu C-42 borehole to about the 9,000-foot level at Reindeer D-27 from where Petracca and Chamney report the same species. The fauna, therefore, seems to be equivalent to Chamney's 11 b unit of Reindeer, or his Middle Cyclammina (vitreous) horizon.

"Cyclammina" 71 was recovered also from the Kugpik O-13 and Titalik K-26 boreholes (to date); however, in the latter section, it was overlain by "Cyclammina" 70, a diagnostic species not found at Taglu C-42 nor Kugpik O-13.

Chamney considers the lower-Middle-and Upper Cyclammina horizons to be of Danian age, "inferring more indicators of Maestrichtian than Paleocene age". However, according to Staplin (1976, p. 132), the arctica-borealis fauna is of "probably Eocene age", a placement compatible with Norris' interpretation for the "Cyclammina" 70 and 71 faunas consistently appear within sections identified by Norris to be of Middle Eocene to older Paleogene in age.

According to this interpretation, a heavier influx of marine waters brought the Cyclammina 71 - Fauna first to the Taglu region at approximately TG-8 time. Terrestrial influences prevailed over the Titalik and Kugpik region at this time interval. As the influences of the marine incursion waned in TG-7 time, the fauna was replaced by the slightly more restricted Haplophragmoides 67 - Fauna at which time the more marine waters had reached the Titalik and Kugpik region. There too, the marine influences waned, however later, and the Haplophragmoides fauna migrated into the area, with the Taglu region at this time being either emergent or covered by water bodies too restricted or hostile to the development of a microfauna.

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