GEOLOGICAL RECONNAISSANCE SAMPLING PROGRAM

EXPLORATION LICENSE 372

9237 - R36 - 1E

RANGER OIL

GEOLOGICAL RECONNAISSANCE SAMPLING PROGRAM
EXPLORATION LICENSE 372

NEB OPERATION IDENTIFIER: 9237-R-36-1E

A report on selective sampling of bedrock in and around Exploration License 372, southeast of NORMAN WELLS, N.W.T.

AUGUST 8 - 11, 1995

by

RANGER OIL LIMITED

prepared by

F. Kent Wallace, P.Geol.
Senior Exploration Geologist

January 1996

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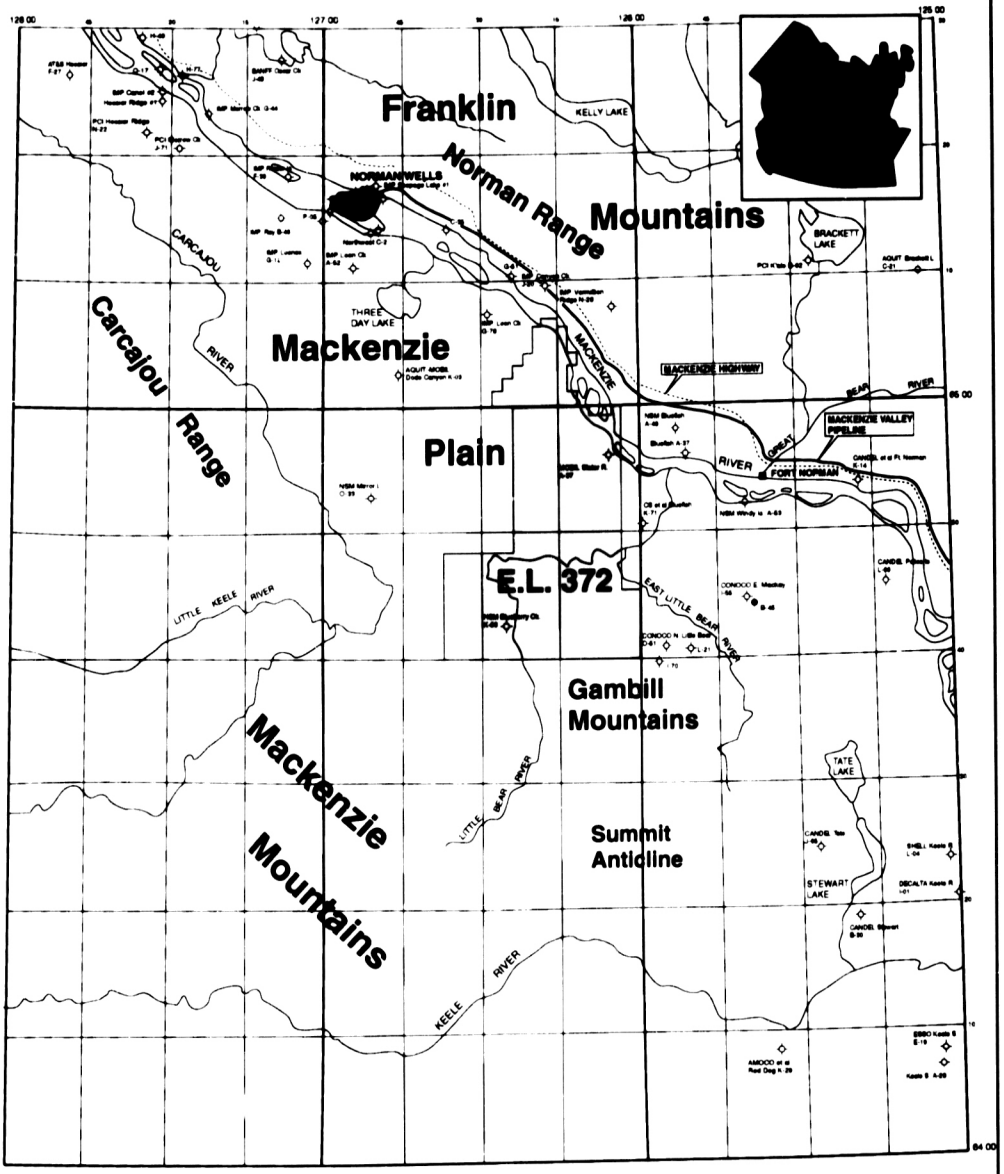
ILLUSTRATIONS



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Exploration License 372

Figure 1

Location Map

Kent Wallace | January 1988

GEOLOGICAL RECONNAISSANCE SAMPLING PROGRAM
Exploration License 372

INTRODUCTION

A short geological field program was undertaken in August, 1995 to accomplish specific exploration objectives related to Exploration License 372. The base of operations was Norman Wells and transportation in the field was provided by Canadian Helicopters Ltd. chartered out of their base at Norman Wells. No time was lost due to inclement weather. Kent Wallace of Ranger Oil Limited was the geologist responsible for the field operations and Ralph Ronza piloted the helicopter.

The work consisted of sampling bedrock in and around the area of interest for the purpose of gaining porosity and permeability measurements on potential reservoir beds, to obtain geochemical data related to source rock potential and to age date certain strata. This latter sampling was done in an attempt to identify the location of a major thrust fault suspected of transecting the southeast part of the License. Additionally, one water sample was taken and a total extractable hydrocarbon analysis was conducted on it.

The area of the Exploration License was flown in reconnaissance fashion to gain information on structural attitude of bedrock, mainly along the Little Bear and East Little Bear Rivers, where bedrock is exposed. The locations of samples and the results of all analyses are contained in the Figures and Tables which accompany this report. The locations of the field stations are shown spatially on Figure 2 and their geographic positions listed sequentially in Table 1.

ABSTRACT

Porosity and permeability samples from the Mount Kindle Formation collected in the Gambill Mountains (W-6), Summit Anticline (W-7), and along the headwaters of Little Bear River (W-8), showed variable permeability but generally poor intercrystalline porosity. These outcrops displayed good vuggy and intraorganic porosity and in places form brachiopod and coral biogenetic banks. The Mount Cap beds from Dodo Creek analysed for source rock potential did not contain any recognizable organic content. The age determinations done through palynology and micropaleontology gave uppermost Cretaceous (Campanian) ages but no significant age discrepancy to suggest structural separation. The one liquid sample on which total extractable hydrocarbon analysis was performed gave a reading of 21.4 mg/l hydrocarbon content.

REGIONAL GEOLOGIC SETTING

Exploration License 372 lies within the Mackenzie Plain about 20 miles southeast of Norman Wells (see Figure 1). It is situated at the hinge of the pronounced change in trend of the Mackenzie Mountains (Mackenzie Deflection) where they assume a more westerly trend from their general north-south pattern to the south. To the north and northeast lie the Franklin Mountains while the Carcajou Range of the Mackenzie Mountains rises on the west. A westerly thickening wedge of Mesozoic and Paleozoic sediments underlies the area and forms an overall synclinal shape with the east flank lying against the structurally high (subsurface) Keele Arch and the west flank abutting the Laramide - uplifted Mackenzie Mountains. The sedimentary veneer ranges from approximately 5000' to 14,000' across the License and is made up of a mixed clastic and carbonate assemblage with interspersed evaporitic material present in the Paleozoic.

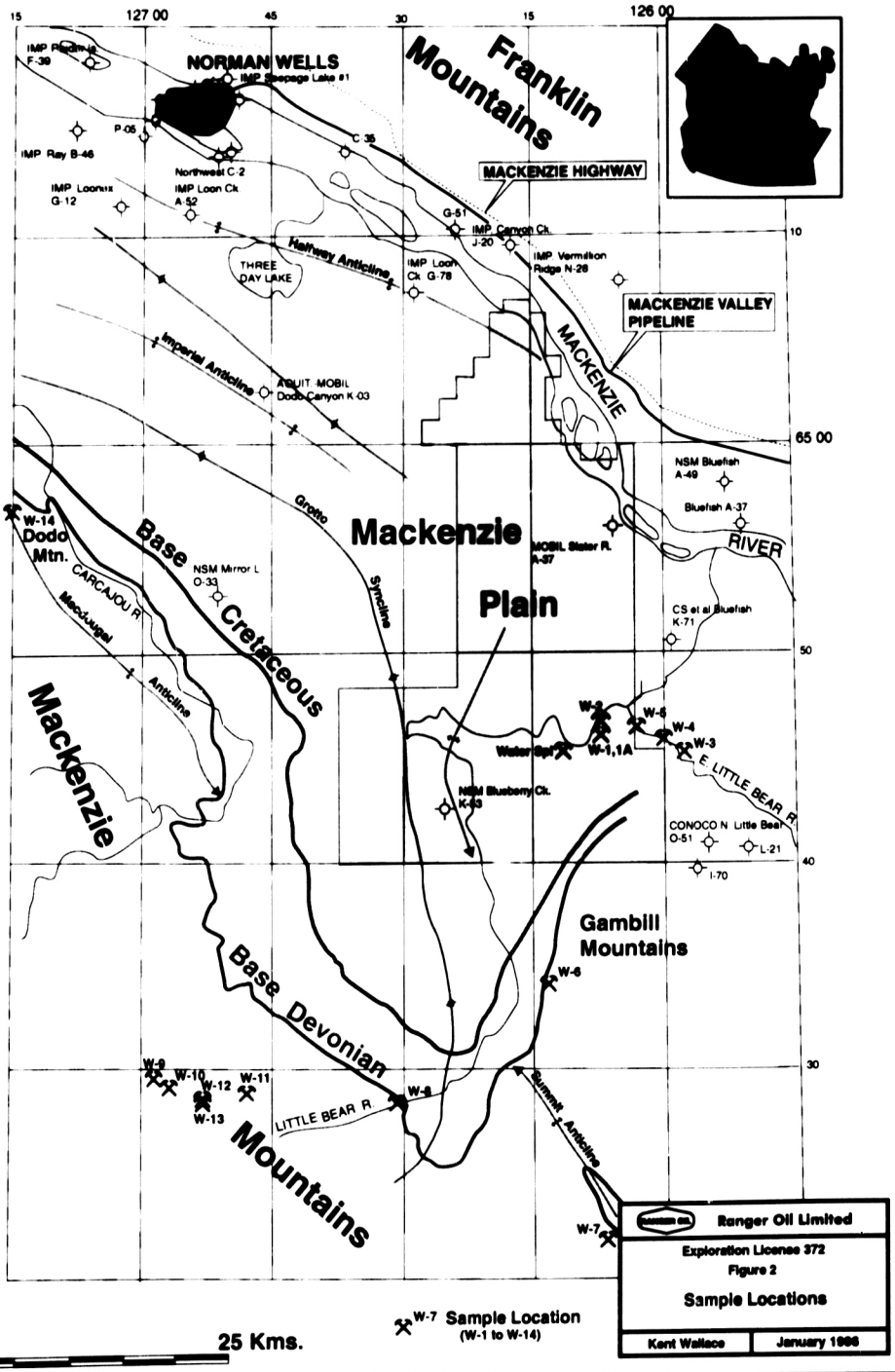
The region has been subjected to compressional tectonics which created folding, thrust faulting and bedding plane detachments rooted in the Cambrian evaporites. The northeast trend of a major structure - the Gambill Mountain Thrust is anomalous and this zone may have been influenced by the presence of a deep seated (Precambrian) northeast trending structural zone termed the Fort Norman Structure which is believed to underlie the area.

Knowledge of the overall stratigraphy of the area has been assembled over the years by workers who have examined the bedrock in the adjacent Mackenzie and Franklin Mountains, and melding that with limited borehole control. Understanding subsurface conditions is dependent upon interpretation of geophysical data which was acquired in this area from the late 1960's through the early and mid 1980's. These data are available for examination at the National Energy Board.

FIELD PROCEDURES

This short geological field program was aimed at adding to our exploration efforts by obtaining information on specific questions which would add to our knowledge base. Unresolved questions were directed at potential reservoir quality, source rock quality and the location and trend of a major thrust fault. Additionally, structural observations were made mainly from the air, on bedrock exposed within the Exploration License and a water sample was obtained from an area suspected of harboring an oil scum.

The geochemical sampling was done as carefully as possible to avoid surface contamination and all samples were double bagged in plastic. The water sample was collected in a clean, airtight glass container.


15
127 00
45
30
15
126 00
NORMAN WELLS
IMP Pleasant F-39
IMP Seepage Lake e1
P-05
IMP Ray B-46
Northwest C-2
IMP Loon Ck A-52
IMP Loonex G-12
C-35
Franklin Mountains
MACKENZIE HIGHWAY
G-51
IMP Canyon Ck J-20
IMP Vermilion Ridge N-26
10
Halfway Anticline
THREE DAY LAKE
IMP Loon Ck G-78
MACKENZIE VALLEY PIPELINE
MACKENZIE
Imperial Anticline
AQUIT MOBIL Dodo Canyon K-03
65 00
NSM Bluefish A-49
Bluefish A-37
RIVER
W-14 Dodo Mtn.
Grotto
Mackenzie Plain
MOBIL Sister R. A-37
Base Cretaceous
NSM Mirror L O-33
CARCAJOU R
Mesozoic
Anticline
Syncline
CS et al Bluefish K-71
50
Mackenzie
W-2
W-5
W-4
W-3
W-1,1A
E. LITTLE BEAR R
NSM Blueberry Ck. K-69
CONOCO N. Little Bear O-51
L-21
I-70
40
Gambill Mountains
W-6
Base Devonian
W-9
W-10
W-11
W-12
W-13
W-8
LITTLE BEAR R.
Summit Anticline
30
Mountains
W-7
Ranger Oil Limited
Exploration License 372
Figure 2
Sample Locations
Kent Wallace
January 1986
W-7 Sample Location
(W-1 to W-14)
0
25 Kms.

All laboratory procedures were done through the facilities of AGAT Laboratories, Calgary.

Porosity and Permeability

The early Paleozoic carbonate succession is regarded as a prospective reservoir zone in the area. As well, biogenetic banks and porous zones are reported in open file data at this stratigraphic level. For these reasons, these rocks were examined at several localities. The quantitative porosity and permeability results from three field stations are shown on Table 2.

At field station W-6 in the Gambill Mountains immediately south of the License, the Silurian-Ordovician Mount Kindle beds were examined (see Plate 2). Here they are about 450' thick and consist of alternating recessive and resistant dolomite. The dolomites are pale buff in color and contain over 150' of variable intercrystalline and vuggy porosity. Intraorganic porosity is also developed in places where brachiopods and corals form local biogenetic banks.

Further south in the Summit Anticline area, the Mount Kindle Formation is thicker - about 675'. The overall lithology and good reservoir characteristics present to the north at W-6 were also noted here. Shallow, subtidal environment of deposition for these carbonates is indicated and near the top of the section a small stromatoporoid and coral bioherm is present. The best porosity in this section is in the upper (Silurian) part of the interval. The massive, vuggy nature of these beds is apparent in Plate 3. Diagnostic fauna here help map the subdivision of Silurian and Ordovician ages within the formation. Unconformities bound this sequence and the eroded eastern limit of the Mount Kindle Formation is believed to underlie the Exploration License.

At field station W-8 along the upper reaches of the Little Bear River, the Mount Kindle section is about 600' thick. Scattered intercrystalline and vuggy porosity occurs over 100' of the upper part of the section, but no organic build-ups were noted. A shallow water environment of deposition is also indicated here which is abruptly terminated at the underlying unconformable Franklin Mountain Formation where chert breccias are present.

Geochemical Sampling

Beds capable of acting as a source for hydrocarbons are known to be present in this part of the Mackenzie Plain. The Canol Formation is the source of the oil in the Kee Scarp Formation at Norman Wells, and throughout this area has high TOC values. The Cretaceous Slater River Formation is also a mature source bed here and displays high TOC content.

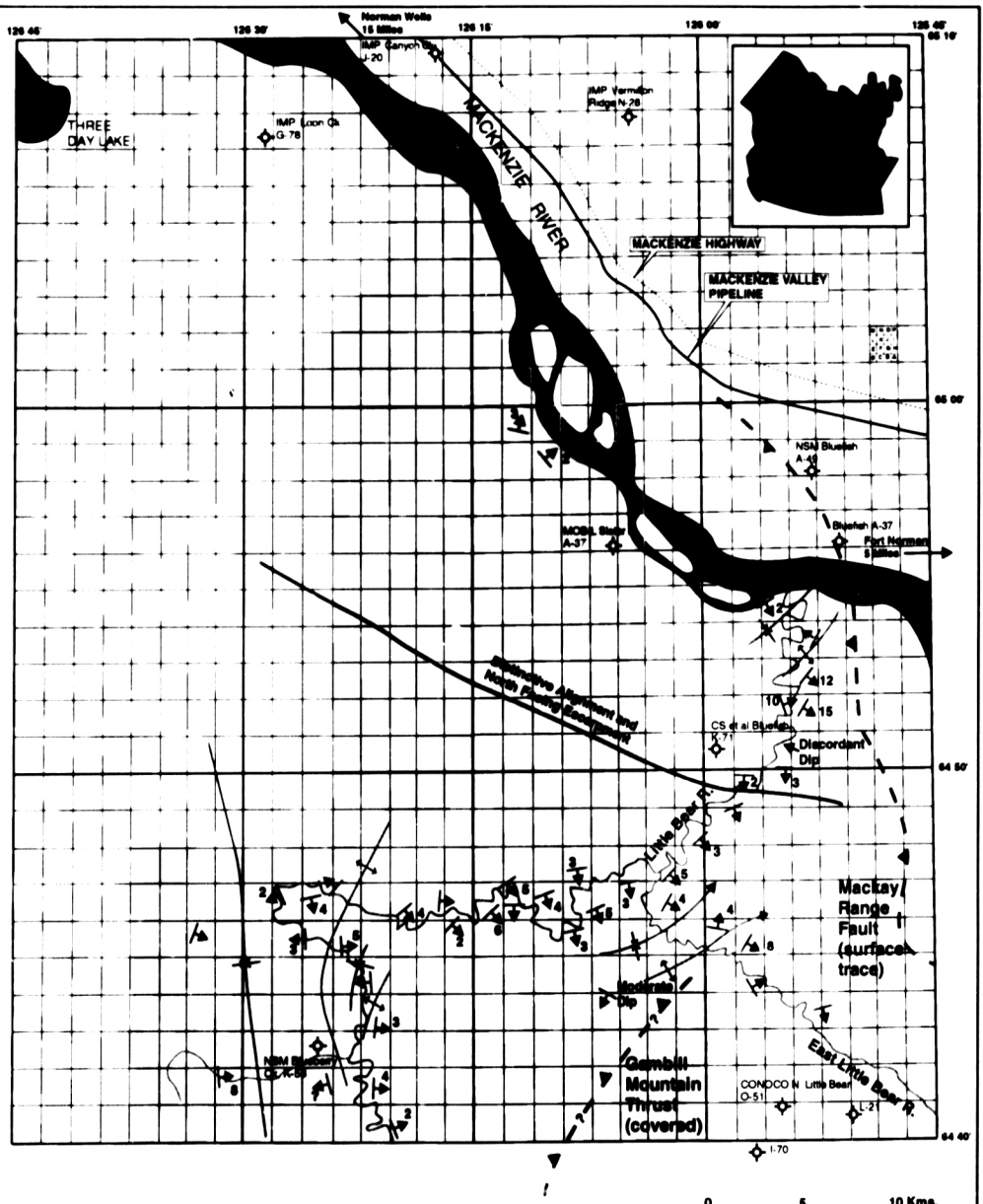
The Mount Cap shales are organically rich (TOC up to 9%), oil prone and are the source of the hydrocarbons in the Colville Hills region to the north. These strata are believed to underlie this part of the Mackenzie Plain. This judgment is based upon exposures in the adjacent mountains and scattered well control north and south of the Exploration License. Open file seismic data also allow for an interpretation of the presence of these beds beneath the Exploration License. In the Colville Hills these strata contain alginite which is an organic rich Type 1 kerogen. This organic matter is known to generate hydrocarbons at high maturities and in effect can withstand greater depth of burial and higher temperatures than normally associated with other source material. In addition the Mount Cap Formation is reported in GSC Paper 73-9, Section U-13 as being "high in carbon" and containing organic markings on its bedding planes in exposures near the headwaters of Little Bear River.

For these reasons it was deemed advisable to attempt to gain further information on the source capability of these strata. One of the best exposed Mount Cap sections is along Dodo Creek in Carcajou Range (see Plate 4). Five samples were collected from this section from black shales and shaly limestones. Analysis showed these samples did not contain any TOC content (see Table 3). Elsewhere it has been demonstrated that Cambrian rocks have contained fair-good oil prone kerogen but display poor analytical results. This may be due to early expulsion (geologically) of carbon from these strata. Other work has also noted low or absent TOC values in early Paleozoic source beds (Exploration Geosciences, 1995 proprietary data), while acknowledging that they are a probable contributor as a source.

Age Determinations

The north trending Gambill Mountains thrust fault clearly documented farther south enters the Exploration License in the southwest and its surface trace is covered by Tertiary and uppermost Cretaceous deposits in the area of interest. Indirect geophysical evidence in the form of poor data areas suggests it may underlie the southeast part of the License. Knowing its position in the subsurface is of importance to future exploration. It was therefore decided to sample bedrock at several outcrops exposed along the Little Bear and East Little Bear Rivers. If significant discrepancies in the age of these clastic strata were mappable, it might help to locate the trace of the fault.

Five field samples (W1 to W5) were submitted for age determination. Three were processed for palynology, one for micropaleontology and two were deemed unsuitable lithologies for both disciplines. As sample W1 consisted of



3 Field Observed Dip or Dip Component

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Figure 3

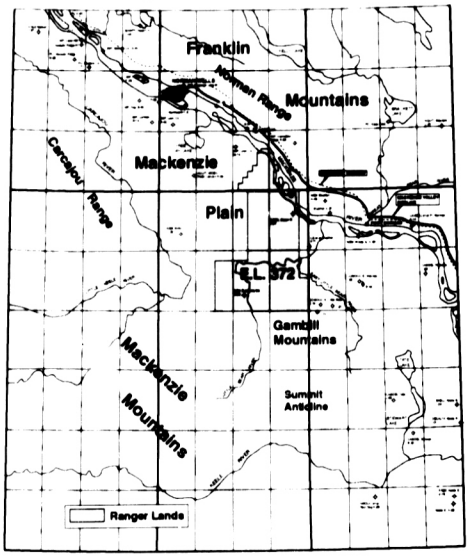
Structural Observations Along Little Bear River and Environs

Kent Wallace | January 1986

STRATIGRAPHIC COLUMN

Era	Period		Norman Wells / Fort Norman
CENOZOIC	QUATERNARY	HOLOCENE	alluvium
		PLEISTOCENE	glacial drift
	TERTIARY		Laramide Orogeny
MESOZOIC	CRETACEOUS	UPPER	Hammond Ck. Fm. ss? to ? tuff. cong; East Fort Formation sh; Little Bear Formation ss; Slater River Formation sh; Trevor Form. ss, sh
		LOWER	Arctic Red Form. sh, silts, ss; Unconformity
	JURASSIC		
	TRIASSIC		
PALEOZOIC	PERMIAN		
	PENNSYLVANIAN		
	MISSISSIPPIAN	UPPER	
		LOWER	
	DEVONIAN	UPPER	Imperial sh, ss; Canol Form. sh; Kee Scarp Form. ls (Ramparts) reef
		MIDDLE	Hare Indian Formation; Hume Formation ls, shly; Bear Rock Form. carb brec.; Landry ls; Arnica evap, red beds; Delorme dol
		LOWER	Caledonian Epeirogeny
	SILURIAN		Mount Kindle Form. dol
	ORDOVICIAN	UPPER	"Cherty" dol; "Rhythmic" dol; "Cyclic" dol; Ramparts Formation; Kee Scarp Formation
		MIDDLE	
		LOWER	
	CAMBRIAN		Undivided (in west); Saline River Form. red & grn gyp; Mount Cap Formation ss; Mount Clark Formation ss
	PRECAMBRIAN		? ? Little Dal carb, sh; Katherine Group ogl, sh, ss, ls, dol

STUDY AREA



Time Intervals, Unit Thicknesses, and Erosional and Depositional Effects Not Shown to Scale.

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Addendum to: Geological Reconnaissance Sampling Program Exploration License 372, Jan. 1996 Ranger Oil Limited

F.K.W. | January 1996

two different lithologies, each was prepared separately for palynological analysis. Field samples from stations W3 and W4 in a critical area along the north bank of the East Little Bear River were barren. Their lithology is conglomerate and may represent a late Cretaceous or early Tertiary channel fill. This would help explain the area of poor data here noted on the seismic records. The two areas of conglomerate and poor data quality appear to correspond areally.

The results from the three productive samples - Field Stations W1, W1A and W5 (see Table 4) all showed a Campanian age. Thus, this method was unsuccessful in helping define the surface trace of this major structural feature. It is probable the age of emplacement of the fault was an early pulse of Laramide, and the clastic deposits may postdate and hence cover the fault trace.

Water Sample Collection

During the course of aerial reconnaissance gathering structural data, a discoloration or scum was noted in a small, quiet backwater of a small stream, which flows into Little Bear River about five miles above its confluence with the East Little Bear River (for location see Figure 2 and Table 1).

A sample of the water was collected and later submitted for a Total Extractable Hydrocarbon Analysis. These results are shown in Table 5. The identity of the type of hydrocarbon could not be ascertained by the gas chromatograph but it is believed to be in the lighter end of the Carbon range (personal communication AGAT Laboratories). It does not have a pattern of diesel oil or gasoline which rules out outside contamination as a source. Its source is unknown, but it is presumed to emanate from the subsurface. No other standing water is present in the immediate area.

STRUCTURAL OBSERVATIONS

Much of the gently rolling topography of the Exploration License is mantled by soils which contain patches of discontinuous permafrost. The only outcrops to be found in this part of the Mackenzie Plain lie along streams which have incised the plain. Structural observations of these exposures mainly along the Little Bear and East Little Bear Rivers are shown on Figure 3. The age of bedrock almost everywhere within the License is believed to be Upper Cretaceous in age. This section is comprised dominantly of shale, siltstone and sandstone.

Gentle dips which rarely exceed about 10° are present, and in places define structures (see Plate 5). These folds are probably a manifestation of Laramide tectonic movements, and within the License no distinct structural grain is apparent. No major faults were observed although one prominent east-west trending distinctive alignment has been mapped. Minor discordant dips were observed, but no major dislocations or interruptions of dip were observed which could be interpreted as the surface expression of a major fault.

CONCLUSIONS

The field work accomplished its stated objectives and unearthed new data. Observations of reservoir characteristics of Paleozoic carbonates was enlightening, but lack of obtaining firm geochemical evidence as to the contribution of early Paleozoic rocks as a source was disappointing. The age determinations add to our overall knowledge of surface bedrock, and the discovery of a conglomerate sequence along the East Little Bear River may provide a partial explanation to the lack of response on geophysical records in this area. The presence of a low but detectable amount of hydrocarbons in a water sample obtained from the Exploration License is a positive indicator and adds intrigue to future exploration.

PLATES

Plate 1 — View to the southwest of Norman Wells. Note the 11 production platforms over the Norman Wells oilfield in the Mackenzie River as well as a rig drilling a development well in the town itself (right centre).

Plate 2 — Vuggy and intraorganic porosity in a biogenetic bank developed in the Mount Kindle Formation at Ration Creek in the Gambill Mountains - Field Station W-6. View north, Franklin Mountains on far distant skyline.

Plate 3 — Massive vuggy porosity developed in Mount Kindle Formation on west flank of Summit Anticline at Field Station W-7.

Plate 4 — Mount Cap Formation exposed on northwest bank of Dodo Creek, Field Station W-14. Section is 350' thick and is unconformably overlain by light colored Pleistocene gravels.

Plate 5 — Moderately southeast dipping Upper Cretaceous sandstone exposed on Little Bear River, just east of Exploration License 372. Recent forest fires have devastated the area.

PLATE 1

View to the southwest of Norman Wells. Note the 11 production platforms over the Norman Wells oilfield in the Mackenzie River as well as a rig drilling a development well in the town itself (right centre).

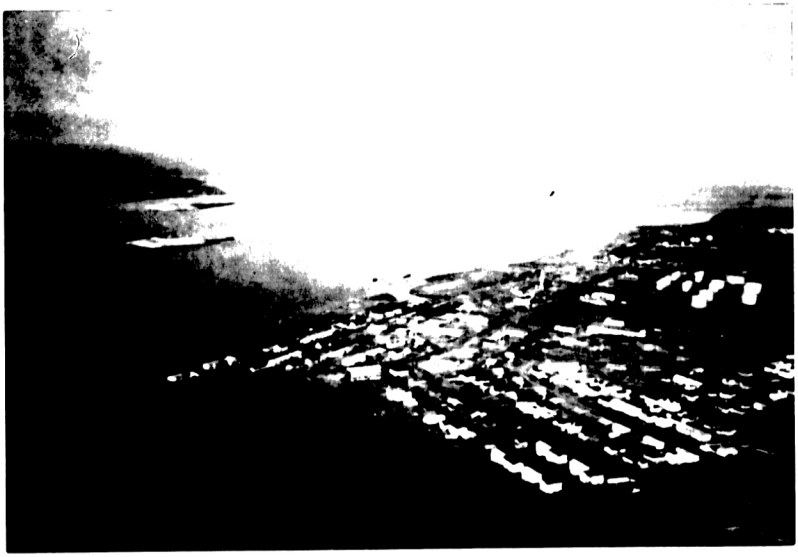

PLATE 2

Vuggy and intraorganic porosity in a biogenetic bank developed in the Mount Kindle Formation at Ration Creek in the Gambill Mountains - Field Station W-6. View north, Franklin Mountains on far distant skyline.

PLATE 3

Massive vuggy porosity developed in Mount Kindle Formation on west flank of Summit Anticline at Field Station W-7.

PLATE 4

Mount Cap Formation exposed on northwest bank of Dodo Creek, Field Station W-14. Section is 350' thick and is unconformably overlain by light colored Pleistocene gravels.

PLATE 5

Moderately southeast dipping Upper Cretaceous sandstone exposed on Little Bear River, just east of Exploration License 372. Recent forest fires have devastated the area.

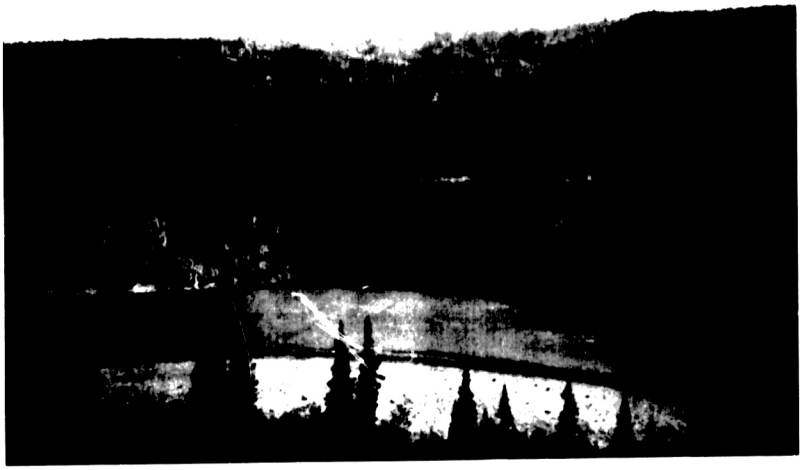

TABLE 1
SAMPLE LOCATIONS

	LATITUDE	LONGITUDE
W-1	64° 46.15' N	126° 08.22' W
W-1A	64° 46.15' N	126° 08.54' W
W-2	64° 46.94' N	126° 06.67' W
W-3	64° 45.09' N	125° 57.51' W
W-4	64° 45.51' N	126° 01.05' W
W-5	64° 46.10' N	126° 02.57' W
W-6	64° 34.35' N	126° 13.55' W
W-7	64° 21.74' N	126° 07 04' W
W-8	64° 28.12' N	126° 30.34' W
W-9	64° 29.53' N	126° 58.27' W
W-10	64° 29.17' N	126° 56.11' W
W-11	64° 28.79 N	126° 47.55' W
W-12/W-13	64° 28.61' N	126° 48.23' W
W-14	64° 57.03' N	127° 00.10' W
Water Sample Collected at:		
	64° 45.51' N	126° 11.68' W

TABLE 2

AGAT® Laboratories

RANGER OIL LIMITED

SELECTED OUTCROP SAMPLES
RC 5482

SPL NO.	KMAX (mD)	POROSITY (frac)	DENSITY (kg/m^3)		REMARKS
			BULK	GRAIN	
W6	12.6	.078	2580	2800	dol;vf-fxln;ppvugs;calc
W7	3.51	.046	2590	2710	ls;vf-fxln;ppvugs
W8	.11	.029	2720	2800	dol;vf-fxln;ppvugs;calc

TABLE 3

Memorandum

carolle lafleur
technologist
analytical geochemistry

367292 ALBERTA LTD
833 - 18th Ave N.W.
Calgary, Alberta
T2M 0V4
289-9546

To: *KENT WALLACE*
From: *CAROLLE LAFLEUR*
Date: *11/09/1995*
Subject: *OSA RESULTS*

Please find enclosed, the pyrograms and OSA results for your five samples. The samples were identified as: W-10, W-14 Unit 7, W-14 Unit 10, W-14 Unit 16 (upper) & (?).

For each samples I picked quite a large piece of material, hopefully representative of the whole, which explains the fair amount of ground material returned to you.

Unfortunatly, the samples did not contain any Total Organic Carbon or Hydrocarbon Potential as determined by the OSA. The samples were run in duplicate. The instrument was working very well as can be established by the results obtained for the IFP standard runs as a sample, identified as 9999. The actual data for the standard are Oil = 0.10, S2 = 8.62, Tmax = 419 and TOC = 2.86

I have also included my invoice for this work.

It was a pleasure to do some work for Ranger Oil, thank you for your support.

Carolle Lafleur

R:DEPTH	WEIGHT:	GAS	OIL	S 2	Tmax	G P I	O P I	T P I	T O C	H I
1111	100.0	0.00	0.02	0.02	294	0.00	0.50	0.50		
1410	98.1	0.00	0.02	0.02	325	0.00	0.50	0.50	0.00	0
147	97.9	0.00	0.02	0.03	320	0.00	0.50	0.50	0.00	0
10	98.5	0.00	0.02	0.02	351	0.00	0.50	0.50	0.00	0
146	97.8	0.01	0.03	0.04	294	0.12	0.37	0.49	0.00	0
1416	98.5	0.02	0.04	0.06	396	0.17	0.33	0.50	0.00	0
9999	99.1	0.00	0.23	8.82	419	0.00	0.03	0.03	2.85	309
146	101.7	0.00	0.01	0.02	333	0.00	0.50	0.50	0.00	0
1410	98.7	0.00	0.03	0.04	326	0.00	0.50	0.50	0.00	0
1416	101.8	0.00	0.01	0.03	424	0.00	0.25	0.25	0.00	0
10	100.7	0.00	0.01	0.04	445	0.00	0.25	0.25	0.00	0
147	99.9	0.02	0.04	0.07	499	0.17	0.33	0.50	0.01	700
9999	100.2	0.01	0.23	8.93	421	0.00	0.03	0.03	2.90	307

DEPTH	WEIGHT:	GAS	OIL	S 2	Tmax	G P I	O P I	T P I	T O C	H I

3H DATE: 95-09-07 ANALYSIS

Sample ID = DEPTH

W-1447 = 147

W-10 = 10

W-1416 (?) = 1416

W-1410 = 1410

W-1416 (upper) = 146

IFP Std = 9999

TABLE 4

FORD BIOSTRATIGRAPHIC SERVICES

Age determination of
five field samples from

NORMAN WELLS AREA

NORTHWEST TERRITORIES

Author: **Jancis H. Ford Ph.D.**
Ford Biostratigraphic Services, Calgary

Date: **August 1995**

Client: **Mr. Anthony Sequeira**
AGAT Laboratories, Calgary

INTRODUCTION

Five field samples (W1 to W5) from the Norman Wells Area, Northwest Territories, were submitted for age determination. Three were processed for palynology, one for micropaleontology and two were deemed unsuitable lithologies for both disciplines. As sample W1 consisted of two different lithologies, each was prepared separately for palynological analysis.

METHODS

The samples selected for palynological analysis were scrubbed thoroughly to remove any contaminants and then crushed and processed to remove all the inorganic constituents and concentrate the residual organic material. Slides prepared from the sieved residue were systematically examined for age diagnostic palynomorphs and particularly for those with short geological ranges.

The sample prepared for micropaleontology was prepared using standard processing techniques and then examined microscopically for microfossil content.

RESULTS AND SUMMARY

The results of the palynology and kerogen analysis are outlined in the charts overleaf which include the sample lithologies, the microfossils recorded, the interpreted age and the depositional environment.

Results are summarized as follows:

- **General**
  Palynological assemblages from the three productive lithologies examined contained relatively rich, shallow marine , inner neritic assemblages which included many terrestrially derived palynomorphs and much recycled material. The single sample processed for micropaleontology from W4 was barren of microfossils.

- **Age**
  The three productive samples appear to be of similar age, ie. Late Cretaceous. An intermix of several different palynomorph suites was recorded in each sample:

i Late Cretaceous, probably Campanian and possibly mid Campanian assemblage consisting of marine and terrestrial taxa including

Laciniadinium biconiculum	*Scriniodinium obscurum*
Chatangiella cf. *spectabilis*	*Aquilapollenites* spp.
Integricorpus sp.	*Mancicorpus* sp.

ii. Cenomanian / Albian microplankton taxa occur in limited numbers including the microplankton taxa:

Ascodinium verrucosum	*Luxadinium propatulum*

iii. Permian / Triassic taxa include a few examples of striate bisaccate pollen grains referrable to *Protohaploxypinus* and ? *Lunatisporites*.

iv. Carboniferous and ? Devonian spores. Definite examples were noted and many other spores may also to be of this age.

From the above it is deduced that there is a considerable quantity of recycled material incorporated into these Late Cretaceous clastics. A probable middle Campanian age is assigned based on the occurrence of *Laciniadinium biconiculum*, a marine dinocyst which is confined to middle Campanian strata (McIntyre 1974).

■ **Depositional Environments**

All productive samples contain marine microplankton and were deposited in a shallow marine, inner neritic environment.

REFERENCES

1974 MCINTYRE, D.J.
Palynology of an Upper Cretaceous Section, Horton River, District of Mackenzie, N.W.T. Geological Survey of Canada Paper 74-14, 1-59.

1986 IOANNIDES, N.S.
Dinoflagellate cysts from upper Cretaceous - Lower Tertiary sections, Bylot & Devon Islands, Arctic Archipelago. Geological Survey of Canada, Bull. 371, 1-99.

TABLE 1 : SUMMARY OF AGE DETERMINATIONS OF FIELD SAMPLES FROM NORMAN WELLS AREA NORTHWEST TERRITORIES

SAMPLE #	LITHOLOGY	AGE	DEPOSITIONAL ENVIRONMENT	FOSSILS REPRESENTED / ABUNDANCE
W1	small pieces dark grey shale	Late Cretaceous Campanian possibly middle Campanian	shallow marine, inner neritic	processed for palynology palynomorphs abundant & moderately diverse including marine microplankton & terrestrial taxa Key taxa: *Laciniadinium biconiculum* (C) *Scriniodinium obscurum* (VR), *Alterbia minor* (R) *Aquillapollenites* sp (R) Reworked taxa (VA) including Carboniferous & Permian / Triassic
W1A	pale grey siltstone & sandstone with iron staining	Late Cretaceous probably Campanian	shallow marine inner neritic	processed for palynology palynomorphs abundant & moderately diverse including marine microplankton & terrestrial taxa Key taxa *Chatangiella* cf *spectabilis* (VR) *Scriniodinium campanulum* (VR) *Palaeohystrichophora infusorioides* (VR) *Aquillapollenites* sp (R), *Triprojectus* sp (VR) Reworked taxa (VA) including ?Devonian / ?Carboniferous, Permian / Triassic & Cenomanian / Albian

J H FORD August 1995

ABUNDANCE KEY:

VVA Extremely abundant
VA Very abundant
A Abundant
C Common
R Rare
VR Very rare

TABLE 2 : SUMMARY OF AGE DETERMINATIONS OF FIELD SAMPLES FROM NORMAN WELLS AREA

NORTHWEST TERRITORIES

SAMPLE #	LITHOLOGY	AGE	DEPOSITIONAL ENVIRONMENT	FOSSILS REPRESENTED / ABUNDANCE
W2	pale grey, salt & pepper sandstone, coarse to fine grained: separate piece of coal	indeterminate	indeterminate	not prepared for palynology or micropaleontology due to unfavourable lithologies
W3	mottled salt & pepper sandstone, coarse grained containing chert & small rounded pebbles	indeterminate	indeterminate	not prepared for palynology or micropaleontology due to unfavourable lithologies

J H FORD August 1995

ABUNDANCE KEY:

VVA Extremely abundant
VA Very abundant
A Abundant
C Common
R Rare
VR Very rare

TABLE 3 : SUMMARY OF AGE DETERMINATIONS OF FIELD SAMPLES FROM NORMAN WELLS AREA NORTHWEST TERRITORIES

SAMPLE #	LITHOLOGY	AGE	DEPOSITIONAL ENVIRONMENT	FOSSILS REPRESENTED / ABUNDANCE
W4	coarse grey & yellow sandstone grading to conglomerate, some thin bands of darker ?organic-rich material	indeterminate	indeterminate	unsuitable lithology for palynology processed for micropaleontology barren of fossils
W5	dark grey homogeneous shale	Late Cretaceous Campanian possibly middle Campanian	shallow marine inner neritic	processed for palynology palynomorphs abundant, both marine microplankton & terrestrial spores & pollen Key taxa recorded: *Laciniadinium biconiculum* (R) *Aquillapollenites* sp.(R) *Alterbia minor* (R), *Florentinia stellatum* (VR) *Spinidinium vestitum* (R), *Diconodinium* sp.(R) Reworking (VA) including Carboniferous / ?Devonian, Permian / Triassic taxa & Cenomanian / Albian

J.H.FORD August 1995

ABUNDANCE KEY:

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AGAT Laboratories

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RANGER OIL TABLE 5

ATTENTION: MR. KENT WALLACE

File Number : 33710.005
Date Sampled : N/A
Date Received: 95-08-16
Date Reported: 95-08-25

TOTAL EXTRACTABLE HYDROCARBONS ANALYSIS (GC/MS) - LIQUID

PARAMETER	LAB NUMBER: 186005 SAMPLE ID :
Total Extractable Hydrocarbons mg/L	21.4

Practical Quantitation Limit: (TPH) 0.010 mg/L
Total Petroleum Hydrocarbons calculation based on O-Xylene response.
Chromatographic pattern gives no indication of type of hydrocarbon.

Accredited by the American Industrial Hygiene Association (AIHA)
Accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL)
*** not all parameters have been reported ***

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