INTERPRETATION OF AEROMAGNETIC SURVEY

BLOCK III, NORTHWEST TERRITORIES, CANADA

FOR

AEROMAGNETIC SURVEYS LIMITED

November 7, 1953

Gravity Meter Exploration Company

Houston, Texas

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Maps

Observed Aeromagnetic Maps, with local anomalies superimposed, Sheets NW,NE,SW,SE, scale 1 in= 1 mi, observed data contoured at interval of 10 gamma, residual anomalies contoured at interval of 10 gamma.

Second Vertical Derivative Maps, with outlines of local areas of interest superimposed, Sheets NW, NE, SW, SE, scale 1 in = 1 mi, contour interval 5×10^{-15} cgs.

Structural Contour Map on the Basement Surface, with structural basement contours (interval 1,000 ft, datum sea level), individual magnetic depth estimates, and local areas of interest superimposed on a composite of the four magnetic maps, scale 1 in = 3 mi.

In general the entire area of this survey suffers from the small thickness of sediments. If an average ground level of 500 ft above sea level is assumed, the sedimentary thickness will vary from approximately 1,000 ft to 3,500 ft. All other aspects of the anomalies being equal, the good anomalies have been selected with the thickness of sedimentary section in mind and the anomalies in areas of thicker sediments have been graded higher. Anomalies 60, 72, and 82 are each estimated to have a sedimentary thickness of approximately 3,000 ft, and each anomaly is graded good.

INTRODUCTION

The interpretation of the aeromagnetic data attempts to resolve the observed magnetic anomalies into two categories, intrabasement and suprabasement anomalies. The intrabasement anomalies are those, which, because of their large areal size and large amplitude, must originate from magnetization contrasts within the basement (i.e. igneous or metamorphic) rocks. The large magnetization contrasts are assumed to originate at the basement surface and to extend infinitely downward with vertical sides. With these assumptions, estimates of the depths to the tops of these anomalously magnetized bodies may be made or, conversely, the thickness of the sedimentary section may be estimated.

After these large features are resolved and are employed for the determination of the sedimentary thickness, residual anomalies remain which may be placed in other categories. The category of principal interest is the suprabasement type, anomalies which are of such shape and amplitude that they can be assumed to be caused by vertically thin sheets of magnetised rock, for example from relief of the basement surface. Another group of anomalies include disturbances from the ground surface. These produce sharp and erratic anomalies which are easily separable from those related to basement rocks. The analysis is based on the study of the observed data, both the observed maps and the flight profiles, together with the second vertical derivative maps.

The second vertical derivative approximates the coverage of the observed magnetic field, and areas shaded red on the derivative map are areas of positive curvature, those shaded yellow, of negative curvature. All observed anomalies have curvature or derivative anomalies and, in general, the large derivative anomalies, large in area and in amplitude, are the derivative anomalies of the large observed, or intrabasement anomalies. Also, in a general way, the small and sharp derivative features are anomalies which are not intrabasement in origin and which, therefore, may be indicative of local basement relief, surface disturbances, and sundry causes.

Therefore, the derivative map assists in the resolution of the intrabasement and suprabasement features although it is at the same time affected by any other anomalies that may be present.

THE OBSERVED AEROMAGNETIC MAPS (Sheets NW, NE, SW, and SE):

The observed magnetic data of the four sheets are characterized by having anomalies of high amplitude over the eastern two-thirds of the northeastern sheet and over the eastern half of the southeastern sheet. The remaining area, or the western area, is on the other hand characterized by having local anomalies almost over the entire area and these are oriented northwesterly for the most part. All of the anomalies of the survey that are on the observed data are considered to be caused by polarization contrasts within the basement rocks. The fact that the eastern portion of the area is more highly anomalous is considered to result from the fact that the basement in this area is relatively more shallow, being generally higher than 1,000 ft below sea level whereas the remainder of the survey is between 2,000 and 3,000 ft below sea level. The 85 residual magnetic features are superimposed on the observed magnetic maps and are discussed in the last section of this report.

THE SECOND VERTICAL DERIVATIVE AEROMAGNETIC MAPS (Sheets NW, NE, SW, and SE):

These maps, colored red and yellow, are prepared by a gird calculation for the second vertical derivative. The derivative approximates the curvature of an anomaly so derivative maxima generally coincide with observed maxima. Also the zero derivative occurs approximately over the edge of the actual magnetic disturbance. Therefore, the red areas, are in a general way, superimposed over basement rock that contain more ferromagnetic minerals than the adjacent rocks and therefore are more highly polarized by the earth's normal magnetic field. These rock units are the main source of magnetic anomalies and the derivative maps delineate these disturbances much more clearly than the observed maps.

A northwestern orientation of almost all of the intrabasement rock units is very conspicuous on the derivative maps. This banding creates a so-called "grain" of the basement. This grain is not of necessity structural in origin but must be derived from petrographic variations of the base rock which may have responded to structural deform-

ation.

The outlines of possible local basement disturbances have been reproduced on the derivative maps. These outlines indicate the presence of local anomalies of such shape that they could be caused by local relief of the basement surface. Often these residual anomalies coincide with derivative anomalies indicating that intrabasement rock units have corresponding structural relief. For example, see residual anomaly 68 F on Sheet SE. In other cases the residual feature transects the intrabasement feature as, for example, the northern portion of anomaly 56P on Sheet NE.

It should be emphasized that the spacing of the grid used in the calculation of the derivative was selected to emphasize the intrabasement anomalies rather than the suprabasement or structural type which are the residual anomalies. It was considered more important to delineate the intrabasment features for the purpose of developing an accurate basement structural contour map. It follows, therefore, that the basement map must be considered the most important result of this analysis.

THE STRUCTURAL CONTOUR MAP ON THE BASEMENT SURFACE

The four sheets of the aeromagnetic data were joined together to form the base map for the basement map. This composite map is at scale 1 in = 3 mi.

The individual magnetic depth estimates are shown on this map, graded good, fair, and poor with three, two and one underlines respectively. A fourth category is that group with the suffix "S" which means that the estimates were made on residual anomalies, that is on a suprabasement rather than an intrabasement anomaly.

The estimates were computed without regard to any other geophysical or geological data, and they have been contoured without consideration of any other data. The contours, at interval 1,000 ft show that the major portion of the survey is generally between -2,000 and -3,000 ft. The basement steepens quite rapidly from this general level in Sheet NE where the highly anomalous observed aeromagnetic data seem to occur over areas where the basement is between 0 and -1,000 ft.

The entire area is considered to be at a disadvantage because of a relatively thin sedimentary thickness. Therefore the synclinal axes on Sheets NW ans SW and on the western portions of Sheets NE and SE should receive particular attention. Two such axes are conspicuous, and the flanks of these lows are considered the best prospective areas of the survey. The first synclinal axis is oriented north-south and occurs along the eastern boundary of Sheet SW. The second axis is oriented more nearly east-west and occurs in the southeastern area of Sheet SE.

THE RESIDUAL MAGNETIC ANOMALIES (Sheets NW, NE, SW, and SE):

The residual magnetic anomalies are superimposed on the observed magnetic data and are contoured at an interval of 10 gamma. In addition to the contours, the periphery of the corresponding area of interest is shown. This area of interest is the area of basement uplift that could conceivably cause the associated residual anomaly. In some cases this perphery is simply a fault trace. The anomalies are graded G, F, and P, for good, fair and poor.

The analysis attempts to place every magnetic anomaly that has been resolved into its proper category. If an anomaly is considered to be intrabasement it served as a basis for estimating the basement depth. Other anomalies may be in the suprabasement category, and therefore, are possibly indicative of basement structure. Of course the suprabasement type of anomaly can be caused by sheets of magnetic material within the basement as well as on the surface of the basement. Therefore, the suprabasement, or the residual anomaly, does not mean that basement structure necessarily is present. Furthermore, if the basement structure is the result of the peneplanation of the Pre-Cambrian and is actually not structure but simply erosional relief of that surface, it is quite conceivable that the sedimentary section will not have any corresponding structure within it. Therefore, further effort must be made through geophysical and geological studies to select residual anomalies that are most likely to originate from basement structure and to have superimposed sedimentary structure.

The grading of the anomalies is a step in this selective process. The anomalies can be graded on the basis of their magnetic dependability but those that are highly graded are believed to have some geologic merit as well as good magnetic dependability. With no other information available, the geologic merit emanates from considerations of the thickness of the sedimentary section. In this area a thicker sedimentary value is considered to be advantageous.

Table I below gives the pertinent facts about each anomaly, anticipating that these facts may be used for the future employment of the anomaly. The characteristic, "derivative correspondence", is indicative of the degree of correlation between intrabasement and suprabasement features. Geologically speaking this is an evaluation of the degree of correspondence between possible basement relief and underlying basement segregations of more highly polarized magnetic rock units. It would seem likely that the great degree of correlation between the derivative and residual features suggests that the basement relief is a product of erosion rather than of structural deformation.

Table I, Residual Anomalies

No."	Location (Sheet)	Amplitude (Gamma)	Orientation	Derivative Correspondence"	Basement Depth(ft)""
1F	NW	40	NNW	G	-2400
2P	NW	20	NW	G	-2400
3G	NW	30	NE	G	-1000
4P	NW	20	NNW	G	-2400
5P	NW	20	NE	G	-2000
6F	NW-SW	50	NW	G	-1800
7F	NW	30	NW	G	-1000
8F	NW	20	NW	F	-600
9F	NW	20	NW	P	-1700
10P	NW	25	NW	F	-1000
11F	NW	30	N-S	G	-1500
12P	NW	30	None	F	-1500
13F	NW	20	NW	G	-1500
14P	NW	20	NW	G	-2000
15F	NW	20	NE	P	-2500
16F	NW	20	NW	F	-1400
17P	NW	50	NW	P	-1300
18F	NW	20	NW	G	-800
19G	NW	10	NW	F	-2500
20F	NW	30	NW	F	-1500
21G	NW-NE	40	NW	F	-1700
22P	NE	20	N-S	P	-800
23F	NW-NE	30	NW	F	-1800
24F	NE	40	NW	G	-1100
25G	NE	50	NE	G	-1700
26P	NE	75	NW	F	-1400
27P	NE	55	NW	G	-1700
28F	NE	20	NE	G	-1100
29P	NE	10	NW	F	-1500
30P	NE	40	NNW	P	-1000
31P	NE	80	NW	F	-400
32P	NE	20	NW	G	-800
33P	NE	20	NNW	P	-1200
34P	NE	40	NW	F	-500
35F	NE	40	NNW	-	-2100
36P	NE-SE	40	N-S	P	-900
37P	NE	30	NW	-	-1700
38P	NE-SE	50	NNW	F	-500
39P	SE	40	N-S	=	-900
40G	NE-SE	30	NNE	F	-1500
41F	NE-SE	20	NNE	F	-1100
42F	NW-SW	20	NW	G	-1900
43F	SW	20	NNW	P	-2700
44G	SW	40	NW	G	-1600
45F	NW-SW	10	NW	F	-2500

"G= Good, F= Fair, P=Poor

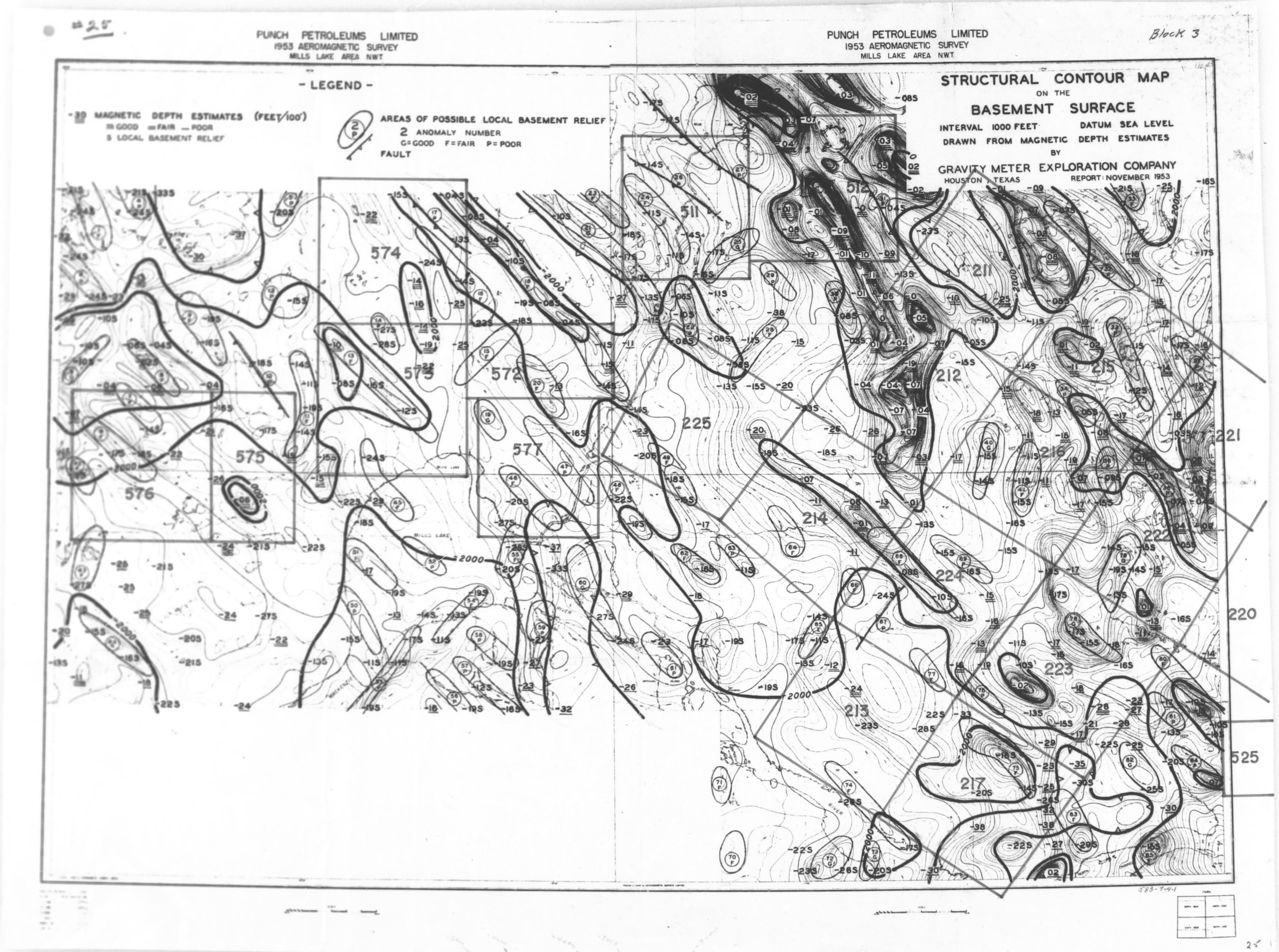
"" From Basement Structural Contour Map.

No.*	Location (Sheet)	Amplitude (Gauss)	Orientation	Derivative Correspondence*	Basement Depth (ft)**
46P	NW-SW	20	NW	P	-2000
47P	NW-SW	20	NW	P	-2200
48P	NW-SW-NE-SE	30	NW	G	-2200
49P	NE-SE	20	NW	G	-1500
50P	SW	20	NW	F	-1500
51P	SW	20	NW	G	-1700
52P	SW	10	NW	G	-2000
53P	SW	20	NW	G	-1100
54P	SW	20	NW	P	-1700
55P	SW	40	NNE	G	-2000
56P	SW	20	NW	-	-1900
57P	SW	20	NW	F	-1400
58P	SW	30	NW	P	-1900
59P	SW	20	NW	G	-2700
60P	SW-SE	30	NW	G	-2700
61P	SE	10	NW	G	-2500
62P	SE	20	NW	G	-1600
63P	SE	20	NW	F	-1100
64P	SE	20	NNW	G	-1100
65P	SE	20	NW	G	-1400
66P	SE	10	NW	G	-2000
67P	SE	30	NW	G	-2400
68P	SE	20	NW	G	-800
69P	SE	20	NW	G	-1600
70P	SE	20	NW	G	-2500
71P	SE	20	NW	G	-2500
72P	SE	30	NW	G	-2500
73P	SE	10	NW	P	-2000
74P	SE	30	NW	G	-2500
75P	SE	40	NW	G	-1000
76P	SE	10	NW	F	-1600
77P	SE	10	NW	P	-2200
78P	SE	40	NW	G	-200
79P	SE	60	NW	G	-1400
80P	SE	30	NW	P	-1000
81P	SE	20	NW	P	-1700
82P	SE	20	NW	G	-2500
83P	SE	40	NW	F	-3000
84P	SE	30	NW	P	-1000
85P	SE	60	NW	G	-1500

Total 12 good
30 fair
35 poor

GRAVITY METER EXPLORATION COMPANY

(Signed) Nelson C. Steenland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PUNCH PETROLEUMS LIMITED
1953 AEROMAGNETIC SURVEY
MILLS LAKE AREA NWT
- LEGEND -
-30 MAGNETIC DEPTH ESTIMATES (FEET/100')
GOOD FAIR POOR
S LOCAL BASEMENT RELIEF
AREAS OF POSSIBLE LOCAL BASEMENT RELIEF
2 ANOMALY NUMBER
G=GOOD F=FAIR P=POOR
FAULT
PUNCH PETROLEUMS LIMITED
1953 AEROMAGNETIC SURVEY
MILLS LAKE AREA NWT
Block 3
STRUCTURAL CONTOUR MAP
ON THE
BASEMENT SURFACE
INTERVAL 1000 FEET
DATUM SEA LEVEL
DRAWN FROM MAGNETIC DEPTH ESTIMATES
BY
GRAVITY METER EXPLORATION COMPANY
HOUSTON, TEXAS
REPORT: NOVEMBER 1953
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STRATIGRAPHIC SECTION NO. 1

COMPOSITE, BEAVER RIVER

TO ACCOMPANY REPORT FOR HARRY H. LIFSIG

D. BRUCE BULLOCK & ASSOCIATES LTD

AGE	ROCK UNIT	LITHOLOGY	DESCRIPTION
DEVONIAN & MISSISSIPPIAN			dark, calcareous shale
DEVONIAN	COARSE DOLOMITE UNIT	0	
		100	medium to coarse crystalline, crinoidal, thick bedded to massive, buff weathering
		200	Good porosity.
		300	
		400	fine to coarse crystalline, crinoidal, thick bedded, grey weathering
		500	Good porosity
		600	
		700	
		800	
		900	fine to medium grained, in part fossil-fragmental, laminated to massive, grey to tan weathering
		1000	Poor porosity.
		1100	
	MIDDLE	1200	crypto to fine, rare medium crystalline, algal textures and lamination, light grey to tan weathering
		1300	Poor porosity.
		1400	
		1500	crypto-crystalline, laminated, well bedded, some algal texture, light grey to tan weathering
		1600	
		1700	
		1800	
		1900	
		2000	crypto-crystalline, regular bedding, light grey weathering
		2100	
		2200	
		2300	
		2400	

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