STRATIGRAPHY

OF THE

LIARD PLATEAU AREA

Imperial Oil Limited

1962

ok

DEPT. OF NORTHERN AFFAIRS & NATIONAL RESOURCES
CALGARY, ALBERTA
JUN 3 1963
OIL CONSERVATION ENGINEER
Northwest Territories & Yukon Territory

TABLE OF CONTENTS

	Page
INTRODUCTION	1
Area Covered	1
Accessibility	1
Purpose of Study	1
Method of Study	2
Communications	3
Weather	4
Operations	4
Previous Investigations	5
STRATIGRAPHY	5
General Remarks	5
Proterozoic	6
Paleozoic	6
Middle Devonian and Older	6
Devonian and Mississippian	7
Carboniferous and Permian	8
Permian	8
Mesozoic	9
Triassic	9
Cretaceous	9
STRUCTURAL GEOLOGY	10
REFERENCES CITED	

LIST OF ILLUSTRATIONS

Figure 1	Location Map	In Text
Figure 2	Table of Formations	In Text
Figure 3	Location Map of Outcrop Section and Line of Cross Section	In Pocket
Figure 4	Isopach Map — Mattson Formation	In Pocket
Figure 5	Stratigraphic Cross Section $A - A_1$	In Pocket

also 7 Log + Outcrop Sections

STRATIGRAPHY OF LIARD PLATEAU AREA

INTRODUCTION

Area Covered

The Liard Plateau Area is located between Latitudes 60°00' N. and 61°30' N. It is bounded on the east by the Liard River, and on the west by 126° W. Longitude. The principal area of investigation during the 1962 field season comprises some 6,000 square miles on the eastern portion of the plateau. (Fig. 1).

Accessibility

Access to this region in summer is difficult, except by float-equipped aircraft operating either from fixed bases such as Fort Nelson, British Columbia, or from previously prepared facilities at convenient points along the Alaska Highway and at settlements along navigable rivers.

Access in winter is feasible by "cat train", or by truck along seismic trails and "winter roads", built to drilling locations.

Purpose of Study

The purpose of the 1962 field work was to gather stratigraphic data on the Upper Paleozoic, Mattson Formation, and to gain more information about the Devonian rocks. The rocks were

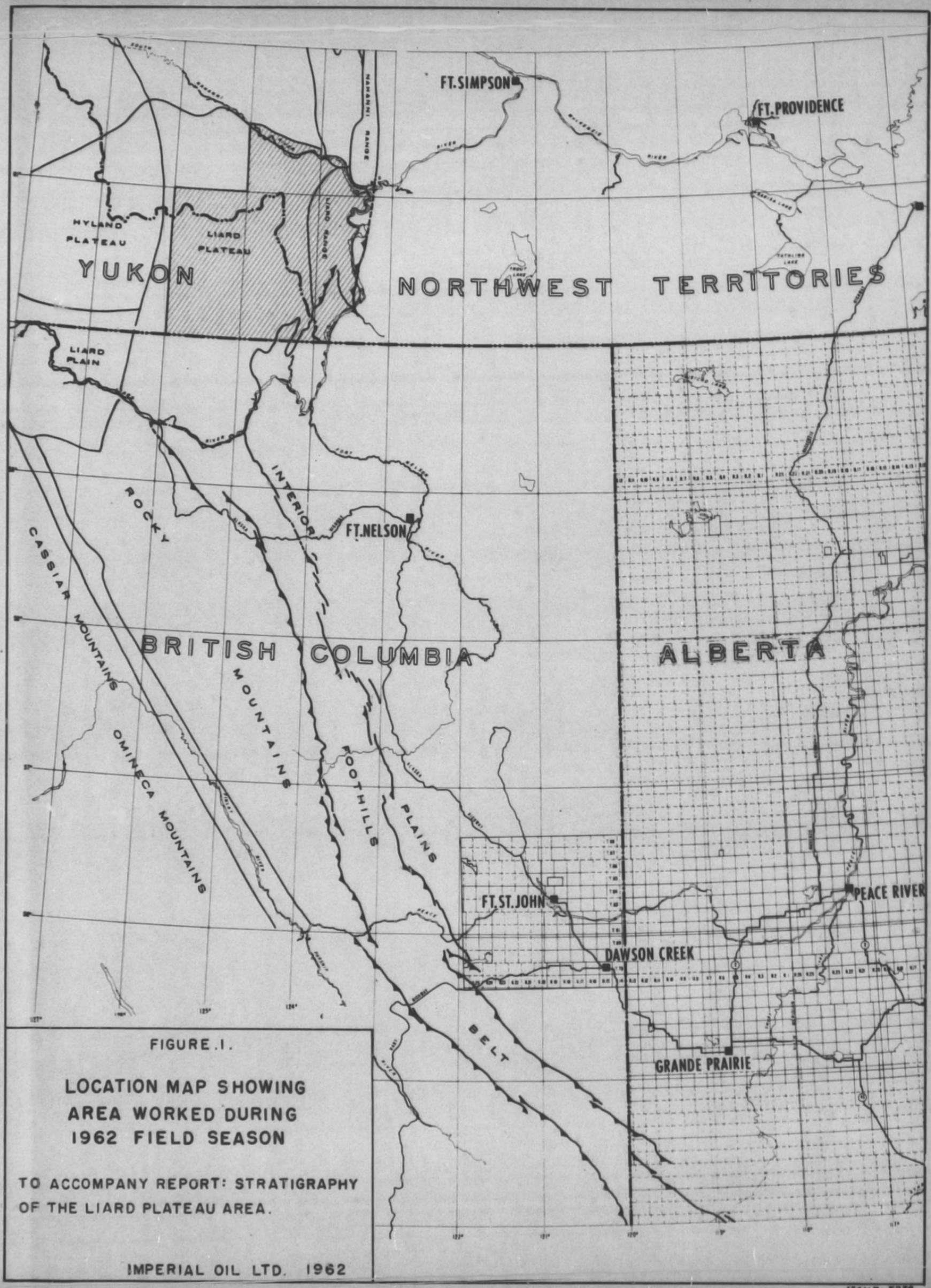

FIGURE .1.

LOCATION MAP SHOWING AREA WORKED DURING 1962 FIELD SEASON

TO ACCOMPANY REPORT: STRATIGRAPHY OF THE LIARD PLATEAU AREA.

IMPERIAL OIL LTD. 1962

RAIID: 7379

studied most extensively by means of measured sections. Outcrop sections with rocks of pre-Devonian, Devonian, Mississippian, Pennsylvanian, Permian, Triassic, and Cretaceous ages were studied at various locations. Outcroppings of rocks ranging from the Proterozoic to Cretaceous were inspected in the course of helicopter reconnaissances.

The studies were performed to evaluate Northwest Territories Permit No. 1143, held by Imperial Oil Limited.

Method of Study

Crew.--A seven man geological party spent more than seven weeks, between the latter part of May and July 24, 1962, in the field. Support aircraft included a Hiller 12-E helicopter, on charter from Okanagan Air Services, and Imperial Oil's Otter aircraft.

Base Camps.--The project area was worked from a base camp on Larsen Lake, Yukon Territory. The crew, equipment, and non-perishable supplies were transported from Dawson Creek, British Columbia to Liard River Cabins at Mile 496, Alaska Highway by truck and car. They were then flown to Larsen Lake by the Company's float-equipped Otter aircraft, operating off the Liard River. Additional supplies of gasoline were transported by truck to Muncho Lake, on the Alaska Highway, from where the Otter could operate more safely than from the Liard River. Weekly

supply trips by the Otter brought perishable goods from Dawson Creek to Larsen Lake.

Work in the extreme northeastern part of the area was aided by a gas cache at the confluence of Liard and South Nahanni Rivers at South Nahanni. This gas was barged, by Dick Turner of South Nahanni, from Fort Nelson via way of the Nelson and Liard River system.

Communications.--Communications were maintained by a Spilsbury and Tindall TRT-300 transistorized radio powered by a heavy duty 12-volt wet battery. This radio provided direct communication with Company radio facilities at Fort Nelson and Dawson Creek and Canadian National Telegraphs radio-telephone installations at Fort Nelson and Blueberry, B.C. In addition, the same radio provided ground-to-air contact with aircraft used in operations, ensuring both a greater degree of safety and more efficient usage.

Base camp to fly camp radio schedules were maintained twice daily. The fly camp radios were Spilsbury and Tindall PRT-20 transistorized transceivers powered by two 90-volt 'B' batteries and six 'D' size flashlight cells. These light, small radios radiate one and one-half watts of radio energy when properly tuned and loaded with the correct antenna. The performance of these radios was most satisfactory. Their use saved many hours of helicopter time -- flights to check fly camps daily

were eliminated, supplies for fly camps could be ordered when needed and requests for moves or information about local weather could be transmitted, thus increasing the efficiency of the overall operation.

Weather.--Generally good weather prevailed through July, with most of the fifteen "weather days" recorded occurring in June. It was noted that local weather varied greatly within the area.

Operations.--The field party was subdivided into three sub-crews, each with two men, a senior geologist and a junior assistant. They operated mainly from fly camps, engaged in measuring sections. After each section was completed these sub-crews returned to base camp to write up field notes and plot logs of the outcrop section. The duration of the fly camps varied from two days to two weeks.

Sections measured were sampled at ten foot intervals. Measurements were accomplished using tape and brunton, plane-table, or jacob's staff. Quality of the exposures was poor to fair, with the best exposures occurring in creek beds or along ridges above tree-line.

Stratigraphic reconnaissance was done by the party chief, using the helicopter. Some early stages of reconnaissance were accomplished with the Otter.

Flying hours for the helicopter totalled 140 hours, and approximately 50 hours were flown by the Otter.

Previous Investigations

Several reports about the geology of the area have been published. Among these, reports by Douglas and Norris, (1959, 1960), Hage (1945), and Stott (1960) are most pertinent. Many oil companies have conducted geological studies on the Liard Plateau and adjacent areas. Recent drilling in the Liard Plateau has indicated the existence of petroleum reserves. The actual potential of the area is, however, unknown.

STRATIGRAPHY

General Remarks

Rocks ranging in age from Proterozoic to Upper Cretaceous occur in the area. The sedimentary section is estimated to have a thickness of approximately 30,000 feet. This total thickness will not be encountered in any one locality because of local erosion or non-deposition.

The interpreted stratigraphic section for the Liard Plateau is well presented by Douglas and Norris (1959, p. 5). A Table of Formations (Fig. 2) shows the divisions made, as well as the lithology and thickness of the units as recognized for this report. Locations of sections measured in 1962 and the line of a stratigraphic cross section are indicated on one of the maps accompanying this report (in pocket). A second map shows the

thickness and distribution of the Mattson Formation. Also included is a stratigraphic cross section showing the relationships among the rocks in the principal sections measured.

Proterozoic

Precambrian rocks were not definitely identified. The lower-most rocks exposed in the area occur in the west. These are thinly bedded, platy argillites overlain unconformably by a massive conglomerate.

Paleozoic

Middle Devonian and Older

A massive boulder conglomerate which is thought to represent earliest Paleozoic deposition is exposed in the southwest part of the area. Definite age criteria are not known, however, the angular relationship with the underlying rocks and the lithology suggest that this is a basal, early Paleozoic deposit.

Banded, dark and medium grey dolomites are found at several localities in the southwest and northeast portions of the area. Their stratigraphic position suggest Ordovician or Silurian age. The thickness can only be estimated because of the folding and faulting which affects these rocks. There appears to be more than 5000 feet of section represented by these rocks.

The Ordovician-Silurian dolomites, in the northeast part

of the area, grade upwards into dark grey, medium bedded limestones. These limestones have been named Nahanni Formation by Hage (1945, p. 5) and are thought to be Middle Devonian or older. They grade laterally into shaly limestones and shales toward the south and west.

Devonian and Mississippian

Above the Nahanni Formation there is a succession of dark shales, shaly limestones, and fine grained, thin beds of sandstone and siltstone. These rocks (Douglas and Norris, 1959, map units 4, 5, and 6) represent an interval from Upper Devonian to Mississippian time. On the stratigraphic cross section these rocks are called 'Besa River Formation'.

The beds below the Mattson Formation, at some localities in the eastern part of the area, are grey limestones with interbeds of dark calcareous shale and fine grained sand. Harker recognizes faunal zones ranging in age from Upper Kinderhook to Lower Chester in these limestones. The beds are referred to herein as "Mississippian Limestones", and correspond to Douglas and Norris' (1959) map unit 7. The limestones become progressively more shaly toward the south and west. No limestones occur at the base of the Mattson in the sections at Tika Creek and Beavercrow Mountain.

Carboniferous and Permian

The Mattson Formation, a succession of thick sandstones with thin interbeds of silty carbonaceous shale and with interbedded limestones in the upper part, represents deposition during the period from Mississippian to Permian time. Previously, it was thought that sands of Permian age occurred only at the top of the Tika Creek and Liard Range sections. Results of the present study suggest that the upper portion of the Mattson at other localities is also Permian in age.

The Mattson Formation thins to the west and southwest, due to erosion and non-deposition. It is sharply bevelled to the northeast.

Above the Mattson Formation there are cherts, silts and mudstones in the southern part of the area. These are Permian in age. The Mattson in the northern part of the area is overlain by sands and shales of Lower Cretaceous age.

Permian

Cherts, sandstones, siltstones, and mudstones occur above the Mattson Formation in the southern part of the area. These are Permian in age, and on the basis of lithologic similarity to beds in British Columbia, will be referred to herein as the Prophet Formation. The Prophet Formation is thought to be unconformable with the underlying Mattson Formation and is itself truncated

toward the north where it is overstepped by beds of Lower Cretaceous age.

Mesozoic

Triassic

In the southeast, exposures of maroon and green, micaceous, silty shales beneath basal Cretaceous sands and overlying Permian chert occur on Kotaneelee River. Their stratigraphic position and lithologic similarity with Triassic rocks toward the south in British Columbia strongly suggests they are Triassic in age. The Triassic rocks thicken very rapidly southward.

Cretaceous

Strata representing deposition during both Lower and Upper Cretaceous time, occur in the area. Work on these rocks during the 1962 field season consisted only of rather superficial examination of some sections described by Stott (1960). The lowermost Cretaceous deposits consist of coarse sands and conglomerates in most places. These coarse rocks are overlain by mudstones, argillaceous sands and sandy shales.

STRUCTURAL GEOLOGY

The Liard Plateau is the southernmost expression of the Mackenzie Mountains.

The structures consist of relatively simple folds with broad, gentle synclines and more highly compressed anticlines. These anticlines are, in some places, overturned and faulted with complex local structures. Most of the structures are south plunging.

The trend of most structural features is predominantly north and south with most of the thrust faults dipping steeply toward the west.

P. W. J. Wood

GEOLOGICAL & EVALUATION
RECORDS DIVISION
MAY 22 1963
OTTAWA, CANADA
Dept. of Northern Affairs & National Resources

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1960: Virginia Falls and Sibbeston Lake Map Areas Northwest Territories; Geological Survey, Canada, Paper 60-19.

Hage, C.O.

1945: Geological Reconnaissance Along Lower Liard River, Northwest Territories, Yukon, and British Columbia; Geological Survey, Canada, Paper 45-22.

Stott, D.F.

1959: Cretaceous Rocks in the Region of Liard and McKenzie Rivers, Northwest Territories; Geological Survey, Canada, Bulletin 63.

The Triassic rocks thicken very rapidly southward.

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toward the west.

P. W. J. Wood

Geological Survey, Canada, Paper 45-22.

Stott, D.F.

1959: Cretaceous Rocks in the Region of Liard and MacKenzie Rivers, Northwest Territories; Geological Survey, Canada, Bulletin 63.

9-1-4-42

LOG OF OUTCROP SECTION

STATION NO. LIARD RANGE
PRI-62 - 102, 103, 104

LOCATION: LSD. SEC. TWP. RGE. W M.
UNIT ZONE N.T.S.
SEC. LAT 60°50' LONG 123°45' M-21

Description of location: MEASURED IN LIARD RANGE APPROX. 5 MILES W. OF MT. FLETT, N.W.T. 60°50' 123°45' M-21 IS AT BASE OF MUSKWA FORMATION (10,400' DEPTH)

ELEVATION: MEASURED METHOD: TAPE & BRUNTON

FORMATIONS

DEPT. OF NORTHERN AFFAIRS & NATIONAL RESOURCES
OIL & GAS DIVISION
JUN 3 1963
Oil Conservation Engineer
Technical Surveillance & Taboo Section

TO ACCOMPANY REPORT

STRATIGRAPHY OF THE LIARD PLATEAU AREA.

BY: IMPERIAL OIL LIMITED

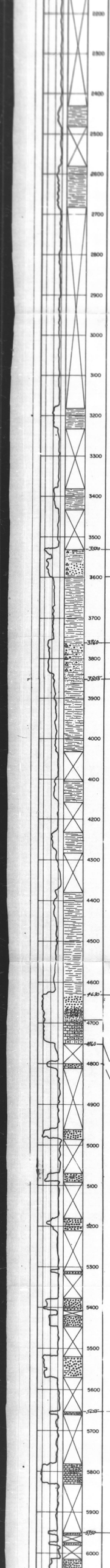
DATE: 1962.

LEGEND

Coal | Salt | Anhydrite | Dolomite | Limestone | Massive Chert | Conglomerate | Sandstone | Siltstone | Shale

IMPERIAL OIL LIMITED EXPLORATION DEPARTMENT PEACE RIVER DISTRICT

Res.	Lith.	Footage	Description
			CRETACEOUS PART OF SECTION FROM D.F. STOTT (1960)
		0	CRETACEOUS (4690')
		30'	Fort Nelson Formation 30'+. sandstone, fine grained, grey, grey buff weathering, soft, porous, some cross laminae, massive 1' to 6' beds.
		100	Lepine Formation (3500')
		115'	Interbedded sandstone and shale. Sandstone, silty argillaceous, very fine grained, fairly cross laminated, carbonaceous. Shale, platy to rubbly, greyish black, rusty weathering siltstone beds.
		300	Shale, fissile, rubbly, greyish black, rusty weathering, some olive drab, occasional selenite rosette, silty ironstone concretionary, occasional sandstone interbed.
		400	
		500	
		600	
		700	
		800	
		900	
		1000	
		1100	
		1200	
		1300	
		1400	
		1470'	Sikanni (360')
		1500	Siltstone, argillaceous, slightly sandy, blocky to massive, greyish black to brownish grey, rusty weathering few concretions, thin siltstone showing cross laminae, glauconite.
		1600	Mudstone, silty, blocky, greyish black, rusty weathering, occasional siltstone laminae.
		1700	
		1800	
		1830	
		1900	Shale, silty at top, slightly silty throughout, fissile to rubbly, greyish black, rusty weathering ironstone concretionary beds.
		2000	
		2100	
		2200	
		2300	
		2400	
		2500	



Scatter Formation (325')

Upper sandstone, fine grained, greenish gray, cross laminated, medium bedded, glauconitic, hashy cross laminated shale partings and siltstone beds.

Middle shale.

Shale, rubbly, rusty weathering concretions.

Sandstone, fine grained, greenish gray, cross laminated, platy, and siltstone, sandy argillaceous.

Lower sandstone, ~~shale~~

Shale, platy, silty, sandy laminations.

Garbutt formation (975')

Shale, dark gray, rusty weathering, slightly silty, ironstone concretions, fissile to rubbly, occasional bentonite bed.

Basal sandstone. (60')

Sandstone, very fine grained, becoming fine to medium grained in upper 10', 15% hematitic chert, feldspar near base, trace glauconite, carbonaceous, buff weathering. Fair to very good intergranular porosity.

-4670'

Conglomerate, chert pebble, poorly consolidated, occasional siltstone pebble, pebbles from coarse sand to 6" diameter, subangular to subrounded, carbonaceous argillaceous matrix. Fossil in chert pebble.

Mattson Formation (1130')

Limestone, skeletal, very sandy, medium to coarse grained, calcite cemented.

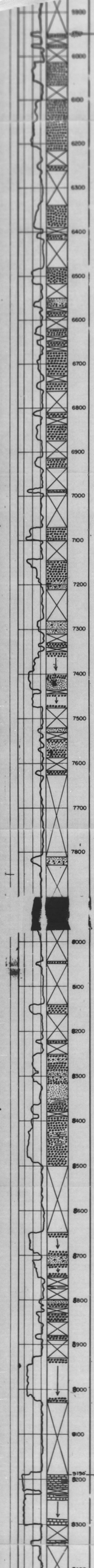
(4950-4900) Siltstone, calcareous medium gray brown calcareous, brachiopods.

1880' Baja section PP-1-62-102.

Sandstone, light buff to medium brown, fine grained to very fine grained, slightly silty in part, calcareous in part, quartzose; good to poor intergranular porosity, thin to massive bedded, cross laminated, frequent ripple markings. Weathers gray brown and buff.

Limestone, skeletal micrite, buff, slightly sandy, thick bedded with minor amount poor, scattered pinpoint vuggy porosity. Contains brachiopods crinoid stems. Weathers buff. Contains minor chert beads and nodules.

Sandstone, gray buff and buff brown, calcareous, minor chert beads, fine to medium grained, very fine grained in part. Scattered silty and shale lines



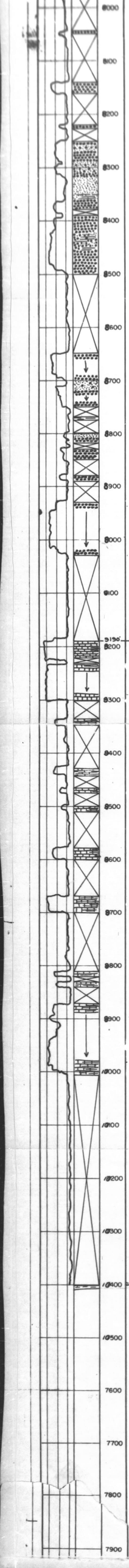
Sandstone, grey buff and buff browns, calcareous, minor chert beds, fine to medium grained, very fine grained in part. Scattered silty and shale lining beds. Thin to massive, cross bedded, carbonaceous with trace to good porosity. Porosity very good in more massive bedded sands. Quartzose sand and shale, grey brown to buff brown, some beds stained orange and reddish brown.

End PAR-62-102

MISSISSIPPIAN LIMESTONE UNIT (820')

Beginning PAR-62-103

Limestone, micritic skeletal, argillaceous, carbonaceous in part, thick to thin bedded, hard, with scattered thin black calcareous shale interbeds. Scattered fossils, scattered traces pinpoint vuggy porosity, strong sulfurous odor from



End PRI-62-102

MISSISSIPPIAN LIMESTONE UNIT (820')

Beginning PRI-62-103

Limestone, micritic skeletal, argillaceous, carbonaceous in part, thick to thin bedded, hard, with scattered thin black calcareous shale interbeds. Scattered fossils, scattered traces pinpoint vuggy porosity, strong sulfurous odor from fresh surfaces. Weathers dark gray.

End section PRI-62-103

Begin section PRI-59-109

Shale, black calcareous, thin-bedded, soft, weathers greyish black.

7-1-4-42

LOG OF OUTCROP SECTION

STATION NO. PRI-62-202

BEAVERCROW MTN.

LOCATION: LSD. SEC. TWP. RGE. W M.
UNIT ZONE N.T.S
SEC h-71 LAT 60°01' LONG 124°57'

Description of location:
BEAVERCROW MOUNTAIN SECTION

SECTION IS MEASURED IMMEDIATELY EAST OF S.O.B.C. BEAVERCROW.

ELEVATION MEASURED Alidade
METHOD Stadia Beaman Arc.

FORMATIONS

GEOLOGICAL BRANCH ASSESSMENT REPORT
JUN 8 1963
OIL CONSERVATION ENGINEER
Petroleum Exploration & Mining Engineering

TO ACCOMPANY REPORT

STRATIGRAPHY OF THE LIARD PLATEAU AREA

BY: IMPERIAL OIL LIMITED

DATE: 1962.

LEGEND

Coal | Salt | Anhydrite | Dolomite | Limestone | Massive Chert | Conglomerate | Sandstone | Siltstone | Shale

IMPERIAL OIL LIMITED EXPLORATION DEPARTMENT PEACE RIVER DISTRICT

Res.	Lith.	Footage	Description
			OVERTHIN BY PROPHET FM.
		0	MATSON FORMATION (2230'+)
		0-398'	Sandstone - light brownish grey to dark grey, quartzitic with minor chert, fine grained to very fine grained massive with some silty interbeds. Fine banding evident in most samples. Cross bedding is some outcrops. Strike N0-10°(T) dip 10°E. Trace to 5% silica cement. Deeply weathered with dusty limonite coating grains, friable.
		400	
		400-435	Limestone - medium to dark grey, interbedded silty micritic and skeletal limestone, medium to thin bedded, platy to blocky fracture, argillaceous and sandy in part. Fetid odour, one bed of skeletal limestone in petroliferous. Crinoidal debris common; occasional large rhynchonellids, solitary horn corals, few productids and rare spirifer(?). Minor to abundant cross bedding and scour-fill structure toward base. Possible intraformational breccia at base?
		500	
		600	
		680-700	Sandstone - light brown to buff, quartzitic, fine to very fine grained, well sorted, deeply weathered, limonite dust lining apparent porosity, massive, good cliff-former. Marks of minor silt. Trace to 5% silica cement.
		700	
		700-1470	Siltstone - light grey brown to dark grey-brown, weathers light brown; platy, finely laminated; micritic limestone matrix common toward top, less common toward base. Becomes sandy toward base; Pelecypod and Brachiopod molds in top micritic silty limestone; Asterid from middle silt and barren of megafossils toward base.
		800	
		900	
		1000	
		1100	
		1200	
		1300	
		1400	
		1500	
		1515-2230	Sandstone - light brownish grey to medium grey, quartzitic, fine to very fine grained, silty in part, massive, cliff forming, deeply weathered with limonite dust coating grains and giving an apparent excellent intergranular porosity (friable) to a quartz cemented light sandstone for at base.
		1600	
		1700	
		1800	
		1900	
		2000	
		2100	
		2200	
		451	base of section measured
		2300	
		2400	

7-1-4-42

LOG OF OUTCROP SECTION

STATION NO. PRI-62-207
MEILLEUR RIVER

LOCATION: LSD. SEC. TWP. RGE. W. M.
UNIT ZONE N.T.S C-70
SEC. LAT 61°10' LONG. 124°30'

Description of location:
North flowing tributary of Meilleur River

ELEVATION MEASURED METHOD

FORMATIONS

DEPT. OF LANDS, FORESTS & WATER RESOURCES
OTTAWA, ONTARIO
JUN 3 1963
OIL CONSERVATION ENGINEER
Northern Territories & Yukon Territory

TO ACCOMPANY REPORT

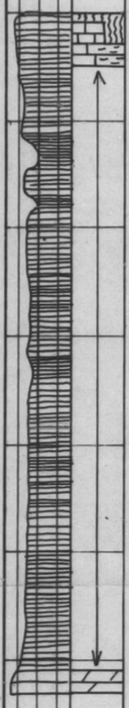
STRATIGRAPHY OF THE LIARD PLATEAU AREA

BY: IMPERIAL OIL LIMITED.
DATE: 1962.

LEGEND

Coal | Salt | Anhydrite | Dolomite | Limestone | Massive Chert | Conglomerate | Sandstone | Siltstone | Shale

IMPERIAL OIL LIMITED EXPLORATION DEPARTMENT PEACE RIVER DISTRICT



Description

MIDDLE DEVONIAN (640'+)

0-610 Interbedded limestone - dark grey, micritic, argillaceous and Shale - fissile to platy, dark grey, calcareous. Top 30' silicified

610-630 Dolomite - dark grey, very fine to fine crystalline with abundant crinoidal debris, tight.

7-1-4-42

LOG OF OUTCROP SECTION

STATION NO. PRI-62-207
MEILLEUR RIVER

LOCATION: LSD. SEC. TWP. RGE. W. M.
UNIT ZONE N.T.S C-70
SEC. LAT 61°10' LONG. 124°30'

Description of location:
North Howard Tributary of Meilleur River

ELEVATION MEASURED METHOD

FORMATIONS

OIL & GAS CONSERVATION BOARD
JUN 3 1963
OIL CONSERVATION ENGINEER
Department of Lands, Forests & Water Resources

TO ACCOMPANY REPORT

STRATIGRAPHY OF THE LIARD PLATEAU AREA

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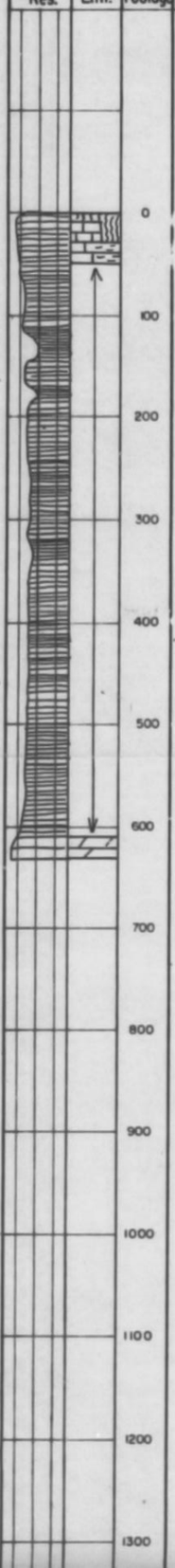
DATE: 1962.

LEGEND

Coal | Salt | Anhydrite | Dolomite | Limestone | Massive Chert | Conglomerate | Sandstone | Siltstone | Shale

IMPERIAL OIL LIMITED EXPLORATION DEPARTMENT PEACE RIVER DISTRICT



Description

MIDDLE DEVONIAN (640'+)

0-610 Interbedded limestone - dark grey, micritic, argillaceous and Shale - fissile to platy, dark grey, calcareous. Top 30' silicified

610-630 Dolomite - dark grey, very fine to fine crystalline with abundant crinoidal debris, tight.

288

7-1-4-42

LOG
OF OUTCROP SECTION

STATION NO. PRI-62-4 S
TLOGOTSHO RGE

LOCATION: LSD. SEC. TWP. RGE. W. M.
UNIT a ZONE 44 N.T.S. 95 F S.E.
SEC LAT 61° 10' LONG 124° 45'

Description of location: Located at top of section at top of Tlogotsho Rge. Measured down small creek flowing north north east off range.

ELEVATION

MEASURED METHOD

FORMATIONS

JUN 3 1963
OIL CONSERVATION ENGINEER
Northwest Territories & Yukon Territory

TO ACCOMPANY REPORT

STRATIGRAPHY OF THE LIARD PLATEAU AREA.

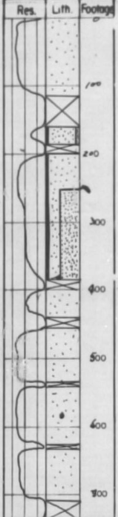
BY: IMPERIAL OIL LIMITED.

DATE: 1962

LEGEND

Coal	Salt	Anhydrite	Dolomite	Limestone	Massive Chert	Conglomerate	Sandstone	Siltstone	Shale
■	☐	☐	⬚	▦	☐	● ☐	▒	☐	▤

IMPERIAL OIL LIMITED **EXPLORATION DEPARTMENT** **PEACE RIVER DISTRICT**


Res.
Lith.
Footage
0
100
200
300
400
500
600
700

Section PR1-62-4

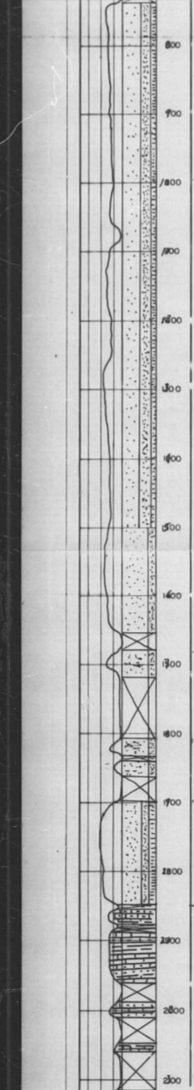
Description

Orthoquartzite; fine to medium, torrential cross bedding
good intergranular porosity

MATTSON FORMATION (2060')

Siltstone; sandy

Sandstone; orthoquartzite; as above; with fair porosity

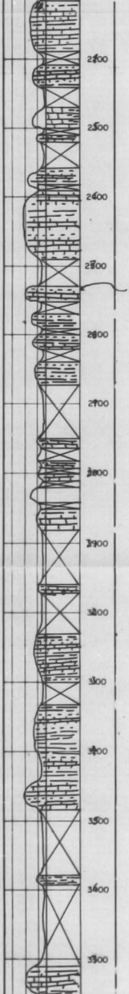

800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300

Orthoquartzite; very fine grained poor intergranular porosity
and
Siltstone; with carbonaceous and argillaceous partings.

Orthoquartzite; very fine grained, slightly silty.

MISSISSIPPIAN LIMESTONE UNIT (1020')

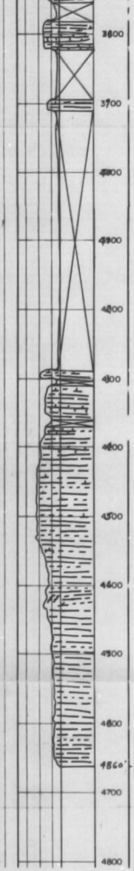
Limestone, skeletal micritic, shaly with varying amounts of shaly partings. Abundant crinoidal and brach. debris. Shales are silty, brownish black, calcareous, thin bedded and fissile.


2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700

-End of Section PR1-62-4-

Start of Section PR1-62-5 -It is continuous with PR1-62-4.

BESA RIVER FORMATION (1780')


3800
3700
4800
4900
4800
4300
4400
4500
4600
4900
4600
4860'
4700
4800

Shale, dark gray, silty, calcareous in part,
soft fissile, papery.

— base of section 5 - no further exposure

7-1-4-42

LOG OF OUTCROP SECTION

STATION NO. PRI-62-205
TWISTED MTN.

LOCATION: LSD. SEC. TWP. RGE. W M.
UNIT 33 ZONE 8 N.T.S. 95 G
SEC. LAT 61° 20' LONG. 123° 30'

Description of location: Twisted Mountain Section on southwest spur

ELEVATION MEASURED METHOD

FORMATIONS

TO ACCOMPANY REPORT

STRATIGRAPHY OF THE LIARD PLATEAU AREA

DEPT. OF MINERALS AFFAIRS & NATURAL RESOURCES
CALGARY, ALBERTA
JUN 3 1963
CONSERVATION SECTION
Mineral Resources & Taxes Section

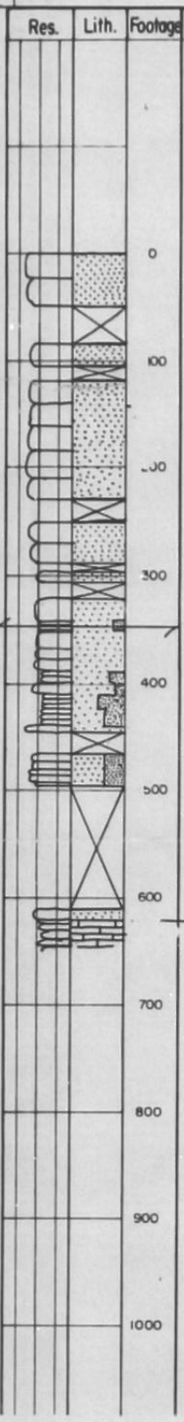
BY: IMPERIAL OIL LIMITED.

DATE: 1962.

LEGEND

Coal | Salt | Anhydrite | Dolomite | Limestone | Massive Chert | Conglomerate | Sandstone | Siltstone | Shale

IMPERIAL OIL LIMITED EXPLORATION DEPARTMENT PEACE RIVER DISTRICT



Description

Mattson Fm. (620')

Sandstone - massive to thin bedded, well sorted, buff to light red-brown orthoquartzite, cross-bedded and with ripple marks, friable, very porous, - porosity may be secondary. Limonite acts as cement in some bands but silica forms most of the cement. Large platy cavities lined with coaly dust or other carbonaceous material appear to be molds of woody material or plant material, now reduced to relicts of carbonaceous film lining cavities, becoming more platy and silty toward base. Contact with Rundle? appears conformable

fault.

MISSISSIPPIAN LIMESTONE UNIT.

Limestone - Micritic skeletal & micritic limestone with some pure skeletal limestone of crinoidal, bryozoa and coral debris. Pentamerites at top and about 500' down; thin-bedded with shale? interbeds which appear covered on the surface.

7-1-H-42

LOG OF OUTCROP SECTION

STATION NO. PR1-62-101 LA BICHE RIVER

LOCATION: LSD. SEC. TWP. RGE. W M.
UNIT ZONE N.T.S
SEC. LAT. 60°30' LONG. 124°30' (P-53)

Description of location: Falls on Labiche River, Yukon Territory. Air Photo #A12320-318 Station #101

ELEVATION MEASURED METHOD Tape & Brunton

FORMATIONS

DEPT. OF NORTHERN AFFAIRS & NATIONAL RESOURCES OTTAWA, CANADA
JUN 3 1963
OIL CONSERVATION ENGINEER
Northwest Territories & Yukon Territory

TO ACCOMPANY REPORT

STRATIGRAPHY OF THE LIARD PLATEAU AREA.

BY: IMPERIAL OIL LIMITED.

DATE: 1962.

LEGEND

Coal | Salt | Anhydrite | Dolomite | Limestone | Massive Chert | Conglomerate | Sandstone | Siltstone | Shale

IMPERIAL OIL LIMITED EXPLORATION DEPARTMENT PEACE RIVER DISTRICT

Res.	Lith.	Footage	Description
		0	PROPHET FORMATION (440')
			Siltstone, light to medium grey, slightly shaly with thin interbedded cherts. Tight, hard, weathers creamy buff. Upper 30' not measured or sampled.
		68	
		100	Shale, black, shaly, very slightly silty, thin bedded. Tight weathers greyish buff to greyish black.
		175	
		200	Siltstone, mottled grey to grey black, shaly, shaly bands. Tight massive, weathers red-buff.
		219	
			Shale, greyish black, silty with scattered silt bands, slightly siliceous thin platy bedded. Tight Weathers buff brown.
		300	
		400	
		420	MATTSON FORMATION (340'+)
		440	Shale, black, siliceous, underlain by red weathering calcareous shale. Siltstone, brownish black, sandy, calcareous, tight. Weathers buff.
		500	Sandstone, dark brown, very fine grained, slightly silty, calcareous, scattered poor intergranular porosity, minor shaly interbeds, weathers buff brown. Massive, hard.
		600	
		665	
		700	
		770	
		780	Sandstone, very calcareous as above.
		800	
		900	
		1000	
		1100	
		1200	
		1300	

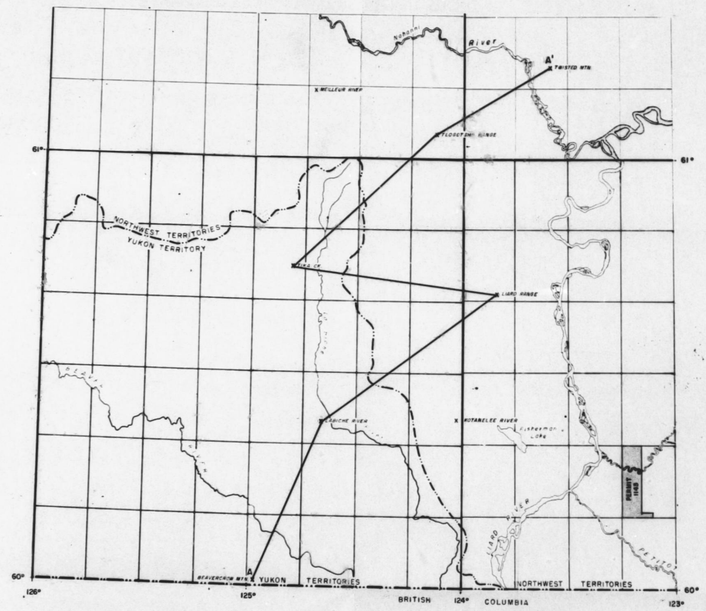


FIG. 3

LOCATION MAP OF
LINE OF CROSS SECTION A-A'
AND
OUTCROP SECTIONS

SCALE: 1 INCH TO 8 MILES

JUN 8 1965

TO accompany report: Stratigraphy of the Liard Plateau Area

By Imperial Oil Ltd. 1962

7-1-4-42 284

30x
West Canadian Graphic Industries Ltd.

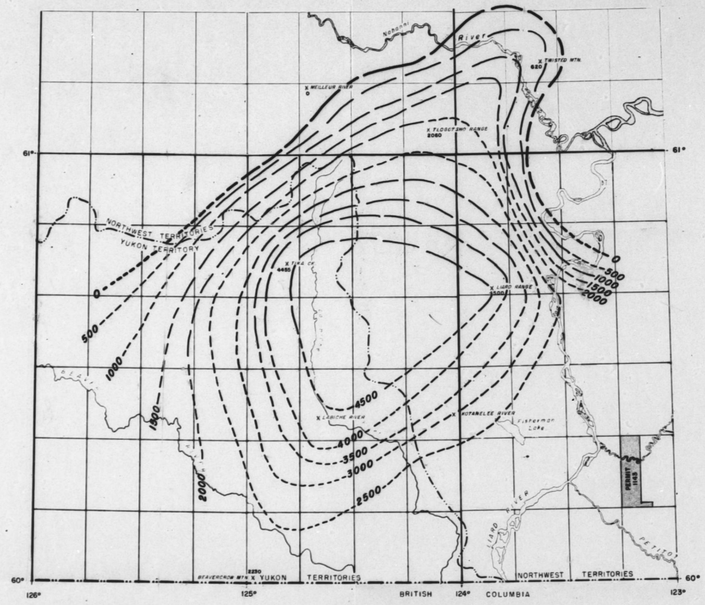


FIG. 4

ISOPACH

MATTSON FORMATION

CONTOUR INTERVAL 500 FT.

SCALE: 1 INCH TO 8 MILES

JUN 3 1965

TO accompany report: Stratigraphy of the Liard Plateau Area

By Imperial Oil Ltd. 1962

7-1-4-42 288

30x
West Canadian Graphic Industries Ltd.

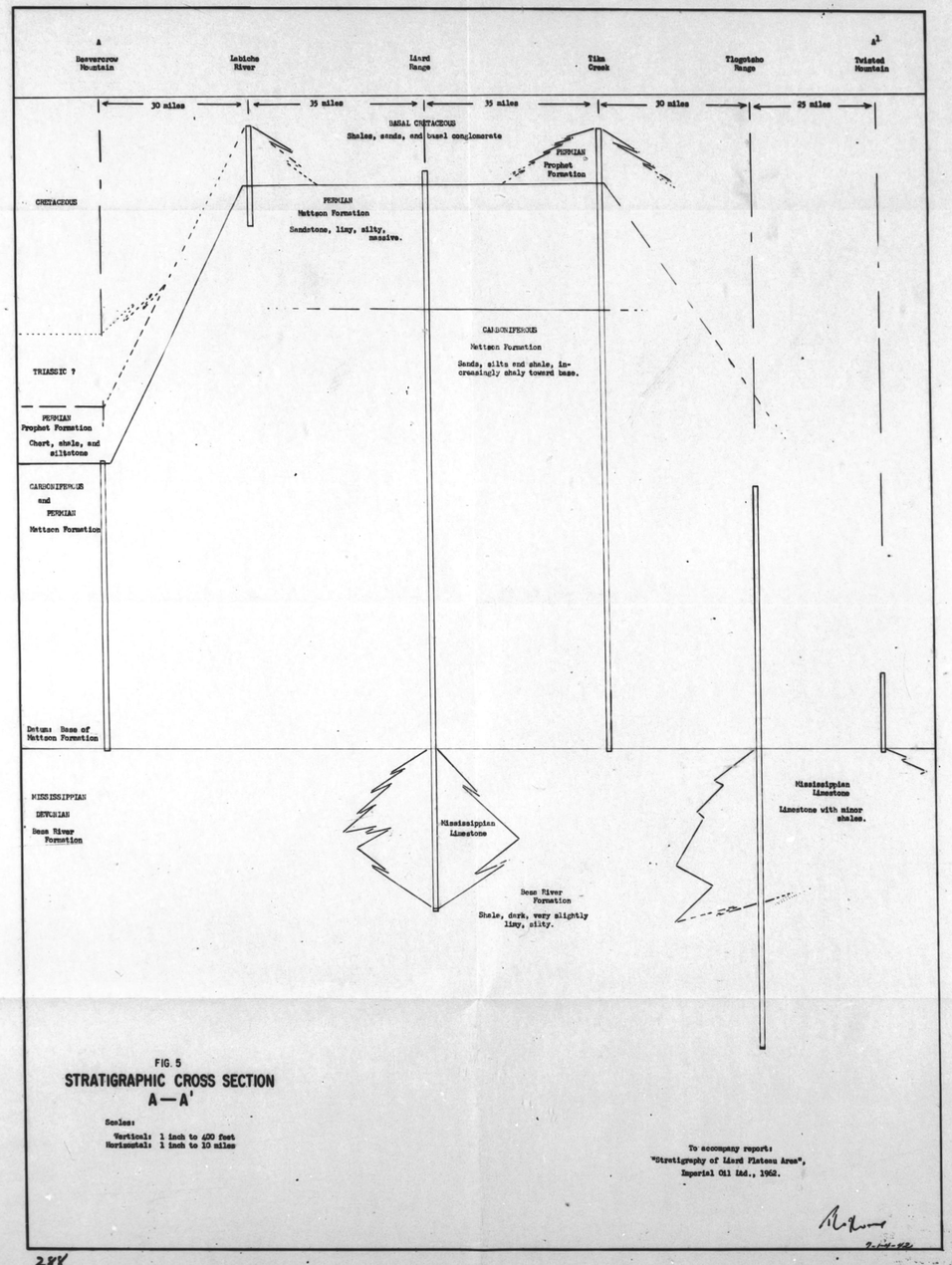


FIG. 5

STRATIGRAPHIC CROSS SECTION
A—A'

Scales:
Vertical: 1 inch to 400 feet
Horizontal: 1 inch to 10 miles

To accompany report:
"Stratigraphy of Liard Plateau Area",
Imperial Oil Ltd., 1962.

9-14-62

284

JUN 8 1965

PROGRESS REPORT

For the Period April 29, 1957 to October 29, 1958

Petroleum and Natural Gas Permit #1143

- TABLE OF CONTENTS -

A.	Introduction	Page 1
B.	Geography	Pages 2 & 3
C.	Stratigraphy	Pages 4 to 9
D.	Structure	Pages 10 to 12

Enclosures

1. Location Map of Ft. Liard-Bovie Lake Area
2. Air Photographs
3. Surface Geological Map

INTRODUCTION

During the period June 1 to June 19, 1958, surface geological work was carried out in the Fort Liard - Bovie Lake area to evaluate acreage held under Permit 1143. The area covered extends from Latitude 60°00' to 60°26' North and Longitude 122°38' to 123°32' West (Plate 1). Permit 1143 lies in the central part of the area and extends from Latitude 60°10' to 60°20' North and Longitude 123°07.5' to 123° 15' West.

Reconnaissance surveys had been carried out in this area by Imperial Oil prior to 1958. In 1945, C.O. Hage traversed the Liard and Petitot Rivers, his work constitutes the only published source of information. Texaco W.F.A. Bovie Lake No. 1 was drilled in 1957 on a structure south-west of Bovie Lake. It was abandoned at 1400 feet.

The purpose of this survey was to examine the stratigraphic section in the area and to obtain structural data along the Petitot and Muskeg Rivers and on the ridges adjacent to Bovie Lake.

A field crew of five geologists supported by a Bell G-2 helicopter was used. Some vertical aerial photography was done by Imperial Oil prior to the field season to aid in the location of seismic lines in the eastern part of the area.

GEOGRAPHY

The area east of the Liard Range lies within the Central Plains physiographic province. It is drained by the Liard River and its tributaries which flow in broad channels, cut several hundred feet below the general level of the country. The Petitot River flows through a canyon 300 to 400 feet deep for ten miles where its course is constricted by resistant rocks. Beyond the river channels, the land is poorly drained, shallow lakes and muskeg are common. The largest lakes in the area are Maxhamish Lake and Bovie Lake.

The southern end of the Liard Range, which lies within the area, has a maximum elevation of 2715 feet above sea level. The maximum relief is 2000 feet. East of the Liard River a broad rolling plain ranging in elevation from 1200 to 1700 feet above sea level extends over the rest of the area. It is broken by two prominent ridges near Bovie Lake which rise sharply to a maximum elevation of 2050 feet.

The entire area is covered by a dense growth of spruce, poplar and alder most of which is second growth over burned out areas.

The Liard River is navigable by barge and supplies may be landed at the settlement of Fort Liard. Float equipped aircraft can land on the Liard River, Maxhamish Lake and Bovie Lake. There are no roads through the area, however, numerous

GEOGRAPHY (Cont'd)

seismic cut lines and trails provide access to the area during the winter. Clearings on the ridges near Bovie Lake and some seismic lines can be used as helicopter landing sites. The muskeg, deadfall and dense second growth make travel difficult through the bush.

STRATIGRAPHY

General Stratigraphy

Rocks exposed in the Fort Liard - Bovie Lake area range in age from Mississippian to Pleistocene. Outcrops are generally poor except along part of the Petitot River. Samples from the Bovie Lake No. 1 well have added valuable stratigraphic information.

Mississippian

Rundle Formation:- No complete section of the Rundle formation is exposed in the area. Outcrops are restricted to the ridges northwest and southwest of Bovie Lake and to the Liard Range. Immediately south of the area, on the Petitot River, the upper 265 feet of the Rundle were examined. There, it consists of light grey weathering, grey, microgranular, fossiliferous, cherty limestone. Fossils collected throughout the area indicate that these beds are correlative to the Rundle formation in the Rocky Mountains.

Mississippian and Pennsylvanian

Mattson Formation:- The type section of the Mattson formation (Patton, 1958, p. 319) in the Wahanni River area consists of 3764 feet of quartzose, light grey to white, fine to medium grained massively bedded sandstone. This is an incomplete section as the upper beds are not exposed. The

Mattson Formation (Cont'd)

lower part contains minor coal beds and coaly lenses. Some calcareous bands are present.

In the Fort Liard - Bovie Lake area, 1000 to 1500 feet of quartzose, fine grained, friable, sandstone overlie the Rundle limestone. This sand is correlated lithologically to the Mattson.

The Mattson outcrops along the Liard Range and along the ridge southwest of Bovie Lake. Bovie Lake No. 1 drilled an incomplete section 1250 feet thick. Corrections for dip of the beds and deviation of the hole place this thickness at about 1000 feet.

Patton (1958, p. 323) considered the Mattson formation to be Mississippian in age; however, Hage (1945, p. 19) found fossils of possibly Lower Pennsylvanian age in it west of the area. It seems probable that the upper part of the Mattson is Pennsylvanian.

Permian

Black, grey and brown chert overlies the sands of the Mattson formation. It is invariably poorly exposed throughout the area. The chert outcrops on the Liard Range and sporadically along the ridge southwest of Bovie Lake. Bovie Lake No. 1 penetrated the lower 120 feet of the chert. On the south end of the Liard Range, Hage (1945, p. 17) measured the

Permian (Cont'd)

upper 75 feet, but did not reach the contact with the Mattson. The thickness of the chert, therefore, is in excess of 120 feet, but it is probably less than 200 feet.

Permian fossils were collected from sandstone above the chert along the Beaver River, 40 miles west of the area. Kindle (1944, p. 5) considered that the sandstone and chert were Permian in age.

Triassic

Beds of Triassic age do not appear to be present in the Fort Liard - Bovie Lake area.

Lower Cretaceous

Garbutt Formation:- The type section of the Garbutt formation lies 50 miles southwest of the area (Kindle, 1944, p. 10). There, it consists of 2000 feet of friable, dark grey, rusty weathering shale. The Garbutt is not exposed in the area and it is possible that it is not present. If the Garbutt is present, it is only a few hundred feet thick.

Scatter Formation:- Rocks lithologically similar to Kindle's (1944, p. 11) Scatter formation were recognised over a large part of the area. Hage, (1945, p. 20) estimated that the

Scatter Formation (Cont'd)

Scatter on the Petitot River was 625 feet thick; however, a section measured along the river gave a thickness of 940 feet for the formation. It is made up of three units: an upper sand, a middle shale and a lower sand. The upper sand is 220 feet thick and consists of buff and greenish-grey weathering, light grey, quartzose, very fine grained, carbonaceous and glauconitic sandstone. The middle shale unit is mainly covered, where exposed it consists of interbedded siltstone and silty shale. The lower sand is 100 feet thick and is composed of sandstone similar to the upper sand with interbedded siltstone and shale. Incomplete sections of the upper sand unit are exposed at the mouths of the Petitot and Muskeg Rivers and at the junction of the Muskeg and Arrowhead Rivers.

Kindle (1944, p. 11) correlated the Scatter to the Gates formation of the Peace River foothills. No fossils were found in the Scatter in the Fort Liard - Bovie Lake area.

Lepine Formation:- The Lepine formation is incompletely exposed along the Petitot River. The lower 310 feet are composed of dark grey silty shale. Hage (1945, p. 20) found dark grey, fissile shale containing selenite crystals and ironstone concretions above this. He considered the Lepine to be about 1600 feet thick. Small outcrops of the Lepine were examined along the Muskeg and Arrowhead Rivers.

Lepine Formation (Cont'd)

The Lepine is correlative to a horizon high in the Shaftesbury formation on the Peace River. It is late Lower Cretaceous in age.

Upper Cretaceous

Fort Nelson Formation:- The Fort Nelson formation is well exposed along the canyon of the Petitot River. It consists of 500 to 800 feet of massive pebble conglomerate and sandstone which grades downward to the underlying shales of the Lepine formation (Hage, 1945, p. 21). In the canyon, the conglomerate forms nearly vertical cliffs 300 to 400 feet high.

Kindle (1944, p. 13) correlated the Fort Nelson to the Dunvegan formation of the Peace River District. The Fort Nelson is early Upper Cretaceous in age.

Kotaneelee Formation:- The Kotaneelee formation overlies the Fort Nelson formation and outcrops sporadically over the southwest part of the area. Hage (1945, p. 21) measured 345 feet of soft grey shale and buff sandstone along the Petitot River. Exposures are poor along the river as the soft shales tend to slump from the top of the Fort Nelson conglomerate.

Fossils collected by Hage indicate that the Kotaneelee is correlative at least in part to the Wapiabi formation of the Alberta Foothills.

Upper Cretaceous (Cont'd)

Post-Upper Cretaceous deposits:- Gravels of questionable Tertiary age occur along the Petitot River. Overlying these, widespread beds of Pleistocene till and gravel occur over most of the area. The most striking glacial deposits are the numerous linear till deposits which trend northeast to southwest. They appear to have been shaped by ice movement toward the southwest as the stoss slope is always at the northeast end of the ridge.

STRUCTURE

Regional Structure

General Remarks: The Fort Liard - Bovie Lake area lies within two major structural provinces. To the west, the Liard Range marks the eastern and southern extension of the Mackenzie Mountains. East of the Liard Range, there is an abrupt transition to the gentle dips and low amplitude folds which characterize the Central Plains in this region. An anomalously steep-dipping complex structure lies within the plains structural province immediately west of Bovie Lake. East of Bovie Lake, there is no surface expression of any structure.

East Liard anticline: The East Liard anticline forms the back of the Liard Range. It plunges sharply to the southeast at the mouth of the Petitot River and disappears in the southern part of the area. West of the Liard River, the west limb dips at 10 to 25 degrees. The east limb has been complicated by west dipping thrust faults. At the mouth of the Petitot River, the Scatter formation outlines the southeast plunging nose of the fold. There it is strongly asymmetric to the east, the dips being 10° west and 40° east. Above the Scatter, the Lepine shale is sheared and contorted, some thrust faulting has probably occurred. To the southeast, the structure passes rapidly to a gentle plains-type fold.

Regional Structure (Cont'd)

Bovie Lake structure: The Bovie Lake structure consists of two double plunging asymmetric, faulted anticlines which lie 15 miles east of the mountain front. It is markedly out of place in the plains area where it occurs. The structure extends from the junction of the Muskeg and Arrowhead Rivers southward into British Columbia.

On the anticline northwest of Bovie Lake, the Rundle formation is exposed for four miles at the culmination of the structure. On the west limb, dips average about 15 degrees; on the east, the dip is nearly 25 degrees. For several miles adjacent to the culmination no east limb is present; there, a forty to sixty foot limestone scarp forms the most easterly outcrop. Thrust faulting, which dies out toward the plunging ends of the fold is inferred to explain the absence of the east limb. Outcrops of the Scatter formation along the Muskeg River outline the north plunging nose of the fold.

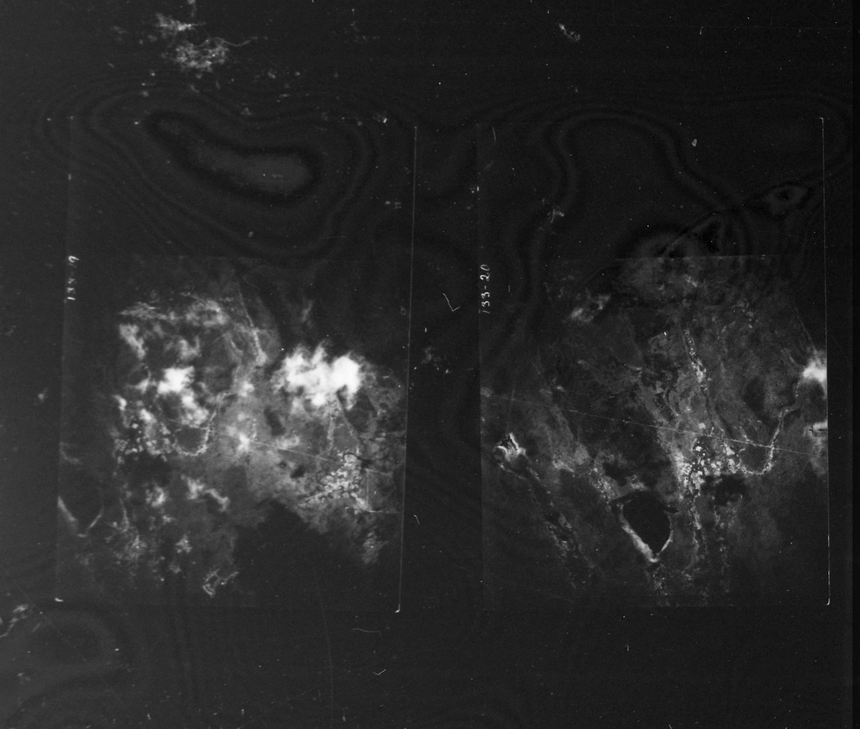
The anticline southwest of Bovie Lake is capped by the Mattson formation over most of its length. The Rundle formation is exposed mainly on the south end of the structure. A small limestone scarp occurs in front of the north end of this anticline. Immediately south of the Bovie Lake No. 1 wellsite a steeply-dipping, normal cross-fault cuts the structure.

Bovie Lake structure (Cont'd)

The fault strikes at 110 degrees and is downthrown to the north. South of the cross-fault only limestone outcrops are found, the limbs of the fold dip 25° west and 60° east, respectively. North of the cross-fault, only sandstone and chert outcrops are present, dips on the west limb vary from 30 to 45 degrees and no east limb is recognizable. A west dipping thrust is postulated along the east side of this structure.

January 23, 1959.

G. B. Darling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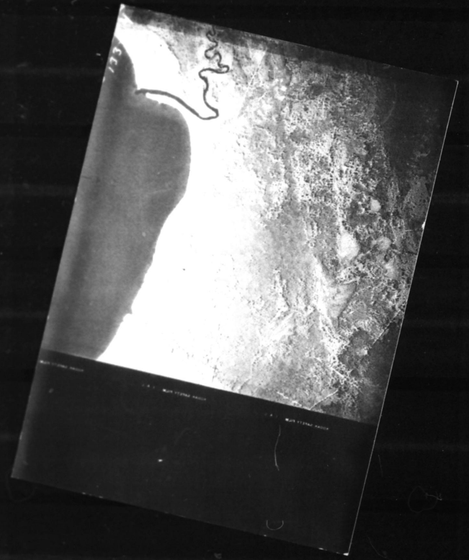

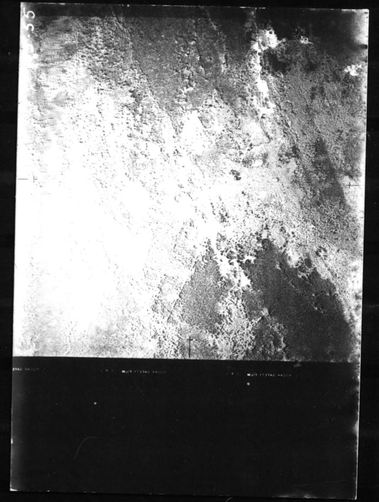

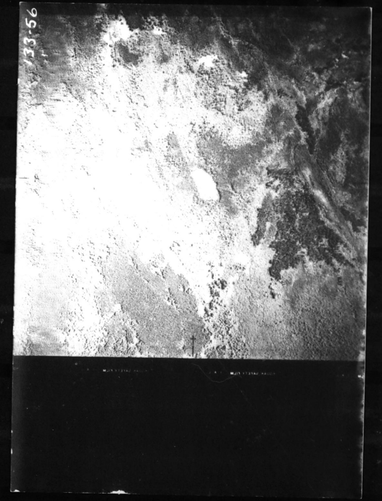

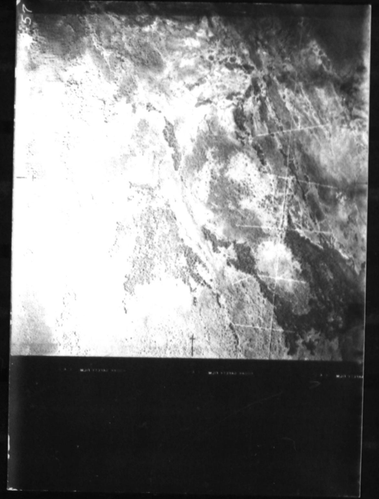

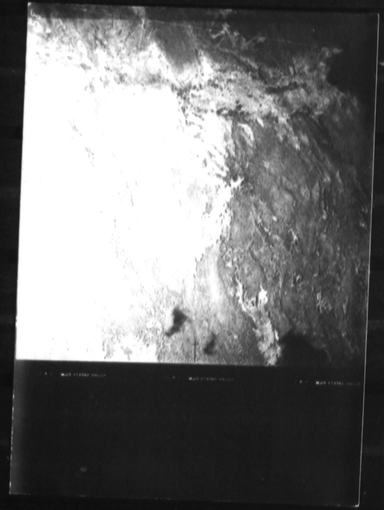

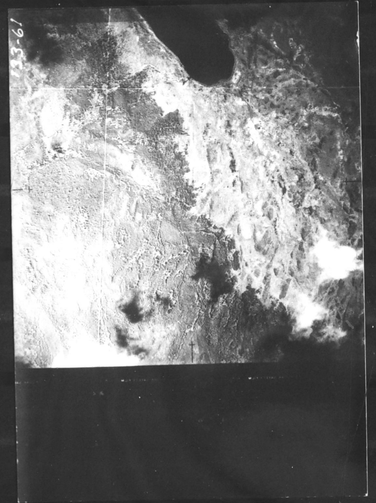

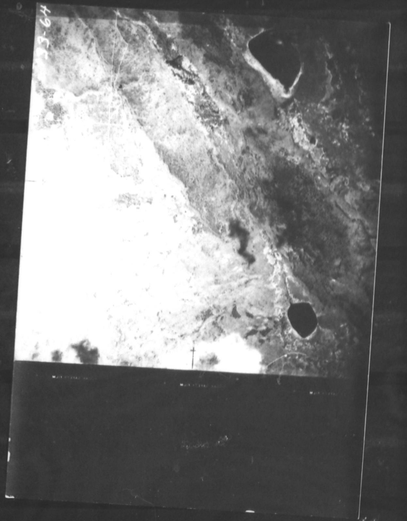

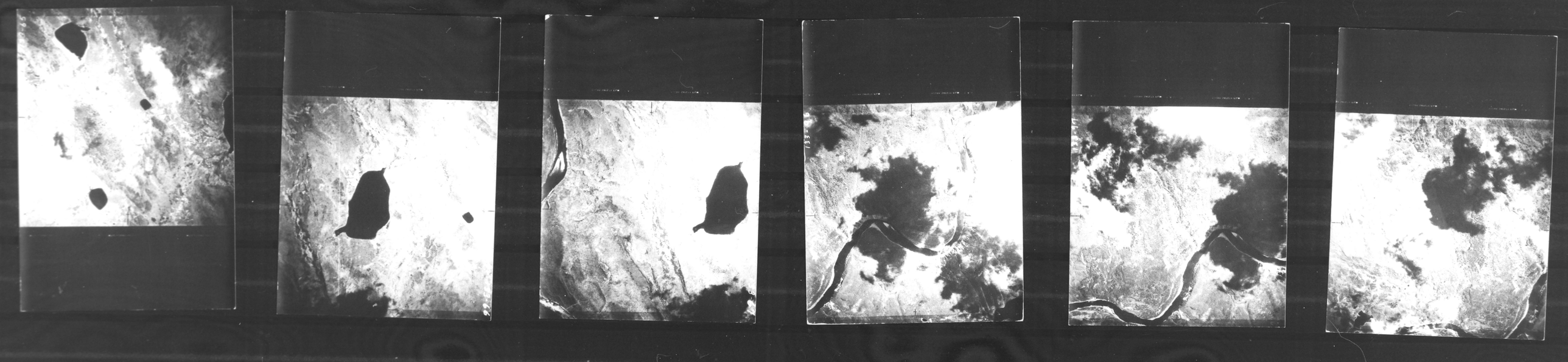

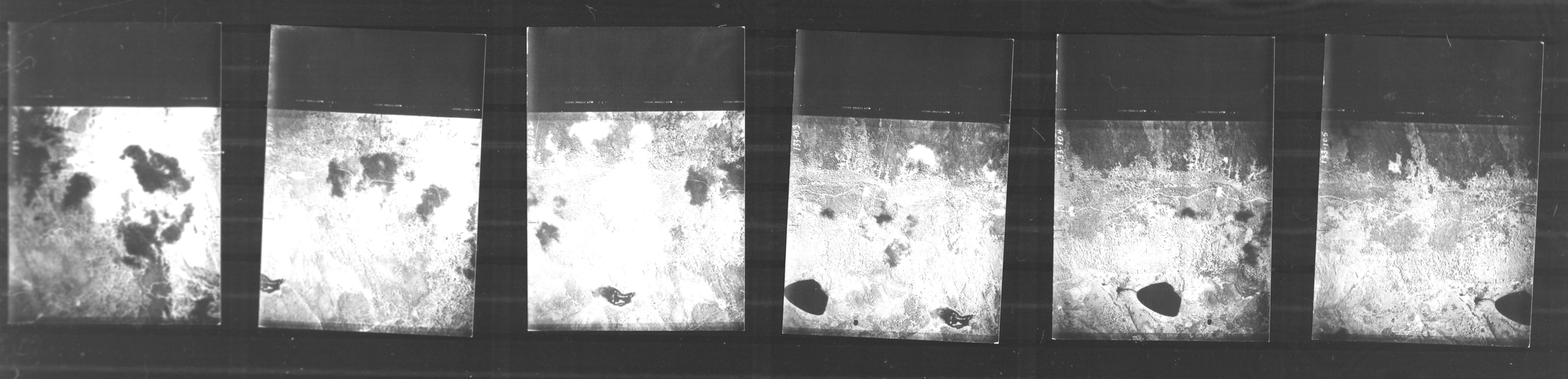
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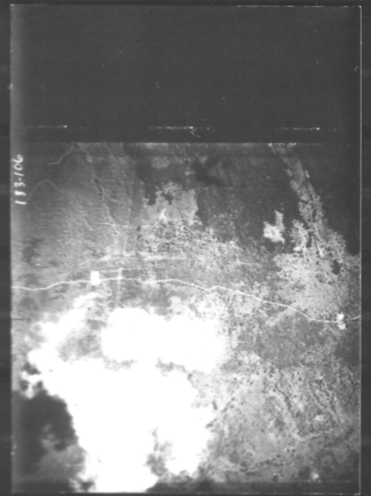
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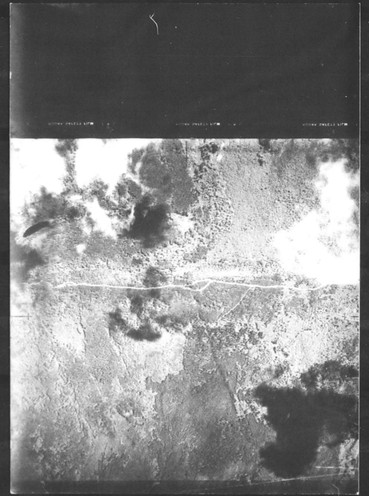

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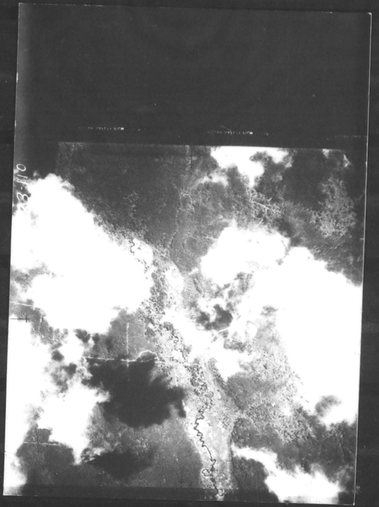
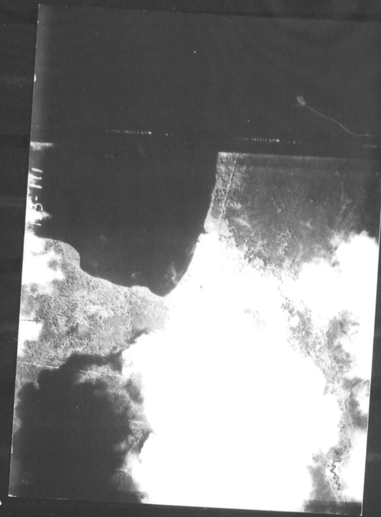

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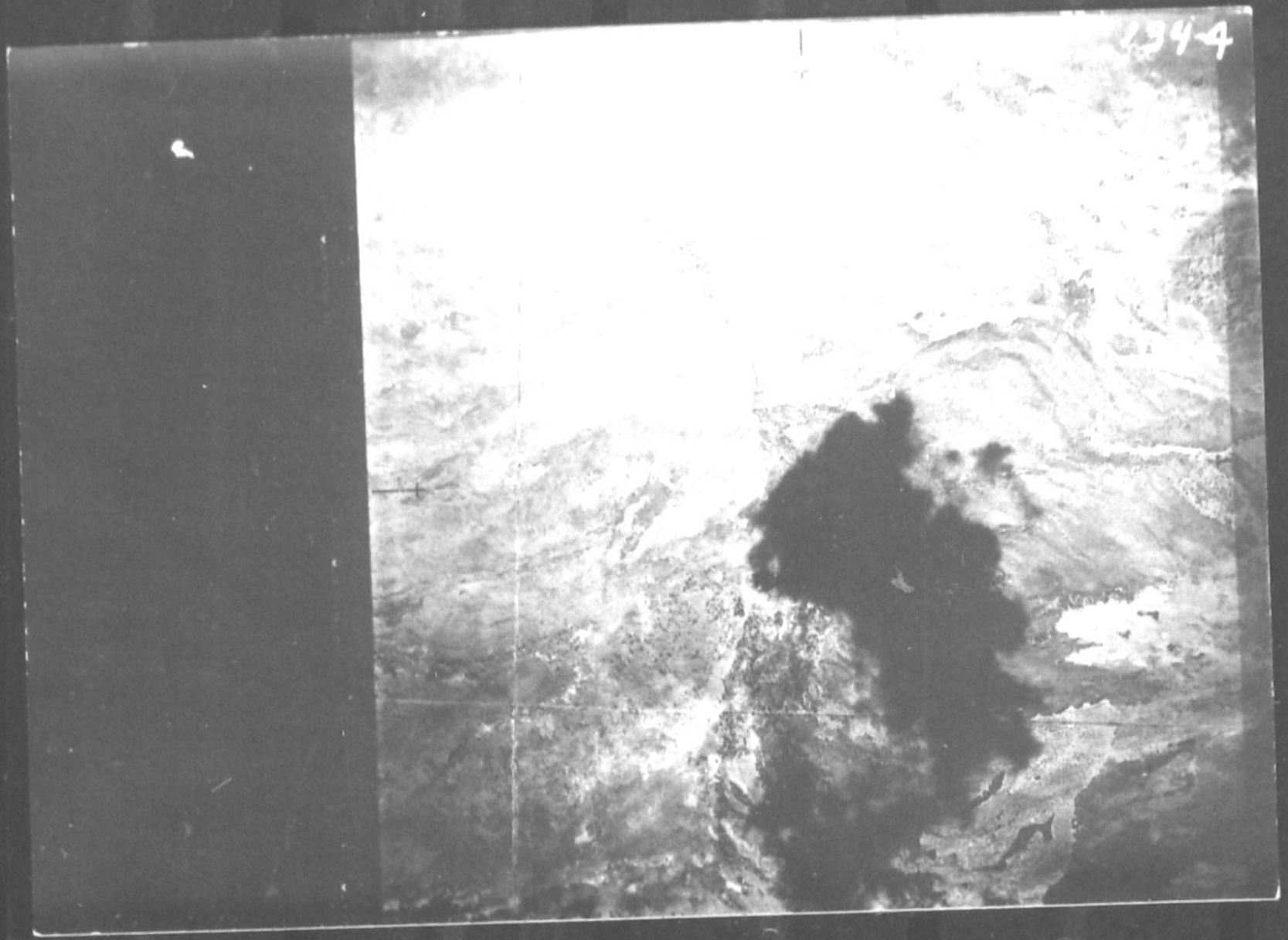
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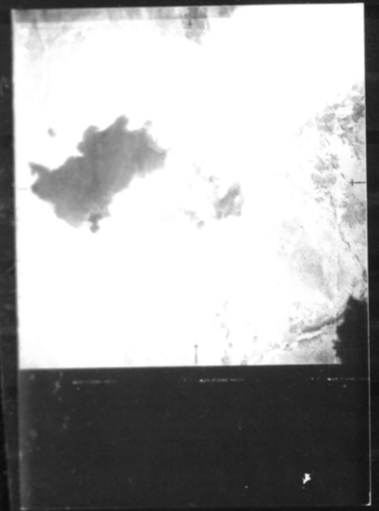

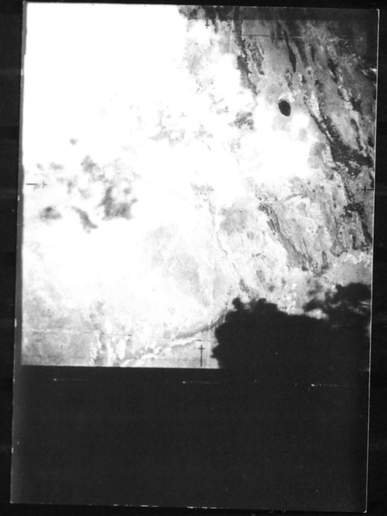

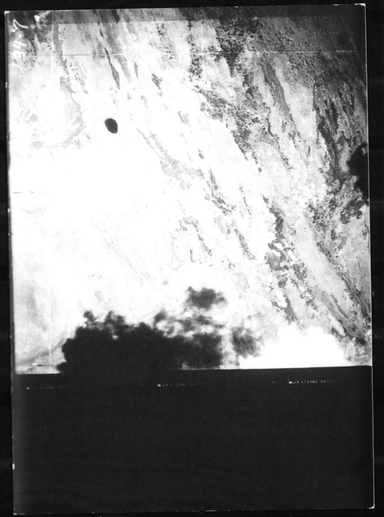

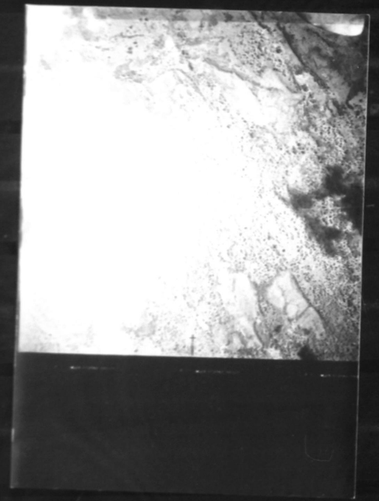
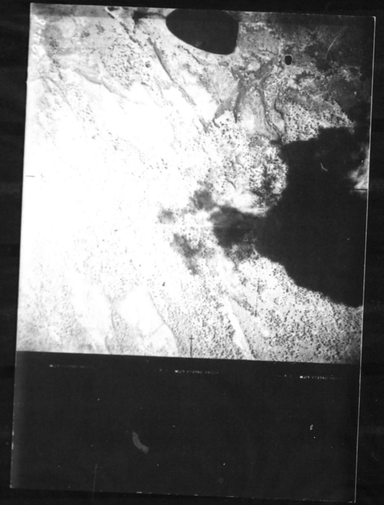
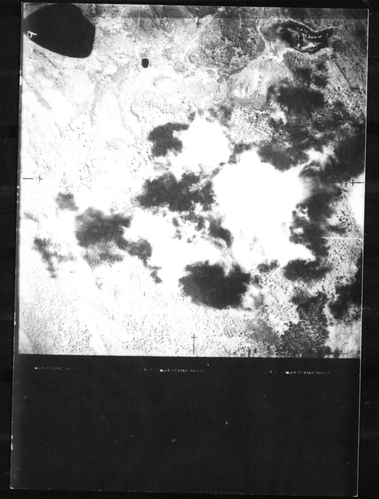

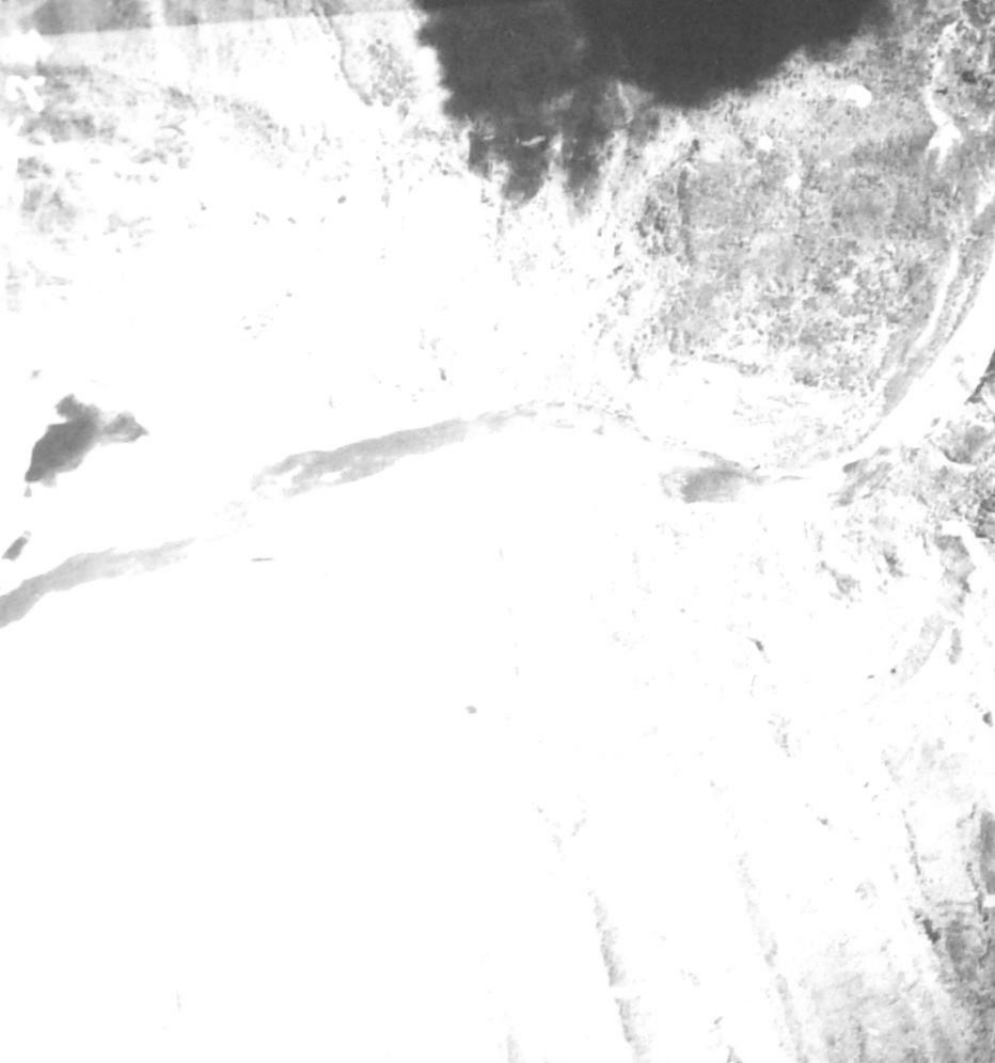

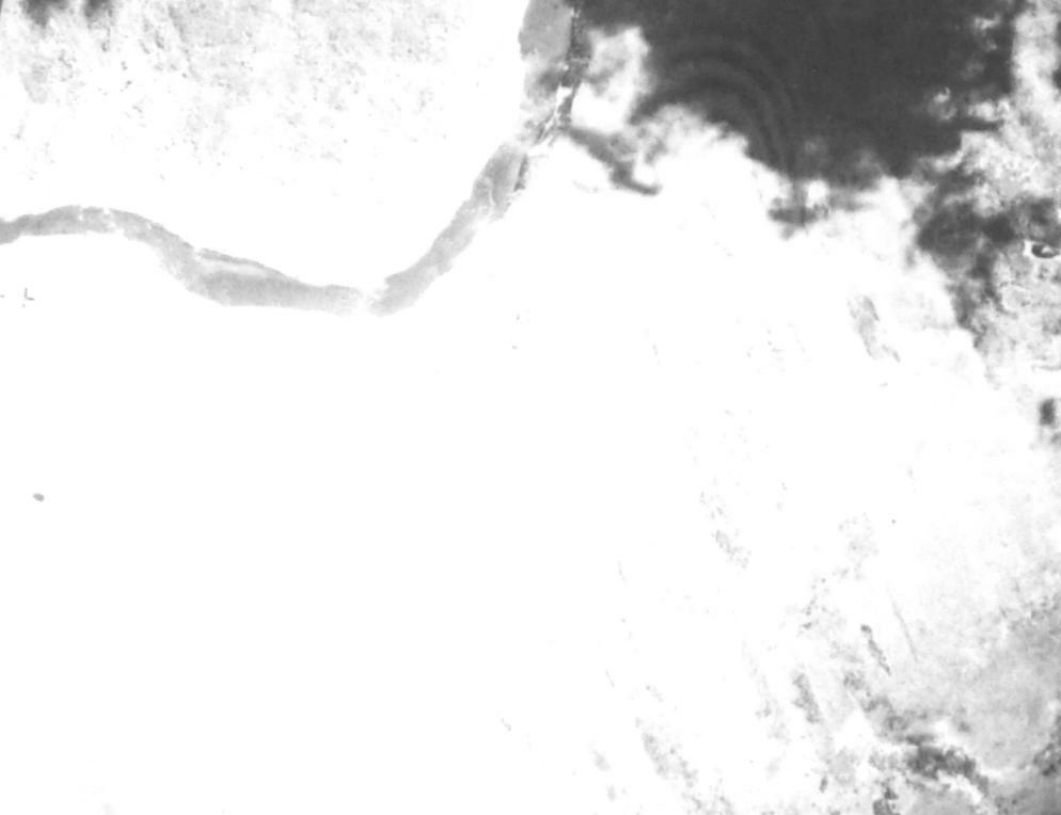

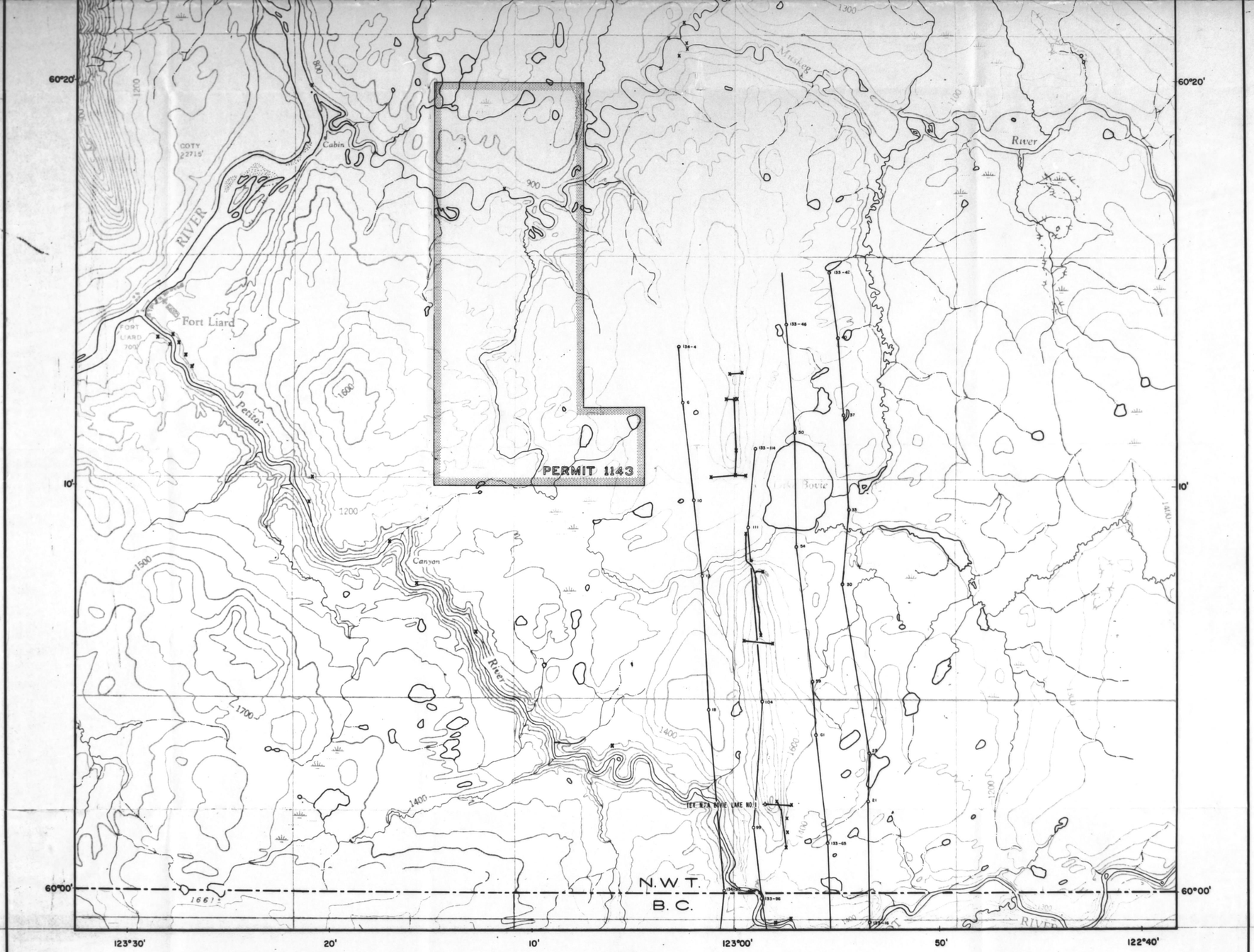

FT. LIARD—BOVIE LAKE AREA

LOCATION MAP

5 MILES

LEGEND

- x — OUTCROP
- x——x — TRAVERSE FROM POINT TO POINT
- 133-21 / 52 — PHOTO FLIGHT LINES
- P.&N.G. PERMIT OUTLINE

7-1-24

IMPERIAL OIL LIMITED — PEACE RIVER DISTRICT

JANUARY 16, 1959

287

30x
West Canadian Graphic Industries Ltd.

123°30' 20' 10' 123°00' 50' 122°40'

60°20'

10'

Arrowhead

Cabin

COTY 2715'

RIVER

Fort Liard

Petitot

PERMIT 1143

Canyon

River

Boyle

1100 1000 1300 1600 800 1200 900 1800 1500 1700 1400

TEX-HCA BOYLE LAKE NO.1

30x

West Canadian Graphic Industries Ltd.

GEOLOGICAL MAP OF FT. LIARD—BOVIE LAKE AREA

5 MILES

IMPERIAL OIL LIMITED— PEACE RIVER DISTRICT

FEBRUARY 5, 1959

TABLE OF FORMATIONS

K_u	UPPER CRETACEOUS Kotaneele Formation — Ft. Nelson Formation — undivided	K_{sc}	Scatter Formation undivided Garbutt Formation
K_b	LOWER CRETACEOUS (undivided)	PC_m	PERMIAN to MISSISSIPPIAN Permian Chert — Mattson Formation — undivided
K_l	Lepine Formation	M_r	Rundle Group

7-1-4-24
Pine
287

30x
West Canadian Graphic Industries Ltd.

APR 27 1966

123°30' 20' 10' 123°00' 50' 122°40'

60°20'

10'

PERMIT 1143

Fort Liard

Petitot River

Muskeg River

Arrowhead

Cabin

Canyon

River

PC_m K_{sc} K_l K_b K_u M_f

NOTE:
NO OUTCROP ON MUSKEG RIVER EAST OF STATION 14

NOTE:
SCATTER & LEPINE FORMATIONS CANNOT BE SEPARATED BEYOND THIS POINT.

NOTE:
SCATTER & LEPINE FORMATIONS CANNOT BE SEPARATED BEYOND THIS POINT.

NOTE:
FORT NELSON FORMATION OVERLAIN BY KOTANEELE FORMATION IN THIS AREA.

1000 1100 1200 1300 1400 1500 1600 1700

30x

West Canadian Graphic Industries Ltd.