PERMIT 5716

PERMIT 5717

PERMIT 5718

PERMIT 5463

PERMIT 5462

POINTED MOUNTAIN

PERMIT 5461

NOTE: CONTOUR INTERVAL .050 SEC

(MATCH 95-C-SE)

60°20'

60°15'

60°10'

60°05'

60°00'

125°30'

125°15'

125°00'

RIVER

WHITEFISH RIVER

LARSEN CREEK

MOONEY CREEK

BOUNDARY RIVER

LILIBELL

(94-N W)

RRITORIES.

LEGEND

- NO CORRELATION
- DOUBTFUL CORRELATION
- FAULT
- POSSIBLE FAULT
- QUESTIONABLE FAULT
- VALUE NOT USED IN CONTOURING
- PHANTOM VALUE
- SMOOTHED VALUE
- QUESTIONABLE DATA
- CHARACTERISTIC EVENT
- DATA NO GOOD
- NOT SHOT
- RAW TIME
- MAGNETIC RECORDING
- REFLECTION SHOT POINT
- SHOOTING BY OTHER COMPANIES
- REFRACTION CONTROL POINT
- MIGRATED POSITION AND VALUE
- HORIZONTAL STACK
- B.A. SHOOTING PRIOR TO JULY 1, 1956
- B.A. SHOOTING PRIOR TO JULY 1, 1956, COINCIDENT WITH GULF CONTROL

WELL SYMBOLS

- LOCATION
- SUSPENDED
- PRODUCER-GAS
- PRODUCER-OIL
- DRY HOLE
- ABANDONED-OIL
- ABANDONED-GAS
- BOTTOM HOLE POSITION
- WATER INJECTION

NEW DATA
REVISED DATA
RESHOOTING
REMAINING PROGRAM
RECOMMENDED PROGRAM

WELLS POSTED
S P POSTED
LAND POSTED
ISSUE NO
DATE

SHOOTING BY

POINTED MOUNTAIN - SEISMOTECH 90

GULF OIL CANADA LIMITED
CALGARY INTERPRETATION

CALGARY, ALBERTA

PORTIONS OF

UNIT MAP 95 - C - SW

FINAL GEOPHYSICAL REPORT
SEISMOGRAPH INTERPRETATION

POINTED MOUNTAIN PROJECT, Y. T.

Contours on Intermediate Horizon

(Near Top of Devonian)

DATUM 1600 ft. AMSL
INTERP BY MLL, RVC.
DEPTH CHART
Ve 12,000 ft/sec.
CONTOUR INTERVAL 0.050 sec.
ORIG MAP SCALE 1 IN = 1 MI

BY R.A. Halvorsen
R.A. Halvorsen GEOPHYSICIST
NORTHERN EXPLORATION DIVISION

FIGURE NO. 2
DATE DEC 19 1969

PERMIT 5716

PERMIT 5717

PERMIT 5718

PERMIT 5463

PERMIT 5462

PERMIT 5461

POINTED MOUNTAIN

60°20'

60°15'

60°10'

60°05'

(MATCH 95-C-SE)

125°30'
(94-N W)

125°15'

125°00'

RIVER

WHITEFISH RIVER

LARSEN CREEK

MOONEY CREEK

BOUNDARY

RRITORIES

LEGEND

- NO CORRELATION
- DOUBTFUL CORRELATION
- FAULT
- POSSIBLE FAULT
- QUESTIONABLE FAULT
- VALUE NOT USED IN CONTOURING
- PHANTOM VALUE
- SMOOTHED VALUE
- QUESTIONABLE DATA
- CHARACTERISTIC EVENT
- DATA NO GOOD
- NOT SHOT
- RAW TIME
- MAGNETIC RECORDING
- REFLECTION SHOT POINT
- SHOOTING BY OTHER COMPANIES
- REFRACTION CONTROL POINT
- MIGRATED POSITION AND VALUE
- HORIZONTAL STACK
- B.A. SHOOTING PRIOR TO JULY 1, 1956
- B.A SHOOTING PRIOR TO JULY 1, 1956, COINCIDENT WITH GULF CONTROL

WELL SYMBOLS

- LOCATION
- SUSPENDED
- PRODUCER-GAS
- PRODUCER-OIL
- DRY HOLE
- ABANDONED-OIL
- ABANDONED-GAS
- BOTTOM HOLE POSITION
- WATER INJECTION

- NEW DATA
- REVISED DATA
- RESHOOTING
- REMAINING PROGRAM
- RECOMMENDED PROGRAM

WELLS POSTED

S P POSTED

LAND POSTED

ISSUE NO

DATE

SHOOTING BY

POINTED MOUNTAIN - SEISMOTECH 90

GULF OIL CANADA LIMITED — CALGARY
CALGARY INTERPRETATION

PORTIONS OF

UNIT MAP 95 - C - SW

FINAL GEOPHYSICAL REPORT

SEISMOGRAPH INTERPRETATION

POINTED MOUNTAIN PROJECT, Y. T.

Shot Point Elevations

DATUM Sea level — INTERP BY M.L., RV

DEPTH CHART -- — Ve --

CONTOUR INTERVAL 100 Ft. — ORIG MAP SCALE 1:N

BY R.A. Halvorsen

R.A. Halvorsen, GEOPHYSICIST
NORTHERN EXPLORATION DIVISION

FIGURE NO. 3 — DATE DEC

PERMIT 5716.

PERMIT 5717.

PERMIT 5718

PERMIT 5463

PERMIT 5462

PERMIT 5461

POINTED MOUNTAIN

60°20'

60°15'

60°10'

60°05'

125°15'

125°00'

(MATCH 95-C-SE)

(MATCH 94-N-W)

RIVER

WHITEFISH

LARSEN

CREEK

MOONEY

BOUNDARY

T-60-12

T-60-10D

T-60-08

T-60-05

T-60-02D

R-125-22D

R-125-15

R-125-24

LEGEND

- NO CORRELATION
- DOUBTFUL CORRELATION
- FAULT
- POSSIBLE FAULT
- QUESTIONABLE FAULT
- VALUE NOT USED IN CONTOURING
- PHANTOM VALUE
- SMOOTHED VALUE
- QUESTIONABLE DATA
- CHARACTERISTIC EVENT
- DATA NO GOOD
- NOT SHOT
- RAW TIME
- MAGNETIC RECORDING
- REFLECTION SHOT POINT
- SHOOTING BY OTHER COMPANIES
- REFRACTION CONTROL POINT
- MIGRATED POSITION AND VALUE
- HORIZONTAL STACK
- B.A. SHOOTING PRIOR TO JULY 1, 1956
- B.A SHOOTING PRIOR TO JULY 1, 1956, COINCIDENT WITH GULF CONTROL

WELL SYMBOLS

- LOCATION
- SUSPENDED
- PRODUCER-GAS
- PRODUCER-OIL
- DRY HOLE
- ABANDONED-OIL
- ABANDONED-GAS
- BOTTOM HOLE POSITION
- WATER INJECTION

SHOOTING BY

POINTED MOUNTAIN - SEISMOTECH 90

- NEW DATA
- REVISED DATA
- RESHOOTING
- REMAINING PROGRAM
- RECOMMENDED PROGRAM

WELLS POSTED

S.P. POSTED

LAND POSTED

ISSUE NO

DATE

GULF OIL CANADA LIMITED
CALGARY INTERPRETATION

CALGARY, ALBERTA

PORTIONS OF

UNIT MAP 95 - C & SW

FINAL GEOPHYSICAL REPORT
SEISMOGRAPH INTERPRETATION

POINTED MOUNTAIN PROJECT, Y. T.

Shot Point Engineering Map

DATUM

DEPTH CHART

CONTOUR INTERVAL

INTERP BY M.L. RVC

Ve

ORIG MAP SCALE 1 IN = 1 MI

BY
R.A. Halvorsen GEOPHYSICIST
NORTHERN EXPLORATION DIVISION

FIGURE NO. 4

DATE DEC 19 1969

2-6-1-36

Ottawa

FINAL GEOPHYSICAL REPORT
REFLECTION SEISMIC SURVEY

Pointed Mountain Project, Y. T.
(Project No. 2-6-1-69-1)
Permits No. 5716, 5717,
5718, 5461, 5462, 5463.

December 12, 1968 to February 26, 1969

Author: R. A. Halvorsen, Geophysicist
Gulf Oil Canada Date: December 19/69

FINAL GEOPHYSICAL REPORT

Reflection Seismic Survey

POINTED MOUNTAIN PROJECT, Y. T.

(Project No. 2-6-1-69-1)

Report on work performed on Permits Nos. 5716, 5717, 5718, 5462, 5463 during the period December 12, 1968 to February 26, 1969.

Reflection Seismic Program Shot for
Gulf Oil Canada Ltd.
by
Seismotech 64 Ltd. Party No. 91.

R. A. Halvorsen, Geophysicist

Date: DEC 19 1969

TABLE OF CONTENTS

A: MAPS:

The following maps are included with this report and are located in the attached expanding envelope:

Figure No. 1 - Project Location Map

Figure No. 2 - Portions of Unit Map 95-C-SW
Contours on Intermediate Horizon
(Near Top of Devonian)

Figure No. 3 - Portions of Unit Map 95-C-SW
Shot Point Elevations

Figure No. 4 - Portions of Unit Map 95-C-SW
Shot Point Engineering Map

B: STATISTICAL DATA:

B: STATISTICAL DATA

1. Dates:

(a) Mobilization of Vehicles - December 12, 1968
(b) Recording crew left base - January 4, 1969
(c) Recording commenced on January 11, 1969
(d) Recording suspended on February 4, 1969
(e) Recording recommenced on February 16, 1969
(f) Recording completed on February 25, 1969
(g) Vehicles released on February 26, 1969.

The base referred to above is Calgary, Alberta.

2. Production:

Performance on these permits was carried out during the months of December, 1968 and January, February, 1969.

Holes Drilled	- 433
Holes Shot	- 433
Mileage	- 55.6
Total Work Days	- 54
Production (recording) days	- 29
"No Production Days" - (equipment failure)	- 2
"No Production Days" - (due to weather, moving in - out, camp moves, waiting on drills, or bulldozers)	- 23
Average mileage per day based on production days	- 1.92

3. Equipment:

(i) The following vehicles were used in the field operations:

(a) Seismotech 64 Ltd.

Recorder-	1962 GMC	1½ ton	Two wheel drive	
Shooting unit-	1964 Chevrolet	2 "	" "	"
Survey unit-	1966 "	3/4 "	" "	"
Survey unit-	1964 "	3/4 "	" "	"
Reel unit-	1966 "	1 "	" "	"
Reel unit-	1966 "	1 "	" "	"
Party Manager unit-	1969 ½ ton Chevrolet		" "	"

All units equipped with front end winches.

(b) Warnke Brothers Drilling

Drill truck	1967	4 ton	Dodge	Two wheel	drive
" "	1967	4 "	"	" "	"
" "	1968	4 "	Chevrolet	" "	"
" "	1968	4 "	Ford	" "	"
Water truck	1967	4 "	Dodge	" "	"
" "	1967	4 "	"	" "	"
" "	1967	4 "	Chevrolet	" "	"
" "	1964	3 "	Ford	" "	"
" "	1962	3 "	Chevrolet	" "	"
Drill supervisor vehicle	1969	1 "	Ford	" "	"

All units equipped with front end winches.

(c) L. I Adam Contractors

2 - D7E Caterpillar Bulldozers
1 - 17A " "

1966 2 ton Ford Fuel Truck Two wheel drive
1968 1 ton " Pick Up " " "

All units equipped with winches.

(ii) Camp equipment and accommodations

8 Trailers (on wheels)
Kitchen-Dining unit
Utilities unit
Sleeper units
1 Power plant unit
1 Portable garage

(iii) Recording Equipment

(a) Instruments - SIE IT-100 & PMR-20
RCF-1 Remote Shooting Unit
(b) Detectors - Mark L-2, 28 c.p.s.
(c) Number of cables used - 5.
(d) Length of cable - 2,640 feet
(e) Number of detector strings - 60
(f) Number of detectors/string - 9
(g) Detector spacing - 14 feet
(h) Group centre distance - 220 feet.

4. Personnel:

Seismotech Party 91 -
1 Party manager
1 Senior Computor
1 Junior Computor
1 Operator
2 Shooters
1 Surveyor
1 Rodman
1 Mechanic
5 Helpers

Warnke Brothers Drilling -
4 Drillers
5 Drill helpers
1 Drill Crew Supervisor

L. I. Adam Contractors -
1 Supervisor
6 Bulldozer Operators
1 Cook

5. Navigation:

(a) Surveying equipment
1 K & E transit
1 Gurley transit

(b) Method used to locate lines and stations:
The survey was tied to a geodetic monument on the B. C. - Y. T boundary. All traverses were looped back to the original take-off point. Star shots were used to determine true north.

6. Conditions:

Access to the project area was through Smith River air strip. The access road was in poor condition, being frequently damaged by springs and high water. Approximately three weeks was required to move the camp and equipment the 90 miles to the campsite and set up camp.

Low temperatures experienced during January slowed production.

Ground fog and snow conditions occasionally restricted the utilization of aircraft.

Fair HF radio reception was experienced throughout the project. VHF radio was not available in this area.

C: FIELD PROCEDURES

The survey was designed to obtain a reflection seismic control grid across a known faulted anticlinal structure.

Shooting parameters were set up to obtain a 300% common-depth-point coverage. Shot points drilled at 880 feet intervals along the profiles were shot into line segments which were varied through a "roll-along" switch.

The average size of the dynamite charges was 11.9 lbs.

The average hole depth was 50 feet.

D: DATA PROCESSING

Data processing was performed by the Calgary, Alberta Geophysical Centre of Gulf Oil. Elevations were corrected to a datum plane of 1600 feet AMSL and weathering corrections were computed by the first arrival plot method.

Presentation of the data was in record section form, 100% single record profiles and 300% C.D.P. stacked, optically filtered sections. The interpretation is based on structural sections. Several sections were presented in a flattened form for experimental purposes.

Typical processing parameters are listed below:

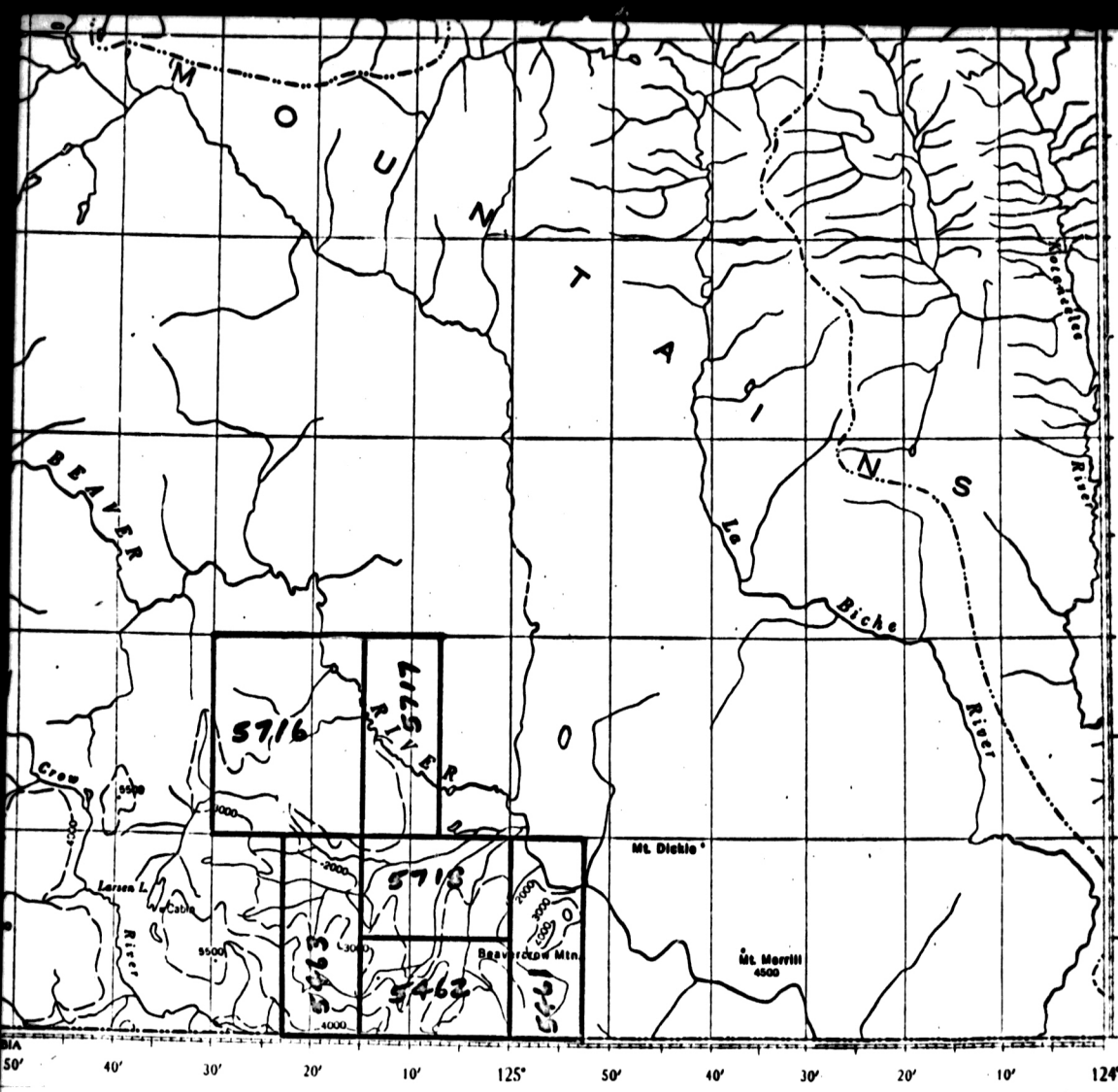
Ve	- 12,000 ft/sec/
Datum	- 1,600 ft. A.M.S.L.
Structural Sections	
Gain	- 14-6, 12-4
AVC	- 1-1
Filter	- 38-4
Plot	- unsmoothed
Regular	-(no mix)

E: RESULTS and INTERPRETATION

The seismic mapping is based on an event labelled "Near Top of Devonian". This event is located approximately 1,500 feet above the prime prospect, a Middle Devonian Carbonate section. While this formation cannot be effectively mapped directly it is believed that

the Top of Devonian event is conformable to the behavior of the lower formation.

The major anticlinal feature centred in section 16, Grid Area 60°10' - 125°15' is the sole anomalous feature adequately delineated by the existing control. Profile T-60-05 recorded the highest point on the anticline. Profiles T-60-02 to the south and T-60-08 to the north show a marked closure to the south and north respectively. A minimum of 700 feet of closure is evident on the west flank and the closure is complimented by a fault zone. To the east, 2,500 feet of dip is mapped. The resultant structure provides an excellent potential reservoir for the entrapment of hydrocarbons.



Gulf Oil Canada Ltd.
Calgary, Alberta

Northern Division
Exploration

POINTED MOUNTAIN PROJECT, Y. T.

Project Location Map

Outline of project area

Scale: 1" = 8 miles
By: R.A. Halvorsen
R. A. Halvorsen, Geophysicist
Northern Exploration Division

Date: DEC 19 1969

Figure No. 1

THE BRITISH AMERICAN OIL CO. LTD.
Calgary, Alberta

GEOLOGICAL REPORT ON 1967 Surface Operations in the CAMSELL BEND, ROOT RIVER, DAHADINNI RIVER and WRIGLEY MAP AREAS, N.W.T.

by D. W. CAPSTICK
Northern Exploration Division 1968

2-3-5-35

THE BRITISH AMERICAN OIL COMPANY LIMITED

Calgary, Alberta

GEOLOGICAL REPORT ON

1967 Surface Operations

in the CAMSELL BEND, ROOT RIVER,

DAHADINNI RIVER and WRIGLEY

MAP AREAS, N.W.T.

by

D. W. CAPSTICK

Northern Exploration Division May, 1968

CONTENTS

(6)	67-DC-1	Deceiver Creek	123°38'00", 62°19'15"
(7)	67-DC-2	Deceiver Creek	123°37'00", 62°19'00"
(8)	67-DC-3	Deceiver Creek	123°36'30", 62°19'15"
(9)	67-CRL-1	Carlson Lake	123°37'00", 62°26'30"
(10)	67-CAM-1	Camsell Range	123°33'00", 62°23'00"
(11)	67-CAM-2	Camsell Range	123°33'00", 62°26'15"
(12)	67-CAM-3	Camsell Range	123°36'00", 62°33'30"
(13)	67-CAM-4	Camsell Range	123°46'00", 62°39'20"
(14)	67-CAM-5	Camsell Range	123°47'30", 62°47'45"
(15)	67-CC-1	Carlson Creek	123°48'00", 62°37'45"
(16)	67-NCR-1 & 1A	North Camsell Range	123°49'30", 62°52'45"
(17)	67-NCR-4	North Camsell Range	123°38'15", 62°58'40"
(18)	67-WLR-1	Willow Lake Ridge	122°53'00", 62°46'40"
(19)	67-MCC-1	McConnell Range	123°00'30", 62°56'15"
(20)	67-MCC-7	McConnell Range	123°02'20", 62°51'40"
(21)	67-MCC-9	McConnell Range	123°01'00", 62°59'30"

ROOT RIVER MAP AREA

(22)	67-NNP-1	North Nahanni Plateau	124°47'00", 62°10'00"
(23)	67-ECA-1	English Chief Anticline	124°10'30", 62°15'15"
(24)	67-IVR-1	Iverson Range	124°26'00", 62°16'20"
(25)	67-IVR-2	Iverson Range	124°38'30", 62°21'30"
(26)	67-IVR-3	Iverson Range	124°40'00", 62°19'40"
(27)	67-IVR-4	Iverson Range	124°33'00", 62°20'00"
(28)	67-IVR-5	Iverson Range	124°29'30", 62°20'00"
(29)	67-IVR-6	Iverson Range	124°41'00", 62°19'30"
(30)	67-IVR-7	Iverson Range	124°32'30", 62°23'30"

(31)	67-IVR-8	Iverson Range	124°40'30", 62°26'20"
(32)	67-IVR-9	Iverson Range	124°34'40", 62°23'10"
(33)	67-IVR-10	Iverson Range	124°36'20", 62°25'00"
(34)	67-IVR-11	Iverson Range	129°45'00", 62°40'30"
(35)	67-IVR-12	Iverson Range	124°37'00", 62°33'20"
(36)	67-IVR-13	Iverson Range	124°43'40", 62°47'10"
(37)	67-IVR-14	Iverson Range	124°42'30", 62°42'30"
(38)	67-IVR-15	Iverson Range	124°45'00", 62°54'45"
(39)	67-IVR-16	Iverson Range	124°49'30", 63°00'30"
(40)	67-IVR-17	Iverson Range	124°43'30", 62°51'15"
(41)	67-IVF-1	Iverson Front	124°35'00", 62°26'45"
(42)	67-TRS-2	Trench Syncline	124°44'40", 62°25'00"
(43)	67-TRS-3	Trench Syncline	124°50'20", 62°39'15"
(44)	67-TRC-1	Trench Creek	124°45'30", 62°30'40"
(45)	67-WTA-1	Whittaker Anticline	124°46'40", 62°31'45"
(46)	67-WTA-2	Whittaker Anticline	124°49'00", 62°31'00"
(47)	67-WTA-3	Whittaker Anticline	124°46'00", 62°31'20"
(48)	67-PTM-1	Painted Mountains	125°27'00", 62°21'30"
(49)	67-PTM-2	Painted Mountains	125°33'45", 62°20'50"
(50)	67-PTM-3	Painted Mountains	125°08'00", 62°25'00"
(51)	67-PTM-4	Painted Mountains	125°18'00", 62°35'15"
(52)	67-BHL-1	Bell Heather Lake	125°52'00", 62°30'00"
(53)	67-BHL-3	Bell Heather Lake	125°46'20", 62°34'25"
(54)	67-DLM-1	Delorme Range	125°08'00", 62°42'30"
(55)	67-DLM-2	Delorme Range	125°20'30", 62°53'45"
(56)	67-DLM-3	Delorme Range	125°13'00", 62°56'10"

(57)	67-DLM-4	Delorme Range	125°14'00", 62°56'00"

DAHADINNI RIVER MAP AREA

(58)	67-IVR-18	Iverson Range	124°46'00", 63°02'30"
(59)	67-DHR-1	Dahadinni Range	124°47'00", 63°08'30"
(60)	67-DHR-2	Dahadinni Range	124°52'30", 63°12'45"
(61)	67-DHR-3	Dahadinni Range	122°56'00", 63°14'00"
(62)	67-DHR-4	Dahadinni Range	124°55'00", 63°25'45"
(63)	67-DHR-5	Dahadinni Range	124°55'00", 63°27'20"
(64)	67-DHR-6	Dahadinni Range	124°55'00", 63°26'35"
(65)	67-DHR-7	Dahadinni Range	124°50'30", 63°30'20"
(66)	67-DHR-8	Dahadinni Range	124°51'30", 63°37'00"
(67)	67-SVA-1	Sylvan Anticline	125°02'00", 63°36'00"
(68)	67-MHW-1	Mount Haywood	125°02'00", 63°45'10"
(69)	67-MPA-1	Moose Prairie Anticline	125°30'00", 63°45'10"
(70)	67-MPA-2	Moose Prairie Anticline	125°33'00", 63°42'00"
(71)	67-MPA-3	Moose Prairie Anticline	125°33'00", 63°44'30"
(72)	67-RED-1	Redstone Range	125°42'00", 63°36'30"
(73)	67-RED-2	Redstone Range	125°49'00", 63°36'00"
(74)	67-RED-3	Redstone Range	125°59'00", 63°50'20"
(75)	67-DKR-1	Dusky Range	125°21'00", 63°08'40"
(76)	67-DKA-2 & 2A	Dusky Range	125°18'00", 63°09'30"
(77)	67-DKR-3	Dusky Range	125°15'00", 63°15'00"
(78)	67-DKR-4	Dusky Range	125°21'00", 63°24'40"
(79)	67-RGR-1	Rouge Range	125°44'00", 63°14'00"
(80)	67-RGR-2	Rouge Range	125°41'00", 63°05'30"
(81)	67-RGR-3	Rouge Range	125°47'00", 63°16'40"

Illustrations (cont.)

PHOTOGRAPHS

following text of Report.

INTRODUCTION

General Statement

During the field season of 1967 the British American Oil Company Limited conducted geological surface operations in the Southern Ranges of the Mackenzie and Franklin Mountains Northwest Territories. Stratigraphic data was compiled in the Camsell Bend, Root River, Dahadinni River and Wrigley map areas encompassing approximately 14,000 square miles of the Southern District of Mackenzie from latitude 62° to 64° North and longitude 123° to 126° West.

This is a continuation of studies carried out by the 1966 Field Party in the Nahanni Range and adjacent areas.

Purpose of Study

The primary objective of the 1967 surface party was to determine the regional character and facies relationships of the Middle Devonian strata.

A secondary objective was the collection of Stratigraphic data to provide the basis for more accurate regional and local correlation of the Paleozoic sequence exposed in the Southern Ranges of the Mackenzie and Franklin Mountains.

This field party fulfills part of the work requirements of the North and South Nahanni, Cli Lake and Camsell Petroleum and Natural Gas Permits held jointly by British American and the Amerada Petroleum Corporation. (Permit Nos. 4616-4627 incl., 4629, 5366-5371 incl.)

Previous Geological Work

The Canadian Gulf Oil Company carried out surface projects under W. Wegmuller (1954) and G. V. Lloyd (1955) in the Nahanni Range and the South Nahanni River areas. The Hudson Bay Oil and Gas company did exploratory work under G. Dann (1953) and S. Paskevich (1953) primarily in the Camsell Bend and Wrigley areas.

Reconnaisance photogeologic coverage was obtained from Geophoto Services, Calgary; Scale: 1 inch = 4 miles in 1954.

The Geological Survey of Canada has expanded its geological coverage of the project area from the work of E. M. Kindle (1920), M. Y. Williams (1922, 1923), G. S. Hume (1924, 1954) with preliminary maps and papers by R. J. W. Douglas and D. K. Norris (1960, 1961, 1962).

The results of 1966 investigations by British American are contained in a report by F. J. Souaya entitled "Geological Studies in the Nahanni Area and Vicinity" dated November, 1967.

Surface Party Operations

The party was made up of the following personnel:

Party Chief	D. Capstick
Senior Assistants	D. Myhr
	D. Patterson
Assistants	D. Dolphin
	S. Johnston
	L. Sanche
Cook	A. P. Jorgensen
Cook's Helper	K. Morrison
Helicopter Pilot, Engineer	D. Kvill

F. J. Souaya was with the party from June 5th to 15th inclusive. In addition the following B. A. personnel visited the party during the summer: C. K. Caldwell, E. A. Cordry, G. D. Childs, B. L. Loney, R. N. Taylor.

Transportation in the field was provided by the following:
Super G-2 helicopter - Associated Helicopters, Edmonton.
Otter and Beaver on floats - Northward Aviation, Norman Wells, N.W.T.
Cessna 185 on floats and Piper Apache on wheels - Northern Air Services, Fort Nelson, B. C.
Found and Beaver on floats - Northern Mountain Airlines, Fort Simpson, N.W.T.

Communication in the field was maintained by Radio-telephone (AM-SSB) through Canadian National Telecommunications Channels, Fort Nelson, British Columbia.

Camp equipment, fuel and non-perishable supplies were barged into the area by Cooper's transport from Fort Nelson and D. Turner from Nahanni Butte.

The camp and a portion of the fuel and supplies were flown by Otter from Camsell Bend to the first campsite. The remainder was cached at Wrigley and flown to subsequent campsites as required. Perishable supplies were flown in weekly from Fort Nelson, B. C. or Norman Wells, N.W.T. At the end of the field season field equipment and empty fuel kegs were barged from Wrigley to Hay River, N.W.T. by the Northern Transportation Company.

Surface operations were carried out by helicopter from four base camps situated on strategic lakes:

Little Doctor Lake	(June 5th to 19th)
Iverson Lake	(June 19th to July 14th)
Slim Lake	(July 14th to August 6th)
Wrigley Airport Lake	(August 6th to September 1st)

The 1967 surface party was in the field from June 4th to September 1st (90 days). During this period 11 days (12.2%) were expended by camp moves and 21 days (23.3%) were lost to inclement weather.

One program of stratigraphic, structural and reconnaissance studies were carried out with the remaining 58 days (64.5%).

One hundred and twenty stratigraphic sections were described and measured for a cumulative 175,670 feet.

ACKNOWLEDGEMENTS

The writer wishes to thank F. J. Souaya for his introduction to the many varied points of geological interest within and surrounding the 1966 project area. The assistance rendered by Drs. P. S. Warren and C. R. Stelck in the identification and connotation of the fossil suite collected in 1967 is greatly appreciated.

Thanks are also due to G. D. Childs for his editing of this report.

PHYSIOGRAPHY

The 1967 project area involved all or a portion of the following physiographic features as subdivided by Bostock (1948):

1) MACKENZIE MOUNTAINS

   (a) The Canyon Ranges:
   Dahadinni, Iverson, Redstone, Dusky, Rouge, Whittaker, Delorme and Manetoe Ranges, plus the North Nahanni Plateau.

   (b) The Backbone Ranges:
   Sombre and Painted Mountains, and Thundercloud Range.

2) FRANKLIN MOUNTAINS

   McConnell, Camsell and Nahanni Ranges.

3) MACKENZIE PLAIN

4) INTERIOR PLAINS

STRATIGRAPHY

General Statement

Strata exposed in the project area range in age from Proterozoic to Mississippian. This study was particularly concerned with the Middle and Lower Devonian sequence thus the majority of sections measured are in this interval. However, twelve sections were described from the Upper Devonian, eleven from the Ordovician-Silurian, and four from the Cambrian-Proterozoic.

In the discussions which follow reference is made only to complete sections of the various formations unless otherwise noted. Incomplete sections where listed are enclosed by parenthesis.

Rock units used in this study are essentially those proposed by the Geological Survey of Canada in Preliminary Papers 60-19, 61-13, 62-33 and 64-52.

The geological maps published with these papers proved to be invaluable in the location of sections and reconnaissance, providing an excellent general framework for the additional stratigraphic information collected.

The nine map sheets prepared by the G.S.C. on the scale of 1" = 4 miles, unfortunately introduced a vast system of numbered rock units. An attempt has been made to correlate the majority of these units regionally and assign them to the proper position on the geological time scale (Figure 2).

Due to the number of sections and footage measured the individual sections have not been described. Instead detailed stratigraphic logs on the scale of 1" = 100' were prepared to include all available information and provide a ready reference of additional data.

PROTEROZOIC

Unnamed Clastics

Refer to Section RGR-6.

In the central Rouge Range a sequence of probable Precambrian rocks are exposed on the east limb of a faulted anticline.

Thirty-five hundred feet of strata were measured between the basal thrust and the overlying Sunblood formation. Thick bedded white, pink and purplish quartzites predominate with interbedded massive coarse grained sandstone units and dark red dolomitic shale. Intercalated red and green shale siltstone and minor dolomite form several distinct rusty weathered units in the upper part of the formation.

These rocks are tentatively correlated with G.S.C. unit 2 of the Wrigley Lake map area but bear a marked resemblance to quartzites of the Mount Clark formation in the McConnell Range.

Unnamed Clastics and Lone Land Formation

Refer to Sections MCP-1, 2; Photographs 34 and 35.

The east face of Cap Mountain near Wrigley exposes a thick sequence of red ferruginous sandstone, siltstone, mudstone and red or green shale with minor dolomite. Conglomeratic sandstone and hematitic quartzites are prominent in the upper part, overlain in turn by dark grey and black shales with intercalated siltstone.

This sequence has been subdivided into G.S.C. units 1, 2, 3 and 4 in the Wrigley map area, unit 4 being referred to the Lone Land formation. A maximum thickness of 5630 feet was measured between the basal thrust and the overlying Mount Clark formation.

Mount Clark--Lone Land and Lone Land--Unit 3 contacts are angularly unconformable, locally on Mount Cap units 4 and 3 are sharply bevelled and truncated.

CAMBRIAN

Mount Clark Formation

Refer to Sections MCP-1, 2; Photograph 33.

Four hundred fifty feet of quartzite and quartzose sandstone are exposed on the crest and dip slope of Cap Mountain. The upper part is white to pinkish, massive, occasionally crossbedded with poorly preserved worm burrows (Scolitus), the lower part is thinly bedded or Laminated generally red to purple. A basal conglomerate about 2 feet thick unconformably overlies the dark shales of the Lone Land formation.

The Lower Cambrian Age assigned to the Mount Clark formation is based on trilobites reported by William (1923) at Mount Clark in the Northern McConnell Range. The local unconformity beneath the quartzites is felt to represent the base of the Cambrian Rocks.

Mount Cap and Saline River Formations

Refer to Section MCC-2, MKD-1; Photographs 31 and 32.

The type section of the Mount Cap formation is at Mount Clark in the Northern McConnell Range. At that locality about 200 feet of grey and green fissile shale, red sandstone and shale with Middle Cambrian trilobites overlie quartzites of the Mount Clark formation.

Exposures in the Wrigley map area are poor to nonexistant. A few feet of shale and siltstone occurs at the south end of Mount Cap and in thrust slices on the east face. These shales contain a Lower Cambrian Trilobite fauna.

The Saline River formation is poorly exposed in the Wrigley area. The base of Mount Kindle exposes a structureless mass of red and greenish gypsiferous shale, with inclusions of coarsely crystalline selenite and gypsum (MKD-1).

Further east a contorted and faulted sequence of banded dark red and green shale with white and pink gypsum, 350 feet thick is overlain by reddish siltstone and buff weathering dolomites of the Franklin Mountain formation (MCC-2).

A similar sequence of shale, siltstone, dolomite and gypsum occupies the core of the Root River Reef exposure at the junction of Root River and Landry Creek.

At the type section on Saline River near Mount Clark, Williams (1923) reported Middle Cambrian fossils.

ORDOVICIAN

Franklin Mountain and Sunblood Formations

Refer to Sections RGR-6, WTA-3, MKD-1, MCC-2, MCC-3, MCP-3; See Photographs 24 and 31.

In the McConnell Range the Franklin Mountain formation overlies the Saline River evaporites. Light grey and brown silty dolomite with interbedded quartzose sandstone, reddish silty shale and siltstone grade upwards to a thick bedded light brown dolomite unit, variably silty and argillaceous. The entire sequence weathers yellow to rusty brown. Rare fossils found near the top of the formation are of Middle Ordovician age. A maximum thickness of 1200 feet was measured on the east face of Mount Kindle, 960 feet outcrops near Smith Ridge.

In the Mackenzie Mountains a similar sequence is referred to the Sunblood formation. Thirteen hundred-eighty feet of yellow to rusty brown weathering, silty to argillaceous dolomite sandstone, and siltstone intercalated with red and dark grey shales were measured in the central Rouge Range. Dolomites predominate the upper part, sandstone the middle and shale and siltstone the base. No fossils were found in this formation but immediately overlying dark grey banded dolomites of the Whittaker formation contain an Upper Ordovician fauna.

Approximately 1,000 feet of rusty brown, reddish and grey weathering limestones, sandy dolomites, sandstone and shale are exposed in the core of the Whittaker Anticline. The base of the section is not exposed. Fossils found near the top of the formation are of Middle Ordovician age.

Similar strata are exposed above the Nahanni thrust at Red Pass and on the slopes of Sunblood and Cathedral Mountains south of the project area. Further west in the Wrigley Lake and Glacier Lake map areas similar carbonates and clastic rocks of Cambrian through Ordovician age are present above the Proterozoic.

ORDOVICIAN AND SILURIAN

Mount Kindle and Whittaker Formations

Refer to Sections SMR-1, 2, MCC-4 (MCC-5), MCC-6. Also RGR-6, DKR-2, WTA-2, 3; See Photographs 15, 23, 24, 30, 31.

The light grey weathering Mount Kindle formation overlies the rusty weathering Franklin Mountain dolomites everywhere in the McConnell Range. Smith Ridge exposes 805 feet of medium to thick bedded fine crystalline light grey brown dolomites. The basal beds contain large colonial corals and numerous blebs and stringers of chert. Zones of fair to good small vug and intercrystalline porosity are scattered throughout the formation. Fossils range in age from Upper Ordovician to Middle Silurian. The variable thickness of the formation north of Ocre River at MCC-5 (1085'+) and MCC-6 (400') when considered in the light of fossil determinations is strongly suggestive of non-deposition and/or erosion of Silurian strata in this area.

The Whittaker formations outcrops on the east flank of the Whittaker anticline, Mackenzie Mountains where 4580 feet of dark grey weathering dolomite, limestone and shale overlie the Sunblood formation. Basal dark grey to grey thinly bedded limestones are overlain by a middle dark grey fine crystalline medium to thick bedded dolomite unit, commonly containing colonial corals. The upper part is dark grey siltstone intercalated with dark grey to black argillaceous limestones generally platy to thin bedded, bearing a graptolitic fauna.

Fossils range in age from Middle or Upper Ordovician to Middle Silurian.

In the Rouge Range to the north 2320 feet of thick to massive cherty medium to dark grey occasionally porous banded dolomite and a thin basal dark grey limestone unit contains Upper Ordovician to Silurian fossils.

In general, limestone and shale form a more prominent part of the formation to the south and west where the carbonate sequence is rapidly lost to a graptolitic shale facies.

On the Nahanni range a similar sequence is mapped as G.S.C. unit 4. Equivalents of the Whittaker formation are also present in the G.S.C. unit 6 on Tundra Ridge and G.S.C. unit 3 on Sunblood Mountain, both in the Virginia Falls map area to the south.

SILURIAN AND LOWER DEVONIAN

Delorme Formation

Refer to Sections WTA-2, RGR-5, DKR-2A, RGR-3, MCC-3A, (NCR-3); See Photographs 15, 22, 23, 29.

In the Southern Mackenzie Mountains the Whittaker formation is overlain by a rusty orange to yellowish brown weathering series of limestones and dolomites referred to the Delorme formation.

Thirty-seven hundred fifty feet of Delorme section were measured on the east flank of the Whittaker Anticline. A basal orange weathering dark grey to black shale and laminated dolomitic siltstone unit with massive interbeds of medium grey dolomite and limestone grades upward to a resistant unit of dark grey cryptograined orange weathering silty or sandy limestone. The uppermost beds are brown weathering recessive light grey limestones. Silurian fossils were found in the upper half of the section.

Approximately 2,000 feet of poorly exposed strata represent the Delorme formation at RGR-5 in the central Rouge Range. Light brown to medium grey micritic dolomites, variably shale and platy, weathering yellow brown make up the bulk of the sequence. A 300 foot thick medium grey limestone unit in the upper Delorme carries a Silurian (Clinton) fauna.

In the Dusky Range at DKR-2a 2,300 feet of Delorme was described. Basal and upper limestone members with a middle series of alternating limestone and dolomite units displays pink to yellowish and grey banded weathering. Upper Ordovician to Silurian fossils are present in the basal limestones. At RGR-3 in the South Rouge Range 1,155 feet of strata are assigned to the Delorme. The lower part is alternating light and dark grey limestone, platy to thinly bedded, interbedded with Dolomite; light grey brown weathering orange to brown. The upper 450 feet is limestone, platy to medium bedded argillaceous, yellow weathering and recessive. Clinton fauna were collected throughout most of the formation.

At one locality in the McConnell Range, MCC-3a, 70 feet of argillaceous, silty brownish weathering dolomites, and gypsiferous shales overlying the Kindle Dolomites may be equivalent to the Delorme formation. G.S.C. unit 10 on the Nahanni Range, unit 5 on Sunblood Mountain and the upper part of unit 6 on Tundra Ridge are lateral equivalents of the Delorme formation.

Strata of Lower Devonian age are not present in several measured sections of this formation. Possibly tectonics that removed parts of the Upper Kindle (of Upper Silurian age) in the McConnell Range had a similar effect in some areas of the present day Mackenzie Mountains.

LOWER TO MIDDLE DEVONIAN

Camsell Formation

Refer to Sections WTA-2, DKR-2a, RGR-3, 5, (DKR-3, 4; RED-1, 3; NCR-2, 3; DHR-5, 6, 7); See Photographs 21, 22, 23, 28, 29.

The massive, resistant light grey weathering limestones that overlie the Delorme formation in a large area of the Mackenzie Mountains are referred to the Camsell formation. The Whittaker Anticline exposes 1,500 feet of light grey cryptograined limestones containing zones of coarse to massive brecciation and a more recessive basal unit with silty and shaly interbeds weathering brilliant orange, yellow and red. Occasional brecciated zones contain angular fragments of dark grey medium crystalline dolomite. Cavernous weathering is common in the more massive breccia units in the Redstone Range near Redstone River. Boxwork structures and salt casts are not uncommon. No fossils were found in the formation. Lithologically the Camsell bears a marked resemblance to the Bear Rock formation. At one locality in the Northern Redstone Range (RED-3) identical breccias of the Bear Rock and Camsell formations are separated by only a few hundred feet of Arnica dolomite.

Strata equivalent to the Camsell formation are mapped in the North Camsell Range and at one locality in the McConnell Range. This formation is not as widespread as under or overlying units.

Sombre Formation

Refer to Sections WTA-1, DKR-1, DKR-3, RGR-2, 3, 4; NCR-2, 3 (DLM-1); See Photographs 15, 20 21.

The Sombre formation refers to a widespread sequence of massive to thick bedded light to medium grey dolomites exposed in the Southern Mackenzie Mountains and the Nahanni and Camsell Ranges.

The type locality for the Sombre is Tundra Ridge in the Virginia Falls map area where a thickness of 4,100 feet is exposed. Further north and east the formation thins rapidly. On the Whittaker anticline 1,050 feet was measured, 1,500 feet to 690 feet is exposed in the north Camsell Range and only 305 feet in the central Rouge Range. The formation is typically light grey to brownish grey cryptocrystalline dolomite weathering silvery light to medium grey. A dark grey dolomite is frequently developed near the centre of the formation to the southwest where the Sombre is thicker.

Silty interbeds and occasional thickly bedded light to dark grey limestone are present in the lower part of the formation in many areas. Rare fossils found in the Sombre are of Lower Devonian age.

Scattered small vug porosity is present in many sections and localities.

A light grey massive coarse crinoidal bank is developed near or at the top of the Sombre on the Iverson Range, north of the English Chief River. The bank extends 400 feet horizontally and 200 feet vertically. Good to excellent fossil and vuggy porosity is present in the upper part.

Arnica Formation

Refer to Sections RGR-1, 2, 3, DKR-1, WTA-1, DLM-1, NCR-2, 3, 4 (DHR-2, MGD-1, WLR-1 etc.); See Photographs 15, 16, 17, 18, 20, 21, 37.

Bear Rock Formation

Refer to Sections MCC-4, SMR-1, 3 (MCC-8, 3a, 6, MCP-3).

Bear Rock and Arnica Intertongued)

Refer to Sections SMR-4, RED-1, 3, RGR-4, DKR-3, 4, DHR-5, 7, (DHR-3, 4, 6, 8; SVA-1, MHW-1, MCC-9.); See Photograph 6.

The Arnica formation is a prominent and widespread sequence of medium to dark grey and black banded dolomites which overlie the Sombre formation in the Southern Ranges of the Mackenzie and Franklin Mountains.

In the Southern Dusky Range 1,845 feet of thick-bedded to massive microcrystalline to fine crystalline dolomites were described at DKR-1. Scattered zones of poor to good vug porosity, thin beds of dolomite breccia and poorly preserved fossils, predominantly Amphipora and Crinoid debris of indeterminate age are present throughout the formation.

The Arnica is thinner where overlain by shaly limestones of the Funeral formation as at measured sections DLM-1 and WTA-1 where the formation is 660 and 950 feet thick respectively. The dolomites immediately underlying the funeral tend to be coarsely crinoidal and occasionally calcareous. Lenses and stringers of black chert are common.

The Arnica formation also thins eastward as at NCR-2, 3 and 4 in the North Camsell Range where measured thickness from 460 to 890 feet were obtained.

The Bear Rock formation is exposed throughout most of the McConnell Range where it forms a massive light grey unit typified by cavernous weathering and isolated knobs and hoodoos where beds are flat lying. On the west flank of the range at MCC-4 710 feet of limestone breccias were examined. Fragments are angular, composed primarily of light grey brown microgranular limestone, with occasional patchs of dark grey fine crystalline dolomite. The limestone matrix is usually softer becoming gypsiferous near the base of the formation. Differential leaching results in cavernous porosity in several massive beds. Solution boxworks and structures resembling salt casks are found at a few localities. No fossils have been found in the Bear Rock formation.

The Bear Rock overlies the Mount Kindle dolomites in the McConnell Range except at one locality east of Wrigley. Section MCC-3a was measured in a narrow gorge on the west flank of the range, east of the Wrigley airport. Three hundred feet of thick bedded orange weathering limestone and breccias, gypsiferous shales and yellow brown weathering thin bedded and platy dolomites are exposed between the massive Bear Rock breccias and the Kindle dolomites. No fossils were found in this section but the strata is representative of similar units in the Camsell and Delorme formations of the Mackenzie Mountains.

In the Northern Franklin Mountains the Bear Rock formation is reported to disconformibly overlie the Silurian and Ordovician dolomites of the Mount Kindle (Hume, 1954). This would be consistant with anomalous thickness and fossil determinations in the Kindle as noted previously.

Dolomites of the Arnica formation are intertongued with limestone breccias of the Bear Rock formation in the Northern Rouge, Dusky, Redstone and Dahadinni Ranges of the Mackenzie Mountains.

Two thousand forty five feet of strata exposed at RED-1 in the central Redstone Range consists of a basal unit of dolomite 145 feet thick, a middle unit of interbedded light grey cryptograined limestone breccias and medium to dark grey dolomite 650 feet thick and an upper unit 1,260 feet thick of normal banded Arnica dolomite. Further north at RED-3 the limestone breccias occupy 950 feet in the center of the sequence. Basal and upper units of interbedded limestone and dark grey dolomite are 550 and 430 feet thick respectively.

In the Dahadinni Range Bear Rock limestones and breccias occupy the upper part of the interval replacing the bulk of the normal Arnica sequence to massive dolomite breccias in the vicinity of Mount Haywood. Arnica dolomites grade laterally to Bear Rock breccias northeast of Mount Gaudet and east of Willowlake Ridge.

MIDDLE DEVONIAN

Manetoe Formation

Refer to Sections LM-1, CM-1, CAM-1, 2, 3, 4, 5, 6, NCR-1A, 4, MGD-1, WLR-1, MCC-4, 7, ECA-1, IVF-1, IVR-1, 2, 3, 4, 5, 7, 9, 10, 13, 14, 15, 17, DKR-1, PTM-1, 2, 4, BHL-3; See Photographs 36, 37, 38, 39, 40, 41.

The Manetoe formation is a massive to thick bedded light grey weathering extremely coarse crystalline dolomite unit that overlies the Arnica formation in the Nahanni, Camsell, and Iverson Ranges, parts of the Ram and North Nahanni Plateaus, Willowlake Ridge and several localities in the Southern Painted Mountains.

Considerable thickness variations are characteristic of several distinct biohermal developments within the formation.

In the Southern Iverson Range where the Manetoe dolomites pass abruptly to the argillaceous limestones and shales of the Funeral formation a reefal buildup in excess of 500 feet is present. (See Sections IVF-1, IVR-2, 3, and 10.) Massive grey weathering rounded isolated knobs and prominences typify the reef front. Cavernous porosity in the upper part is partially destroyed by epigenetic dolomite and quartz. Fossil ghosts are frequently silicified and the original texture and bedding destroyed by dolomitization. Zones of zebroidal dark grey and white coarse crystalline dolomite are suggestive of the Stromatactoid dolomites described from the Cathedral carbonates in the Rocky Mountains (Aitken, 1966). The basal contact with the Arnica is not exposed along the reef front.

To the southeast the Back Reef facies of the Manetoe formation is markedly thinner, represented by 95 feet of light grey massive porous dolomite overlain by well bedded Landry limestones at IVR-5. In the North Camsell Range at NCR-4 145 feet of interbedded coarse crystalline porous dolomite and dark grey, cryptograined well-bedded limestones are referred to the Maretoe-Landry facies. Dolomites predominate the lower part and are gradational upward to the light grey weathering Landry formation. Gradations of the typical Manetoe and Landry formations are common in the back reef facies.

In the McConnell Range at MCC-4 10 feet of massive light grey weathering slightly vuggy coarse crystalline dolomite with thin limestone interbeds overlies the Bear Rock breccias. This is felt to be representative of the eastern depositional edge of the Manetoe formation.

Pinnacle Reef growth occurs at several localities in the back reef facies. A 200 foot thick structureless rusty weathering dolomite mass protrudes from a platform of 150 feet of massive Manetoe dolomite on the west face of Lone Mountain. This pinnacle extends through the Landry formation midway into the recessive Headless limestones.

Slight draping of the enclosing Landry limestones was observed. Similar inaccessible features are present on the east face of the Camsell Range. At PTM-4 and DKR-1 in the central Mackenzie Mountains isolated Manetoe pinnacles or reef masses grow from an Arnica platform and are enclosed or overlain by the Landry limestones.

Rare fossils collected from the Manetoe were identified as Eifelian by Drs. Stelck and Warren.

Funeral Formation

Refer to Sections WTA-1, NNP-1, DLM-1, IVR-3, 8, 11, 12, TRS-2, 3, PTM-1, 2, 3 (BHL-1, TRC-1); See Photographs 19, 20, 38.

The Funeral formation crops out in large areas of the Ram and North Nahanni Plateaus and southern ranges of the Mackenzie Mountains. The Funeral is generally considered to be the basinal or fore-reef equivalent of the Landry, Manetoe and upper Arnica formations.

At IVR-3 in the South Iverson Range 670 feet of dark grey calcareous shale and mudstone, variably recessive and platy weathering light pinkish grey to rusty yellow brown with more resistant interbeds of dark grey to black argillaceous cryptograined limestone weathering light grey to rusty overlie the southwest flank of the Manetoe reef mass. Higher on the reef the Funeral is approximately 200 feet thick while further to the northeast the Headless formation caps the reefoid dolomites.

In the North Nahanni Plateau at NNP-1, 1,545 feet of Funeral shales and limestones lie between strata of the Headless and Arnica formations. A Basal limestone member developed at NNP-1, BHL-1 and PTM-3 is gradational between the Funeral shales and Arnica dolomites.

The few fossils collected from the Funeral formation in 1967 are of Eifelian age. The type section of Funeral near Tundra Ridge in the Virginia Falls map area has been described by Douglas and Norris (GSC Paper 60-19) as being 2,550 feet thick. Souaya (1967) measured 2,045 feet at this locality and collected fossils identified by Dr. Stelck as the Lower Givetian Stage.

Although the Funeral formation is normally overlain by recessive limestones of the Headless Formation a thick light grey weathering unit of massive limestones assigned to the Landry formation overlies the Funeral in a small part of the Iverson, Whittaker and Delorme Ranges. This massive unit passes abruptly into the Funeral formation to the south and east of TRC-1 and IVR-12. Sections measured in the Painted Mountains along the North Nahanni River indicate the Funeral limestones and shales also front on and overlie isolated Manetoe reef masses in this area.

Landry Formation

Refer to Sections LM-1, WLR-1, SMR-1, IVF-1, NCR-1, 1A, 2, 3, DLM-1, 2, 3, TRC-1, PTM-4, DKR-1, 3, CAM-2, IVR-4, 5, 7, 9, 10, 12, 13, 14, 16, 18, WTA-1, TRS-3, RGR-2, RED-1, 2; See Photographs 15, 18, 19, 20, 21, 36, 41.

The Landry formation is more widespread in the project area than either the Manetoe or Funeral formations. At IVR-5 in the southern Iverson Range 320 feet of light grey weathering, medium to thick well bedded cryptograined limestones overlie dolomites of the Manetoe back reef facies. Rocks of the Landry formation appear to be restricted by the Manetoe reef front and are apparently equivalent to dolomites of the Manetoe and argillaceous limestones and shale of the Funeral formations.

In the back reef facies the Landry limestones are frequently interbedded with dolomites of the Manetoe formations. (See Sections CM-1, ECA-1, BHL-3, PTM-1, SMR-3, 4, NCR-4, MGD-1, IVR-1, 11, 15, 17, CAM-1, 3, 5, 6, RGR-3.

A thick sequence of argillaceous and shale limestones occupies a large part of the Northeast Dahadinni Map area. (See sections RGR-4, RED-3, DKR-4, CAM-4, MHW-1, SVA-1, DHR-1, 2, 3, 4, 5, 6, 7, 8.)

Douglas and Norris (G.S.C. Paper 62-33) refer this sequence to the Funeral formation. However it is felt that these rocks are not continuous with Funeral strata in the Root River map area but rather represent a marked change in the character of the Landry formation.

At Mount Haywood (MHW-1), 660 feet of thick bedded resistant and recessive light brown and grey weathering platy limestones lie between Bear Rock breccias and the Headless formation. The lack of association with dolomites of the Manetoe formation and the anomalous thickness in the vicinity of Mount Haywood and Shell Cloverleaf Lake I-46, point to a separate restricted environment to the northwest.

A massive light grey weathering limestone unit continuous with the Landry formation overlies rocks assigned to the Funeral formation at IVR-11, 12, TRC-1, WTA-1, DLM-1 and TRS-3. To the south and east of TRC-1 and IVR-12 these limestones pass abruptly into the Funeral formation.

Rare fossils identified from the Landry formation are of Eifelian age.

Headless Formation

Refer to Sections LM-1, CAM-1, 2, 3, 4, 5, 6, NCR-1A, 2, 3, 4, MGD-1, ECA-1, IVR-1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, DHR-1, 2, 3, 4, 5, 6, 7, 8, DLM-1, 2, 3, PTM-1, 2, 3, 4, RGR-1, 2, 4, DKR-1, 2, 3, RED-1, 2, 3, NNP-1, TRC-1, MHW-1, TRS-2, 3, BHL-3, SMR-1; See Photographs 11, 15, 17, 18, 19, 36, 38, 41.

The Headless formation is a widespread persistant generally recessive sequence of dark grey thin to medium bedded argillaceous limestones and brown weathering shaly limestone and shale separating the more resistant Nahanni formation from the underlying Landry, Manetoe or Funeral formations throughout the project area.

The thickness of the formation varies from 20 feet on Smith Ridge (SMR-1), 100 feet at CAM-1 on the Camsell Range, 180 feet at Trench Creek (TRC-1), 200 feet at DKR-1 in the Southern Dusky Range, to 415 feet at PTM-4 in the central Painted Mountains.

A more massive unit in the basal Headless formation is typically dark grey cryptograined limestone commonly rubbly weathering and very fossiliferous. Abundant fauna from the Headless formation indicates a Lower Givetian and/or Uppermost Eifelian age at most localities. A few collections in the Iverson Range suggest homotaxial development with the Nahanni. At IVR-1 a fossil suite similar to the Horn Plateau reef collections was identified by Drs. Stelck and Warren.

In general the Headless formation absorbs strata normally referred to the Nahanni in the Western Mackenzie Mountains and is eventually lost in a sequence similar to the Besa River formation.

The Headless formation thins rapidly eastward and is absorbed by the Nahanni formation on the McConnell Range.

Nahanni Formation

Refer to Sections TRC-1, TRS-2, 3, BHL-3, PTM-4, DKR-1, RGR-4, (DLM-3, IVR-6, MHW-1, ECA-1); See Photographs 11, 12, 15, 17, 18, 19, 25, 38.

A massive resistant limestone unit which forms the dip slopes of the Nahanni, Camsell and McConnell Ranges plus the Ram and North Nahanni Plateaus, is referred to the Nahanni formation.

Approximately 350 feet of dark grey micrograined to fine grained massive to thick bedded, light grey weathering limestone is exposed on the Camsell Range. In the Iverson, Dahadinni, Redstone, Rouge and Dusky Ranges of the Mackenzie Mountains thickness varies from 700 to 1,000 feet.

However, in the latter areas the formation is made up of alternating resistant and recessive units of thick bedded to platy limestone and frequently resembles strata of the underlying Headless formation.

The Nahanni limestone are usually highly fossiliferous and numerous collections of solitary and colonial Corals, Stromatopods, Brachiopods, Crinoids, and Gastropods indicate a Lower Givetian Stage.

The Nahanni formation is overlain conformably by the Fort Simpson or Horn River formations throughout the project area. To the south in the Virginia Falls and west in the Glacier Lake map areas, rocks of the Nahanni formation pass directly into strata assigned to the Headless or Besa River equivalents.

MIDDLE AND UPPER DEVONIAN

Fort Simpson Formation

Refer to Sections DC-1, 2, 3, MPA-2; See Photographs 7, 9, 10.

The Fort Simpson formation and younger unnamed rock units are generally poorly exposed throughout the project area. A complete sequence of Upper Devonian rocks is described by Souaya (1967) and Douglas and Norris (1961) from the western flank of the Yohin Syncline near the North Nahanni River in the Camsell Bend map area.

In a composite section along Deceiver Creek west of the Camsell Range (DC-1, 2, 3) 2,670 feet of strata are assigned to the Fort Simpson formation. The lower part of the formation is predominantly dark grey and black fissile shale and mudstone with minor intercalated siltstones, ironstone concretions and rare nodular limestone beds. The upper part consists of grey brown weathering silty or calcareous mudstones and shales with interbedded calcareous siltstones, ironstone concretions and minor argillaceous limestones.

Several faults and accompanying drag folds were observed in the sequence. The basal contact with the Nahanni is not exposed.

In a similar section on the east flank of the Moose Prairie Anticline near Redstone River in the Dahadinni River map area 1415 feet of strata are assigned to the Fort Simpson formation. No identifiable fossils were found in the formation at either locality but overlying beds have yielded Middle Frasnian fossils. The basal beds of the Fort Simpson formation may include equivalents of the Horn River formation of Middle Devonian age at these localities but the lack of fossil evidence or pronounced lithologic breaks make correlation difficult. Nontheless a Middle-Upper Devonian contact is assumed to exist in the lower Fort Simpson formation.

Root River Reef and Associated Rocks

Refer to Sections DLM-4; See Photographs 11, 12, 13, 14.

An isolated exposure of massive light grey weathering limestones overlies the Nahanni formation at the junction of the Root River and Landry Creek in the Northern Root River map area. The exposure is broken by faulting and doubly folded on itself in the southern part. The apparently conformable contact with the Nahanni is exposed only on the eastern cliff face. The approximate thickness of the biohermal structure is 400 feet on the northwest flank at DLM-4. The very thick basal beds are highly fossiliferous consisting primarily of very coarse crinoid columnals with associated colonial corals, brachiopods and trilobites. The upper beds are extremely massive, light brown cryptograined algal limestones with occasional brachiopod, coral and stromatoporoid fragments. Fossils identified from the limestones are of the Middle Givetian stage.

The massive limestones are presumed to be laterally equivalent to the basal part of the Fort Simpson formation but no contacts are exposed locally. However the Fort Simpson shales and mudstones conformably overlie the Nahanni limestones at all other exposures on the east and west flanks of the Delorme Syncline.

A sequence of dolomitic shales, mudstone and gypsum form the core of the faulted structure. The entire sequence is in marked fault contact with beds of the Headless and Nahanni formations on the east limb. Several hundred feet of brown weathering dolomitic mudstones and shales on the west limb are severely brecciated and crumpled. The underlying brecciated red and green gypsiferous shales and pink gypsum are exposed in a deep ravine adjacent to the Root River. This sequence bears a marked lithologic similarity to strata of the Saline River formation of Cambrian age exposed in the McConnell Range of the Franklin Mountains. Unfortunately no fossils were found in this sequence at the Root River exposure. Brady and Wilson (1967) describe these beds as an intrusive evaporite plug.

UPPER DEVONIAN

Unnamed Rock Units (at least partially equivalent to the Yohin formation)

Refer to Sections CRL-1, CC-1, NF-1, 2, WA-1, 2, MPA-1, 2, 3; See Photographs 7, 8.

In the Camsell Bend map area the Fort Simpson formation is overlain by a generally resistant yellow to brownish weathering sequence of sandstones, limestones and shales. These are variably referred to G.S.C. units 19 and 21 to the west and as G.S.C. unit 22 to the east of the Camsell and North Nahanni Ranges. Throughout a large part of this area a light to medium grey limestone referred to G.S.C. unit 20 occupies the basal part of these units.

At CRL-1 and CC-1 this massive to thick bedded limestone is 150 to 205 feet thick. It is locally composed of Crinoid, Coral and Stromatoporoid debris but is normally cryptograined, variably argillaceous and occasionally silty at the base. Fossils identified from the limestone are of the Middle Frasnian stage, near the top of the Macgeea Zone.

Further north in the Wrigley and Dahadinni River map areas, a similar limestone unit is exposed on the crests of the Wrigley and Johnston anticlines above the shales of the Fort Simpson formation. Where examined at WA-1, 2 the upper part of the limestone was composed predominantly of tabular Stromatoporoids and Amphipora. Only 50 feet of the limestone were exposed at these localities. Beds near the base of the interval at WA-1 were flaggy, variably argillaceous and silty. Fossils identified from these localities are of the Upper Frasnian stage in the Cyrtinaeformis zone.

The interbedded sandstones and shales below the massive limestone at CRL-1 contain fossils of Frasnian age. A silty medium grey limestone member at the top of the interbedded shale and sand sequence yielded fossils of Late Frasnian to Lower Fammenian age. The overlying sandstone, limestone and shale series is assigned to G.S.C. unit 21.

East of the Nahanni thrust about 8 miles north of Cli Lake several folded and possibly faulted exposures of Upper Devonian rocks were examined at NF-1, 2.

Fossils collected from a 50 foot thick yellow brown weathering silty limestone were identified by Drs. Stelck and Warren as High Frasnian. Souaya (1967) collected fossils identified as Basal Famenian from a similar limestone exposure nearby. The overlying 200 feet of dark grey shale with reddish siltstone interbeds and ironstone concretion yielded no fossils. These rocks, presumed equivalent to similar strata described from CRL-1 are mapped locally as G.S.C. unit 22.

In the Dahadinni River map area part of a thick sequence of Upper Devonian rocks were examined at MPA-1, 2, 3 adjacent to the Redstone River. A resistant brownish weathering unit of interbedded grey shale and thick bedded very fine grained sandstone and siltstone referred to G.S.C. unit 24 overlies the Fort Simpson formation. At MCP-2 on the east flank of the Moose Prairie anticline 710 feet were assigned to this unit. Sandstone was more prominent in the upper part of the sequence at this locality. No fossils were found.

Overlying rocks are assigned to G.S.C. unit 26. A maximum thickness of 1515 feet of recessive grey weathering shale with minor interbedded siltstones and intercalated argillaceous limestones was examined at MPA-1, 2, 3. Limestones are more common in the upper parts as are siltstones in the lower part. Fossils of Late Frasnian age were found near the base of the unit while Late Frasnian to Lower Fammenian fauna were collected from the limestones in the upper part.

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Upper Devonian strata are unconformably overlain by Cretaceous sandstones and shale in the northeast part of this map area. No complete section of Upper Devonian was examined.

STRUCTURAL GEOLOGY

The structural geology of the Virginia Falls, Sibbeston Lake, Camsell Bend, Root River, Dahadinni River and Wrigley map areas has been described and mapped in detail by the Geological Survey of Canada, (Douglas and Norris 1960, 1961, 1962.)

Souaya (1967) summarized the principal structural features of the Sibbeston Lake and Eastern Virginia Falls map areas.

The principal structural element in the southern ranges of the Mackenzie and Franklin Mountains, Mackenzie Plain and Western Interior Plains is the north trending fold.

Folds are frequently complicated by thrust faults which break the flanks or crestal areas with the resultant repetition or omission of strata. Deformation is considered to be Laramide, with faulting and folding essentially contemporaneous throughout the area.

The Interior Plains are limited on the west by the Southern Franklin Mountains, namely the McConnell, Camsell and Nahanni ranges. The gently folded region between the Franklin Mountains and the front ranges of the Mackenzie Mountains is referred to as the Mackenzie Plain. The Dahadinni and Iverson Ranges and the North Nahanni Plateau form the western limit of the Mackenzie Plain. A broad area of folded Upper Devonian rocks between the Dahadinni and Redstone or Dusky Ranges is referred to as the Sylvan Plateau. The broad valley between the Redstone and Rouge range is called the Martin Syncline.

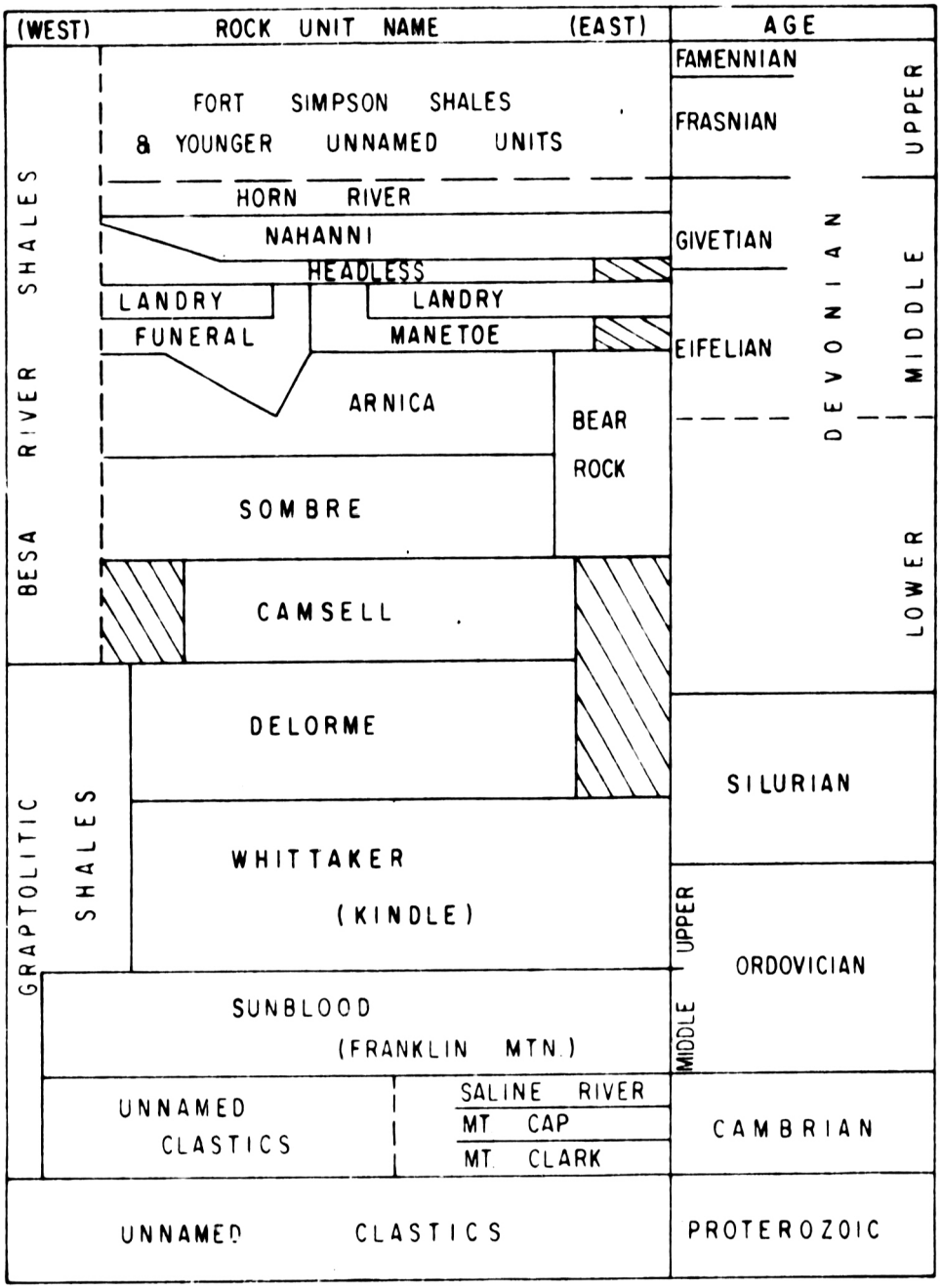
With few exceptions the remainder of the 1967 project area is mountainous. Rocks from Middle Devonian to Proterozoic are variably exposed in the faulted anticlinal structures and homoclinal thrust sheets.

The strata uplifted by the Nahanni and Camsell thrusts form narrow sinuous generally west dipping mountain ridges overlooking the flatlands of the Interior Plains. Although anticlinal structures are known to exist in some parts of the Nahanni and Camsell Ranges these features are generally thought to have been formed through predominantly vertical rather than horizontal movement. However, the northern extremity of the Camsell Range and the remaining major ranges in the Franklin and Mackenzie Mountains are essentially imbricate anticlinal structures involving rocks older than Middle Devonian, usually separated by broad synclinal valleys exposing only Upper Devonian rocks.

The limited amount of structural reconnaissance carried out in 1967 was predominently in the Mackenzie Plain and Western Interior Plains. Scattered exposures are present along major streams on the crest of the Wrigley Plateau and Root River Anticline and Yohin Syncline. These observations added little to the information already available but confirmed the existence of the majority of structures mapped by the Geological Survey of Canada (Maps 22, 23--1960; 22, 23--1961; 44, 45--1962). The heavy forest cover prevented ground observation throughout most of the Mackenzie Plain.

FIGURE 1

TABLE OF FORMATIONS

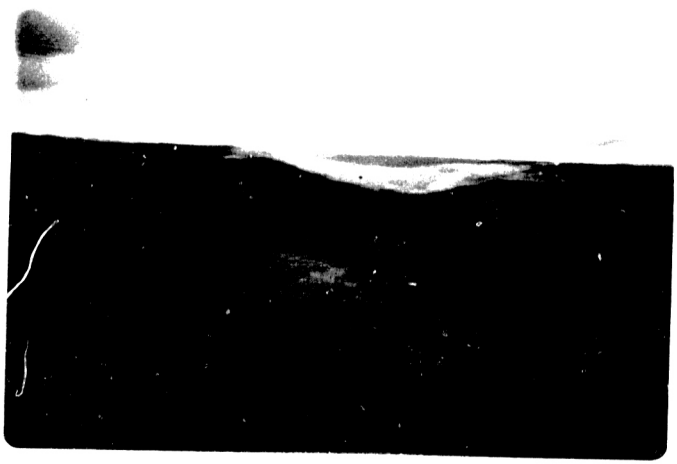


NB THE UNITS ARE NOT NECESSARILY TO SCALE

1. View to north near Grainger River of Nahanni Range and Western Interior Plains. Isolated Exposures of Middle Devonian Carbonates are present near the small lakes on the right.

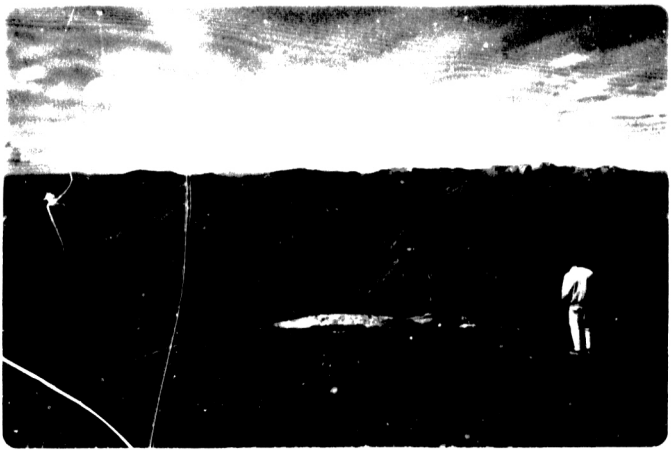
2. View to northwest near termination of Nahanni Range, of Mt. Nahanni, (left), Lone Mountain (right), Mt. Camsell (left middle), and the Camsell Range (left distance).

3. View to north at junction of Willow Lake and Mackenzie Rivers showing terrain. Willow Ridge (right distance) and McConnell Range (left distance) are visible.



4. View to the north of Wrigley 2 terrain gravity station. Wrigley location. Note the heavy forest cover and absence of outcrop.

5. View to the north of the Camsell Range at the Root River gap showing sinuous character of the Range.



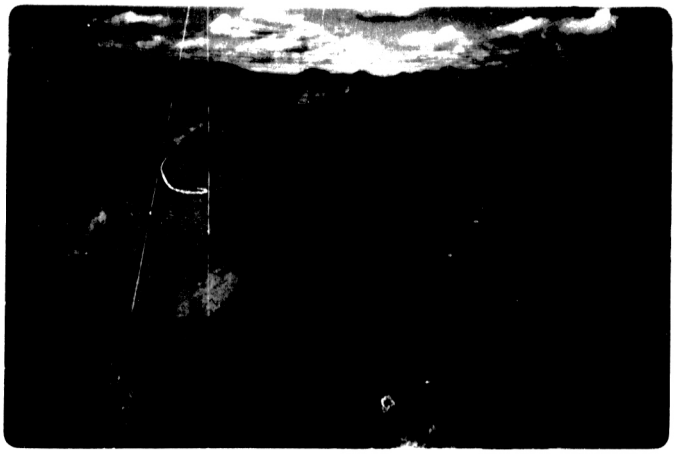
6. View to north near Slim Lake of Dahadinni Range. Bear Rock and Arnica formations (light and dark gray banding) are intertongued (center).

7. View to north of Sylvan Plateau showing folded Middle and Upper Devonian Rocks cut by the deeply encised Redstone River.

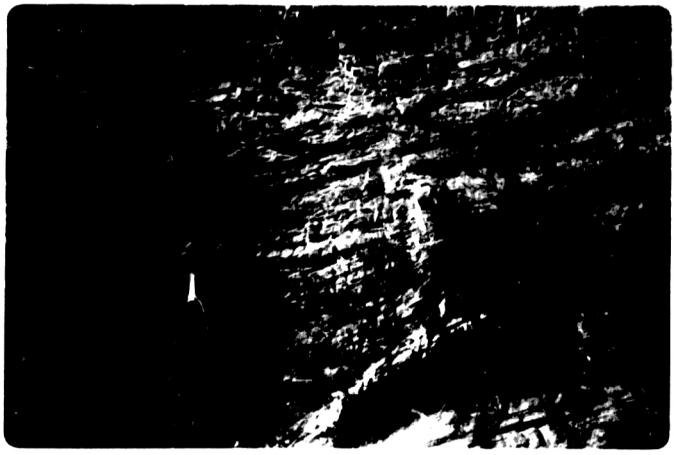
8. View to northwest of massive Upper Devonian reefal limestone capping the east flank of the Wrigley anticline.

9. View to northwest of Fort Simpson formation exposed along Deceiver Creek on the west flank of the Camsell Range.

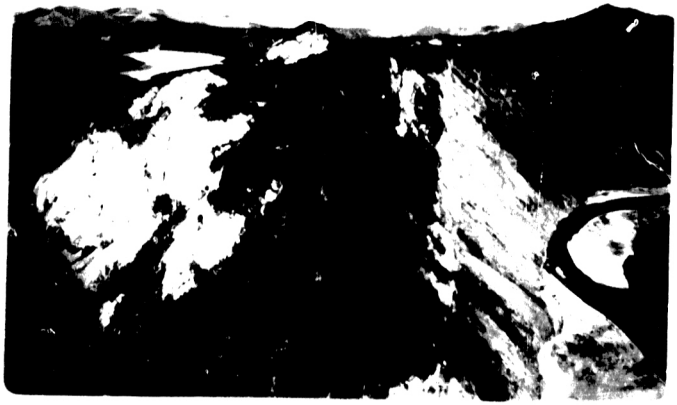
10. View to northwest of basal Fort Simpson shales and sandstones at TRS-2 on the east flank of the Whittaker Anticline.



11. View to north of Root River Reef exposed at the junction of Landry Creek (right) and Root River (north). A normal Nahanni, Headless, Landry, Arnica sequence is exposed above the creek. The contact with reefal limestone is near the treeline.

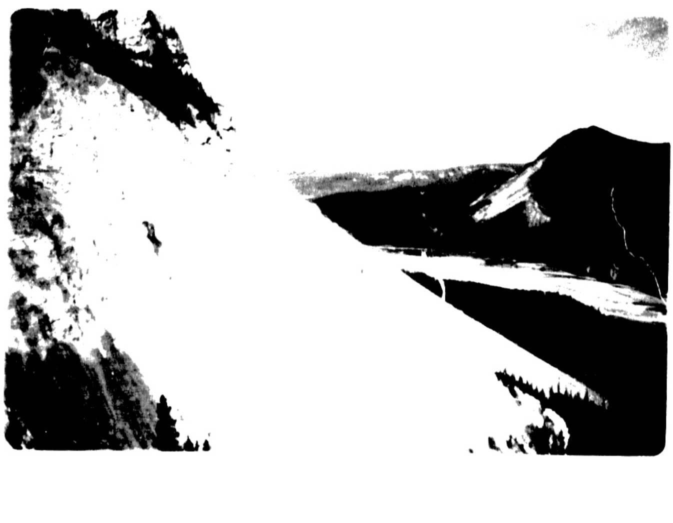


12. View to west of contact between reefal limestone (above treeline) and Nahanni formation (lower right) above Landry Creek.



13. View to southwest of Root River Reef exposure showing east flank, core and west flank segments.

14. View to the northwest across core of Root River Exposure showing reefal limestone (upper left), Buff weathering shales and dolomites (left) and red, green and grey gypsiferous shales and pink gypsum (lower right).

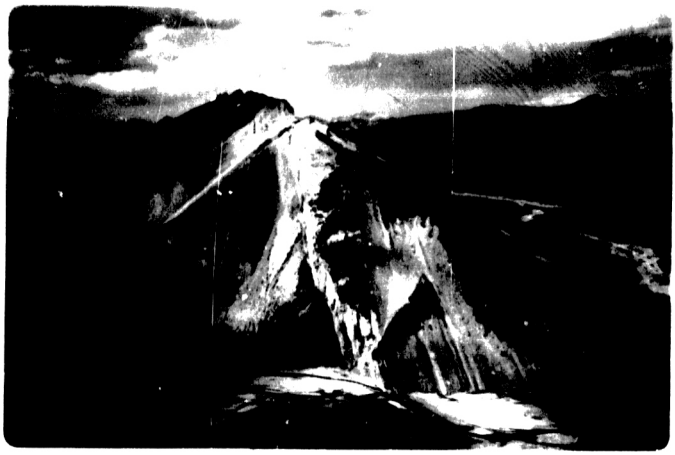


15. View to the northwest of sequence exposed in gap at Little Doctor Lake, Nahanni Range. Thin units of Nahanni, Headless, Landry, Manetoe, Arnica, Sombre (medium grey--left) overlie Delorme Equivalent (yellow brown) and Whittaker (dark grey banded--right).

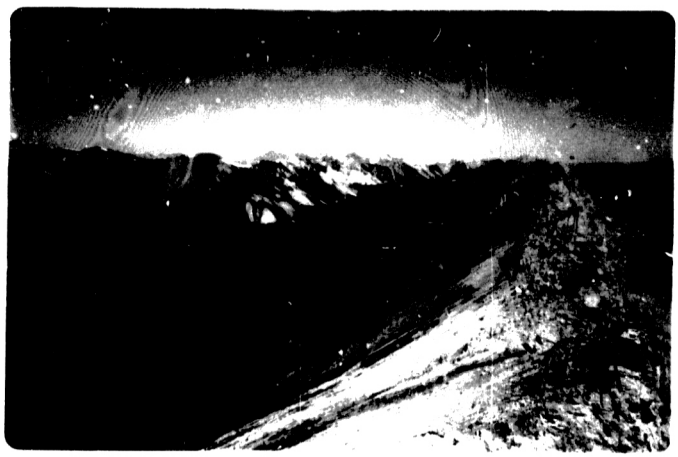
16. View to northwest of sequence at Cli Lake. Note that the syncline above the Nahanni thrust is separated from the homoclinal sheet on the west by a subsiduary thrust.

17. View to northwest of Chevron folds in the Nahanni-Arnica sequence above the Camsell thrust at the Root River Gap.

18. View to west of Camsell escarpment exposing thin units of Nahanni, Headless, Landry, Manetoe (top) overlying a thick sequence of banded dark grey Arnica dolomites.

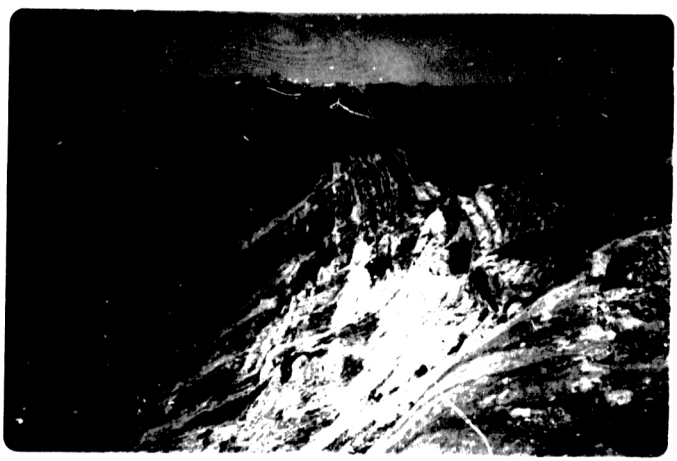


19. View to north on Trench Creek of Nahanni-Headless (grey recessive--right), Landry (light grey massive--middle) and Funeral (brown-grey recessive--left) at section TRC-1 on the east flank of the Whittaker Anticline.

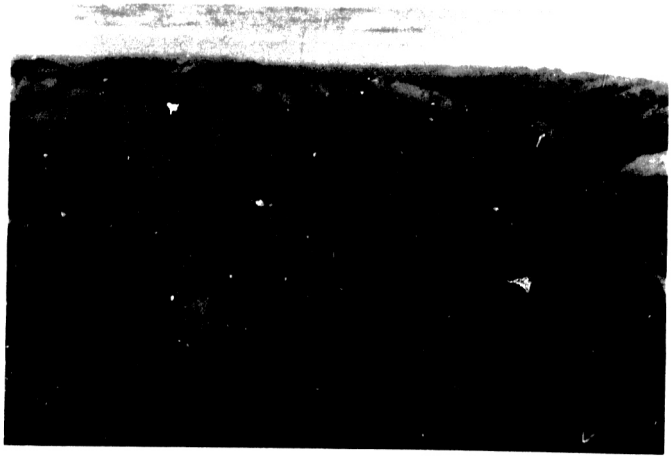


20. View to north of vertical Landry "cockscomb" ridge, recessive Funeral (grey brown--left) and Older Arnica, Sombre, Camsell, Delorme Strata (extreme left) are exposed.

21. View north of section WTA-1 shows vertical Landry Ridge and recessive Funeral (right) overlying Arnica (tree covered) and Sombre (grey banded--middle) with resistant massive Camsell breccias (extreme left).



22. View north on resistant Camsell formation showing alternating recessive yellow weathering basal beds. Underlying dark grey and yellow rusty Delorme formation is visible at top left.

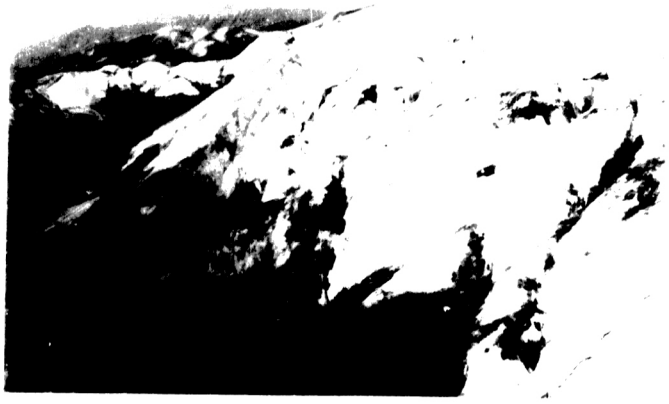


23. View northeast of dark grey and rusty weathering Delorme with overlying Camsell (right) and underlying Whittaker formations (left) at Section WTA-2.

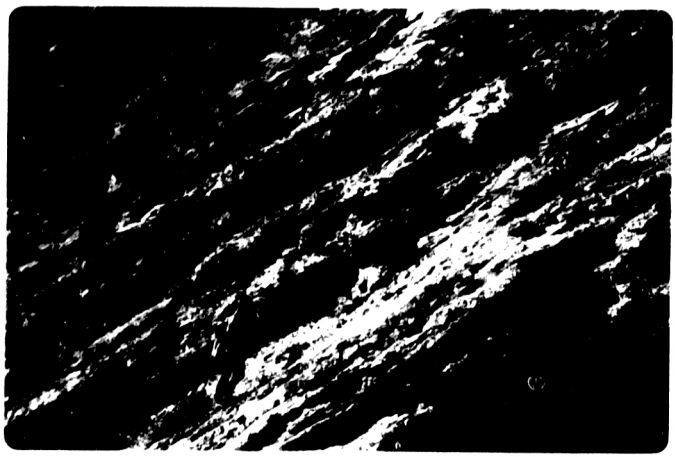
24. View northeast of Whittaker (grey recessive--right) overlying Sunblood (rusty weathering--left) on the east flank of the Whittaker anticline at Section WTA-3.

25. View northeast of cavernous weathering Bear Rock breccias near Smith Ridge on the McConnell Range. A thin Nahanni unit overlies the Bear Rock on the extreme left.

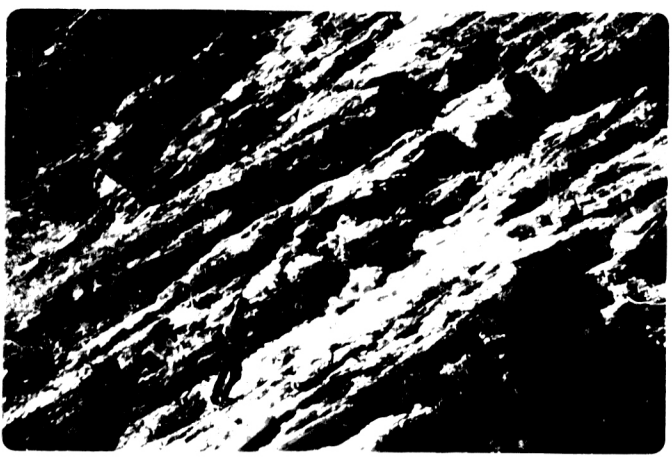
26. Closeup of Bear Rock breccias on Smith Ridge. Note the differential leaching.

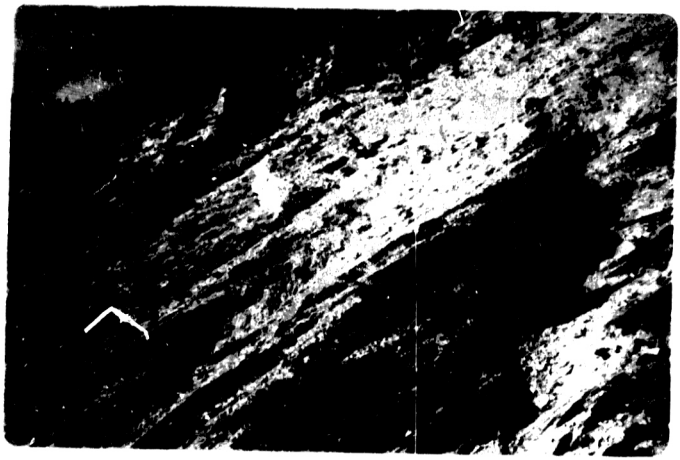


27. View to north in ravine near Smith Ridge at Section MCC-3a showing banded limestone breccias of the Bear Rock formation.



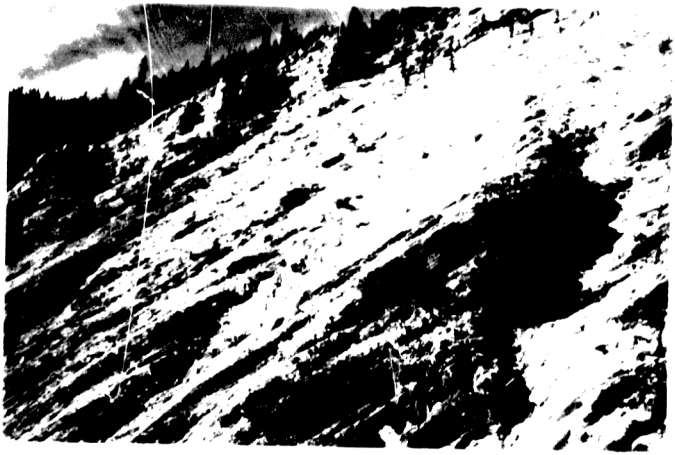
28. View to north at MCC-3a of west dipping yellow weathering limestone breccias and dolomites referred to the Gamsell formation.

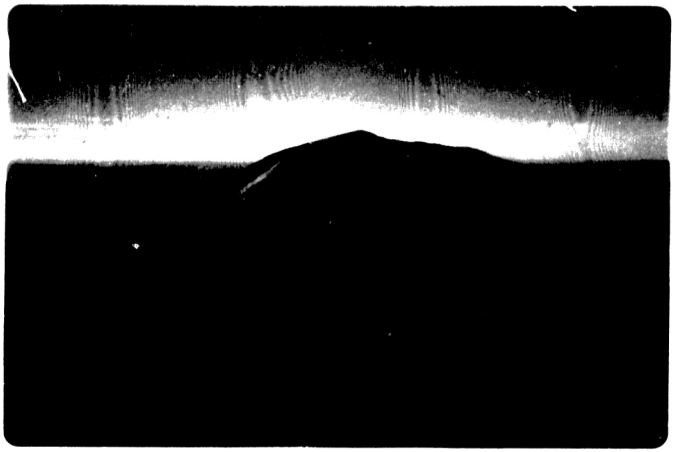




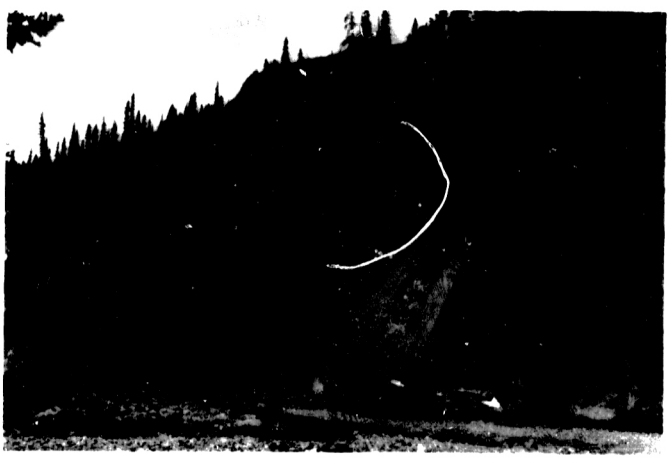
29. View to north at MCC-3a showing Camsell breccias (left top) with recessive gypsiferous shale and dolomites referred to the Camsell and/or Delorme formations.

30. View east of thick bedded dolomites of the Mount Kindle formation at MCC-3a in the McConnell Range.

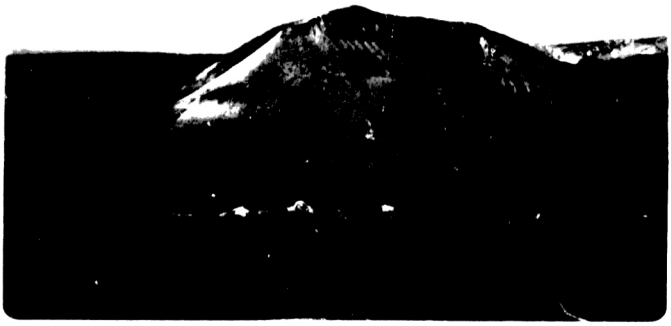




31. View to west of Mount Kindle near Wrigley exposing grey dolomites of the Silluro-Ordovician Kindle formation (top) with dolomites, sandstone and shale of the Middle Ordovician Franklin Mountain formation (middle-brownish) and white gypsum and gypsiferous shale of the Cambrian Saline River formation (base).



32. View northeast on Saline River near Mount Clark of type exposure of the Saline River formation of Cambrian age. Alternating beds of red shale, gypsum and brecciated limestone are overlain here by brownish weathering Franklin Mountain Dolomites and sandstones.

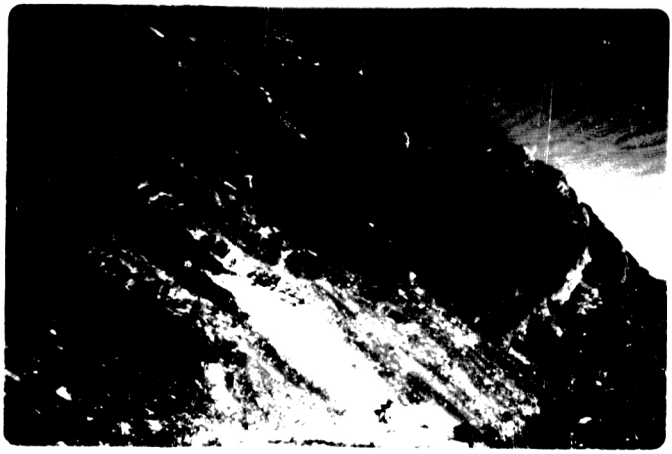


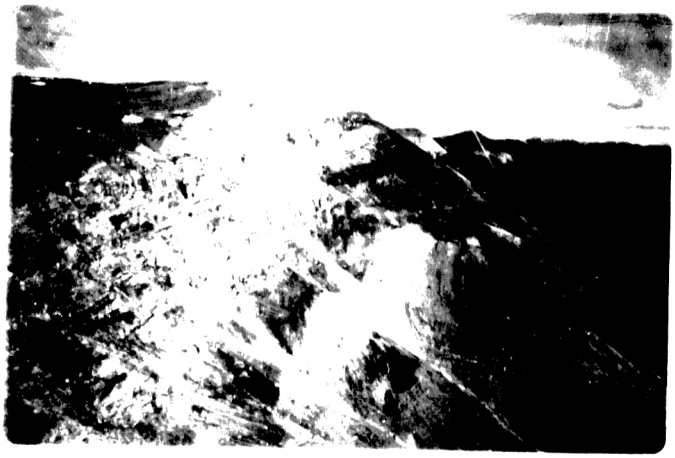
33. View north of massive crossbedding quartzites of the Mount Clark formation near the peak of Cap Mountain, McConnell Range.

34. View southeast of the north face of Cap Mountain showing the thick sequence of Proterozoic redbeds exposed beneath the Mount Clark quartzite (top right) of Lower Cambrian age which unconformably overlies the older beds.

35. View north of folded proterozoic redbeds above the Cap thrust on the east face of Cap Mountain.

36. View north of east face of Iverson Range above Iverson Lake, showing a thick sequence of massive Manetoe dolomites thrust over the overturned syncline containing Landry and Headless strata.





37. View west of thick massive Manetoe dolomite overlying dark grey banded Arnica dolomite on the front of the Iverson Range. This is part of the Iverson Manetoe Reefmass.

38. View east of the Manetoe Reef front on the east flank of the Iverson anticline. The Manetoe, weathered light grey and irregular is overlain by the recessive Nahanni and Headless formations (top right) and fronts on the recessive brown weathering Funeral formation (lower foreground).

[illegible] View west of [illegible] massive [illegible] dolomite [illegible], dark grey banded [illegible] dolomite [illegible] Iverson [illegible] Range. This is part of the Iverson [illegible].

[illegible] [illegible] The [illegible] [illegible] foreground [illegible] by the recessive [illegible] [illegible] formations (top right) and [illegible] on the recessive brown weathering [illegible] formation (lower foreground).

39. View to the northeast of the east dipping Manetoe Reefmass showing the typically irregular weathering and massive character.

40. Closeup of the Manetoe reef mass showing white and dark grey Stromatactid? structures and cavernous porosity.

41. View east of the west face of Lone Mountain. An irregular rusty weathering reef-mass (center) extends from a platform of bedded Manetoe dolomites (lower foreground) through the Landry limestones (middle into the recessive Headless formation (top). Slight draping of the enclosing Landry formation was observed on the cliff face.

42. View east of the Gap in the Nahanni Range at Little Doctor Lake. Note the camp (yellow dot) in the left foreground.

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