Coal Shale # 9
12 of 16

(14)-3-6

62 J/6W

# ARDEN
## MANITOBA

ECHELLE 1/50000

99°30 R 15 R 14 R 13 99°15

51°00 51°00

Tp23 Tp23

Ste Amélie

Hansen Creek

Tp22 Tp22

LAURIER-E

Turtle River Ditch

Little Otter Lake

Onabeesn Lake

Beaver Dam Lake

Rushmere Lake

Meezee Lake

Glenhope Lake

Tp21 Tp21

Dauphin

CANADIAN NATIONAL

Mc CREARY

Ochre River 31m

Alonso 14m

N. BORDER

AQUITAINE RESERVATION

E. BORDER

Tp 20 Tp 20

Mc Creary Junction

50°45 50°45

99°30 R 15 R 14 R 13 99°15

Margate 5m Neepawa Portage La Prairie

GLENELLA-W

# Mc CREARY

## MANITOBA

ECHELLE 1: 50 000

Kwid 2 m

Black shale
Bentonite

B. Geolog. Section 8
From top to bottom
SZ 243: *Pembina*
SZ 242
SZ 241: grey shale, kerabit., *white* specks — Boyne

Millewood, Pembina — Bentonitic shale

Vermilion River

Douglas 10 m

Edwards Creek

Edwards Lake

Moon Lake

Jackfish Lake

Shoal Lake

Vermilion River

Elphinstone 19 m

Lake Audy

R I D I N G  M O U N T A I N

R I D I N G

M O U N T A I N

N A T I O N A L  P A R K

WHITE WATER LAKE W

LAURIER W

Tp 23 / Tp 22 / Tp 21 / Tp 20

55' / 50'

100°15' / 10' / 05' / R 20 / R 19 / 100°00'

51°00' / 50°45'

# WHITEWATER LAKE
## MANITOBA

ECHELLE: 1/50 000

99°45'
50°30'
R 17
40'
R 16
35'
R 15
99°30'
50°30'

MARSH AND LAKE AREA

Kerr Lake

Tp 17

Mountain Road

Elk Ranch

BH6

Platy silicous shales

SZ 52246

Riding Mountain

SZ 247

SZ 245

R I D I N G

25

M O U N T A I N

POLONIA

SZ 369

Alluvium

Top of Vermilion format.

SZ 370

Gravel pit

Farm

BH5

DARK GREEN SILTY SHALE

Tp 16

Creek

Campbell

20

Mill

SZ 358

BH4

Clarskville

Gl.al.

New Idea

Pine trees Slumping

NEW DELLIS

Spring hills

Pine Trees

SZ 359

Duck water

Flat area

Rosco

no water supply

Cultivated plateau

Bridge

Rough track

Gravel Pit

BH3

Nepawa

Bethany

Tp 15

CANADIAN NATIONAL

Springhill

Orville

Tp 15

50°15'

99°45'

R 17

40'

R 16

35'

R 15

99°30'

CLANWILLIAM W

ARDEN W.

# CLANWILLIAM
## MANITOBA

ECHELLE :1/50000

99°45 — R 17 — R 16 — R 15 — 99°30

50°15

To Winnipeg

Tp 15

CANDIAN

Franklin

PACIFIC

AQUITAINE RESERVATION S. BORDER

Neepawa Aerodrome

To Portage la Prairie

To Neepawa

Tp 14

MOOREPARK - W

To Rivers City

Cordova

CANADIAN NATIONAL

Mentmore

To Portage la Prairie

NEEPAWA - W

Tp 13

To Moorepark

CANADIAN PACIFIC

BROOKDALE

To Portage la Prairie

Tp 12

50°00

99°45 — R 17 — R 16 — R 15 — 99°30

# MOOREPARK
## MANITOBA

ECHELLE 1:50 000

100°00
50°15

R 19

To Minnedosa R 18

To Binscarth

Erickson 20m

Minnedosa R.

R 17

99°45
50°15

W. B.

CANADIAN PACIFIC

AQUITAINE RESERVATION
S. BORDER

To Neepawa

MINNEDOSA

Tp15

RIVER

PACIFIC

CANADIAN

MINNEDOSA

Tp14

Riverdale

Neepawa 1m

CANADIAN NATIONAL

To Rapid City

To Carberry

Rapid City 2m

Tremaine

MOOREPARK-E

Tp13

CANADIAN

Varcoe

CANADIAN PACIFIC

Moorepark

To Brookdale

Tp12

PACIFIC

Rivers 11m

50°00
100°00

R 19

To Brandon

Brandon 11m

R 18

R 17

99°45
50°00

# MOOREPARK
## MANITOBA

ECHELLE 1: 50 000

99°30 — 50°15 — R 15 — R 14 — R 13 — 99°15 — 50°15

Eden 8m — To Dauphin — To Neepawa — Arden 2m

AQUITAINE RESERVATION S. BORDER

PACIFIC

CANADIAN

To Minnedosa — Minnedosa 11m — Lotorus 15m To Portage la Prairie — Gladstone 13m

NEEPAWA

Whitemud River

Tp 14

CANADIAN NATIONAL

Hallboro

CANADIAN NATIONAL

To Rapid City

Carberry Junction

CANADIAN NATIONAL

Hummerston

To Portage la Prairie

Tp 13

Whitemud River

CANADIAN NATIONAL

MOOREPARK E

To Virden — Brookdale 3m

Oberon

CANADIAN PACIFIC

Wellwood

To Portage la Prairie

Tp 12

NATIONAL

50°00 — 99°30 — R 15 — R 14 — 99°15 — 50°00

Carberry 14m — To Carberry — Carberry 9m

# NEEPAWA
## MANITOBA

ECHELLE 1: 50 000

LAURIER E.

Our Shale #9
Sup 16

(14) 3-8

62 J/12 E

R 17 | 40' | R 16 | 35' | R 15

99°45' 50°45' — 99°30' 50°45'

Tp 20 — Tp 20

Wasagaming 12 m — Norgate 1 m

40' — 40'

R I D I N G

M O U N T A I N

McKinnon

Tp 19 — Tp 19

Seyland Lake

Campbell

Watson Lake

Muskrat Lake

Helen Lake

WASAGAMING W — GLENELLA W

green, grey silty shale

BH 7
Slumping

35' — 35'

Tp 18 — Tp 18

SOUTHERN LIMIT OF RIDING MOUNTAIN NATIONAL PARK

Kerr Lake

Tp 17 — Tp 17

50°30' — 50°30'

99°45' — 99°30'

R 17 | 40' | R 16 | 35' | R 15

# WASAGAMING

## MANITOBA

ECHELLE: 1/50000

R 19 | R 18 | R 17

100°00 | 99°45

50°45 | 50°45

Tp20 | Tp20

Ministic Lake

Cowan Lake

Whirlpool Lake

R I D I N G  M O U N T A I N  N A T I O N A L  P A R K

C L E A R  L A K E

WASAGAMING

Katherine L.

Swanson River

Carson Lake

Norgate 12m

Tp19 | Tp19

Onatole

Hemingston Lakes

North Pacey L.

South Pacey Lake

M O U N T A I N

N. BORDER

AQUITAINE RESERVATION

W. BORDER

Whirlpool

Gertrude Lake

Bethel

Tp18 | Tp18

Proven Lake

Rolling River

Elphinstone

CANADIAN NATIONAL

Falcon L.

Leda Lake

Erickson

Otter Lake

Tp17 | Tp17

50°30 | 50°30

100°00 | 99°45

R 19 | R 18 | R 17

Neepawa | Minnedosa 20m | Clanwilliam 10m

CLANWILLIAM

# WASAGAMING

## MANITOBA

ECHELLE 1:50 000

WASAGAMING-E

Oil Shale #9
2 of 16 (14) - 3 - 5

62J/5W

# CLANWILLIAM
## MANITOBA

ECHELLE :1/50000

62 J/13 E

99°45 — R 17 — R 16 — R 15 — 99°30

51°00

Dauphin

MAKINAK

Tp23

Kerguwenan

3rd Rose du Lac 5m

CANADIAN NATIONAL

Tp22

Henderson

LAURIER

Wardens Cabin

Mc CREARY W

R I D I N G

M O U N T A I N

RIDING

N A T I O N A L

Creek

Scott

MOUNTAIN P A R K

Mc Kinnon Creek

Ditch

N. BORDER
AQUITAINE RESERVATION

W BORDER

Mc Creary 2nd

Tp21

Tp20

50°45

WASAGAMING E

# LAURIER
## MANITOBA

ECHELLE 1:50 000

(14)-3-15 Geol Study #9 13 of 16 62 N/13E

40' 35'

Tp35 Tp 35

SZ 377

Section of the Meander.
From top to bottom
SZ 381 Bed with large Inoceramus fragments
SZ 380 White specks
SZ 379
SZ 378 Jarosite colours

RIVER

BENITO
Water hole
Drift: 14'
Morden: 39'
Favel: 87'
Ashville: 314'

Tp34 Tp 34

SWAN

BENITO

MANITOBA
SASKATCHEWAN

Tp33 Tp 33

Tp32 Tp32

40' 35'

# ARRAN

SASKATCHEWAN MANITOBA

100°15'
51°15'
R 20
10'
Sifton
05'
R 19
Winnipegosis 30m.
100°00'
51°15'

VALLEY RIVER
River
Valley River
Tp26
Tp 26

Wilson
C.NADIAN
River
Grand View
CANADIAN NATIONAL
Tp 25
10'
Gilbert Plains 10 m.
NATIONAL
Water hole
DAUPHIN
Ste Rose du Lac 23 m.
Winnipeg
SZ 232
River
Creek
Rough track
05'
Tp 24
Vermilion
Gradationnal Zone of Favel
Favel Base
Good section in the river
Roslack
Keld
Meander section From top to bottom
SZ.233
SZ.234
SZ.235
SZ.236
SZ.237
SZ.238
Upper Part of Favel
Pionnee Bridge
Edwards
Tp 23
RIDING MOUNTAIN NATIONAL PARK
SZ 243bis Bank section
Thickness: 52ft
up to down:
SZ. 239 Black platy Carbonaceous
SZ 240 Shale no Bituminous
Septaria
51°00
100°15'
R 20
10'
05'
Minnedosa 60m.
R 19
100°00'
51°00

DAUPHIN W

OCHRE RIVER 62 O/4

# DAUPHIN
## MANITOBA

ECHELLE : 1/50000

14-3-21

# CANADA

OIL SHALE MANITOBA

OUTSIDE OF AQUITAINE RESERVATION N°9

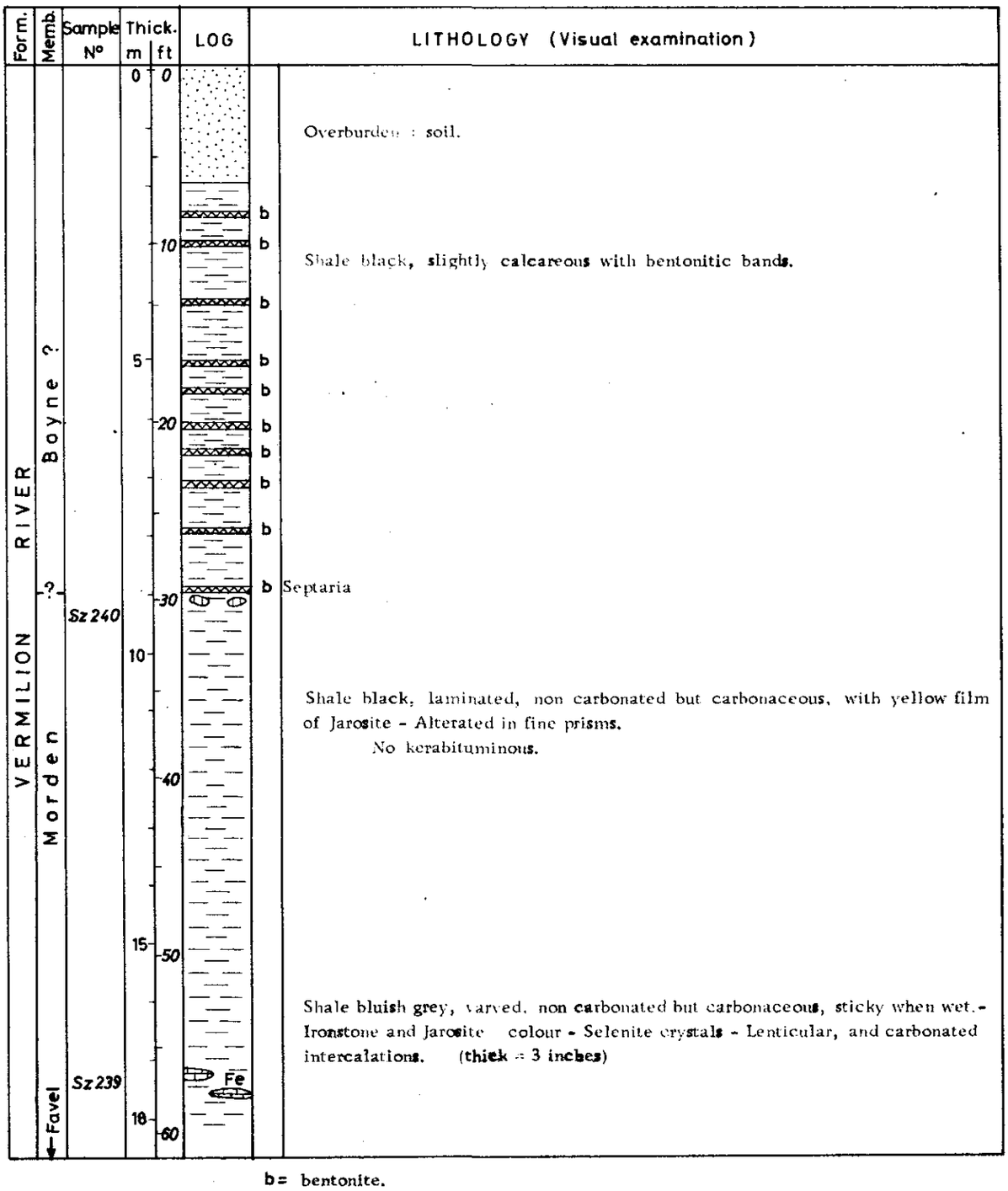
- B.I.7 -

## SECTION OF THE MEANDER OF THE VERMILION RIVER

S_W Corner of Lsd 15_Sec 23_Twp 23_Rge 20 WPM

Sheet DAUPHIN. E.

Scale 1/100




b= bentonite.

14-3-25

# C A N A D A

## OIL SHALE MANITOBA

## INSIDE AQUITAINE RESERVATION Nº9

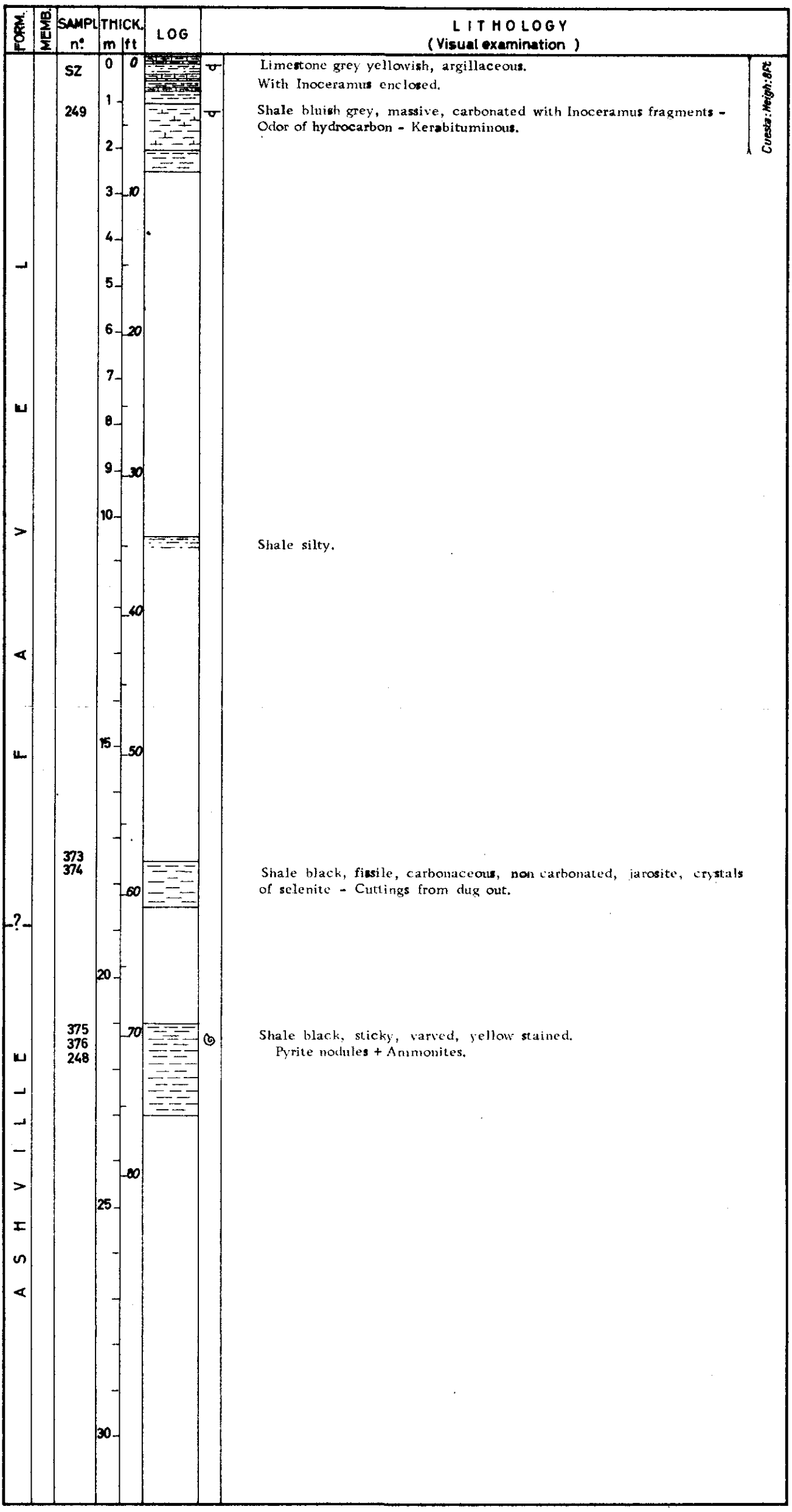
- A.C.C.8 - A.C.C.6 -

## SECTION 2 miles SOUTH OF KELWOOD

## Sheet GLENELLA. W.

---

**Scale: 1/100**



14-3-L-3

# CANADA

OIL SHALE MANITOBA

OUTSIDE OF AQUITAINE RESERVATION N°9

- B.II.1 -

## SWAN RIVER

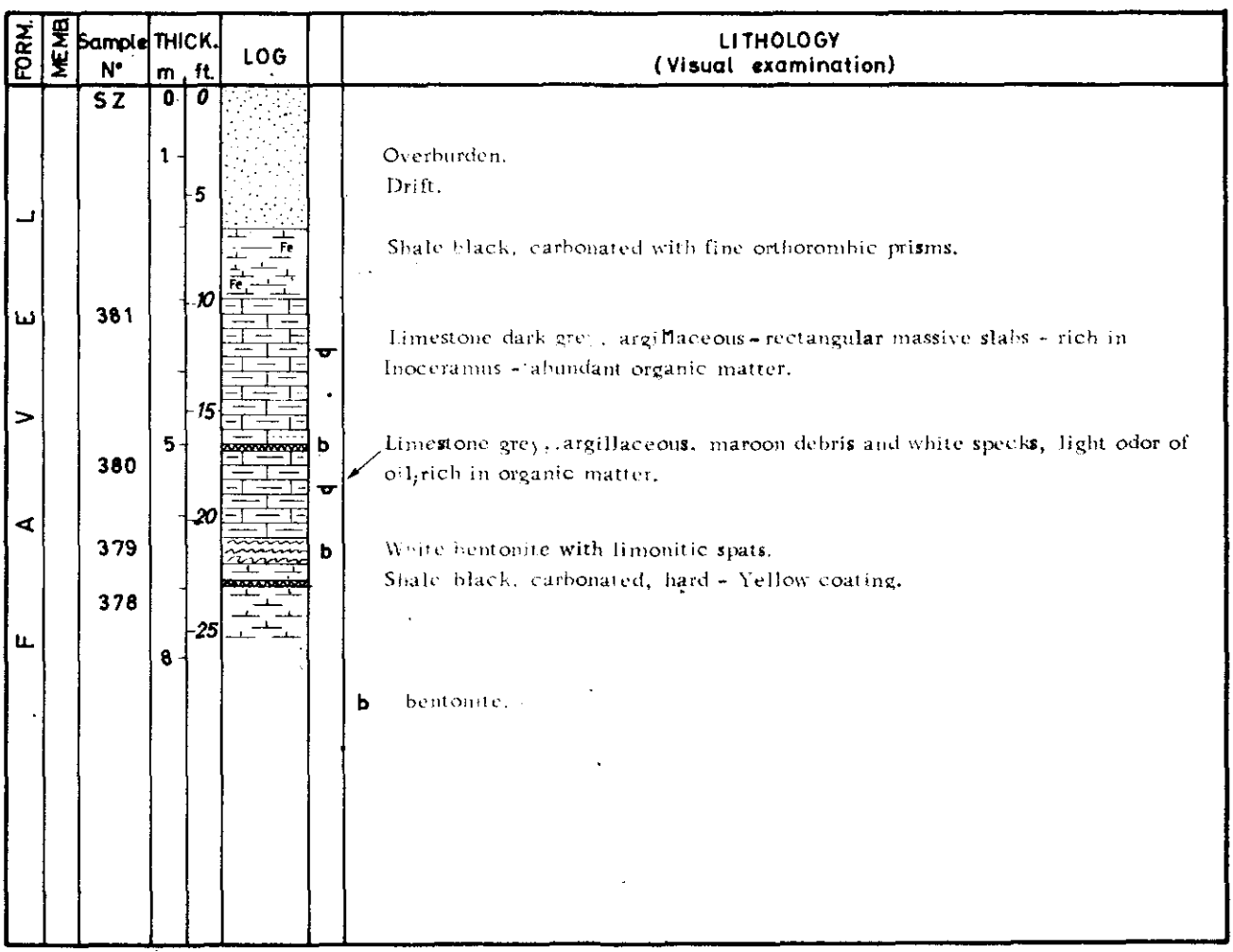
## SECTION IN THE BOTTOM OF THE CREEK

## Approx. center of Lsd 1_Sec 3_Twp 35_Rge 29 WPM

## Sheet ARRAN. E.

---

**Scale 1/100**



14-3-66

# CANADA

OIL SHALE MANITOBA

INSIDE OF AQUITAINE RESERVATION N°9

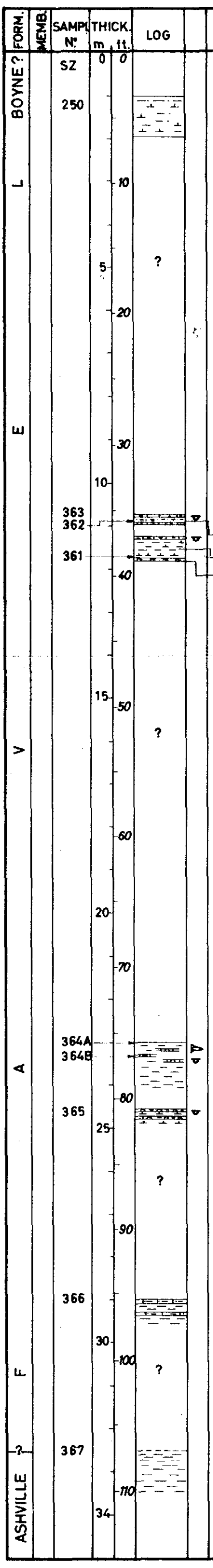
- A.C.C.7 -

## SECTION IN THE NORTHERN VICINITY OF KELWOOD VILLAGE

Sheet GLENELLA. W.

---

**Scale 1/100**




LITHOLOGY (Visual examination)

Shale black. laminated, carbonated, a little silt or sand, kerabituminous Big selenite crystals - Jarosite coating.

Marl brown, bioclastic, a little sand with large Inoceramus moulds (thick 2") recurring in small ledges perceptible in the morphology.

Silt clayey, yellowish grey stained by iron oxydes, laminated, sticky - Prisms of Inoceramus (thick 6").

arl shammy grey, sticky, laminated, carbonated (th. 4")

bentonite.

- Section measured to the N. Wayout of Kelwood

Paper shale, black, sticky, carbonated. selenite crystals, Fish bones.

Very thin intercalations of Lumachelle - Just beside the level crossing - Inoceramus

Marl rustly yellow, sticky, laminated - Platy fragments of Inoceramus wearing an Oysters lumachelle.

Limestone silty, argillaceous, in thin plates.

Shale black, laminated, sticky, jarosite coating - Cuttings from the dug out.

(14)-3-2

ext Sheet # 9
16 of 16

(14)-3-14

62 N/1W

R 22 | 25' | Ethelbert 18m | R 21 | 20' | R 20

100°30' 51°15' | 100°15' 51°15'

Tp 26 | Tp 26

Sulphurspring Creek

Ashville Outcrop

Lower part of Ashville Interesting facies Yellow Stain

RIVER VALLEY

S Z. 217 Ditch Road
S Z. 218 Black shale, sticky, Jarosite + Selenite
S Z. 224

Biosparite with Inoceramus Prims very abundant. Phosphates Organic matter
S Z. 225
S Z. 226

ASHVILLE

Tp 25 10' | Tp 25 10'

CANADIAN NATIONAL FIELDS FARMS

Bridge

CONTACT T. OF ASHVILLE River
Good outcrop Ashville Bentonite

Creek

Ashville good outcrop clean shales

GILBERT PLAINS

Grand View 9m | Dauphin 9m

From top to bottom:
S Z. 227
S Z. 228
S Z. 229
S Z. 230
S Z. 231

Section sampled in thalweg from top to bottom:
S Z. 219
S Z. 220
S Z. 221
S Z. 222
S Z. 223

Close to the top of Ashville Favel Base

Wilson River

Seventh Base Line

Wilson Ranch creek

Ditch

05' Tp 24 | 05' Tp 24

RIDING MOUNTAIN NATIONAL PARK

Tp 23 | Tp 23

51°00' 100°30' | 51°00' 100°15'

R 22 | 25' | R 21 | 20' | R 20

GRAND VIEW 62 N/2

OCHRE RIVER 62O/4

# DAUPHIN
## MANITOBA
SCALE 1: 50000

Oil Shale #9
15 of 16

(14)-3-7

62 J/11W

99°30' 50°45' | 25' | 20' | 99°15' 50°45'

Tp 20 | Tp 20

CANADIAN

AQUITAINE PERMIT BORDER

NATIONAL

NORGATE — Ashville Formation

CANADIAN

40' | 40'

Water storage

SZ 367 (Cuttings with Jarosite coating) "Ashville Formation"

SZ 366

SZ 365 Very coarse fragments of Inoceramus holding Lumachelles with oysters

Water storage

SZ 364 B

SZ 364 A Shale Fish bones; gypsum

SZ 250 calcite 18%

Water storage

<=<1°

WASAGAMING E.

Tp 19 | Tp 19

SZ 363 } Biomicrite + 90% de Co3 Ca phosphatic debris } "Base Favel"

SZ 362 } Co3 Ca 50%

SZ 361 }

P:1,50

Farm Outcrop Water

KELWOOD

Water storage

SZ 360 Carbonate 30% Lignite Sélénite Jarosite } "Base Favel"

Ledge

Water storage

Cuttings

Water storage

SZ 373 Non carben. plastic. Shale

SZ 374 Sélénite + Jarosite } "Top Ashville"

Ditch

Argillaceous Silt

100 Feet

SZ 375 SZ 376 Shale (Chlor + montmor) Amm. Pyrit Jarosite } "Ashville Formation"

SZ 248

Dense carbonate Shale rich in organic layered matter Big Inoceramus imprints Phosphate remains of Fishes.

SZ 249

P 2,50

1°

0 Thalweg

NORTH KELWOOD SECTION

Descending in the lithologic serie, the section is set up as follows: from Top to bottom

Up SZ 250

P:1,50 { SZ 363 Ledges with big Inoceramus, non bituminous
SZ 362 Favel Formation
SZ 361

SZ 364 B

SZ 365

SZ 366

Down SZ 367 and SZ 364 A "Ashville Formation"

35' | 35'

NATIONAL

Tp 18

Riding MOUNTAIN

SZ 371 Marls with Inoceramus
SZ 372 Platy limestone Phosphated remains of fishes } "Favel Formation"

Tp 17 | Tp 17

50°30' 99°30' | 25' | 20' | 99°15' 50°30'

GLENELLA W

GLENELLA E

# MANITOBA

## OIL SHALE RESERVATIONS

14-2
Oil Shale #9
1 of 16

### I - GEOLOGICAL LEGEND

**TERTIARY**

- 8 — "Turtle Mountain Formation" : Clay, sand, sandstone, coal intercalation.
- 7 — "Ravenscrag Formation" : Clay, sand, sandstone, coal intercalation.
- 6 — "Boissevain Formation" : Sand, sandstone.

**CRETACEOUS — UPPER (TURONIAN)**

- 5 — "Riding Mountain Formation" : Shale, grey and greenish grey, silty siliceous, scattered, glauconite and phosphate fragments.
- 4 — "Vermilion River Formation".
  - c - Pembina Member : Shale, black, non calcareous with bentonitic beds - Radiolaria - Foraminifera.
  - b - Boyne Member : Shale, grey, laminated, non calcareous, "black specks", stained with iron oxyde; yellow veinlets of jarosite. Shale grey, silty, calcareous, phosphate spots. Argillaceous matrix very rich in organic matter.
    Marker : "2nd speck".
    Outcrop thickness : ?
  - a - Morden Member : Shale black, soft, carbonaceous but non kerabituminous, non calcareous, stained with yellow colour of jarosite. Small amount of sulphur content. Selenite crystals disseminated.
    - " Septaria and limy intercalary beds " - Th. : 2 to 3 inches.
    - Prismatic alteration of some shaly beds stained with iron oxyde and jarosite colours.
    At the bottom, small layers of whitish bentonite.
    Measured thickness of the outcrop : 52 ft.
- 3 — "Favel Formation" : Shale grey to dark grey, laminated, calcareous lignitic and brown fish remains. Rich microfauna : Globigerina, Praeglobotruncana ordinaria, (SUBBOTINA).
  Several intercalations of bioclastic limestone or shale with, Inoceramus and fish remains.
  - Several layers of bentonite interbedded with shale.
  - Jarosite colours, scattered selenite crystals.
  - Grey and dark grey shales rich in organic matter.
  - Marker : 1st White specks.
  - Age : Upper cretaceous : Turonian.
  - Measured thickness of the outcrop. : ?

**LOWER AND UPPER CRETACEOUS**

- 2 — "Ashville Formation" : Shale dark grey very soft, non calcareous with thin layers of siltstones and micaceous sands.
  Scattered, Remains of bones and fish - Rare Inoceramus prismatic fragments - Phosphate spots - Pyritic Ammonites - Globigerina - Praeglobotruncana ordinaria (SUBBOTINA) - E. Kelwood.
  Jarosite colours and numerous selenite megacrystals.
  Bentonitic thin layers.
  Measured thickness : ?

**JURASSIC**

- 1 — Sands, sandstones, red and variegated shale. Glauconitic spots.

### II - PERMITS

- SUN
- AQUITAINE
- ATLANTIC
- BISON
- HUSKY
- MONTREAL
- MILL

### III - SYMBOLS

- Wells and core drill.
- Field sections - Field sections A, C, C.
- Formation Contour line
- Isobath line - Base of the Favel Formation - in ft. -
- Orientation of the sections from water drillings

SCALE
0 15 30 miles
0 15 30 Km

AQUITAINE COMPANY OF CANADA
Drawing 3446

GEOLOGIST : E. SALINI and others

December 15, 1965

**SUN OPERATION**

Drillings: 12(?) core holes; Air coring; Recovery > 98%
Complete section of the Niobrara Formation
Thickness: Black shales ± 108'
Oil content: 15 to 20 US gal/ft for 25' thickness
Sulfur content: 7%

NORTHWEST ETOMAMI RIVER SECTION
Sec 32, tp 42, rge 3, W 2nd mer
Vermilion River: Boyne (Th. ft. 0–16.9) — Alternating of shale and bentonite. Shale dark grey, calcareous, speckled with white, bentonite.

SOUTHWEST HUDSON BAY JUNCTION NEAR BERTWELL
Vermilion River: Morden (Th. ft. 0–X) — Non calcareous shale.

EAST BRANCH OF FAVEL RIVER SECTION
sec 30, tp 35, rge 28, W.P.M.
Vermilion River: Assiniboine (Th. ft. 0–9.33) — Shale dark. Limestone hard, buff, grey stone shale. Shale, dark grey, speckled. b = bentonite
Favel: Ashville (Th. ft. 0–30.33) — Shale dark. b = bentonite

WEST BRANCH OF FAVEL RIVER SECTION
sec 26, tp 35, rge 28, W.P.M.
Favel: Ashville (Th. ft. 0–30.33) — Shale, medium grey with white inoc calcareous specks, thin beds of impure limestone. Shale dark grey. b = bentonite

VALLEY RIVER SECTION
S 30, T P 25, R 21, W.P.M.
Vermilion River: Morden (Th. ft. 0–32.7) — Boulder clay. Shale, dark bituminous Several at bottom limestone grey. Shale grey, speckled, calcareous. Shale, grey, speckled, limestone grey. Shale, grey, speckled, calcareous. Shale, hard, speckled. Small limestone bands. + Inoceramus. b = bentonite.
Favel: Ashville (Th. ft. 32.7–77) — Shale, grey, speckled, calcareous. Shale, hard, speckled. Small limestone bands. + Inoceramus. b = bentonite.

WILSON RIVER SECTION
La 8, sec 15, tp 25, rge 21, W.P.M.
Favel: Ashville (Th. ft. 0–31.6) — Shale dark grey. Let and Sh blocks. Shale calcareous. Shale dk grey, pet. ish. blocky. Shale calcareous. Shale, calcareous, speckled. Shale, black petrol. fine silt bands. Hard, dark, petrol. shale. b = bentonite

VERMILION RIVER SECTION
La 8, sec 3, tp 24, rge 20, W.P.M.
Vermilion River: Assiniboine (Th. ft. 0–13.4) — Shale medium to dark grey speckled, calcareous. Limestone, soft impure. Limestone grey impure. Shale dark grey partly speckled. Shale dark grey speckled slightly calcareous. Shale dark grey speckled.
Favel: Keld (Th. ft. 13.4–70.5) — Shale dark grey non calcareous.
Favel: Ashville (Th. ft. 70.5–85.72) — b = bentonite

EAST BANK OF VERMILION RIVER SECTION
Sec 23, tp 23, rge 20, W.P.M.
Vermilion River: Boyne (Th. ft. 0–41.17) — Alternating of shale and bentonite. Shale, dark grey, non calcareous massive. less massive. soft, friable. Few white specks, very friable to massive. Shale brownish black. Shale with bentonite bands.
Vermilion River: Morden (Th. ft. 41.17–71.17) — b = bentonite

EAST BANK OF VERMILION RIVER
Sec 23, tp 23, rge 20, W.P.M.
Vermilion River: Morden (Th. ft. 0–52) — Shale dark grey.

VENTURES KAMSACK N° 7 Well
La 14, Sec 23, tp 29, Rge 32 WPM
Vermilion River: Boyne (Depth ft. 179–310) — Shale dark grey. Shale medium grey with white specks. Fish bancs. Shale dark, light grey bentonite. Shale dark grey with whole specks probably shell fragments. Shale medium grey with whole specks some shell fragments.
Vermilion River: Morden (Depth ft. 310–445) — Shale dark grey few fish bancs. Fish. Fish. Inoc. Shale medium grey with few white specks. Inoc. Some grey limestone. Glob. Glob. Pieces of grey limestone. Bentonite and grey shale.
Favel: Ashville (Depth ft. 310–445) — b = bentonite

COMMONWEALTH MANITOU N° 2 Well
La 8, sec 26, tp 2, rge 9, W.P.M.
Vermilion River: Boyne (Depth ft. 140–290) — missing. Shale medium grey, some white calcareous specks, some fine Fo white silt. Shale, medium grey few white calcareous specks. missing. Shale, medium grey few white calcareous specks.
Vermilion River: Morden (Depth ft. 290–430) — Shale, medium to dark grey. Missing. Shale, medium to dark grey, non calcareous.
Favel: (Depth ft. 410–580) — Shale, medium to dark grey, speckled with white calcareous material. Some fine grained calcareous sandstone. Shale, dark grey slightly calcareous, few white scerks. A little silt or sand. Limestone grey impure Fo. Shale dark grey with specks as above. Some bentonite.

NORTH SIDE OF PEMBINA VALLEY SECTION
sec 4, tp 1, rge 6, W.P.M.
Vermilion River: Boyne (Th. ft. 0–147.75) — Shale with bentonite beds. Shale, medium grey, speckled white, calcareous. Shale or impure limestone. Shale, dark grey to black, non calcareous. Shale, dark grey, speckled white. Shale, dark grey, non calcareous, much yellow stain. Shale, medium grey speckled white, calcareous. Shale, medium to dark grey. Shale black, non calcareous. Shale medium g a little silt.
Vermilion River: Morden (Th. ft. 147.75–167.5) — b = bentonite

RIVE SUD PEMBINA VALLEY
Sec 5, tp 1, rge 6, W.P.M.
Vermilion River: Morden (Th. ft. 0–35) — Speckled, calcareous, shale. Dark grey to black, non calcareous, blocky shale.

Sun 1 — 1.894 080 ac
Sun 2 — 289 760 ac
Sun 3 — 446 080 ac
Sun 4 — 471 060 ac
Sun 5 — 115 200 ac
Sun 6 — 392 355 ac
Sun 7 — 3 500 000 ac
Sun 8 — 118 000 ac
Sun 9 — 728 000 ac
Sun 10 — 16 618 ac

Trail Blazer 1; Regalties 1; Pewo 1; Thunder Hill 1; Bronlo 1; Ventures Kamsack 7; Dauphin well; Newport Creek; Con Prospect; Dome; Manitou 2; Fleming Well; Commonwealth Manitou 2

CUMBERLAND LAKE; MOOSE LAKE; CEDAR LAKE; LAKE WINNIPEG; CARROT RIVER; TISDALE; HUDSON BAY JUNCTION; PORCUPINE FOREST RESERVE; SWAN RIVER; DUCK MOUNTAIN PROVINCIAL PARK; RIDING MOUNTAIN NATIONAL PARK; DAUPHIN LAKE; QUILL LAKE; ESTERHAZY; REGINA; KELWOOD; NEEPAWA; MC CREARY; BRANDON; PASQUA HILLS; QU'APPELLE; ASSINIBOINE; SECOND MERIDIAN; Carrot River; Man River; Deer River; Red River; Swan River; Vermilion River

(14-1)

C A N A D A

OIL SHALE MANITOBA

AQUITAINE RESERVATION N° 9

1 - Study from old Notes about oil shales

# C A N A D A

## OIL SHALE MANITOBA

### Aquitaine Reservation n° 9 and Neighbouring Area

-:-:-

## 1 - STUDY FROM OLD NOTES ABOUT OIL SHALES

-:-:-

### I - LOCATION OF THE PROBLEM -

Looking North from the U.S. Border in a direction N 20° W towards Porcupine Forest (separating Saskat. from Manitoba) one observes a crest line hovering about 1000' above the Manitoba plain strewn with numerous lakes.

From a geological view point these hills are formed from top to foot by layers formerly called "Pierre and Niobrara Formation" (1), but since 1930 (2) the following terminology was given to them :

- Riding Mountain Formation
- Vermilion River Formation ( Pembina Member
  ( Boyne Member
- Niobrara Formation ( Morden Member
- Favel Formation Assiniboine
- Ashville Formation

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(1) - J.B. TYRRELL and D.B. DOWLING - Report on Northwestern Manitoba with portions of the adjacent districts of Assiniboine and Saskatchewan - Geol. Survey of Canada - 1892.

- Wm Mc INNES - The Basins of Nelson and Churchill Rivers - Geol. Survey of Canada - Mem. 30. 1913

(2) - KIRK S.R. - Cretaceous Stratigraphy of the Manitoba Escarpment - Geol. Surv. Canada - Sum. Rept. 1929, pt. B, p. 117 - 1930.

According to Paleontological surveys an "upper Cretaceous" age may be attributed to this aggregate.

From 1900 to 1921, the existence of layers of Kerabituminous shales called for attention. These shales evidenced in sections of the various valleys cutting through the above mentionned formations.

In 1913 (1), quoting Mc INNES, reports the existence in Saskatchewan of kerabituminous clusters 120' thick at the Northern end of Porcupine Forest - Manitoba.

In 1914 A. Mc LEAN (2) mentions the presence of carbonaceous shale (in the Valley River - Gilbert Plains area) and calls attention on the existence of kerogene shale producing oil - by pyrolisis - in the Pembina mountains Manitoba.

In 1921, S.C. ELLS (3) publishes a paper on the Cretaceous Shales of Manitoba, he gives a good description of the different types of shale encountered, of their alteration , of the minerals tied up with them (namely Pyrites) which explain the spontaneous combustion of certain outcrops.

A table of various analysis in appendix to this work shows that a number of samples of outcrops have an oil content up to 9 U.S. gal/t with water content of frequently 15 U.S. gal/ton.

The same year A.A. SWINNERTON published data on tests carried out on oil shales of Canada by the Fuel Testing Laboratory. A number of samples originated from the Niobrara Formation in Manitoba and showed oil content of 15 U.S. gal/t.

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(1) - MALCOLM W. - Oil and Gas prospects of the Northwest provinces of Canada - G.S.C. Memoir 27.E. 1913.

(2) - Mac LEAN A. - Pembina Mountain - Manitoba - Report on N.W. Manitoba - Part E. Annual Report, G.S.C. Vol. V, p. 86.

(3) - S.C. ELLS - Cretaceous Shales of Manitoba and Saskatchewan, their economic value - Mines Branch - Dept. of Mines.

To conclude, a rapid examination of former publications, suggests in Manitoba, extending on 450 kms between Porcupine to NW and Pembina Mountains to the S.E., marine formations of upper Cretaceous age with interbedded layers of carbonaceous and bituminous shales which, if buried enough to be free from alteration, could eventually be an objective.

II - CHOICE OF AQUITAINE PERMIT - ENVIRONMENT - PROGNOSTICS -

Following interest aroused by oil shales in Manitoba, Aquitaine Company of Canada bid in 1964 for an area of 118.000 acres the permit was granted on the 23d.9.1964.

As regards environment this area extends on topographic sheets scale 1/50.000 listed below : LAURIER E, Mc. GREARY W., WASAGAMING W. and E., CLAN. ILLIAM W. and E., ARDEN W., MOOREPARK and NEEPAWA W. and is limited to the North by Sun Company Reservations, to the South by Atlantic. All these permits are astride a string of outcrops to allow an easy investigation of oil shales and eventually a surface or shallow underground development.

Potential objectives are made up of base of Vermilion, Favel and eventually top of Ashville.

Thickness expected are determined by reference to sections provided by near by holes and would be :

a - Around SW Corner of permit

Hole n° 20 (1) shows :

| | | |
|---|---|---|
| Vermilion Formation | : 227 ft | Thick |
| Favel | : 70 ft | - |

.../

(1), (2), (3) : cf. E. SALINI : OIL SHALE RESERVATION

b - Middle W. border of Permit

Hole n° 15 (2) shows :

Vermilion Formation : 163 ft Thick
Favel : 97 ft -

c - N.W. Corner of Permit

Hole n° 17 (3) shows :

Vermilion Formation : 163 ft Thick
Favel : 83 ft -

As regards the Morden, base of Vermilion formation, its thickness is expected to be between 30' and 45'.

According to base of Favel isobaths, the thickness of capping masses formed of silty and siliceous shales of the Riding Mountain formation would be of 600' at the SW corner, 913 ft for the middle of the western border and 769 ft for the NW corner of permit

The reconnaissance of potential objectives even on the western border of our permit can thus be achieved by boring holes to a maximum depth of 1000'.

January 27. 1966

F. TORTOCHAUX

(14)

# MANITOBA

## OIL SHALE RESERVATION N° 9

## Geological Study on the Oil Shale

## Riding Mountain, Favel, Vermilion and Ashville Formations

-:-:-:-

SUMMARY

-:-:-:-


1 - Study from old Notes about oil shale

2 - General Geological map of Manitoba from compiled data
Interpretative Sections from water drilling

3 - Field Notes

4 - a) - Lithologic Examination of the field samples
b) - Geochemical Examination
c) - Fisher Analysis Results

5 - Final Estimation
Drilling program


Pau, January 28, 1966

(14) - (2)

C A N A D A

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CITY OF MANITOBA

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AQUITAINE RESERVATION N° 9

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- - - -

2 - General Geological Map of Manitoba from compiled data

- Interpretative Sections from water drillings

(14) - (2)

C A N A D A

OIL SHALE MANITOBA

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AQUITAINE RESERVATION N° 9

-

NOTES ON THE MAP OF THE RESERVATIONS

This map shows

- the areas for which various Companies have obtained Oil Shale Reservations
- outcrops of kerabituminous formations and surrounding formations
- base of Favel Formation isobaths -lower limit of kerabituminous formations-
- the location of a few sections and wells as described in Bibliography or provided by A C C

Main results

This map shows a rather important regional thickening of all members of the Vermilion River Formation towards the South-East end of the map. It seems that this thickening may be extended in the U S A

The kerabituminous formations are located in the "Niobrara Formation" referred to by old authors that is to say from the higher member of Favel Formation up to the Boyne member of Vermilion River Formation -as defined actually-

According to the same authors, oil content tests carried out on surface samples, showed a rather more favorable kerabituminous facies from the Vermilion River towards the North and more significantly in the Pasquia Hills, part of the actual Sun Reservation

In this location, a recent exploratory survey carried out by this Company evidenced the presence at slight depths, in the unalterated areas, of oil contents of about 15 to 20 gals per ton

It seems at the moment that the areas of interest for the exploration of oil shales, would be located in the whereabouts of the Sun Reservation, and near enough to the Vermilion River and Favel Formation outcrops, to avoid a too important sterile overlap

In these areas, notwithstanding an important decrease in thickness, the kerabituminous beds still retains a power of interest

As regards the area South of Vermilion River, we possess no data concerning oil contents of these formations which further North attracted our attention

It should be of interest to obtain information, for this part of the basin where Favel and Vermilion River Formations show both important thickness

E SALINI

APPENDIX 1

Notwithstanding the important thickness of kerabituminous formations South of Vermilion River, it cannot be expected to find here high grade of oil content

In fact, a field survey carried out during 1965 by AQUITAINE showed for surface samples an oil content of $\leq 8$ gals/Ton These results are comparable to those mentioned by the old authors for the Vermilion River Area

On the other hand, according to information recently received, the average oil content of oil shales encountered by ATLANTIC when drilling their South Manitoba Permit, is lower than 11 gals/Ton, the thickness of the overburden being 250' and more

These above data tend to reduce the interest in the kerabituminous shales South of Vermilion River

Nevertheless before giving up this area, it would be convenient to await the results of tests to be made on unalterated samples collected in depth by a campaign of holes drilled inside AQUITAINE's permit

January 5th, 1966

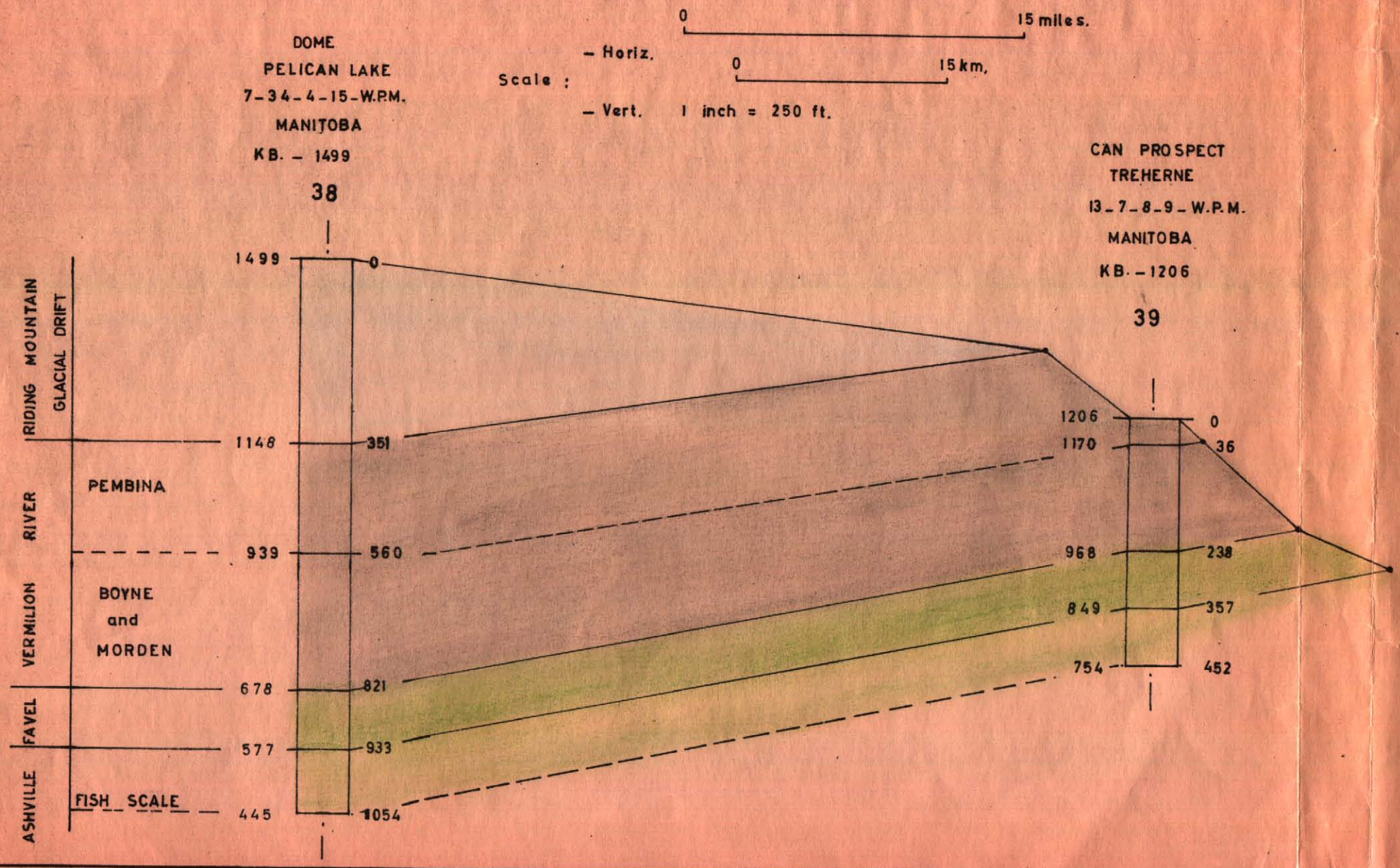
OIL SHALE RESERVATION

# MANITOBA

## SECTION A – B

Scale : – Horiz. 0 15 miles. 0 15 km.

– Vert. 1 inch = 250 ft.



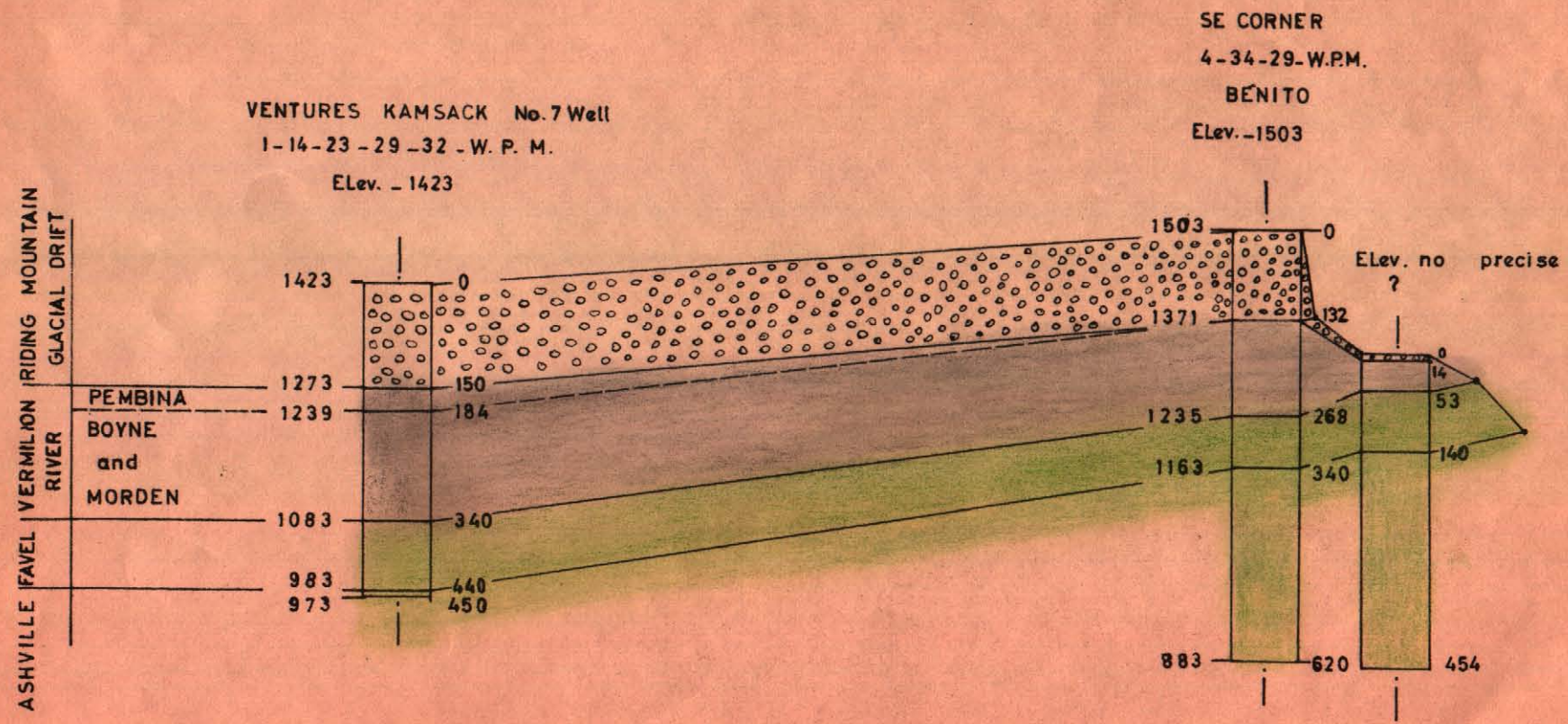
OIL SHALE RESERVATION

MANITOBA

# SECTION C - D

Scale : - Horiz. 0 15 miles. 0 15 km.

- Vert. 1 inch = 250 ft.



OIL SHALE RESERVATION 14-2

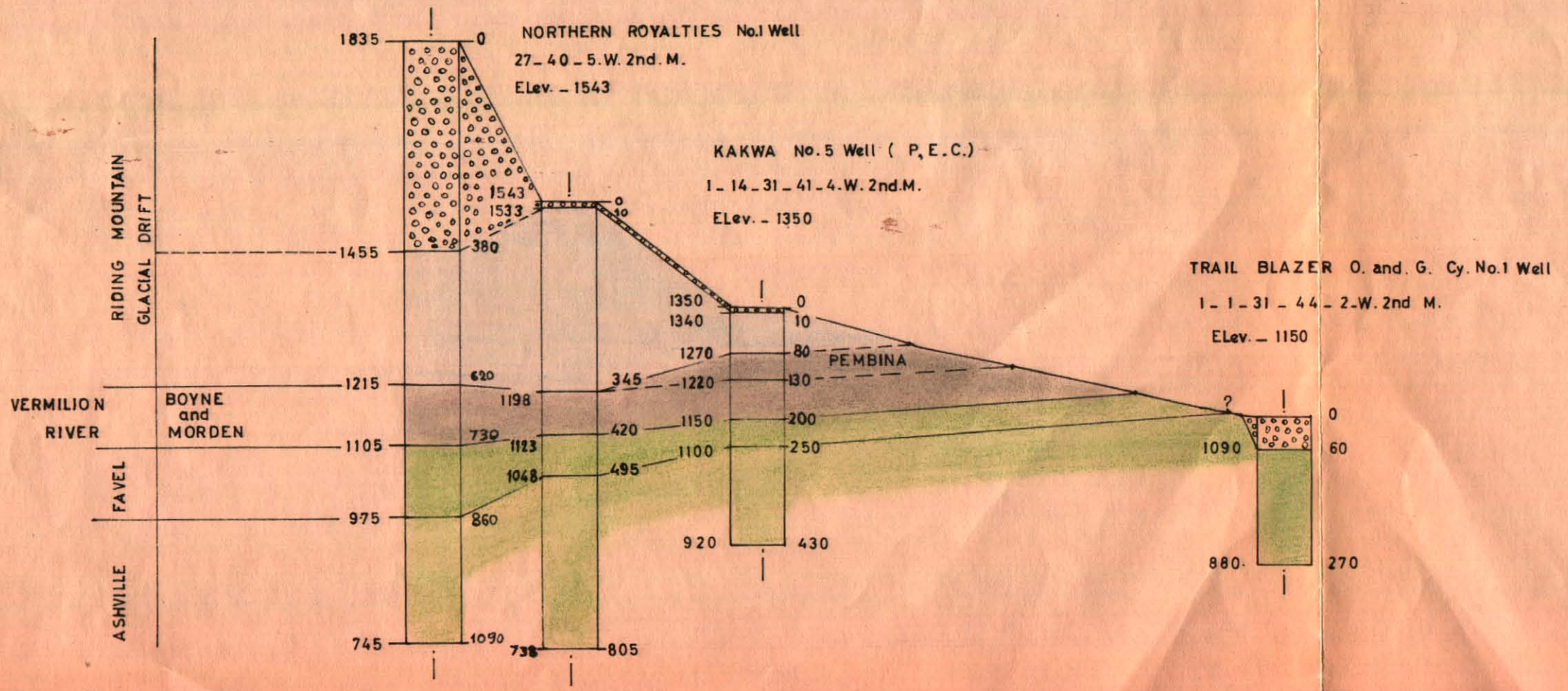
# MANITOBA

## SECTION E _ F

Scale : — Horiz. 0 15miles, 0 15km.

— Vert. 1 inch = 250 ft.

PIWEI No.1 Well (R.D.C.C.O.G.C.)
34-39-5 _ W.2nd.M.
ELev. _ 1835



OIL SHALE RESERVATION

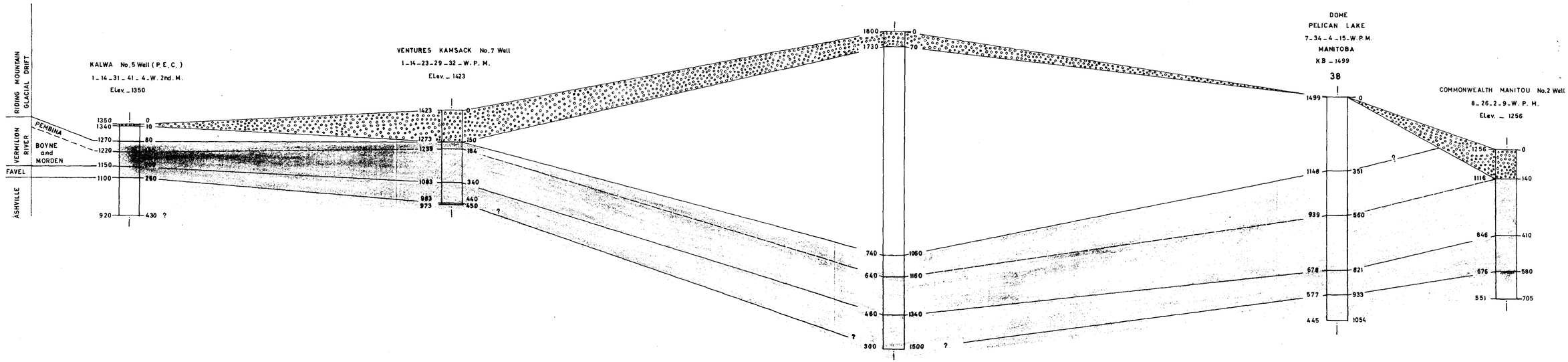
# MANITOBA

## SECTION G_H_I

Scale :

_Horiz. 0 15miles / 0 15km

_Vert. 1 inch = 250 ft



14-2

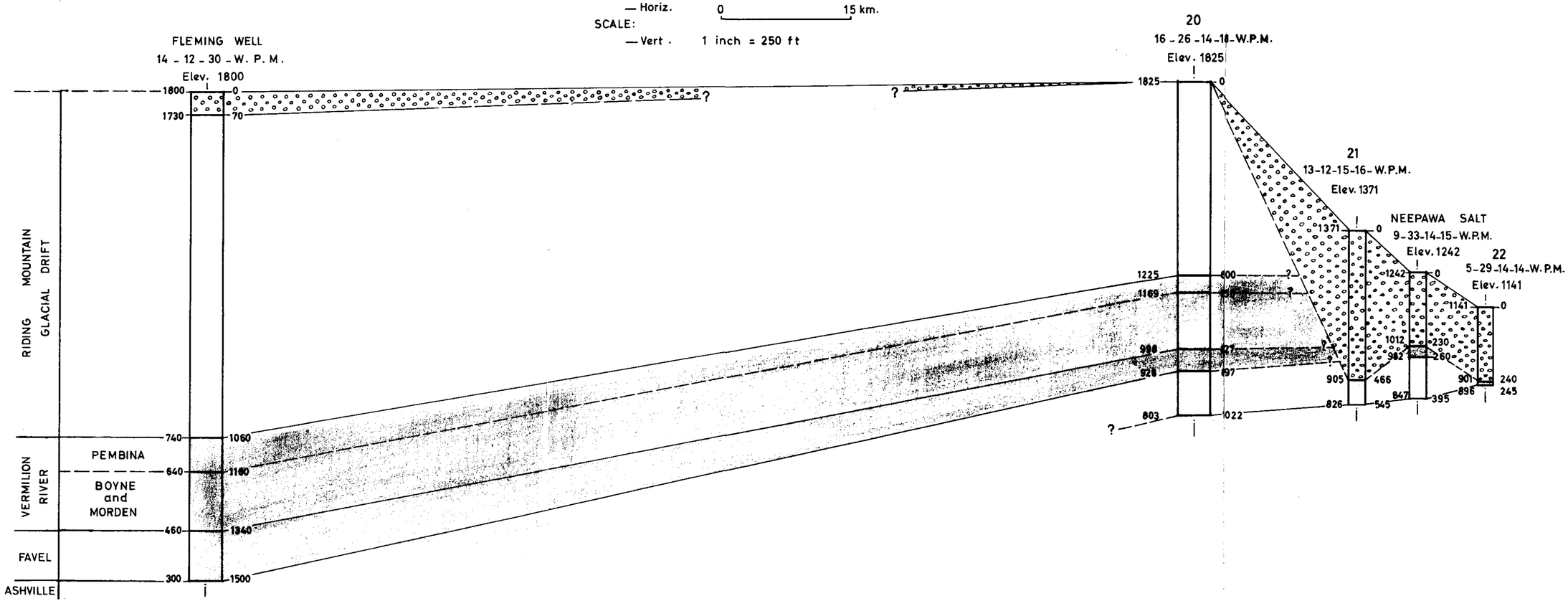
# OIL SHALE RESERVATION – MANITOBA –

## SECTION H.K-L

0 15 miles

SCALE: — Horiz. 0 15 km.

— Vert. 1 inch = 250 ft



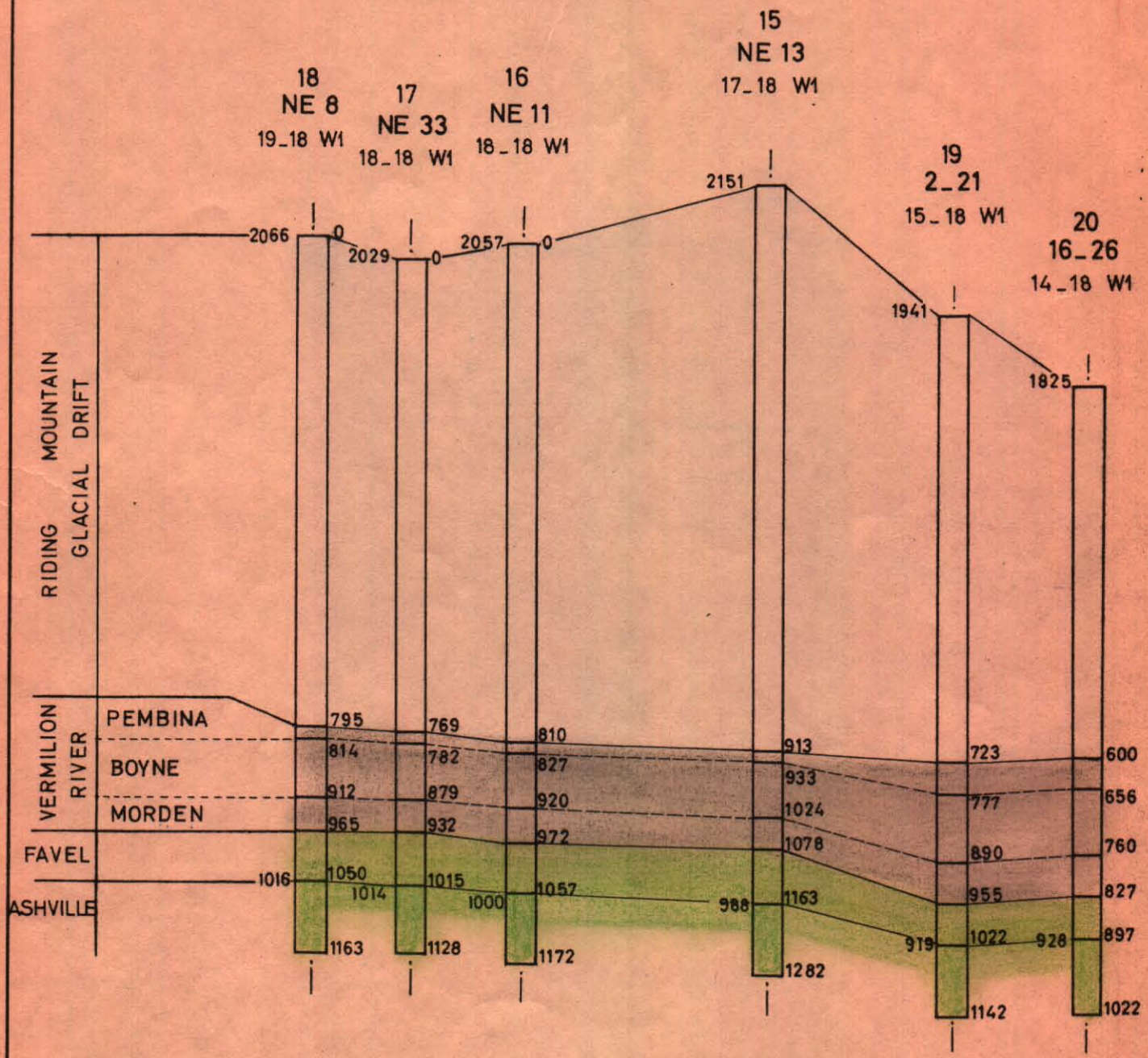
# OIL SHALE RESERVATION MANITOBA

## SECTION J-K

0 — 15 miles

SCALE : — Horiz. 0 — 15 km.

— Vert. 1 inch = 250 ft



C A N A D A

OIL SHALE MANITOBA

AQUITAINE RESERVATION N° 9

3 - Field Notes

CONTENTS

C A N A D A

OIL SHALE MANITOBA

AQUITAINE RESERVATION N° 9

INDEX OF THE SAMPLES TAKEN DURING THE FIELD TRIPS

A/ Inside the reservation or in the close vicinity

/ A C C 1 / Vicinity of Minnedosa - Sheet Clanwilliam W

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to - C R P |
|---|---|---|---|---|
| SZ 351 | East Minnedosa village - Edge of road - South of Lake | Shale silty, greenish grey, splintered, hard, non carbonated Limonitic traces - Spots of pyrite | | Clays examination<br>X Rays<br>Thin sections |
| SZ 352 | North of Minnedosa dam - East edge of road ditch at 1 km from the preceding | Shale silty, greenish grey, non carbonated, hard, cracky - Brown traces | | As above |
| SZ 353 | Road bend North way-out of Minnedosa to Erikson | Shale silty, greenish grey, hard, iron coating | | As above<br>Picking<br>Washing |
| SZ 354 | Thalweg between Minnedosa village and crossing of Minnedosa valley | Shale silty, greenish grey, a little softer than the preceding - Foliated weathering | | Clays examination<br>X Rays<br>Thin sections |

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3-3-1

/ A C C 2 / Section W E through the Southern part of the permit from Minnedosa to the Rossburn Junction-Sheets Clanwilliam W , Clanwilliam E , Arden W

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 355 | Crossing of Minnedosa Road and Thalweg | Shale finely silty, dark green-grey, foliated weathering, non carbonated | | Clays examination<br>X Rays<br>Thin sections |
| BT 6<br>SZ 356 | E W Section from Minnedosa valley - Clanwilliam Eden | Shale silty, hard, dark green-grey, ovoid or platy shaped, non carbonated - Marine sediments - Covered with overburden | | Clays examination<br>X Rays<br>Picking<br>Washing |
| SZ 357 | Same as S E Clanwilliam Section along Railway Ditch outcrop | Shale dark green-grey, siliceous, hard and cracky plates - fragments involved in sandy eluvial deposits | | Clays examination<br>X Rays<br>Thin sections |
| SZ 358 | North of the track Same section near Clarksville school | Shale dark green-grey, silty, hard and cracky plates - Fragments involved in sandy eluvial deposits | | As above |
| SZ 244 | On the Plateau N E of Bethany | Shale siliceous, greenish-grey - | | Thin sections |
| SZ 359 | Same as section East-West Picked up in water storage cuttings - Going down Eastward | Black shale finely foliated, soft- Probably to the top of Vermilion River Formation | Vermilion plain | Clays examination<br>X Rays |

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3-3 2

/ A C C 3 / Section from Birnie to Elk Ranch - Western border of Mountain Riding - Sheets Arden W - Clanwilliam E

| N | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 245 | Birnie - Elk Ranch road ditch | Shale dark green | | Clays examination<br>X Rays<br>Determination |
| SZ 246 | East of Elk Ranch - Bunch of 50 meters | Shale light grey, siliceous, hard and cracky plates - non carbonated | | Lithologic study<br>Clays examination<br>X Rays<br>Thin sections |
| SZ 247 | Elk Ranch Road - Top of second Cuesta | Shale light grey, siliceous, platy | | Clays examination<br>X Rays<br>Thin sections |

/ A C C 4 / Section of Polonia Hillock - Sheet Clanwilliam E

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 369 | East Polonia - 800 meters from road bank | Silt argillaceous, hard, cracky | Riding Mountain | Clays examination<br>X Rays<br>Thin sections |
| SZ 370 | Polonia Section | Shale silty, siliceous, hard Iron concretions, platy - Fresh sample | | As above |

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/ A C C 5 / Section of Riding Village - Sheet Glenella W

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 371 | 3 miles S E of Riding Mountain | Shale carbonated, yellow colored by iron oxyde, soft, sticky bioclastic thin intercalations - Inoceramus | Favel | Determination<br>Clays examination<br>X Rays |
| SZ 372 | S E Riding Mountain | Calcareous intercalation brown bioclastic, in yellowish-brown clays | | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Thin sections |

/ A C C 6 / Section 2 miles South of Kelwood - Sheet Glenella W from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 249 | Inoceramus ledge in ditch S E of Kelwood | Shale bluish-grey, carbonated with fragments - Odor of Hydrocarbon - Bituminous | Favel | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Picking<br>Thin sections |
| SZ 375 | 3 miles E Kelwood road | Shale black, sticky , Pyritic ammonites | | Clays examination<br>X Rays - Picking<br>Washing |
| SZ 376 | As above | Pyritic ammonites and pyritic nodules | | Clays examination<br>X Rays<br>Thin sections |
| SZ 248 | Section WE-SE Kelwood, near small bridge | Shale black, plastic, non carbonated, varved, yellow stained | Ashville (?) | Clays examination<br>X Rays<br>Picking - Washing |

/ A C C 7 / Section in the Northern vicinity of village - Sheet Glenella W from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 250 | Farm between Kelwood and Norgate - W Dug water road, in plain | Shale black, granular, carbonated, odor of hydrocarbon - Big selenite crystals on the surface - Jarosite coating - Bituminous | Top Ashville or Favel Boyne Member ? | Clays examination<br>X Rays<br>Thin sections |
| SZ 363 | Section North way-out of Kelwood, on about 1,5 meter - Road bank | Marl bioclastic, sandy - brown with large Inoceramus moulds - Th = 5 cm recurring in small ledges perceptible in the morphology | Base of Favel | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Thin sections |
| SZ 362 | Same section (underneath) | Silt clayey-calcareous - yellowish grey-colored by iron oxydes - Foliated, soft - Prisms of Inoceramus - Th. = 15 cm - Gradational transition | | Clays examination<br>X Rays<br>Picking<br>Washing |
| SZ 361 | Same section (bottom) | Marl shammy grey, plastic, layered, varves of some mm, carbonated | | As above |
| SZ 364 B | Edge of Railway - North of Kelwood | Intercalations of Lumachelles Fragments of Inoceramus | Downward, in succession. Base of Favel | Clays examination<br>X Rays<br>Picking |
| SZ 364 A | Edge of Railway - North of Kelwood - Water storage cuttings | Paper shale black, selenite crystals, soft, carbonated - Very thin intercalation of Lumachelles - Fish bones | Base of Favel | Clays examination<br>X Rays |
| SZ 365 | Track N S Kelwood Norgate | Marl rusty yellow, plastic, banded, beds and fragments of Inoceramus wearing an oysters-Lumachelle | Favel | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Picking<br>Thin sections |

| | | | | |
|---|---|---|---|---|
| SZ 366 | Same as above going downward in the section - 1,5 mile South of Norgate near the Farm, in the ditch | Limestone silty - argillaceous in fine plates | | Determination<br>Lithologic study<br>Clays examination<br>X Rays - Thin sections |
| SZ 367 | South of Norgate - Limite of the carriageable track - Water storage cuttings | Shale black, non carbonated, in soft plates, few mm thick Jarosite coating | Ashville ? same as W Dauphin | Clays examination<br>X Rays - Picking<br>Washing |

/ A C C 8 / Section from the S E to Kelwood village - from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 360 | South way-out of Kelwood - Water storage cuttings | Shale black, soft, paper shale carbonated - Lignite debris - Selenite crystals - Jarosite and sulphur ? | Base of Favel | Clays examination<br>X Rays<br>Thin sections |
| SZ 373 | 2 miles S E of Kelwood dug-out in plain | Shale, argillaceous, carbonaceous, black, plastic folia Jarosite - Crystals of Gypsum - non carbonated | | Clays examination<br>X Rays<br>Picking<br>Washing |
| SZ 374 | Same as above | Selenite crystals | | Clays examination<br>X Rays |

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B/ Outside of the Reservation

These samples have been taken outside of the Reservation in order to check the beds hidden by overburden inside the Permit

I - W and S W Area of Dauphin

1 - W ditch Ashville Road near the intersection with Gilbert Plains Roads (Lsd 1 - Sec 14 - Twp 25 - Rge 21 - W P M) - from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 217 | Crossing of Ashville and Gilbert Plains roads - Manitoba | Shale black - hematized on the surface - Inoceramus shells prismatic debris - Gypsum surfaced, yellow jarosite and native sulphur | Ashville | Clays examination<br>X Rays<br>Washing |
| SZ 218 | Bottom of preceding - 1,5 meter below | Shale black - yellow vugs of Gypsum - Prisms of Inoceramus | | Clays examination<br>X Rays<br>Picking |
| SZ 224 | Edge of Gilbert Plains roads in ditch | Bioclastic Limestone - Lumachelles - Iron - Pelecypoda - Inoceramus - Fish remains brown, abundant - Globigerines | Favel ? | Determination<br>Lithologic study<br>Clays examination<br>X Rays - Thin sections |

2 - Section along the Thalweg located S of Ashville Gilbert Plains Roads - intersection - Lsd 16 - Sec 11 - Twp 25 - Rge 21 W P M

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 219 | Section Soth Thalweg of crossing Gilbert Plains and Ashville Roads | Shale black, more or less dense - carbonated spots - Bones remains - Mica | | Clays examination<br>X Rays<br>Picking - Washing |
| SZ 220 | Same section - from top to bottom | Shale black and silty - lightly calcareous - Pyritic Inoceramus | Transitional zone Ashville - Favel | As above |

3-37

| | | | | |
|---|---|---|---|---|
| SZ 221 | As above | Shale black, smooth surface sticky<br>" - carbonated spots | Ashville | Clays examination<br>X Rays |
| SZ 222 | As above | Shale black, laminated with limonitic bands - Odor of hydrocarbon - White specks - Calcareous - Fish remains | " | Determination<br>Lithologic study<br>Clays examination<br>X Rays - Picking |
| SZ 223 | Bottom of same section | Paper shale brown grey, light - Yellow coating, Microcrystals of selenite - Bituminous | " | Clays examination<br>X Rays - Picking<br>Washing |

3 - Wilson River bridge on Ashville Road (Lsd 13, Sec 13, Twp 25 - Rge 21 W P M)

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to - C R P |
|---|---|---|---|---|
| SZ 225 | Near Wilson River Bridge | Shale grey, laminated, silty, non carbonated | Close to top Ashville | Clays examination<br>X Rays - Picking<br>Washing |
| SZ 226 | As above - Ashville Road | Carbonated intercalation, microcrystalline - Bioclastic in black shales sequence | " | Determination<br>Lithologic study<br>Clays examination<br>X Rays - Thin sections |

/

4 - Meander of the Wilson River S E Gilbert Plains Road (Lsd 14 - Sec 10 - Twp 25 - Rge 21 W P M)

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 227 | Bridge Gilbert Plains River - Wilson River | Shale black carbonated, fragments of Inoceramus, Globigerines, fish remains - Numerous white specks, carbonated from 0,1 to 5 mm - Calcite - Iron oxyde | Transition Ashville - Favel | Clays examination<br>X Rays<br>Picking |
| SZ 228 | Same as above going downward | Shale black, carbonated, fish remains, white specks | | Clays examination<br>X Rays - Thin sections |
| SZ 229 | Same section - 2 meters lower | Shale black, carbonated, Inoceramus - Fish remains, white specks | Base Favel | As above |
| SZ 230 | Same section - 4 meters lower | Shale dark grey, carbonated, fragments of Inoceramus - Brown fish remains, numerous organic frâgments - Rare Iron and white specks - Thick bedding | | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Picking - Washing |
| SZ 231 | Same section in Wilson River Cliff | Shale black, carbonated, white specks - Very thin banding of argillaceous and ferruginous bentonite, rich in kerogene | Typical Favel | Clays examination<br>X Rays<br>Thin sections |

5 - Ditch along the track S of Spruce Creek - W border of Lsd 4 - Sec 3 - Twp 25 - Rge 20 W P M

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 232 | Crossing Spruce Creek, after "Drive Inn" - Ditch | Shale, dark brown, yellow jarosite coating, bentonitic, bituminous | Ashville | Clays examination<br>X Rays<br>Picking - Washing |

6 - Meander of Vermilion River - Sheet Dauphin E - N E Corner of Lsd 3 - Sec 35 - Twp 23 - Rge 20 W P M - from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 233 | Vermilion River - S W Meander of Spruce Creek | Shale brownish and rusty, limonitic coating, finely varved, carbonated | Gradational zone of Favel | Clays examination<br>X Rays<br>Picking - Washing |
| SZ 234 | 1,20 meter lower than preceding same section | Shale black, thin bedded, plastic carbonated, odor of hydrocarbon, Selenite - Thickness = 1,50 meter | | Clays examination<br>Picking Washing |
| SZ 235 | Going downward in same section Top of calcareous bed | Black shale, non carbonated, fragments of Inoceramus - Foliated weathering | | Clays examination<br>Picking<br>Washing |
| SZ 236 | Same Meander section - Base of carbonated bed - 0,80 meter thick | Limestone, crystalline, bioclastic brown-red fish remains - The shales become more carbonated - Numerous Pelecypoda beds | | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Thin sections |

| | | | | |
|---|---|---|---|---|
| SZ 237 | Same section under 236 | Shale dark grey, carbonated, white fragments of bivalves, banding of kaolinite - White specks - Fish remains - Thickness = 2 meters | | Clays examination<br>X Rays<br>Picking |
| SZ 238 | Extreme base of section 233 | Shale silty, black, cracky, carbonated, granular weathering - White specks | | Clays examination<br>X Rays - Picking<br>Washing |

7 - Meander of the Vermilion River - Sheet Dauphin E - S W Corner of Lsd 15 - Sec. 23 - Twp. 23 - Rge 20 W P I

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 240 | Vermilion River Meander - Same as SZ 239<br>Higher than Septaria level | Shale black, foliated, yellow pellicule of Jarosite - non carbonated carbonaceous | Vermilion formation Morden Mbr | Clays examination<br>X Rays<br>Picking - Washing |
| SZ 239 | South Dauphin Sheet - South of Footbridge - S E Kelwood - In Vermilion River - Appearing thickness = 52 ft | Shale bluish grey, varved, plastic when wet, jarosite and limonitic colours - , non carbonated but carbonaceous - Septaria beds - Selenite crystals | | Clays examination<br>X Rays<br>Picking<br>Washing |

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8 - Meander of the Vermilion River - Sheet White Water Lake - Approx center of Lsd 4, Sec 23, Twp 23, Rge 20 W P M - from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 243 | Vermilion Meander - North of Riding Mountain National Park border - Outcrop lower than Farm, 45ft above Cattle-park river | Shale grey silty, jarosite stained , very foliated, non carbonated, Radiolaria and Foraminifera | Vermilion F Pembina Mbr ? or Riding Mountain ? | Clays examination<br>X Rays<br>Picking<br>Thin sections |
| SZ 242 | Same section, appearing thickness 9 ft | Paper shale grey - Film of limonite, jarosite and small crystals of selenite Small faults N W - Beds non carbonated - Black specks | | Clays examination<br>X Rays<br>Picking<br>Washing |
| SZ 241 | Same section | Shale grey silty, carbonated, - Odor of hydrocarbon, small white specks - Fish remains | Vermilion Fm, Boyne Mbr | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Thin sections |

9 - In the bottom of the Creek - Sheet Dauphin E

| N° | Location outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 243 bis | In Vermilion River | Carbonated argillaceous beds , Slab alteration- White specks | | Clays examination<br>X Rays |

II - Swan River Area in the bottom of the creek
Sheet Arran E - Approx center of Lsd 1, Sec 3, Twp 35, Rge 29 W P M

1 - Section Swan River Meander, from top to bottom

| N° | Location of outcrops | Lithology (visual examination) | Formation | Examination ordered to C R P |
|---|---|---|---|---|
| SZ 381 | Swan River - South Thunder Hill - Meander section - Thickness = 12 ft | Limestone, argillaceous, dark grey, rectangular massive slabs, rich in Inoceramus, abundant organic matter | Top Favel | Determination<br>Lithologic study<br>Clays examination<br>X Rays<br>Thin sections |
| SZ 380 | Same going downward | Limestone argillaceous grey, maroon debris and white specks, light odor of oil, rich in organic matter | | Determination<br>Lithologic study<br>X Rays - f<br>Thin sections |
| SZ 379 | Same section downward<br>Thickness = 50 cm | White bentonite with limonitic spots (the bentonite is due to reworked volcanic ashes) | Favel | Clays examination<br>X Rays<br>C<br>Washing |
| SZ 378 | Base of Meander Section<br>Thickness = 70 cm | Shale black, carbonated, hard Yellow coating | | As above |

(14)-(3)

3-c/1

C A N A D A

OIL SHALE MANITOBA

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AQUITAINE RESERVATION N° 9

-

STUDY OF THE SAMPLES TAKEN DURING THE FIELD TRIPS

Ref Request n°102 - 103

A/ Inside the reservation or in the close vicinity

/ A C C 1 / Vicinity of Minnedosa - Sheet Clanwilliam W

| N° | Geological Sample Description | Formation | Age MF Microfaun f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 351 | Shale, greenish grey, silty, flaky, hard, non carbonated Spots of pyrite - Phosphate - Rusted glauconite | Riding Mountain | | not made |
| SZ 352 | Shale as above -cracky- Brown traces - Phosphate - Mica - Glauconite | " | | " |
| SZ 353 | Shale as above - flinty fracture - Iron coating Phosphate | " | | " |
| SZ 354 | Shale as above - but a little less hard - Phosphate - Glauconite - laminated foliation | " | | " |

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/ A C C 2 / Section W E through the Southern part of the permit from Minnedosa to the Rossburn Junction Sheets Clanwilliam W , Clanwilliam E , Arden W

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 355 | Shale, dark green grey, finely silty Non carbonated - Phosphate - Laminated foliation | Riding Mountain | | not made |
| SZ 356 | Shale green-grey, silty, hard, platy or ovoid - Non carbonated - Phosphate covered with sandy overburden | " | | " |
| SZ 357 | Shale dark green-grey - siliceous - hard and cracky plates - Fragments involved in sandy eluvial deposit - Phosphate - Glauconite - Brownish macrospores | " | | " |
| SZ 358 | Shale dark green, silty, hard and cracky plates - Fragments involved in sandy eluvial deposit - Phosphate - Brown macrospores - Rusted glauconite | " | | " |
| SZ 244 | Shale siliceous, greenish grey - Glauconite | " | | " |
| SZ 359 | Black shale, finely foliated, carbonated | ? | | 2,54 |

/ A C C 3 / Section from Birnie to Elk Ranch - Western border of Mountain Riding - Sheets Arden W - Clanwilliam E

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 245 | Shale dark green - Possibility of Jarosite and Phosphate occurence | Riding Mountain | | not made |
| SZ 246 | Shale light grey, cryptocristalline, with very fine quartz, hard and cracky plates - Non carbonated, rich in organic matter - Rare phosphated fragments - Radiolarite (?) | " | | " |
| SZ 247 | Shale light grey, siliceous, platy Clay with phosphate content - Glauconite | " | | " |

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/ A C C 4 / Section of Poloria Hillock - Sheet Clanwilliam E

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 369 | Silt argillaceous, hard, cracky - Brown spores - Glauconite | Riding Mountain | | not made |
| SZ 370 | Shale silty, hard, platy - Iron concretions - Mica | " | | " |

/ A C C 5 / Section of Riding Village - Sheet Glenella W

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 371 | Shale, soft, yellow colored by iron oxyde - bioclastic banded - Inoceramus | Favel | Turonian (f) | not made |
| SZ 372 | Brown limestone intercalation, bioclastic intercalated in yellowish brown, soft shale | " | " | " |

/ A C C 6 / Section 2 miles South of Kelwood - Sheet Glenella W from top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 249 | Shale brown, carbonated - Prisms of Inoceramus - Abundant Globigerines Odor of hydrocarbon - "Big Globigerines" (Praeglobotruncana ordinaria Subbotina) | Favel | Turonian MF | 6,76 |
| SZ 375 | Shale black, flaky - Pyritic ammonite - Megaspores - Small arenaceous foraminifera | Ashville | | traces |
| SZ 376 | As above - Pyritic nodule | " | | " |
| SZ 248 | Shale black, plastic, non carbonated, varved, yellow pellicule - 20 % of quartz - Rare megaspores and small Arenaceous | " | | 0,8 |

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Section in the Northern vicinity of village - Sheet Glenella W from top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 250 | Shale black, granular, carbonated, odor of hydrocarbon - Jarosite coating and selenite crystals | Ashville ? | Turonian (f) | 11,95 |
| SZ 363 | Limestone brown, bioclastic, sandy, large Inoceramus mould - Thickness = 5 cm recurring in small ledges perceptible in the morphology | Favel | " | |
| SZ 362 | Marl, yellowish grey, silty, foliated, soft, Inoceramus prims - Abundant Globigerines - Th = 15 cm "Big Globigerines"- (Praeglobotruncana ordinaria subbotina) | " | Turonian (MF) | |
| SZ 361 | Marl shammy grey, soft, layered - Varves of some mm, carbonated - Inoceramus prims - Fish remains (Vertebras, teeth, plates) "Big Globigerines" | " | " | |
| SZ 364 P | Marl with abundant prims of Inoceramus - Phosphated remains (teeth, bones, fishes) Globigerines - "Big Globigerines" (Praeglobotruncana ordinaria Subbotina) | " | " | |
| SZ 364 A | Paper shale black, carbonated, selenite crystals - Intercalation very thin of Lumachelles - Fish bones | Ashville | | 6,16 |
| SZ 365 | Marl rusty yellow, soft, banded, abundant Inoceramus prisms | Favel | Turonian (f) | |
| SZ 366 | Silty limestone with poecilitic cement - Glauconite, phosphated fragments - Rare remains of Inoceramus - Pyrite - Epidote | " | | ? |
| SZ 367 | Shale black, non carbonated, soft plates of some mm thick - Jarosite coating - Inoceramus prisms "Big Globigerines" (Praeglobotruncana ordinaria Subbotina) | " | Turonian (MF) | 2,14 |

/ A C C 8 / Section from the S E to Kelwood village from top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 360 | Paper shale, black, soft, carbonaceous Lignite debris - Possibility of Jarosite - Rare quartz - Glauconite | Favel | | 2,09 |
| SZ 373 | Shale black, carbonaceous, carbonated - Plastic folia - Possibility of gypsum and Jarosite | " | | 1,2 |
| SZ 374 | Selenite crystals | " | | |

B/ Outside of the Reservation

These samples have been taken outside of the Reservation in order to check the beds hidden by overburden inside the Permit

I - W and S W Area of Dauphin

1 - W ditch Ashville Road near the intersection with Gilbert Plains Road (Lsd 1 - Sec 14 - Twp 25 - Rge 21 - W P M) - from top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 217 | Shale black, limonitic surface, with Inoceramus shells - Possibility of Jarosite and Gypsum - 20 % of quartz | Transition Ashville Favel | | 3,03 |
| SZ 218 | Shale black, Inoceramus prisms, vugs filled with Jarosite - Gypsum - 20 % of quartz | " | ? | 0 |
| SZ 224 | Bioclastic limestone - Inoceramus prisms - Shell fragments of big Pelecypoda - Phosphated fragments - | " | Turonian (f) | |

2 - Section along the Thalweg located S of Ashville Gilbert Plains Roads intersection - Lsd 16 - Sec 11 - Twp 25 - Rge 21 W P M -

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 219 | Shale black, more or less dense, platy Carbonated spots - Bones remains - Mica - 20 % of quartz - Megaspores - Teeth and fish remains | Transition Ashville Favel | | 5,36 |
| SZ 220 | Shale black, silty - slightly calcareous - Content Inoceramus prisms Pyritic Megaspores - Teeth and fish remains - Pyrite - Chalcopyrite | " | | 8,04 |
| SZ 221 | Shale black, plastic, smooth surface - Carbonated spots (calcite) Possibility of gypsum and Jarosite - 20 % of quartz | Ashville | | 6,8 |
| SZ 222 | Shale black, laminated with limonitic lands - White spots (calcareous) Fish remains - Possibility of Jarosite and Gypsum - 20 % of quartz "Big Globigerines" (Praeglobotruncana Ordinaria Subbotina) | " | Turonian (MF) | 4,02 |

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| | | | | |
|---|---|---|---|---|
| SZ 223 | Paper shale light grey brown - Yellow coat - Microcrystals of Selenite - Possibility of gypsum and Jarosite - 20 % quartz | Ashville | Turonian (MF) | 1,34 |

3 - Wilson river bridge on Ashville Road (Lsd 13, Sec 13, Twp 25, Rge 21 W P M)

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 225 | Shale grey, laminated, silty, non carbonated - Megaspores - Small Arenaceous | Ashville | | 0 |
| SZ 226 | Black shale with carbonated intercalation , microcrystalline, bioclastic | " | Turonian (f) | ? |

4 - Meander of the Wilson River S E Gilbert Plains Road (Lsd 14 - Sec 10 - Twp 25 - Rge 21 W P M)

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 227 | Shale black, carbonated, micaceous, Inoceramus fragments, Globigerines Fish remains - Phosphated fragments Rare quartz - "Big Globigerines" ( Praeglobotruncana ordinaria Subbotina) | Favel | Turonian (MF) | 5,76 |
| SZ 228 | Shale black, carbonated - Fish remains Globigerines - Rare quartz | " | " (f) | 6,7 |
| SZ 229 | Shale black - carbonated - Inoceramus Fish remains - Globigerines - Rare quartz | " | " " | 6,7 |
| SZ 230 | Shale dark grey - Carbonaceous - micaceous in thick beds - rich in Inoceramus - Fish remains and organic matter - Globigerines - Rare quartz "Big Globigerines" (Praeglobotruncana ordinaria Subbotina) | " | " " (MF)(f) | 4,55 |
| SZ 231 | Shale black, carbonated - Globigerines Very thin bending of argillaceous and ferruginous bentonite - Rare quartz | " | Turonian (f) | 2 ,87 |

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5 - Ditch along the track S of Spruce Creek - W border of Lsd 4 - Sec 3 - Twp 25 - Rge 20 W P M

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 232 | Shale dark brown, bentonitic, yellow Jarosite coating | Ashville | | ? |

6 - Meander of Vermilion River - Sheet Dauphin E - N E Corner of Lsd 3 - Sec 35 Twp 23 - Rge 20 W P M - From top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 233 | Shale brownish and rusty, limonitic coating, finely varved, slightly carbonated - 10 % quartz - Teeth and fish remains | Favel | | 3,48 |
| SZ 234 | Shale black thin bedded, plastic, slightly carbonated - 10 % quartz - Hydrocarbon odor - Selenite - Prismatic Inoceramus - Teeth and fish remains | " | | 8,31 |
| SZ 235 | Shale black, slightly carbonated, fragments of Inoceramus, flaky - Teeth and fish remains | " | | 7,37 |
| SZ 236 | Limestone ,crystalline, bioclastic, fish remains brown-red - Numerous Pelecypoda beds | " | Turonian (f) | |
| SZ 237 | Shale brown, carbonated, abundant prismatic Inoceramus, and numerous phosphated debris - Kaolinite lamination -"Big Globigerines" (Praeglobotruncana ordinaria Subbotina) | " | " (MF) | |
| SZ 238 | Shale silty, black, slightly carbonated - granular weathering - White spots - 10 % quartz - Teeth and fish remains - Prismatic Inoceramus - "Big Globigerines" | " | " (MF) | 7,63 |

7 - Meander of the Vermilion River - Sheet Dauphin E - S W Corner of Lsd 15 - Sec 23 - Twp 23 - Rge 20 W P M

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 240 | Shale black-foliated - carbonaceous Non carbonated - Possibility of Jarosite | Vermilion (Morden member) | | 0 (S = 3,5 %) |
| SZ 239 | Shale bluish-grey varved, non carbonated - Medium-bedded - Septaria intercalation - Pins of Selenite - 20 % quartz - Possibility of Jarosite | " | | 0 (S = 6,2 %) |

8 - Meander of the Vermilion River - Sheet White Water Lake - Approx center of Lsd 4, Sec 23, Twp 23, Rge 20 W P M - from top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 243 | Shale brownish-grey, silty, very foliated, carbonated, conchoidal fracture - Foraminifera and Radiolaria - Possibility of Jarosite - Prismatic Inoceramus - "Big Globigerines" | Vermilion River | Turonian (MF) | 0,52 |
| SZ 242 | Paper shale grey - non carbonated Limonitic colour - Black spots - Possibility of Jarosite - Selenite crystals | Vermilion River (Boyne member) | | 0,52 |
| SZ 241 | Shale grey - carbonated - silty - Conchoidal fracture - White spots Phosphated debris - Rich in organic matter - Odor of hydrocarbon | " | | 3,61 |

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9 - In the bottom of the Creek - Sheet Dauphin E

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 243 bis | Shale carbonated - Slab structure White spots - Possibility of Jarosite - Rich in organic matter and phosphated debris | Vermilion River | Turonian (f) | 7,5 |

II - Swan River Area in the bottom of the creek
Sheet Arran E - Approx center of Lsd 1, Sec 3, Twp 35, Rge 29 W P M

1 - Section Swan River Meander, from top to bottom

| N° | Geological Sample Description | Formation | Age MF Microfauna f Microfacies | Oil content US Gal/Ton |
|---|---|---|---|---|
| SZ 381 | Limestone argillaceous dark grey, rectangular slabs, massive (Cuesta) Rich in Inoceramus - Abundant organic matter - "Big Globigerines" (Praeglobotruncana ordinaria Subbotina) | Favel | Turonian (f) MF | 10,4 |
| SZ 380 | Limestone argillaceous, grey, maroon, debris and white spots Rich in organic matter - Odor of oil - Inoceramus - Globigerines - Gumbelines - Phosphate and spores | " | Turonian (f) | 7,77 |
| SZ 379 | Level of white Bentonite and limonite spots (the bentonite is due to reworked volcanic ash) | " | | |
| SZ 378 | Shale black, carbonated, hard - yellow coat - Gypsum - Pyrite - Prismatic Inoceramus - "Big Globigerines" | " | Turonian (MF) | 2,01 |

C A N A D A

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OIL SHALE MANITOBA

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AQUITAINE RESERVATION N° 9

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# 3 - FIELD NOTES

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## I - TIMING

The study of the outcrops inside the Area of the Aquitaine Reservation n° 9 has been made during two field trips In addition, some sections have been checked along the walls of the rejuvenated meanders of the creeks

1 - May 13 - 17, 1965 - Geological team Borocco - Tortochaux

a) Inside the Aquitaine Reservation

Section WE 5 miles from the Southern border of the Permit - Ref ACC 2

b) Outside the Aquitaine Reservation

Parts of sections concerning the beds of the Ashville, Favel and Vermilion Formations following the creeks - SW of Dauphin - Ref BI 1, 2, 3, 4, 5, 6, 7, 8, 9

2 - May 27 - June 1, 1965 - Geological team Bonafoux - Tortochaux

a) Inside the Aquitaine Reservation

- Examination of the exposures and picking of samples in the following areas Minnedosa, Polonia, Elk Ranch and Kelwood - Ref ACC 1, ACC 3, ACC 4, ACC 5, ACC 6, ACC 7, ACC 8

- On the jobsite, preparation of a drilling program to evaluate the bituminous objectives

b) Outside the Reservation

Examination and sampling of a section of the Favel Formation - Location Valley of the Swan River - Ref BII 1

## II - MAIN RESULTS

The notes made during these two trips may be summarized as follows

1) Very little significant exposures inside the Aquitaine Reservation

The overlaying siliceous shale of the Riding Mountain Formation hid entirely the different strata of the Vermilion formation The trench of the creeks has never reached the Boyne Member, neither the Morden Member nor the top of the Favel

In the Northern part of the Permit -Kelwood vicinity- the ledge of the carbonated shales bearing Inoceramus -Favel Formation- appears in the landscape The surrounding formations show very little outcrops Only the cuttings from the dug out may be sampled and studied - Ref Sect ACC 7, ACC 8 and ACC 6 In spite of the weathered cap and of forests, the layers of the Riding Mountain Formation are easier for sampling However, it is not of any interest since it is located at the top of kerabituminous objective

2) To the North of the Aquitaine Reservation, the meanders of the creeks cutting through the Riding Mountain Formation have exposed certain beds of the Vermilion, Favel and Ashville Formations However, the thickness of these sections exceed scarcely 60 ft These exposures are composed of banks hard, isolated, between which the correlations are uneasy It is difficult to establish a continuous vertical log with these erratic data

3) Lithologic characteristics of the Formations encountered

From the top to the bottom, the following sequences appear

Riding Mountain Formation light grey shale, silty and siliceous, cleavabl in thin slates

Vermilion Formation

Pembina Member Shale dark grey to black, non calcareous, with numerous bentonitic intercalations near the bottom

Boyne Member Shale dark grey, laminated, more or less carbonated, marine deposit - Black specks - Thin bands of bentonite - $0 < \text{thick} < 1$ ft R T D WICKENDEN mentions, in some place "petroliferous shale" In the creek of Vermilion River, the shales seem very poor in oil content

Morden Member Shale black, speckled white, fish remains, carbonaceous, sulphur content, Septaria bands and limy intercalations - Thick 2 to 3 inches, jarosite, iron oxyde - Bentonitic cluster

Favel Formation shale grey to dark grey, laminated, carbonated, speckled with white - Cluster of hard beds of marine limestone bearing Inoceramus (ledge) near the top - $5" < \text{thick} < 3$ ft - Fish remains brown red, selenitic crystals, lignitic rare fragments - Bentonitic bands - Carbonated shales, with white spots, are usually kerabituminous

Ashville Formation Shale grey, plastic, silty, micas and fine sandy bands , generally non carbonated though it is possible to find some thin platy calcareous beds $< 1"$ Rare fragments of Inoceramus - Gypsum, jarosite - Some shale beds of small thickness, at the top of the Ashville, seem to be kerabituminous

The dip of these formations is at low angles -Probably $<$ 1 grade

III - LABORATORY ANALYSIS

The samples picked during the field trips have been sent to the Research Center of SNPA in Pau (France)

Some studies, mentioned in the attached index, have been required from these laboratories, in order to state more precisely the lithologic nature of the formations and the age of the microfauna contained in the samples

Pau, January 28, 1966

F TORTOCHAUX

C A N A D A

OIL SHALE MANITOBA

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AQUITAINE RESERVATION N 9

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INDEX MAP SHOWING LOCATIONS OF SAMPLES,

DRILLING PROGRAM AND ORIENTATION OF FIELD SECTIONS

-

SCALE 1/50 000e

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A - Inside AQUITAINE Reservation n° 9

B - Outside of AQUITAINE Reservation Sheets Dauphin and Arran

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Symbols

Location of the Field Section

Proposed Coredrills

SZ 240 Field Sample

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# CANADA

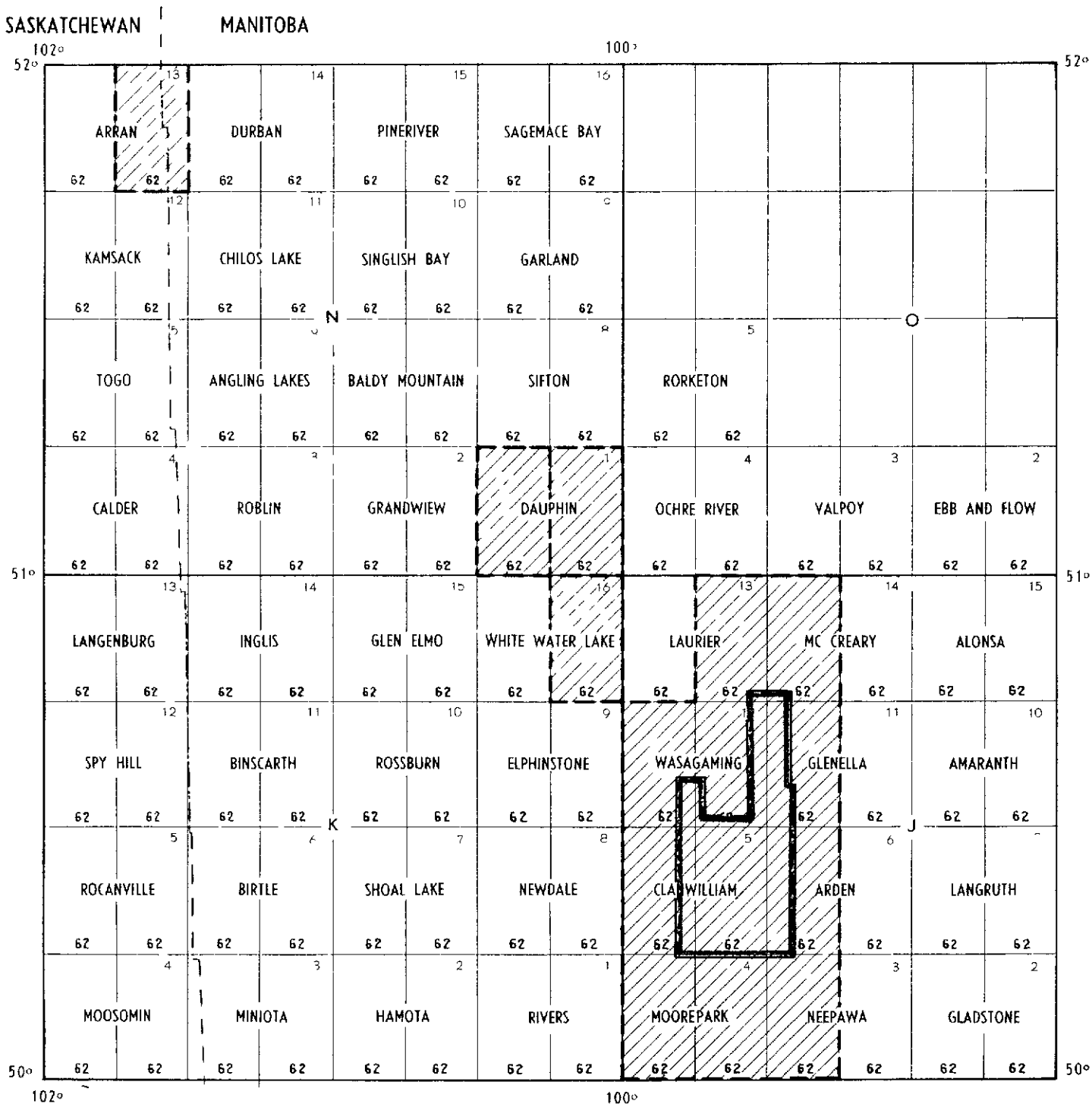
## OIL SHALE MANITOBA

# INDEX MAP OF SHEETS 1 50000

# CONCERNED THE SAMPLED AND SURVEYED AREAS

Aquitaine Reservation N° 9

Concerned Sheets



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3-2

C A N A D A

OIL SHALES MANITOBA

AQUITAINE RESERVATION N° 9

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List of samples taken during the field trips

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A/ /Inside the Reservation or in the close vicinity /

1 - Vicinity of Minnedosa sheet Clanwilliam W

SZ 351
SZ 352
SZ 353
SZ 354

2 - Section W.E. through the Southern part of the Permit, from Minnedosa to the N of Rossburn Junction

Sheets ( Clanwilliam W
( " " E
( Arden W

SZ 355
SZ 356
SZ 357
SZ 358
SZ 244
SZ 359

3 - Section from Birnie to Elk Ranch - Western Border of Mountain Riding

Sheets ( Arden W
( Clanwilliam E

SZ 245
SZ 246
SZ 247

4 - Section of Polonia Hillock - Sheet Clan William E.

From W to E

SZ 369
SZ 370

5 - Section S E of Riding Village - Sheet Glenella W

SZ 371
SZ 372

6 - Section 2 miles South of Kelwood - Sheet Glenella W

From top to bottom

SZ 249
SZ 375
SZ 376
SZ 248

7 - Section in the Northern vicinity of Kelwood Village - Sheet Glenella W

From top to bottom

SZ 250
SZ 363
SZ 362
SZ 361
SZ 364 B
SZ 364 A
SZ 365
SZ 366
SZ 367

8 - Section from the S E to Kelwood Village

From top to bottom

SZ 360
SZ 373
SZ 374

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B/ /Outside of the Reservation/

These samples have been taken outside of the Reservation in order to check the beds hidden by overburden inside the Permit

- W and S W Area of Dauphin

1 - W ditch Ashville Road near the intersection with Gilbert Plains Road

Lsd 1 - Sec. 14 - Twp 25 - Rge 21 W PM

From top to bottom

SZ 217
SZ 218
SZ 224

2 - Section along the thalweg located S of Ashville - Gilbert Plains roads intersection

Lsd 16 - Sec 11 - Twp 25 - Rge 21 W PM

From top to bottom

SZ 219
SZ 220
SZ 221
SZ 222
SZ 223

3 - Wilson River bridge on Ashville Road Lsd 13 - Sec 13 - Twp 25 - Rge 21 W PM

SZ 225
SZ 226

4 - Meander of the Wilson River - S.E Gilbert Plains Road - Lsd 14 - Sec 10 - Twp 25 - Rge 21 W PM

From top to bottom

SZ 227
SZ 228
SZ 229
SZ 230
SZ 231

5 - Ditch along the Track - S of Spruce Creek - W border of Lsd 4 - Sec 3 - Twp 25 - Rge 20

SZ 232

/

6 - Meander of the Vermilion River - Sheet Dauphin E - N.E. corner - Lsd 3 - Sec 35 - Twp 23 - Rge 20 W PM
From top to bottom

SZ 233
SZ 234
SZ 235
SZ 236
SZ 237
SZ 238

7 - Meander of the Vermilion River - Sheet Dauphin E - S W. corner of Lsd 15 - Sec 23 - Twp 23 - Rge 20 W PM

From top to bottom

SZ 240
SZ 239

8 - Meander of the Vermilion River - Sheet White Water Lake E
Approx center of Lsd 4 - Sec 23 - Twp 23 - Rge 20 W PM

From top to bottom

SZ 243
SZ 242
SZ 241

9 - In the bottom of the Creek - Sheet Dauphin E

SZ 243 bis

- Swan River Area - In the bottom of the Creek - Sheet Arran E.

Approx center of lsd 1 - Sec. 3 - Twp 35 - Rge 29 - W P M
Section Swan River Meander, from top to bottom

SZ 381
SZ 380
SZ 379
SZ 378

December 17, 1965

F TORTOCHAUX

14-5-2 3

CANADA

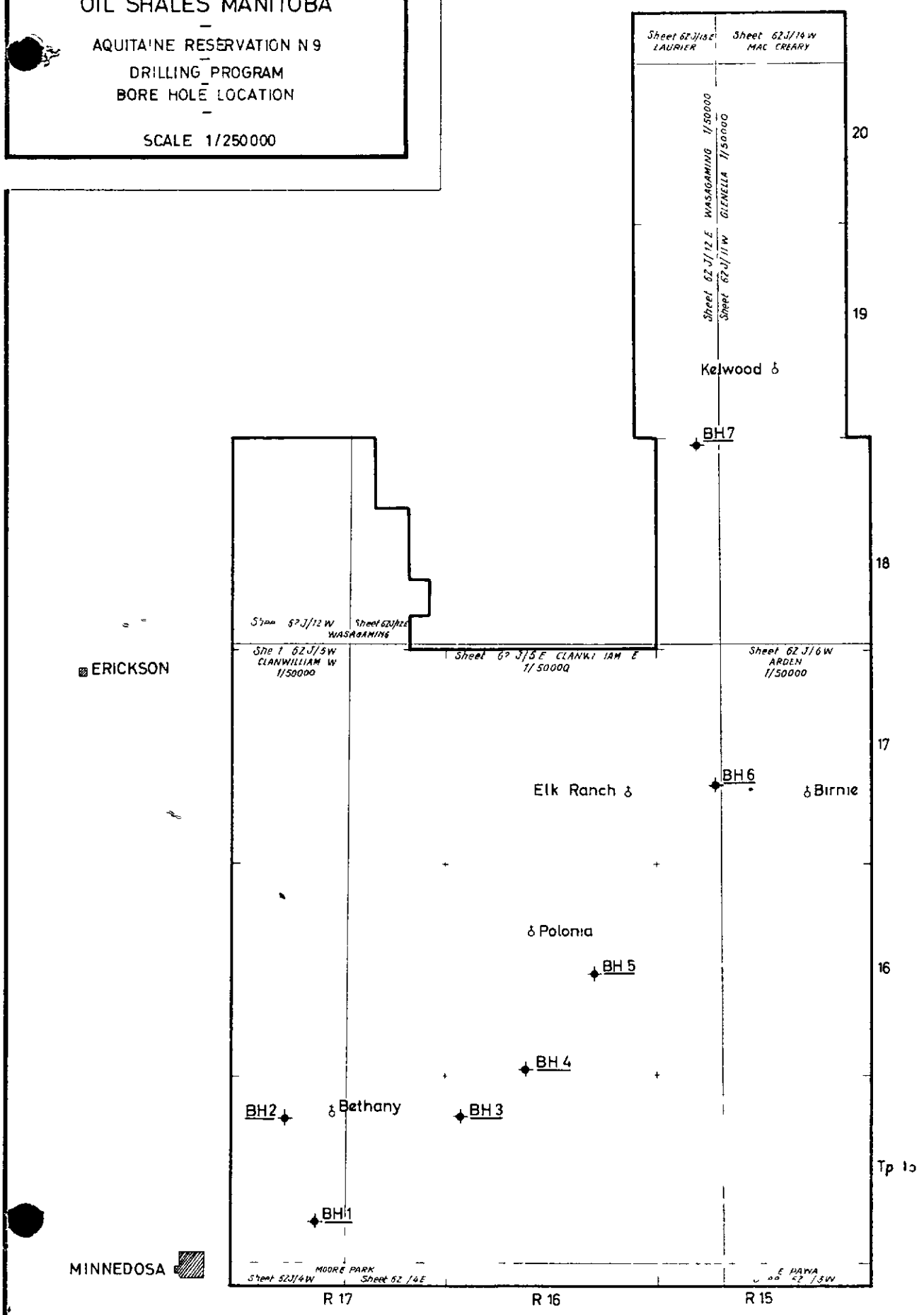
OIL SHALES MANITOBA

AQUITAINE RESERVATION N 9

DRILLING PROGRAM

BORE HOLE LOCATION

SCALE 1/250000



| | | | | | |
|---|---|---|---|---|---|
| Manitoba Reservation n° 9 | BH 5 | 2,50 miles SE of Polonia Sheet 1/50 000 - Clanwilliam E - 62 J/5 E - Lsd 14 - Sec 14 - Twp 16 - Rge 16 W P M | < 830' (Base Favel) | | Spudding level - Siliceous silt "Riding Mountain Formation" Ground elevation 1835' Priority 3 |
| " | BH 6 | Between Birnie and Elk Ranch Sheet 1/50 000e - Clanwilliam E - 62 J/5 E - Lsd 2 - Sec 17 - Twp 17 - Rge 15 W P M | < 400' (Base Favel) | | Spudding level - Siliceous silt "Riding Mountain Formation" Ground elevation 1450' Priority 2 |
| " | BH 7 | SW Kelwood - Sheet 1/50 000 Wasagaming E - 62 J/12 E - Lsd 13 - Sec 32 - Twp 18 Rge 15 W P M - E Border - Cuesta of the Riding Mountain Formation | < 195' (Base Favel) | | Pudding level - Siliceous silt - "Riding Mountain Formation" Ground elevation 1335' Priority 1 |

Conclusions

The planning herewith calls for the following conclusions

In case reconnaissance of AQUITAINE Reservation were decided, it would be recommended to drill three test holes BH 7, BH 6, BH 5 for a total of 1425 ft

According to the results, another 3460 ft would be drilled on the locations BH 1, BH 2, BH 3, BH 4 for a total of 4885 ft of which 1425' in first priority and the eventual remainder

December 28, 1965

14-5-2 2

C A N A D A

OIL SHALE MANITOBA

-

AQUITAINE RESERVATION N° 9

-

OIL SHALES DRILLING PROGRAM

| Province | Symbol | Location | Objective Depth in feet | Thickness of the kerabit shale | Specific data |
|---|---|---|---|---|---|
| Manitoba Reservation n° 9 | BH 1 | Cross section WE - SW corner of Permit - 3,50 miles NE of Minnedosa - Sheet 1/50 000 - Clanwilliam W - 62 J/5 W - Lsd 14 - S 9 - Twp 15 - Rge 17 W P M | < 890' (Base Favel) | ? | Spudding level - Siliceous silt "Riding Mountain Formation" Ground elevation 1825' Priority 4 |
| " | BH 2 | Cross section WE towards N 5 miles NE of Minnedosa - Sheet 1/50 000 - Clanwilliam W - 62 J/5 W - Lsd 15 - Sec 29 - Twp 15 - Rge 17 - W P M | < 900' (Base Favel) | ? | Spudding level - Siliceous silt "Riding Mountain Formation" Ground elevation 1855' Priority |
| " | BH 3 | Cross section WE towards E 1,30 mile W of Bethany Sheet 1/50 000 - Clanwilliam E - 62 J/5 E - Lsd 14 - Sec 30 - Twp 15 - Rge 16 W P M | < 895' (Base Favel) | ? | Spudding level - Siliceous silt "Riding Mountain Formation" Ground elevation 1875' Priority |
| " | BH 4 | Cross Section towards NE, S Polonia - Sheet 1/50,000 Clanwilliam E - 62 J/5 E - Lsd 3 - Sec 4 - Twp 16 - Rge 16 W P M | < 785' (Base Favel) | | Spudding level - Siliceous silt "Riding Mountain Formation" Ground elevation 1775' Priority |

3) Relation between Carbonate rates and kerogene content :

The speckled shale dark-grey coloured and the carbonated shaly intercalation seem to be the most favourable horizons for bearing kerogene to the exception of pure bioclastic marine limestone.

4) Age .

The samples picked up on the Vermilion Formation , the Favel Formation the top of Ashville Formation and on which the studies have been carried out may be located in the Upper Cretaceous - Turonian. The identification of Praeglobotruncana delrioensis - Subbotina observed on the thin sections is determinant regarding the chronostratigraphy.

II - DRILLING PROGRAM

The Kerabituminous beds of the Vermilion and Favel Formations are generally hidden by overburden and soils. In the creeks, the rejuvenation of the meanders gives sometimes small exposures, 20-30 ft thick. But these outcrops are unfortunately isolated and make uneasy their location in a vertical stratigraphic column.

We recommand a drilling program including 7 core holes for checking the possibility of Kerabituminous beds. Each hole may start in the silty and siliceous shales of the Mountain Riding Formation, that overlay the bituminous objective. The purpose of the drilling campaign is to obtain representative core samples of the lower members of the Vermilion Formation, the Favel Formation and the top of the Ashville Formation. Locations and Characteristics of those holes are mentioned on the plates and maps accompanying the report. The locations of bore holes have been chosen on the crown rights area.

Pau, January 26, 1966

F. TORTOCHAUX

Fountain Shale Formation

Silty and siliceous shale no oil content

Vermilion River Formation

Boyce Member

Some shaly bands with white specks are slightly kerabituminous in the creek of Vermilion River.

0,52 < Oil Content < 3.61 US Gal/ton.

Gordon Member

The section of the member sampled in the Vermilion River is rich in carbonaceous matter. The yield of sulphur obtained reaches 6 %.

Favel Formation

In spite of the low oil value obtained from field samples, in Aquitaine Reservation area, this formation appears as the best objective. The shales speckled with white have commonly a high content in organic matter.

The average of the oil yield made on the samples picked up on the weathered outcrops reaches 6 US Gal/ton with some picks of 10 US Gal/t. The water content of the field samples is 30 US Gal/t. with a maximum of 72 US Gal/ton

Ashville Formation

Some thin intercalations of shales located to the top of Ashville may be considered kerabituminous. The average oil Fisher Assay comes, around 3 US Gal/ton.

2) Phosphated debris and Fish Remains Content :

The beds of the Favel Formation, that include several intercalations of marine limestone with Inocerames, display frequent banas rich in fish remains and phosphated debris

C A N A D A

OIL SHALE MANITOBA

AQUITAINE RESERVATION N° 9

-:-:-:-

5 - FINAL ESTIMATION - DRILLING PROGRAM

-:-:-:-

I - FIELD ESTIMATION

The studies carried out on the oil shales inside and outside the Reservation n° 9 bring to the following conclusions :

a) Oil yields - Water and Sulphur Content :

The best oil grade checked on the field samples has given 41,72 US Gal/ton. It concerns the sample numbered SZ 250, a little weathered, picked up on the cuttings from a dug out located to 2 miles - N. . of elwood . This bituminous shale is made by a clay rich in organic matter with pyrite Foraminifera and phosphated debris content. According to lithologic facies, this sample may be located in the upper beds of the Favel. Due to the argillaceous sandy overburden, no precision may be brought on the sequence and the thickness of that keratobituminous isolated material.

The different results of the oil analysis made on the samples picked up in the Aquitaine Reservation and in the vicinity may be therefore connected with the formations :

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(14-4) (c) 4(a) 1

CANADA

OIL SHALE MANITOBA

ASHUANIPI RESERVATION N° 9 and Neighbouring Area

Oil content Evaluation by Fisher Assays

Process.

Fisher assays in accordance with the directions preconised in the T.I. n° 4477 of the US Bureau of Mines.

Results

The oil contents are measured on the dry samples.

The results are expressed :

Oil : US Gal and liters/metric ton

Water US Gal/metric ton and % in weight

Sulphur : % in weight.

| Sample N° | OIL CONTENT l/t | OIL CONTENT US Gal./t. | WATER CONTENT % | WATER CONTENT US Gal./t. | SULPHUR CONTENT |
|---|---|---|---|---|---|
| | I.- INSIDE THE RESERVATION. | | | | |
| | A002 | Section N.E. through the southern part of the permit from Pinnedosa to the Ross burn Junction - Sheets Clanwilliam E | | | |
| SZ 359 | 9,4 | 2,54 | 5,5 | 14,5 | |
| | A006 | Section 2 miles South of Kelwood - Sheet Glenella . From Top to bottom | | | |
| SZ 249 - Favel | 25. | 6,76 | 1,25 | 3,3 | |
| SZ 375 - Waterville | Traces | Traces | 27,5 | 72,75 | |
| SZ 248 - Ashville | 3 | 0,8 | 25.3 | 66,9 | |

.../...

| SAMPLE N° | OIL CONTENT l/t. | OIL CONTENT US Gal./t. | WATER CONTENT % | WATER CONTENT US Gal./t. | REMARKS |
|---|---|---|---|---|---|
| | 007 Section in the northern vicinity of Kelwood village - Sheet Shoal Flonelle<br>From top to bottom | | | | |
| SZ 250 Travel | 4,6 | 1,95 | 2,9 | 10,2 | 7,16 on the oil |
| SZ 264 A | 2 | 6,16 | 11,75 | 21,1 | |
| SZ 267 Ashville | 8 | 2,14 | 17,5 | 46,3 | |
| | 008 Section from the SE to Kelwood village<br>From top to bottom | | | | |
| SZ 360 Travel | 7,8 | 2,09 | 7,25 | 19,2 | |
| SZ 373 Travel | 4,5 | 1,2 | 24,5 | 64,8 | |
| | B - <u>COURSE OF THE RESERVATION</u> | | | | |
| | <u>and 5) area of Dauphin</u> | | | | |
| | 1) - <u>Ditch Ashville Road near the intersection with Gilbert Plains Road Sheet Dauphin</u> Lsd 1 - Sec. 14 - Twp 25 - Rge 21 - WP | | | | |
| SZ 217 Ashville | 11,52 | 2,05 | 13,9 | 37 | |
| SZ 218 | 0 | 0 | 16,7 | 44,4 | |
| | 2) - <u>Section along the thalweg located S of Ashville - Gilbert Plains Road intersection</u> - Sheet Dauphin - Lsd 16 - Sec 14 - Twp 25 Rge 21 - WP<br>From top to bottom | | | | |
| SZ 219 Ashville | 20 | 5,36 | 12,4 | 35 | |
| SZ 220 | 30 | 8,04 | 11,3 | 29,8 | |
| SZ 221 | 22,5 | 6,8 | 12,9 | 34,1 | |
| SZ 222 | 15 | 4,02 | 11,2 | 29,8 | |
| SZ 223 | 5 | 1,34 | 14,6 | 38,6 | |
| | 3) - <u>Wilson River bridge on Ashville Road - Sheet Dauphin</u> - Lsd 15 - Sec. 15 - Twp 25 - Rge 21 - WP | | | | |
| SZ 225 Travel | 0 | 0 | 2,9 | 7,7 | |

.../...

| SAMPLE N° | OIL CONTENT l/t. | OIL CONTENT US Gal./t. | WATER CONTENT % | WATER CONTENT US Gal./t. | SULFUR CONTENT |
|---|---|---|---|---|---|
| | 4) - Meander of the Wilson River - SE Gilbert Plains Road - Sheet Dauphin - Lsd 14 - Sec. 10 - Twp 25 - Rge 21 - WPM | | | | |
| SZ 227 } Favel | 21,5 | 5,76 | 11,9 | 29,4 | |
| SZ 228 } Favel | 25 | 6,7 | 8,2 | 21,7 | |
| SZ 229 } Favel | 25 | 6,7 | 10,4 | 27,5 | |
| SZ 230 } Favel | 17 | 4,55 | 9,5 | 25,1 | |
| SZ 231 } Favel | 7 | 2,87 | 7,4 | 19,5 | |
| | 6) - Meander of the Vermilion River - Sheet Dauphin E-NE Corner of Lsd 3 - Sec. 25 - Twp 25 - Rge 20 - WPM From top to bottom | | | | |
| SZ 233 } Favel | 13 | 3,48 | 1,9 | 5 | |
| SZ 234 } Favel | 31 | 8,31 | 18,4 | 48,6 | |
| SZ 235 } Favel | 27,5 | 7,35 | 5,9 | 15,6 | |
| SZ 238 } Favel | 28,5 | 7,63 | 15,6 | 41,2 | |
| | 7) - Meander of the Vermilion River - Sheet Dauphin E - S-W Corner of Lsd 15 - Sec. 23 - Twp 23 - Rge 20 - WPM From top to bottom | | | | |
| SZ 240 } Mordenite | 0 | 0 | 20,3 | 60,8 | 3,5 % on the rocks |
| SZ 239 } Mordenite | 0 | 0 | 10,2 | 27,2 | 6,2 " |
| | 8) - Meander of the Vermilion River - Sheet White Water Lake E. Approx. center of Lsd 4 - Sec. 25 - Twp 25 - Rge 20 - WPM From top to bottom | | | | |
| SZ 243 - 2 | 2 | 0,53 | 6,4 | 16,9 | |
| SZ 242 } Mordenite | 2 | 0,53 | 4,55 | 12 | |
| SZ 241 } Mordenite | 13,5 | 3,61 | 2,95 | 7,8 | |
| | 9) - In the bottom of the Creek. - Sheet Dauphin E | | | | |
| SZ 243 bis - 2 | 28 | 7,5 | 2 | 5,3 | 0,70 on the oil |

./...

| SAMPLE N° | OIL CONTENT l/t. | OIL CONTENT US Gal./t. | WATER CONTENT | WATER CONTENT US Gal./t. | WATER CONTENT |
|---|---|---|---|---|---|
| | Swan River Area | | | | |
| | In the bottom of the creek - Sheet Arran 3 - Approx. center of Sec. 5 - Twp 35 - Rge 29 - WP | | | | Lead 1 - |
| SZ 381 } Fault | 39 | 10,4 | 9,35 | 24,7 | 7,3 on the oil |
| SZ 380 } | 29 | 7,77 | 2,6 | 6,8 | 6,7 " " |
| SZ 378 | 7,5 | 2,01 | 16,4 | 43,4 | |

N.B. - The low oil yield did not permit the oil density measurement, usually made with a pycnometer

From. - A. MACIA and B. MALLET

(14)-(4) 4(a)-2:5

# MINERALOGY SZ SAMPLES - CANADA - MANITOBA

| ORDER NUMBER | SAMPLE NUMBER | QUARTZ | CALCITE | DOLOMITE | SELENITE | FELDSPAR | JAROSITE | ILLITE «Montmorillonite | ILLITE | CHLORITE | MONTMORILLONITE | Phosphate K-Ca-Al hydrate | PHOSPHATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 245050 | 360 | 5 | 32 | | | | X | Trace | | X | XXX | | |
| 1 | 361 | 9 | 41 | | | | | X | | X | XX | | |
| 2 | 362 | 16 | 7 | | | | | X | | X | XX | | |
| 3 | 363 | 19 | 14 | | | | | X | | X | XX | | |
| 4 | 364 | 6 | 51 | | | | | X | | X | XX | | |
| 5 | 364B | 7 | 53 | | | | | X | | X | XX | | |
| 6 | 365 | 17 | 14 | | | | | X | | X | XX | | |
| 7 | 366 | 38 | 37 | | | | | X | | X | XX | | |
| 8 | 367 | 31 | 18 | | | | X | X | | XX | XX | | |
| 9 | 368 | | 92 | | | | | | | | XXX | | |
| 245060 | 369 | 7 | | | | | | | | | XXX | | X |
| 1 | 370 | 11 | | | | | | | | | XXX | | X |
| 2 | 371 | 36 | | | | | | X | | XX | XX | | |
| 3 | 372 | 17 | 5 | | | | | X | | XX | XX | | |
| 4 | 373 | 22 | | | X | | X | X | | XX | XX | | |
| 5 | 374 | Absent | | | | | | | | | | | |
| 6 | 375 | 19 | | | | | | X | | XX | XX | | |
| 7 | 376 | | Pyrite | | | | | X | | XX | XX | | |
| 8 | 377 | 26 | | | | | | | | | XXX | X | |
| 9 | 378 | 73 | | | | | | | | | XXX | X | |
| 245070 | 379 | 16 | 8 | | | | | Absent | | | | | |
| 1 | 380 | Indistinct | | | | | | | | | XX | X | |
| 2 | 381 | 17 | 4 | | | | | | | | XXX | X | |

Imp. 679 A GEPA

# MINERALOGY SZ SAMPLES - CANADA - MANITOBA

| ORDER NUMBER | SAMPLE NUMBER | QUARTZ | CALCITE | DOLOMITE | SELENITE | FELDSPAR | JAROSITE | ILLITE Montmorillonite | ILLITE | CHLORITE | MONTMORILLONITE | Phosphate K-Ca-Al hydrate | PHOSPHATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2450006 | 217 | 22 | | | | | x | x | - | x | xx | | |
| 7 | 218 | 16 | | | x | | x | x | - | x | xx | | |
| 8 | 214 | 25 | 3 | | | 1 | | x | - | x | xx | | |
| 9 | 222 | 26 | 1 | | | | | x | - | x | xx | | |
| 2450100 | 221 | 20 | 3 | | | | | x | - | x | xx | | |
| 1 | 222 | 19 | | | | | | x | - | x | xx | | |
| 2 | 223 | 19 | | | | | | x | - | x | xx | | |
| 3 | 224 | | 14 | | | | | x | - | x | xx | | |
| 4 | 225 | 18 | | | | | | x | - | x | xx | | |
| 5 | 226 | 14 | | | | | | x | - | x | xx | | |
| 6 | 227 | 6 | 38 | | | | | x | trace | x | xxx | | |
| 7 | 228 | 3 | 60 | | | | | x | " | x | xxx | x | |
| 8 | 229 | 3 | 74 | | | | | x | " | x | xxx | x | |
| 9 | 230 | 1 | 67 | | | | | x | " | x | xxx | | |
| 2450200 | 231 | 3 | 67 | | | | | x | " | x | xxx | | |
| 1 | 232 | 16 | | | | | x | | trace | x | xxx | | |
| 2 | 233 | 14 | 17 | | | | | trace | | xx | x | | |
| 3 | 234 | 13 | 17 | | | | | " | | xx | x | | |
| 4 | 235 | 14 | 4 | | | | | " | | xx | x | | |
| 5 | 236 | 19 | 1 | | | | | " | | xx | x | | |
| 6 | 237 | 6 | 41 | | | | | " | | xx | x | | |
| 7 | 238 | Absent | | | | | | " | | xx | x | | |
| 8 | 239 | 15 | | | | | x | x | | x | xx | | |

# MINERALOGY SZ SAMPLES - CANADA - MANITOBA

| ORDER NUMBER | SAMPLE NUMBER | | QUARTZ | CALCITE | DOLOMITE | SELENITE | FELDSPAR | JAROSITE | ILLITE (Montmorillonite) | ILLITE | CHLORITE | MONTMORILLONITE | Phosphate K_Ca_Al hydrate | PHOSPHATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 240 | | 35 | | | | | x | x | | x | xx | | |
| 245030 | 241 | | 11 | 28 | | | | | trace | | x | xxx | | |
| 1 | 242 | | 18 | | | | | x | " | | x | xxx | | |
| 2 | 243 | | 14 | | | | | x | " | | trace | xxx | | |
| 3 | 243 | bulk | 4 | 53 | | | | | " | | " | xxx | | |
| 4 | 244 | | 6 | | | | | | | absent | | | | |
| 5 | 245 | | 10 | | | | | | | | | xxx | | x |
| 6 | 246 | | 5 | | | | | | | | | xxx | | x |
| 7 | 247 | | 13 | | | | | | | | | xxx | | x |
| 8 | 248 | | 21 | | | | | | trace | | x | xx | | |
| 9 | 249 | | 4 | 63 | | | | | " | | x | xx | | |
| 245040 | 250 | | 8 | 18 | | | | x | " | | x | xx | | |
| 245041 | 351 | | 5 | | | | | | | | | xxx | | x |
| 2 | 352 | | 8 | | | | | | | | | xxx | | x |
| 3 | 353 | | 12 | | | | | | | | | xxx | | x |
| 4 | 354 | | 7 | | | | | | | | | xxx | | x |
| 5 | 355 | | 10 | | | | | | | | | xxx | | x |
| 6 | 356 | | 12 | | | | | | | | | xxx | | x |
| 7 | 357 | | 10 | | | | | | | | | xxx | | x |
| 8 | 358 | | 10 | | | | | | | | | xxx | | x |
| 9 | 359 | | absent | | | | | | | | | | | |

(14) 4(a)-1 1

S. N. P. A.
DIVISION EXPLORATION
E/SB - n° 66/1 1C

Pau, JANUARY 19 - 1966

CANADA

OIL STATE MANITOBA

JIT HILL RESERVATION N° 9 and Neighbouring Area

Lithological Examination and Determination of Field samples - upper Cretaceous age.

Request n° 102 23.8.1965

From : R. ELLOY and J. AUBERT C.P.P. PAU

## A - LITHOLOGICAL DESCRIPTION

I - Riding Mountain Formation -

SZ 246 - Clay rich in organic matter ; rare phosphatic debris and some Radiolaria ? detrital - Quartz : rare (Size 50 μ)

II - Vermilion River Formation -

Boyne member - SZ 241 : Clay rich in organic matter, phosphatic debris.

III - Favel Formation -

a) Gradationnal zone : Ashville - Favel :

SZ 246 - Vermilion River

Biosparite with poikillitic-texture, very rich in Inoceramus prisms, fibrous fragments of lamellibranchs and phosphatic debris (dahllite) belonging to fish (ossicles).

SZ 371 - 372 : Biomicrites similar to the above but without sparitic cement.

Inoceramus prisms

Fibrous mollusc tests

Phosphates (fish) and abundant organic matter.

b) Favel base .

SZ 369 Biomicrite similar to the above but with large Globigerina. Phosphated debris are still present (no detrital) .

SZ 365 - Very large Inoceramus debris.

SZ 290 - Marl - Very rich in organic matter with .

Inoceramus prims

Globigerina - Gumbelina

Phosphated Debris - Spots of organic matter.

.../...

NB. - It must be noted that the "white specks" refered to in the report, tally with the Globigerina whose chambers are filled generally by a calcite monocrystal standing out on the dark organic-clay background of the rock. In these bituminous clays, the carbonated fraction is found exclusively in the organisms.

c) Near Ashville top :

SZ 226 - Biosparite almost with debris of Inoceramus.
Some fragments of fibrous tests of lamellibranchs.
Very abundant phosphates - Organic matter.

d) Favel :

SZ 224 - comparable in every respect to SZ 226

SZ 249 - Clay laminated - very rich in organic matter Gumbelina Globigerina - Inoceramus.
Phosphated fish debris.

SZ 381 - Swan River section.
Similar clay, ever phosphated with the same white specks due to Globigerina and more generally to limy organic debris.

IV - Ashville Formation -

SZ 366 - Sandy limestone with poikilitic cement , small angular quartz ; glauconite, Phosphatic debris.
Rare Inoceramus fragments.

V - Drift sample - Silurian age -

SZ 368 - Limestone - (Sparite recrystallised, calibrated grain size, around 75 $\mu$) metamorphic.

REMARK - Samples SZ 243 bis (ref. : J. STEVAUX's work on clay ) and SZ 241 are identical.

Both are clay rich in microfauna with phosphatic debris (Gumbelina and Globigerina).

.../...

Sz 366 differs from all other samples regarding its detrital and glauconitic character. Inoceramus prisms and phosphates being ever present.

GENERAL CONCLUSION - Almost all of these samples can be classified under two leading facies :

1) - Bioclastic limestone more or less sparitic with occasionally very abundant Inoceramus prisms, fibrous test, debris of large lamellibranchs, phosphated debris of fishes, sometimes when the limestone gets less detrital some Globigerina appear.

These samples belong to the Favel, to its base, to the transition zone and are numbered Sz 224 - 225 - 363 - 365 - 371.

2) - The organo-clayey facies is mainly a foraminifera facies (large Globigerina, Gumbolina causing the white spots observed on the rock). The Inoceramus prisms are scarce whilst phosphated debris and organic matter abund.

Thus are samples n° SZ 250 - 249 - 381 which belong also to the Favel or to its base.

3) - SZ 241 is conspicuous by the presence of very fine detrital material, the extraordinary abundance of organic matter and the absence of foraminifera. It belongs to the Boyne Member of Vermilion Formation.

SZ 246 - belongs to the Mountain Riding Formation. It is a crypto cristalline clay with rare phosphated debris, Bealolaria and some very fine quartz.

SZ 366 - Sandy limestone with poikillitic calcite cement and Glauconite. Phosphated matter and scarce Inoceramus prisms - Pyrite Epidote.
Ashville Formation.

5 - [illegible] -

General Remark - 8 of the 13 samples examined contain large size Globigerina (= Praeglobotruncana ordinaria (SUBBOTINA) a Miocene character.

Detailed Examination :

SC 218 Gypsum and very scarce phosphated debris (scale)

SC 24 : Very slightly calcareous shale, and phosphated debris, fish scales and teeth.

Large Globigerina abundant at this level.

SCHLUMBERGER.

SC 247 : (Brown shale with spots
(Micaceous shale

Inoceramus prisms

Abundant Praeglobotruncana ordinaria (SUBBOTINA)

Gumbelina sp. scarce.

SC 250 Same as above less clear

SC 257 : Brown shale, abundant Inoceramus prisms and numerous phosphated debris.

Praeglobotruncana ordinaria frequent.

SC 262 : Brown shale, agglutined foraminifera among which :

Bathysiphon sp

? Trochammina sp.

Very rare Praeglobotruncana ordinaria. (SUBBOTINA)

SC 269 Brown shale with Inoceramus Prisms

Abundant Praeglobotruncana ordinaria (SUBBOTINA)

Gumbelina sp.

SC 325 : No Foraminifera.

SC 356 : No Foraminifera.

SC 362 : Shale with abundant Inoceramus prisms.

Abundant Praeglobotruncana ordinaria (SUBBOTINA)

Hedbergella sp.

Gumbelina sp.

SZ 364 : Shale with abundant Inoceramus prisms, phosphated debris (fish teeth and bones).

Frequent Praeglobotruncana ordinaria (SUBBOTI )

Hastigerinella aff. simplex.

Gumbelina sp.

SZ 365 : Abundant Inoceramus prisms.

SZ 381 : Inoceramus prisms.

Abundant Praeglobotruncana ordinaria ( [illegible] ).

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S. U. F. A.
DIVISION EXPLOITATION

E/SB - n° 66/141

4(a)-2

P.U, JANUARY 19 - 1966

C.F.D.

OIL SEEDS MANITOBA

AQUITAINE PROSPECTION n° 9 and Neighbouring Area

Object. Study on the clays of bituminous beds and enclosing formations - Upper Cretaceous age.

Request n° 10 May 23, 1965

From ... J. SILVAUA and ...G. DARROT.

PIDLICROLITHIFORMATION -

SZ 226 - 227 - Quartz 10 %

Montmorillonite : Predominant clay elements together with a phosphate (as in SZ 225)- Average quartz content for this formation : 40 %

SZ 228 to 230 clay minerals alike to those of SZ 226 - 227 that is to say : predominant montmorillonite along with a phosphate.

MILLION RIVER FORMATION -

- Lower part :

- SZ 239 - 240 - Quartz 20 % - Jarosite possible - Chlorite 30 % montmorillonite 60 % - about 10 % illite - montmorillonite.

- Upper part :

- SZ 241 - 242 - Quartz 15 % - Calcite disappears : 50 % present in n° SZ 241 and none in n° SZ 242 but here jarosite possible.

Chlorite 15 % traces of mixed layer illite - montmorillonite montmorillonite predominant.

FORMATION -

SZ 227 - 231 - Quartz low, 4 %, but high carbonate content (calcite 60 %).

Clay minerals : traces of chlorite, 10 to 20 % illite-montmorillonite, 90 % montmorillonite. Presence of a mineral in SZ 228 and 229 which is a hydrated phosphate of K, Ca, Al.

- SZ 235 to 238 . Average quartz content 10 % - Average . Limestone (10 % calcite), becoming very abundant in n° SZ 236 (90 %) and less abundant in SZ 237 (40%).

Chlorite 50/50 , Traces of mixed-layer illite-montmorillonite. Complement montmorillonite.

SZ 249 : highly carbonated : 60 % calcite - poor in quartz 5 %.

Clay components : chlorite, montmorillonite

../...

illite - montmorillonite.

SZ 360 : Jarosite possible with 5 % Quartz and 30 % calcite.

Clay components : predominant chlorite and montmorillonite slight mixed-layer illite - montmorillonite contents.

SZ 361 - Calcite 50 % Quartz 10 alternating highly calcareous beds - SZ 362 calcite above 90 .

Chlorite 50 to 60 % mixed layer illite - montmorillonite 10 % to 15 - Remainder montmorillonite.

SZ 371 - 376 - Quartz 10 . Series commencing by a carbonated bed : 60 % calcite for SZ 371 - 372 with gypsum and jarosite possible , presence of pyrite in SZ 376.

Chlorite 40 %, montmorillonite with traces of the mixed-layer illite - montmorillonite.

SZ 377 - 381 - Quartz 5 % calcite 65

SZ 380 undosable.

Montmorillonite and presence of mineral : hyarated phosphate of K, Ca, Al. SZ 428 and 429 are identical to above.

<u>WESTFIELD FORMATION</u> -

<u>SZ 247 to 249</u> : average quartz content 15 to 20 ; calcite present, gypsum and Jarosite possible. Jarosite being a double sulfate of K and Fe.

Clay minerals chlorite 25 mixed-layer illite montmorillonite 25 - montmorillonite 50 .

<u>SZ 248</u> : Quartz 20 .

Clays chlorite 30 % montmorillonite 70 % toget er with the mixed-layer illite - montmorillonite.

<u>SZ 250</u> : Average quartz content 10 % carbonates : calcite 18 % Jarosite possible.

Chlorite 25 %, montmorillonite 75 , trace of the mixed-layer illite- montmorillonite.

<u>SZ 267</u> : Quartz 20 calcite 15 Jarosite possible.

Chlorite 40 %, the remainder, mixed-layer illite-montmorillonite and montmorillonite.

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Samples lacking criterae for their classification.

SZ 224 to 226 . Pavel ? Near Ashville Top.

Quartz (weak) Average 10 %. Important calcareous beds (75 Calcite) except for SZ 225.

Clay minerals . 10 to 15 % chlorite, mixed-layer illite - montmorillonite (20 to 25 %), main component . montmorillonite.

SZ 242 : Ashville.

Quartz 10 % Jarosite present.

Chlorite 20 % montmorillonite 80 %, illite (traces?)

SZ 243 and 243 bis . Vermilion or Riding Mountain ?

Quartz 10 % Jarosite possible

Enrichment in Carbonates : calcite 50 % - Rich in montmorillonite, slight trace of chlorite and of the mixed-layer illite - montmorillonite.

SZ 245 : Formation as above.

Quartz 10 % - Predominant montmorillonite; presence of a phosphate.

SZ 368 - 369 - 370 : Silurian - Drift's overlap.

Quartz 10 % in SZ 369 and 370 - Calcareous bed : 50 % in n° SZ 368

Clay minerals : Predominant montmorillonite with a phosphate.

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C A N A D A

OIL SHALE MANITOBA

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AQUITAINE RESERVATION N° 9

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GEOCHEMICAI EXAMINATION - CONCLUSIONS

Ref Request n° 103 of May 23th, 1965

The deposit conditions of these bituminous beds can only be connected with an euxenic and reducing environment

This brings to mind, but on a larger scale, the deposit conditions of the "Kupferschiefer"

One can thus imagine a shallow basin, partly and periodically cut from the sea

In this pre-basin, water was constantly renewed by ingression of sea waters carrying with them their fauna and flora

The reducing environment of this basin developing an unfavorable medium for the marine biotopes, these are rapidly destroyed

It is normal that under such conditions, an adapted biotope should thrive on the remnants of the original marine biotopes Thus the accumulation of organic matter finds here an extremely favorable environment

In such a reducing environment, kaolinite is ever present (neoformation) It should be traced (even in small percentages) in the argillaceous stage along with sea clay (interstratified illite, montmorillonite, chlorite)

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In all the samples examined, we have never encountered any kaolinite Consequently, an actual pedological action may be contemplated

This action reaching the surface sections would bring about a hydrolysis of phlosilicates, the enrichment in silica and sesquioxydes, determining the formation of an excess of montmorillonite and of illite-montmorillonite

During this action, the sulphides shift to sulphates (gypsum - porosity) and iron oxydes may be generated

This should also entail organic matter to go into solution, in the form - namely of a silico-organic complex, with wash-away losses, especially when the subjacent is not clayed In the same way, part of the organic matter may oxydize and thus be lost

It may therefore be expected that the content in organic matter and consequently the oil output of these formations will be higher than at the surface provided an overlay of 20 or 30 m protects them from the effects of pedogenesis

J STEVAUX
Geochemistry - CRP/SNPA
Pau

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# CANADA

OIL SHALE MANITOBA

OUTSIDE OF AQUITAINE RESERVATION N°9

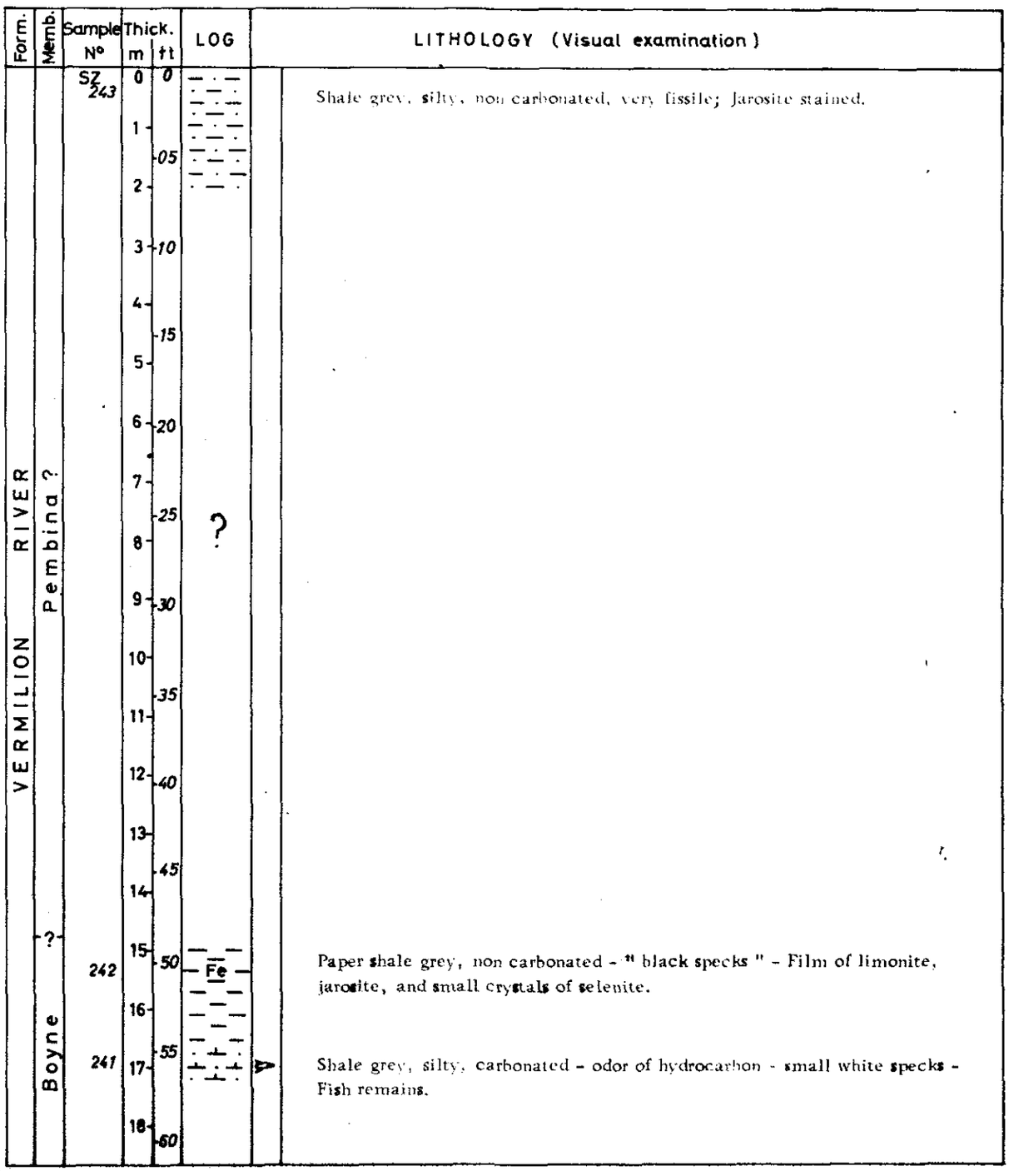
- B.I.8 -

## SECTION OF THE MEANDER OF THE VERMILION RIVER

Approx. center of Lsd4 - Sec 23 - Twp 23 - Rge 20 W PM

Sheet WHITE WATER LAKE.E.

Scale 1/100



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# CANADA

OIL SHALE MANITOBA

OUTSIDE OF AQUITAINE RESERVATION N°9

- B.1.6 -

## SECTION OF THE MEANDER OF THE VERMILION RIVER

N.E Corner of Lsd 3. Sec 35. Twp 23. Rg 20 W P M

Sheet DAUPHIN. E.

Scale 1/100