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BIOSTRATIGRAPHIC ZONATION

SHELL KIPNIK 0-20

68° 49' 59" N. Lat.; 134° 48' 19" W. Long.

NORTHWEST TERRITORIES

AUSTIN & CUMMING EXPLORATION CONSULTANTS

CALGARY, ALBERTA

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SUMMARY & CONCLUSIONS

BY

L. W. CUMMING, P. GEOL.

SHELL KIPNIK 0-20SUMMARY AND CONCLUSIONS

Biostratigraphic analysis of Shell Kipnik 0-20 includes a palynostratigraphic study carried out by Dr. Glenn E. Rouse and a micropaleontological analysis by Mr. M. B. Mickey, Anderson, Warren and Associates, Inc.

Ninety one palynomorph slides, prepared from sidewall and conventional cores, were provided by the Operator. A total of 45 terrestrial species and 59 aquatic palynomorphs were identified. No palynomorph samples were available through the interval 2450-3035 feet.

Eight palynological zones identify ages ranging upwards from Lower to Middle (?) Jurassic (KI-8) at the base to Maestrichtian in the interval 950-1050 (KI-1). The uppermost 950 feet of section proved barren of palynomorphs, and likely represent beds of Neogene age.

One hundred and six microfaunal slides from ditch samples and one core sample provided by the Operator were examined for microfossil content. Micropaleontological analysis identifies seven faunal zones which range from probable Middle to Late Jurassic at the base (10,950-11,600 feet) to an undifferentiated Tertiary-Quaternary zone through the interval 300-360 feet. Correlation of the Palynological Zonation with the Micropaleontology is illustrated in Table 1 of the Micropaleontology report.

TABLE 1
SHELL KIPNIK 0-20

PALYNOLOGICAL ZONATION

DEPTH	ZONE	DEFINITIVE PALYNOMORPHS	ENVIRONMENT	AGE	ORG. MAT.
1000	-BARREN- KI-1	950'	?		1-2
		MEMBRANOSPAERA MAASTRICHTICA	MARINE	MAESTRICHTIAN	
2000	KI-2	1050'	OFF-SHORE MARINE	APTIAN - CENOMANIAN	1-2
		2450'			
3000		3035'			3
	KI-3	3835'	NEAR-SHORE MARINE	BARREMIAN - APTIAN	
4000	KI-4		MARINE	HAUTERIVIAN - BARREMIAN	3
		5138'	NEAR-SHORE MARINE		
5000	KI-5		NEAR-SHORE MARINE	VALANGINIAN - L. HAUTERIVIAN	3-4
		5876'			
6000	KI-6		OFF-SHORE MARINE	TITHONIAN - BERRIASIAN	4-5
		7642'			
7000			NEAR-SHORE MARINE	UPPER JURASSIC	4-5
	KI-7				
8000			NEAR-SHORE MARINE	UPPER JURASSIC	4-5
	KI-8				
9000			TERRESTRIAL	LR.-(?) MID- JURASSIC	6
	KI-8				
10,000			TERRESTRIAL	LR.-(?) MID- JURASSIC	6
	KI-8				
11,000			TERRESTRIAL	LR.-(?) MID- JURASSIC	6
	KI-8				

PALYNOSTRATIGRAPHIC STUDY

BY

GLENN E. ROUSE, PH.D.

SHELL KIPNIK 0-20SUMMARY

A total of 45 terrestrial and 59 aquatic (mostly marine) palynomorphs were identified from 91 sidewall cores, distributed to a depth of 10,391 feet. (Fig. 1)

Eight palynozones are recognizable, ranging from Maastrichtian to Lower-Middle Jurassic. The upper interval 0-950 feet was barren, and likely represented Tertiary sedimentation. All the zones except the Lower-Middle Jurassic (Zone 8) are based on dinoflagellate species, which correlate well with those in Shell Unak B-11, and more generally with those of Brideaux from the delta region. From the mixture of terrestrial and marine palynomorphs in all but the basal zone, the environment appears to have been near-shore, possibly deltaic for much of the time. (Table 1)

ZONATION

Zone KI-1 950-1050 feet. Maestrichtian

The only definitive palynomorph in this narrow interval is Membranosphaera maastrichtica.

The other dinoflagellates appear to be recycled from older deposits.

Zone KI-2 1050-2450 feet. Aptian-Cenomanian

This zone is characterized by the following species:

Cyclonephelium cf. compactum

Cyclonephelium-1

Cyclonephelium-2

Polysphaeridium cf. pumilum

Polysphaeridium-2 & 3

Baltisphaeridium bifidum

Baltisphaeridium-1, 2 & 3

Gonyaulacysta-4

Araucaricites-3

There is a break in the palynomorph record between 2450 feet and 3445 feet because of a lack of samples.

Zone KI-3 3035-3835 feet. Barremian-Aptian

The two definitive palynomorphs in this interval are:

Subtilisphaera (Deflandrea) perlucida.
Cirratrriadites teter

Others occurring only in this zone are:

Polysphaeridium-2
Baltisphaeridium-4
Cingutriletes clavus
Acanthotriletes cf. varispinosus

Zone KI-4 3835-5138 feet. Hauterivian-Barremian

The two most indicative species of this zone are:

Cleistosphaeridium disjunctum
Oligosphaeridium complex

Others that appear to be restricted to this zone include:

Pseudoceratium cf. nudum
cf. Canningia-2
Polysphaeridium-3
Cyclonephelium-4

Although not restricted to this zone, Cyclonephelium distinctum is common in this interval.

Zone KI-5 5138-5876 feet. Valanginian-Lower Hauterivian

The most indicative palynomorph of this zone is Canningia-2, which occurs in low to moderate frequency in most samples. Also characteristic are:

Pseudoceratium cf. regium
Imbatodinium villosum
Oligosphaeridium-3
Canningia-3
Alisporites bisaccus

and single occurrences of:

Foraminisporis-1
Clavatipollenites couperii
Hymenozonotriletes mesozoicus

Zone KI-6 5876-7642 feet. Tithonian-Berriasian
(cf. Husky Formation)

Characteristic palynomorphs of this zone are:

Adnatosphaeridium-1 (cf. A. aemulum)
Adnatosphaeridium-2 (cf. A. filamentosum)
Gonyaulacysta spp. (Gonyaulacysta-5, 6 & 7)
Oligosphaeridium-4

This assemblage is also marked by single occurrences of:

Pareodinia spinosa
Cicatricosisporites-3
Verrucosisporites asymmetricus
Lycopodiumsporites austroclavidites

Zone KI-7 7642-10,391 feet. Upper Jurassic

This zone is defined by the occurrence of typical Upper Jurassic dinoflagellates, most notably:

Imbatodinium-2
Imbatodinium cf. kondratjev
Pareodinia cf. groenlandica
Pareodinia osmingtonense
Paleoperidinium-2

Also present are badly preserved cysts labelled Gonyaulacysta-9 and Gonyaulacysta-10 and a terrestrial spore Lycospora-2 of unknown age-range.

Zone KI-8 10,391-11,040 feet. Lower (?)Middle Jurassic

The only sample to yield identifiable palynomorphs is 10,391. This contains a good assemblage of bladdered conifer grains of Lower and (?) Mid-Jurassic age. Characteristic species include:

Protoconiferus cf. grandis
Protopicea cf. cerina
Podocarpidites cf. biformis
cf. Podocarpus mollis
Paleopicea cf. glæsaria

Although there is no positive evidence that lower samples represent the same zone, there was no marked change in the colour index, suggesting that the samples to total depth at 11,600 feet are also Lower-(?) Mid-Jurassic.

A summary of Kipnik palynozones, depositional environments, ages, and colour indices is outlined in Table .

CORRELATIONS

Kipnik zones correlate remarkably closely with those of Shell Unak B-11, and also reasonably well with Brideaux's zones from Gulf-Mobil Parsons N-10. The major difference in Kipnik is in the dino-flagellate composition from KI-6, identified as the Husky Formation. The two species of Adnatosphaeridium have not been reported from either Unak B-11 or Parsons N-10, and the other species are also different than those from the "Husky" zones of the other wells.

MICROPALEONTOLOGICAL STUDY

SHELL KIPNIK O-20

Prepared by:

Anderson, Warren & Associates, Inc.

Interpreted by: M. B. Mickey

SHELL
KIPNIK 0-20

PALYNOLOGY			MICROPALAEONTOLOGY	
Zones	Environment	Age	M. B. Mickey	
-BARREN- KI-1	?		910	
950'	MARINE	MAESTRICHTIAN	HAPLOPHRAGMOIDES ROTA	Marginal Marine to
KI-2	OFF-SHORE MARINE	APTIAN CENOMANIAN	1160	Inner Neritic
1050'			Late Cret.	
2450'			2150	
3035'			TROCHAMMINA RAINWATERI	
			Early Cret.	
KI-3	NEAR-SHORE MARINE	BARREMIAN -APTIAN	GAUDRYINA TAILLEURI	Inner Neritic to
3835'			BARREMIAN-HAUTERIVIAN	Upper Bathyal
KI-4	MARINE	HAUTERIVIAN - BARREMIAN	4100	
5138'	NEAR-SHORE MARINE		HAUTERIVIAN-VALANGINIAN	
KI-5	NEAR-SHORE MARINE	VALANGINIAN - L. HAUTERIVIAN	5200	Delta Front ?
5876'			UNDIAGNOSTIC	
KI-6	OFF-SHORE MARINE	TITHONIAN - BERRIASIAN	5876	
7642'			BERRIASIAN	
			6250	Middle-Outer Neritic
			GAUDRYINA MILLERI	
			TITHONIAN-BERRIASIAN	
			7065	
KI-7	NEAR-SHORE MARINE	UPPER JURASSIC	NOT DIAGNOSTIC	Non-Marine to Marginal Marine
10,391'				
KI-8	TERRESTRIAL	LR.-(?) MID-JURASSIC	10,950	Middle-Outer Neritic?
11,600'			TROCHAMMINA GRYCI-	
			TOPAGORUKENSIS	

SHELL KIPNIK 0-20SUMMARY OF MICROPALEONTOLOGICAL STUDY

The following micropaleontological summary is based on the examination and checklisting of previously picked microfaunal slides from 106 ditch samples and one conventional core sample. (Fig. 2).

Since the bulk of this well contained Mesozoic strata the species identified for the most part appear in published literature on the Mackenzie Delta area and adjacent North Slope of Alaska. Occasionally references are made to species previously reported in literature on the English and German Mesozoic stratigraphic succession. Several locally important, but unpublished, species appear on the checklist with numerical or lettered species nomenclature. A comparison of palynological and micropaleontological zonation is shown in Table 1.

300-630 feet"Zone of Reworking"

This interval contains rare and spotty occurrences of reworked Cretaceous Inoceramus prisms and worn poorly preserved reworked foraminifera. A couple of specimens, specifically Ostracod 5 and Anmobaculites 3, occurring in the sample from 420-480 feet offer rare evidence supporting a possible equivalence to Braun and Brooke's Assemblage I and/or Assemblage II. The basis for the above correlation is very tenuous though, and these two specimens could also represent reworking into non-marine Pleistocene strata. The age of this interval is therefore reported as Tertiary to Quaternary (Undifferentiated).

AGE: Tertiary to Quaternary
(Undifferentiated)

ENVIRONMENT: Non-marine to Marginal Marine

630-910 feet"Haplophragmoides 67" Faunule

Based on rare occurrences of Saccamina 13, Trochamminoides ? 68, Hyperammina 17, Haplophragmoides cf. 67, and Cyclammina cf. Cyclammina 71, this interval is believed to be an equivalent to the "Haplophragmoides 67" faunule of Braun and Brooke. Once again the faunas are rare and spotty. This faunule is considered by the author to indicate a Paleogene age based on Palynological calibrations. There appear to be some faunules missing between the "Zone of Reworking" and "Haplophragmoides 67" Faunule, suggesting that this

faunule is unconformable at its upper contact. The relative thinness of this faunule and apparent lack of development of the normally underlying "Cyclammina 71" Faunule suggests that the unit may also be unconformable at its lower contact. The poor diversity and relatively low abundance of these agglutinated faunas suggest deposition in marginal marine to inner Neritic waters. These strata probably represent inner Delta Plain (interdistributary bay, distributary channel, and estuarine) deposits.

AGE: Possible Paleogene

ENVIRONMENT: Marginal Marine to Inner Neritic

910-1160 ±50'

"Haplophragmoides rota-Trochammina albertensis" Faunule

This faunule represents a very thin interval in the well. Occurrences of Haplophragmoides rota, Hyperamminoides cf. H. barksdalei, Trochammina whittingtoni, T. stephanssoni, T. albertensis, Verneulinoides fischeri and V. bearpawensis indicate a Late Cretaceous (probable Senonian) age for these strata. Here again, the poor diversity and relatively low abundance of these agglutinated faunas suggest deposition in marginal marine to inner Neritic water depths. This unit appears to be unconformable at both contacts.

AGE: Late Cretaceous (Probable Senonian)

ENVIRONMENT: Marginal Marine to Inner Neritic

1160 ±50-2150 ±150'

"Trochammina rainwateri-Gaudryina subcretacea" Faunule

Occurrences of Ammobaculites fragmentarius, Haplophragmoides topagorukensis, Trochammina rainwateri, T. gatesensis, Gaudryina subcretacea, G. tappanae, Verneulinoides borealis, Conorboides umiatensis, Gyroidina cf. G. nitida, Valvulineria loetterlei, Pseudobolivina sp., Saracenaria trollopei and Marginulinopsis collinsi indicate that this interval is Early Cretaceous (probable Aptian to Middle Albian) age. A relatively large faunal change at about 1600 feet may represent the Albian-Aptian boundary with forms such as Gaudryina tappanae, G. subcretacea and Pseudobolivina sp. occurring in the lower interval. These faunas are typically found in the Albian Shale-Siltstone and Upper Sandstone Divisions of Jeletzky outcropping in the Richardson Mountains to the west.

The predominantly agglutinated nature of these faunas, coupled with the rare occurrences of calcareous forms suggest a moderate depth (probably inner to middle Neritic) in an area of fluctuating turbidity. These strata may represent outer Delta Plain interdistributary bay or distributary channel deposits.

AGE: Early Cretaceous

ENVIRONMENT: Inner to Middle Neritic

2150 ±150-5200 ±100'

"Gaudryina tailleuri-Gravellina sp." Faunule

These strata are characterized by occurrences of the following species: Gravellina sp., Haplophragmoides duoflatis, H. inflati-grandis, Trochammina squamata, T. conicomina, Gaudryina tailleuri, Glomospirella arctica, Praebulimina cf. P. nanina, P. 2, Quinqueloculina 2, Saracenaria dutroii, Lenticulina cf. L. subalata, L. topagorukensis and Ammodiscus cf. A. thomasi. Most of the above agglutinated species are described by Chamney from the Upper Shale-Siltstone Division of Jeletzky outcropping at Mount Goodenough in the Richardson Mountains to the southwest. These forms suggest a Neocomian age for this faunule. A possibly significant faunal change occurs at around 4100 feet. The faunas above 4100 feet are probably Hauterivian to Barremian in age, while a few forms found below 4100 feet suggest a Valanginian to Hauterivian age for these strata. The abundance of fauna and higher faunal diversities found about 4100 feet indicate that these faunas probably represent Pro-delta and Delta Front environments. The less abundant, less diverse faunas found below 4100 feet are probably indicative of Delta Plain deposition.

AGE: Neocomian
(Probable Valanginian to Barremian)

ENVIRONMENT: Inner Neritic to Upper Bathyal

5200 ±100-6250 ±150'

The ditch samples through this interval were faunally very sparse. They contained no new age diagnostic forms. The forms found may be caved from the overlying faunule. The interval appeared to be sandy from the picked slides, but this is difficult to be certain of without availability of washed residues. A single core sample from 5876-5900 feet, sent to us in the closing stages of this investigation, contains a dwarfed agglutinated foraminiferal fauna which shows a close affinity with the underlying "Gaudryina millerileffingwelli" Faunule. This faunule usually tops in the uppermost Husky Formation but can be found occasionally in shale stringers in the lower portion of the Buff Sandstone Member of the Lower Sandstone Division of Jeletzky. This core sample is probably Berriasian in age but could possibly be as young as Valanginian, although I have not seen it in anything definitely dated that young based on other fossil criteria as yet.

The occurrences of this moderately diverse, probably Pro-delta, fauna in the above mentioned core suggests that the lack of fauna in the ditch samples may be due to dilution rather than environmental limitations. Possibly this interval represents a Delta Front (distributary channel mouth, barrier bar) deposit.

AGE: Probable Berriasian below 5876 feet.

ENVIRONMENT: Delta Front ?

6250 ±150-7065 ±15'

"Gaudryina milleri-leffingwelli" Faunule

The top of the "Gaudryina milleri-leffingwelli" Faunule in ditch material is at 6400 feet, but as we previously mentioned, the top of this faunule may be as high as 5876 feet. This faunule is characterized by such forms as: Haplophragmoides canui, Gaudryina milleri, G. leffingwelli, Trochammina gryci, T. instowensis, Ammobaculites alaskensis, Ammodiscus thomsi, Saracenaria topagorukensis, Lenticulina wisniowskii, and L. cf. L. varians. This fauna is typical of the Husky Formation in the delta region and a Latest Jurassic to Earliest Cretaceous (probable Tithonian to Berriasian) age. These faunas suggest a middle to outer Neritic environment of deposition. These strata are probably Pro-delta deposits.

AGE: Latest Jurassic to Earliest Cretaceous
(Probable Tithonian to Berriasian)

ENVIRONMENT: Probable Middle to Outer Neritic

7065 ±15-10,950 ±50'

The fauna almost entirely drops out of this large stratigraphic interval. No older age diagnostic species occur. There appears to be a lot of coal associated with these deposits. This faunally poor interval probably represents a period of non-marine to marginal marine deposition. These strata may represent Alluvial Plain and inner Delta Plain facies of the Bug Creek Formation.

AGE: Indeterminate

ENVIRONMENT: Non-marine to Marginal Marine

10,950 ±50-11,600 feet. Last Sample

"Trochammina gryci-topagorukensis" Faunule

This faunule is characterized by the following species: Haplophragmoides canui, H. kingakensis, Trochammina gryci, T. topagorukensis, T. sablei, T. instowensis, Bathysiphon anomalocoelia, Eoguttulina metensis and Involutina cheradospira. This assemblage appears to be no older than Middle Jurassic and no younger than Late Jurassic in age. This influx of fauna probably marks an environmental change to "deeper water" middle to outer Neritic (Delta Front or Pro-delta) deposition.

AGE: Probable Middle to Late Jurassic

ENVIRONMENT: Middle to Outer Neritic

SHELL KIPNIK O - 20

PALYNOLOGICAL PLATES

SHELL KIPNIK 0-20

All photos x 1000 unless otherwise noted.

PLATE 64

1. Densoisporites-2
2. Todisporites minor
3. Lycospora cf. cretacea
4. Appendicisporites tricornitatus
5. Foraminisporis-1
6. Lycospora cf. cretacea
7. Alisporites rotundus (x500)
8. Hymenozonotriletes mesozoicus
9. Arancariates-3
10. Sequoiapollenites-3
11. Protoconiferus cf. grandis (x500)
12. Arancuricites-2
13. cf. Protopodocarpus mollis (x500)
14. Cyclonephelium cf. compactum
15. Cyclonephelium distinctum
16. Cyclonephelium cf. distinctum
17. Cyclonephelium-1

SHELL KIPNIK O-20

All photos x 1000 unless otherwise noted.

PLATE 65

18. Polysphaeridium-2
19. Membranosphaera maastrichtia
20. Baltisphaeridium-1
21. Baltisphaeridium bifidum
22. Baltisphaeridium-3
23. Cleistosphaeridium disjunctum
24. Polysphaeridium-3
25. - No photo -
26. Oligosphaeridium-4
27. Hystrichosphaeridium-2
28. Canningia-1
29. Canningia-1
30. Canningia-2
31. Canningia-2
32. Subtilisphaera perlucida

SHELL KIPNIK 0-20

All photos x 1000 unless otherwise noted.

PLATE 66

- 33. "Broomea" longicornuta
- 34. Adnatosphaera cf. filamentosum
- 35. Adnatosphaera cf. aemulum (x500)
- 36. Gonyaulacysta-9
- 37. Gonyaulacysta cretacea
- 38. Paleoperidinium nudum
- 39. Pareodinia ceratophora
- 40. Imbatodinium osmingtonense
- 41. Imbatodinium cf. kondratjevi