352-06-04-041

Oil and Mineral Division
MAY 10 1974
OTTAWA, CANADA
Dept. of Indian Affairs & Northern Development

AEROMAGNETIC INTERPRETATION

ARROWHEAD AREA, N.W.T.

PERMITS 6433, 6434

FOR

ASHLAND OIL CANADA LTD.

UNITED CANSO OIL & GAS LTD.

CALGARY, ALBERTA

BY

AQUA-TERRA CONSULTANTS LTD.

CALGARY, ALBERTA

JANUARY, 1974

PROJECT 352-6-4-74-1

Original field work carried out by Canadian Aero Service Ltd.

1952 - 1953

352-06-04-041

WEST CANADIAN GRAPHIC INDUSTRIES LTD.
810 - 5th Avenue S.W. CALGARY 1, ALBERTA
Phone 263-2555

MICROMAT
105 M.M.

11x

May 1974

123°00' 50' 40' 30' 20' 10' 122°00'
61°05'

BLACKSTONE RIVER

SCURRY et al
Cormack LG-15
TD-3576
(PRE-DEV. SILT)

61°00'

AMOCO MURPHY
Cormack N-33
TD-4378
(PRE-DEV.)

MURPHY BOC.
Arrowhead I.
-4565

55'

50'

SUN
Netla C-07
TD-5752
(PRE-DEV. QTZ)

IMP SUN
Arrowhead I-46
TD-5521
(PRE-DEV)

45'

MURPHY BOC.
Muskeg I
TD-5085
(PRE-DEV)

IMP SUN
Netla Raven F-73
TD-5992
(PRE-DEV)

IMP SUN
Arrowhead M-47

RIVER

ARROWHEAD

40'

35'

GOBLES et al
Celibeta D-66
TD-7129
(PRESQ DOL)

60°30'

BA TEX
Arrowhead B-76
TD-8539
(PRESQ DOL)

25'

GOBLES
Celibeta K-01

352-06-04-041

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MICROMAT
105 M.M.

11x

May 1974

123°00' 61°05' 50' 40' 30' 20' 10' 122°00' 61°05'

61°00' 55' 50' 45' 40' 35' 60°30' 25' 20'

BLACKSTONE RIVER

SCURRY et al
Cormack LG-15
TD-3576
(PRE-DEV. SILT)

AMOCO MURPHY
Cormack N-33
TD-4378
(PRE-DEV.)

MURPHY BOC.
Arrowhead I.
-4565

SUN
Netla C-07
TD-5752
(PRE-DEV. QTZ)

IMP SUN
Arrowhead I-46
TD-5521
(PRE-DEV)

MURPHY BOC.
Muskeg I
TD-5085
(PRE-DEV)

IMP SUN
Netla Raven F-73
TD-5992
(PRE-DEV)

IMP SUN
Arrowhead M-47
-6763

RIVER

ARROWHEAD

GOBLES et al
Celibeta D-66
TD-7129
(PRESQ. DOL.)

BA TEX
Arrowhead B-76
TD-8539
(PRESQ. DOL.)

GOBLES
Celibeta K-01
TD-6440
(PRE-DEV QTZ)

352-06-04-041

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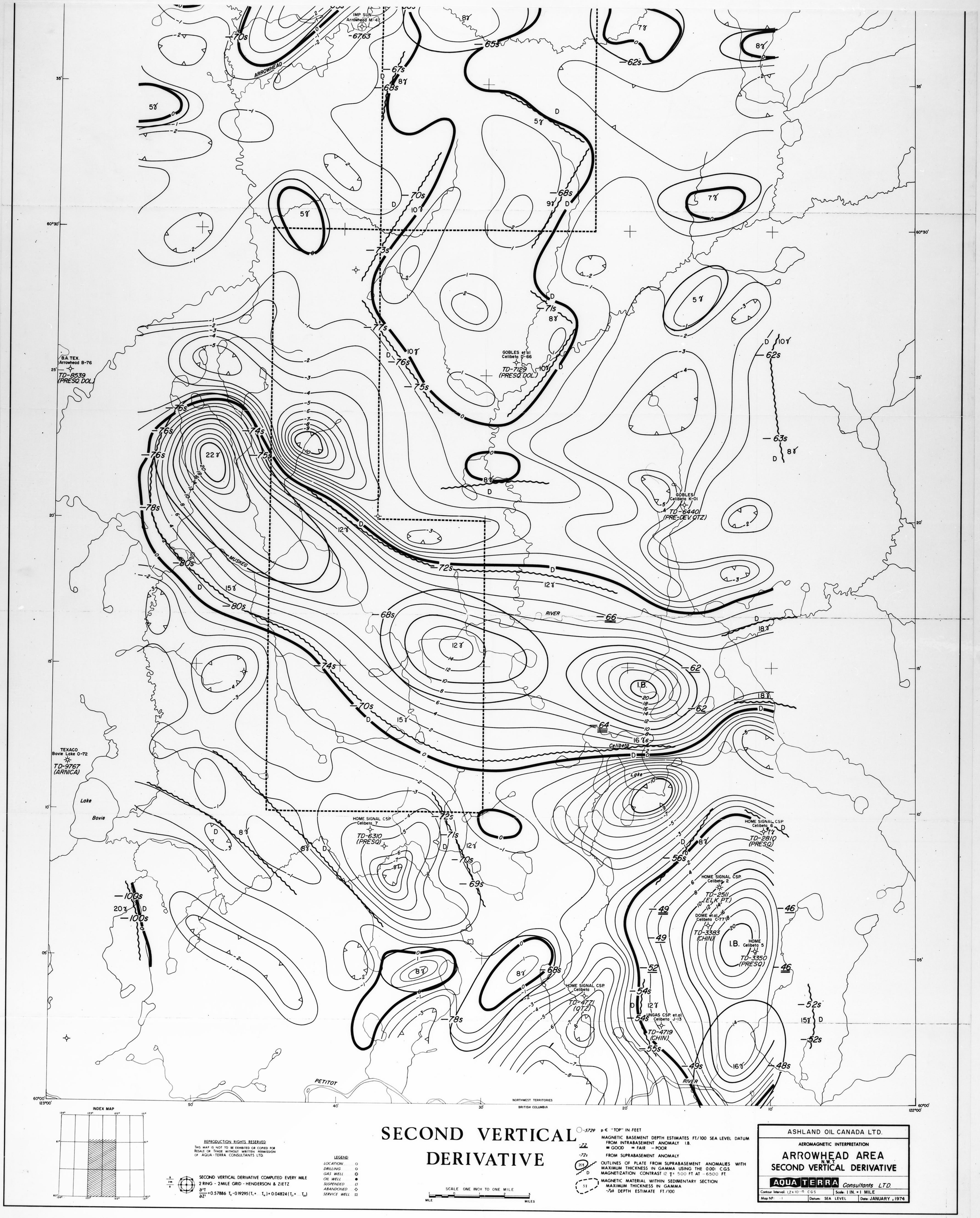
MICROMAT
105 M.M.

11x

May 1974



INDEX MAP

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SECOND VERTICAL DERIVATIVE COMPUTED EVERY MILE
2 RING - 2 MILE GRID - HENDERSON & ZIETZ

$$\frac{\partial^2 T}{\partial z^2} = 0.57886\,T_0 - 0.19295\,(T_1 + T_4) + 0.04824\,(T_2 + T_{4'})$$

LEGEND
LOCATION
DRILLING
GAS WELL
OIL WELL
SUSPENDED
ABANDONED
SERVICE WELL

SECOND VERTICAL DERIVATIVE

SCALE ONE INCH TO ONE MILE
0 1 2 3
MILE MILES

-5729 p.€ "TOP" IN FEET

MAGNETIC BASEMENT DEPTH ESTIMATES FT./100 SEA LEVEL DATUM FROM INTRABASEMENT ANOMALY I.B.
■ GOOD ▪ FAIR – POOR

-72s FROM SUPRABASEMENT ANOMALY

201 D OUTLINES OF PLATE FROM SUPRABASEMENT ANOMALIES WITH MAXIMUM THICKNESS IN GAMMA USING THE 0.001 C.G.S. MAGNETIZATION CONTRAST 12 γ = 500 FT. AT -6500 FT.

51 MAGNETIC MATERIAL WITHIN SEDIMENTARY SECTION MAXIMUM THICKNESS IN GAMMA
-7sh DEPTH ESTIMATE FT./100

ASHLAND OIL CANADA LTD.

AEROMAGNETIC INTERPRETATION

ARROWHEAD AREA
N.W.T.
SECOND VERTICAL DERIVATIVE

AQUA TERRA Consultants LTD.

Contour Interval: 1.2 x 10⁻⁵ C.G.S.	Scale: 1 IN. = 1 MILE	
Map No.: -1	Datum: SEA LEVEL	Date: JANUARY, 1974

352-06-04-041

WEST CANADIAN GRAPHIC INDUSTRIES LTD.
810 - 5th Avenue S.W. CALGARY 1, ALBERTA
Phone 263-2555

MICROMAT
105 M.M.

11x

May 1974

IMP SUN Arrowhead M-47 -6763

ARROWHEAD

GOBLES et al Celibeta D-66 TD-7129 (PRESQ. DOL.)

GOBLES Celibeta K-01 TD-6440 (PRE-DEV. QTZ)

B.A. TEX Arrowhead B-76 TD-8539 (PRESQ. DOL.)

MUSKEG RIVER

I.B.

TEXACO Bovie Lake O-72 TD-9767 (ARNICA)

Lake Bovie

HOME SIGNAL CSP Celibeta 7 TD-6310 (PRESQ)

HOME SIGNAL CSP Celibeta 6 TD-2810 (PRESQ)

HOME SIGNAL CSP Celibeta 2 TD-2511 (ELK PT.)

DOME et al Celibeta C-77 TD-3383 (CHIN)

HOME Celibeta 5 TD-3350 (PRESQ)

HOME SIGNAL CSP Celibeta 1 TD-4771 (OTZ)

UNGAS CSP et al Celibeta J-13 TD-4719 (CHIN)

Celibeta Lake

PETITOT RIVER

NORTHWEST TERRITORIES
BRITISH COLUMBIA

INDEX MAP

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LEGEND
LOCATION
DRILLING
GAS WELL
OIL WELL
SUSPENDED
ABANDONED
SERVICE WELL

MAGNETIC BASEMENT

SCALE ONE INCH TO ONE MILE
0 1 2 3
MILE MILES

-5729 p∈ "TOP" IN FEET
MAGNETIC BASEMENT DEPTH ESTIMATES FT./100 SEA LEVEL DATUM
-72 FROM INTRABASEMENT ANOMALY I.B.
■ GOOD ▬ FAIR – POOR
-72s FROM SUPRABASEMENT ANOMALY
201 D OUTLINES OF PLATE FROM SUPRABASEMENT ANOMALIES WITH MAXIMUM THICKNESS IN GAMMA USING THE 0.001 C.G.S. MAGNETIZATION CONTRAST 12 γ = 500 FT. AT -6500 FT.
51 MAGNETIC MATERIAL WITHIN SEDIMENTARY SECTION MAXIMUM THICKNESS IN GAMMA
-73s DEPTH ESTIMATE FT./100

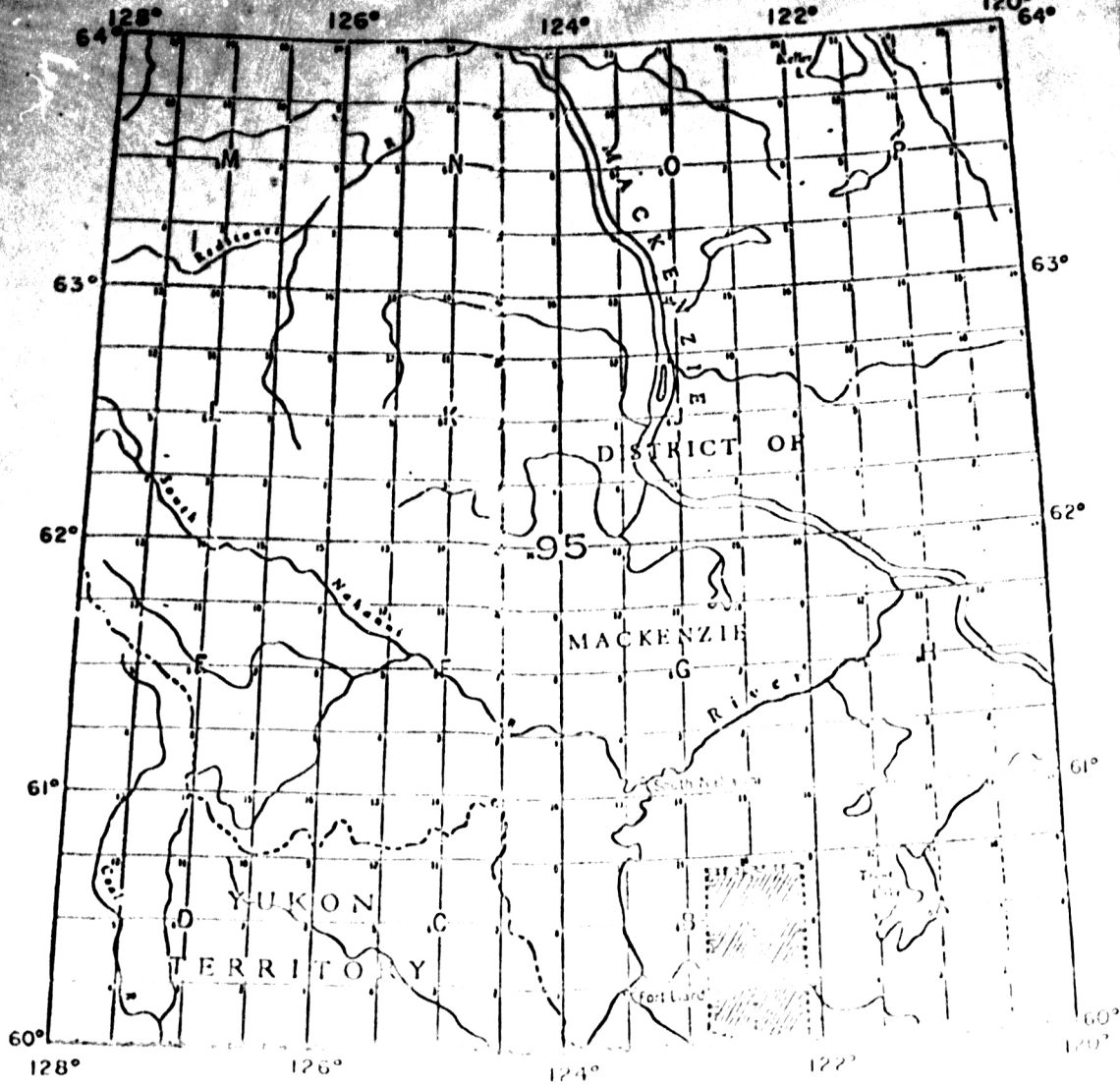
ASHLAND OIL CANADA LTD.
AEROMAGNETIC INTERPRETATION
ARROWHEAD AREA
N.W.T.
MAGNETIC BASEMENT
AQUA TERRA Consultants LTD.
Contour Interval: 200 FEET | Scale: 1 IN. = 1 MILE
Map N°: 1 | Datum: SEA LEVEL | Date: JANUARY, 1974

AEROMAGNETIC INTERPRETATION
ARROWHEAD AREA
NORTHWEST TERRITORIES

ASHLAND OIL CANADA LTD.

AQUATERRA Consultants Ltd.

Calgary, Alberta



INDEX MAP

Scale : 1 IN / 35 MI

SUMMARY

The Arrowhead aeromagnetic interpretive area is located in the Northwest Territories near Fort Liard. The interpretive area is indicated on the Index Map, but in general terms extends from Lat. 60° 00'N to Lat 60° 45'N between Long 122° 10'W and 122° 50'W. The specific part of the survey covered in this report is indicated in red on the Index Map.

The observed data are from a survey conducted by Canadian Aero Service Limited in May 1952 - May 1953 at a flight altitude of 3500 ft asl.

The interpretation is based on techniques developed by AQUITAINE & ASSOCIATES LTD. These techniques involve the use of Observed and Second Vertical Derivative Maps in conjunction with profile analysis. Available geological information is incorporated as control for the analysis. The significant contribution of this analysis is a map that is geological in nature. It is, where possible, related to a particular geological horizon.

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Geology . . . . . Page 1
Observed Map . . . . . Page 1-2
Second Vertical Derivative Map . . . . . Page 2
Magnetic Basement Map . . . . . Page 2-3
Conclusion . . . . . Page 3

Appendix 1, Data Resumé

FRONTISPIECE
(Index Map, Scale 1 in/ 35 mi)

MAPS
(1 in/1 mi, 1 Sheet, 1 in/2 mi, 1 Sheet)

Second Vertical Derivative, contour interval [illegible] gals/sq mi
Magnetic Basement, contour interval 500 ft

INTRODUCTION

The Arrowhead interpretive area is located in the District of Mackenzie, Northwest Territories. The area under investigation extends from Lat. 60° 00'N to Lat. 60° 43'N between Long 122° 10'W and 122° 50'W. See Index Map for exact boundaries. A total of approximately 1000 sq mi are analyzed to evaluate the two permits leased by Ashland Oil Canada Ltd., the boundaries of which are indicated on all interpretive maps.

The interpretation is based on data obtained from a Gulf Fluxgate magnetometer with analog recording and photo control for positioning. A summary of the survey operations and other descriptive details is given in Appendix I, Data Resumé.

Geology

The Precambrian Shield, exposed to northeast of the survey, dips gently southwestward beneath the sedimentary cover. Paleozoic and younger rocks crop out in elongated northwesterly striking bands at the southwestern end of Great Slave Lake. Rocks that crop out within the interpretive area are generally Cretaceous in age but the major waterways, the Liard and Mackenzie Rivers, cut through the Cretaceous cover to expose rocks of Devonian age.

Drill holes with rather sparse distribution to the east of the interpretive area furnish a regional picture of the Precambrian surface. The continuation of the regional southwesterly dip of that surface beneath the sediments is confirmed. That this dip is complicated by local structure is demonstrated by the Tathlina, Liard and Colville Hills Structures which are not penetrated by drilling, but their presence is well established by [illegible] rocks designated as Precambrian in age at 4228 in a area where the Precambrian would normally be expected below 6000 ft. The lateral extent of this feature is not defined by drilling.

Drill holes to the north and south of Cehbeta Lake encounter a pre-Devonian quartzite. Although Precambrian igneous material is not reached, it is in this area that the Magnetic Basement Map will be able to predict this horizon.

The IMP-SUN Area [illegible] reached the Precambrian surface at 6763 ft.

OBSERVED MAP

The Observed Map is dominated by [illegible] strikes north in the southeastern corner of the area and [illegible] 15°N changing to northwesterly at the [illegible] of contrasts of varying total [illegible] shown along with several strong [illegible] structure.

The southeastern positive is so anomalously oriented with respect to the remainder of the magnetic field that it is not difficult to believe that it is associated with the equally anomalous Celibeta High.

The northerly plunging noses of the northern flank of the central positive are large enough to be the result of mineralization changes but still in the range of possible structural origin. The analysis indicates that both cases are present in this area.

The remainder of the Observed Map to the north and in the southwestern corner is represented by large negative anomalies with small amplitude. These anomalies have a major northwesterly alignment, and a subordinate northeasterly alignment. A few weak positive anomalies are distributed throughout this area and one with northeasterly strike is located immediately north of the IMP-SUN Arrowhead M-47 Precambrian test.

SECOND VERTICAL DERIVATIVE MAP

The Second Vertical Derivative Map construction used is described in general terms in Part I of this report. The specifics are listed in Appendix I, Data Resumé. The grid spacing is selected on the basis of line spacing and magnetic basement depths. The derivative map is principally a mineralization map and is used to outline causative bodies of magnetic anomalies. The strong development of mineralization trends that coincide with predicted structural trends indicate that there is a close association between structure and mineralization. The 1 in/2 mi composite maps have areas of positive curvature shaded red and negative areas yellow. Outlines of suprabasement anomalies, fault's and intrabasement anomalies are shown [illegible] sub-sea depth estimates indicated.

The general appearance of the Second Vertical Derivative Map is the result of mineralization trends within the magnetic basement. The mineralization as reflected by the magnetic [illegible] appears to be within the normal range for this area. Some of the variations in the derivative field may be the direct result of intrabasement sources, or structure may be related to mineralization to cause an anomalous condition in the derivative field. The only reliable method of isolating structural effects from those caused by [illegible]

MAGNETIC BASEMENT MAP

On the Magnetic Basement Map are interpretive depth calculations and [illegible] information. Drill holes that reached the Precambrian are circled [illegible] is indicated. The subsea elevation of the total depth is indicated for [illegible] no Precambrian tops available and the last formation [illegible] addition, suprabasement anomalies, intrabasement anomalies [illegible] expression in gammas is located. [illegible] thickness or relief in feet of the [illegible] the depth of burial [illegible] equivalent to 500 feet of relief at a depth of 6000 feet below sea.

The Magnetic Basement Map is believed to be equivalent to the Precambrian surface and is contoured at 200 ft interval. The detail in the contour configuration is guided to a large degree by the derivative trends and the suprabasement outlines. Nosing and closure on the magnetic basement surface are particularly indicated by the presence of plate or fault outlines since these positive magnetic features are believed to offer the best possibilities of having local relief.

The magnetic basement expression of northerly strike of the Celibeta High is located in the southeastern corner of the map. Another plunging magnetic basement high intersects the north end of the Celibeta structure and dips from above -6200 ft to below -8000 ft in the west.

Regional strike is observed west of the Celibeta structure and, except for two thin suprabasement plates, dip is relatively uniform until a reversal is encountered near the western boundary of the map.

The north half of the interpretive map develops a strong northeasterly trend with indications of a northwesterly trend present. Only the IMP-SUN Arrowhead M 47 well reached the Precambrian surface.

The magnetic basement surface dips from above -5400 ft in the northeastern part to below -10,000 ft in the southwest.

CONCLUSION

The results of this interpretation are presented in the form of a Second Vertical Derivative Map and Magnetic Basement Map. The latter is derived from profile analysis and is equivalent to a map of the Precambrian surface.

The analysis of the aeromagnetic data is believed to successfully depict the regional Precambrian attitude of the region. Future exploration activity should define and correlate further to the complexities presented on this analysis.

AQUA-TERRA Consultants Ltd.

D. C. Burr
Oil and Gas Exploratory License No. 2076

B. E. MacLaren

APPENDIX 1
Data Resumé

NAME OF SURVEY	Arrowhead
AREA	Northwest Territories
CONTRACTOR	Canadian Aero Service Limited
FLYING	
INITIATION	May 1952
COMPLETION	May 1953
SURVEY MILEAGE	
SQUARE	1090
LOCATION SYSTEM	Photographic
FLIGHT DIRECTION	East-West
FLIGHT ALTITUDE	3500 ft asl
TRAVERSE INTERVAL	1 mile x 6 miles
MAGNETOMETER	Gulf Fluxgate

ORIGINAL RECORDING

	Type	Vertical Scale	Horizontal Scale	Quality
ANALOG	Rectilinear	60γ/in	0.75 - 1.0 miles/in	Poor Fair

PRINCIPAL FACTS OF EARTH'S NORMAL FIELD

INCLINATION	79°
DECLINATION	34°E
INTENSITY	59,850 gammas

OBSERVED MAP

BASE	Canada Department of Mines and Technical Surveys
SCALE	1 inch/1 mile
NUMBER OF SHEETS	2
CONTOUR INTERVAL	25 gammas

SECOND VERTICAL DERIVATIVE MAP

BASE	Latitude-Longitude	
SCALE	1 in/1 mi	1 in/2 mi
NUMBER OF SHEETS	1	1
CONTOUR INTERVAL	1 and 2 x 10^{-9} cgs	
GRID SPACING	2 ring, 2 mi computed every mile	

FORMULA

2 mi grid $\frac{\partial^2 T}{\partial Z^2} = 0.57886\ T_0 - 0.19295\ (T_{11} + \ldots T_{14}) + 0.01824\ (T_{21} + \ldots T_{24})$

MAGNETIC BASEMENT MAP

BASE	Latitude-Longitude	
SCALE	1 in/1 mi	1 in/2 mi
NUMBER OF SHEETS	1	1
CONTOUR INTERVAL	200 ft.	

REPORTS

FINAL	January 1974