

GRAVITY METER EXPLORATION COMPANY

1321 ESPERSON BUILDING
HOUSTON 2, TEXAS

CABLE: TORBALEX

PHONE CAPITOL 9018

REPORT NO. I

INTERPRETATION OF AEROMAGNETIC SURVEY

OF

BLOCK I, NORTHWEST TERRITORIES, CANADA

FOR

**AEROMAGNETIC SURVEYS, LIMITED
AND ASSOCIATES**

FEBRUARY 26, 1953

SUMMARY

Report No. I covers the interpretation of the aeromagnetic survey of that portion of Block I, Northwest Territories, included within longitudes $123^{\circ}00'W$ - $123^{\circ}40'W$ and latitudes $60^{\circ}00'N$ - $61^{\circ}40'N$. This is the western column of maps, namely, Sheets 1 through 4. The entire survey comprises sixteen individual sheets.

The interpretation provides a structural map of the basement surface which shows the regional configuration of this surface, contoured at an interval of 2,000 ft. from estimates of the sedimentary thickness calculated from the magnetic data. The configuration shown on the basement map is preliminary as it is dependent on additional estimates which will be made on the remaining twelve sheets. The preliminary configuration shows the basement to be at a general level of approximately -12,000 ft., subsea, or that the sediments are generally about 16,000 ft. thick.

Two conspicuous features of the basement surface are the postulated synclinal axis of the basin developed mainly from the estimates made along the southern edge of the map, and, secondly, a prominent eastward nosing of the basement in the vicinity of the large magnetic anomaly which dominates the observed magnetic map.

Sixteen local areas of interest, indicating basement relief, are also shown. These are developed from a study of the observed data themselves, both profiles and maps, together with a second vertical derivative map which was prepared for the entire area. Four of the local features are graded "good," six, "fair," and six, "poor." Two of the good local anomalies are on the large observed anomaly, and two are located on a rather prominent nosing in the extreme northern portion of the area.

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MAPS

✓ Observed Aeromagnetic Map, with local anomalies superimposed, Sheets 1 through 4, scale 1" = 1 mi.; observed data contoured at an interval of 10 gammas; residual anomalies contoured at an interval of 5 gammas.

✓ Second Vertical Derivative Aeromagnetic Map, with outlines of local areas of interest superimposed, Sheets 1 through 4, scale 1" = 1 mi., contour interval 2×10^{-15} cgs.

not included
Structural Contour Map on the Basement Surface (preliminary), with structural basement contours (interval, 2,000 ft.; datum, sea level), individual magnetic depth estimates, and local areas of interest superimposed on a composite of the sixteen observed magnetic maps; scale 1" = 3 mi.

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 large magnetization contrasts within the basement (i.e., igneous or metamorphic) rocks. These 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 arise from vertically thin sheets of magnetized rock, for example, from relief of the basement surface. Another group include disturbances from the ground surface, which in this area are assumed to arise from the erratic distribution of glacial materials. This produces 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 a second vertical derivative map. The second vertical derivative approximates the curvature of the observed magnetic field, and areas shaded red on the derivative map are areas of positive

curvature, those shaded yellow are areas 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 other 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 1 through 4):

The observed magnetic data over the area of Sheets 1 through 4 is dominated by one large anomaly at the junction of Sheets 3 and 4, together with a very conspicuous southwestward nosing from this large anomaly. The remainder of the area is very flat, indicating that the basement is relatively devoid of magnetization contrasts thereby making it very difficult to estimate the sedimentary thickness over much of the area.

The sixteen residual magnetic features are superimposed on the observed magnetic maps and these will be discussed in a later section.

THE SECOND VERTICAL DERIVATIVE AEROMAGNETIC MAP (Sheets 1 through 4):

This map is likewise dominated by a large derivative anomaly over the large observed magnetic anomaly. In a general way, the zero value of this derivative anomaly approximates the area on the basement surface which will be under-

lain by a more highly magnetized suite of rocks than the surrounding areas. This large anomaly has a prominent nosing to the northwest, indicating that an extension of this intrabasement rock unit lies in that direction. The remainder of the map is an erratic pattern of positive and negative values, and no significant pattern is developed. This random distribution of derivative values is occasioned by two things; first, there are no large magnetization contrasts within the basement over much of the area, and, secondly, there are many sharp and local disturbances of the observed magnetic data from the ground surface. Nevertheless, the derivative, in addition to separating the intrabasement features that are present, has, in some cases, supported the suprabasement anomalies developed by the residual analysis.

The outlines of the areas of interest of the suprabasement anomalies are superimposed on the derivative map, and the correlation of the derivative values with the residual anomalies will be discussed in the section on residual anomalies.

THE STRUCTURAL CONTOUR MAP ON THE BASEMENT SURFACE:

The sixteen sheets of the observed aeromagnetic data were joined together to form the base map for the Structural Contour Map on the Basement Surface. The individual sheets, scale $1'' = 1$ mi., were reduced to $1'' = 3$ mi., to form the composite map.

This composite map is the most useful map resulting from the interpretation. It has collated on it all the significant results, including (1) the individual estimates of the depth to the basement surface, shown in hundreds of feet below sea level, together with the configuration of the basement surface, contoured at an interval of 2,000 ft. from the magnetic depth estimates, and (2) the outlines of

the local areas of interest which are included so that they may be reviewed in light of the basement contours and the observed magnetic data.

This map will be revised with each succeeding report as additional magnetic depth estimates and local anomalies are placed on the eastern sheets. The present preliminary configuration of the basement surface is based on only twenty-two magnetic depth estimates, almost too few in number to be contoured. However, as the data on which the contouring is based are shown, the reliability of the contouring can be evaluated.

The most significant feature of the basement surface is the synclinal axis shown in the southeastern corner of Sheet 4 and continuing, with much less control, into the northeastern corner of Sheet 3. The presence of this axis is dependent almost entirely on the series of depth estimates on the southern boundary of Sheet 4.

The second conspicuous feature is the prominent eastward nosing postulated over the general western portion of the large observed anomaly. The conspicuous southwestward nosing from the large anomaly may be related to this regional nose.

Note that the individual depth estimates are graded with three underscores indicating a good depth estimate; two lines, fair; and one line, poor. In addition, there is a fourth category, that is, those estimates which are followed by the letter "S." "S" indicates that the estimate was made on a suprabasement anomaly and, therefore, is the least reliable depth estimate. This is because the suprabasement anomalies are difficult to resolve and because the coefficients used for the computation of the depth estimates from suprabasement anomalies are relatively untested.

THE RESIDUAL MAGNETIC ANOMALIES (Sheets 1 through 4):

The residual magnetic anomalies are superimposed on the observed magnetic data and contoured at an interval of 5 gammas. In addition to the contours, the outline of the related area of interest is shown. This outline is the periphery of the postulated basement relief that could cause the anomaly. Again, the anomalies are graded "G," "F," and "P" for "Good," "Fair," and "Poor." The outlines of the local areas of interest are also shown on the Second Vertical Derivative Aeromagnetic Map and the following table contains comments on each of the anomalies after consideration of their residual and derivative appearances.

TABLE I
Residual Anomalies

<u>Number*</u>	<u>Location</u>	<u>Remarks</u>
1-P	Sheet 4	The anomaly has a relief of approximately 20 gammas and is of such shape that it could be caused by displacement of the basement surface along the trace shown on the map, down-thrown to the north. However, this interpretation is considered unlikely and the anomaly is graded poor because the faulting is disharmonious with the regional basement contours and the presence of residual feature 2-F to the north.
2-F	Sheet 4	The residual and derivative indication of the anomaly are not consistently developed throughout the area of the anomaly, nor are they very strong. However, the anomaly lies in an interesting position relative to the regional basement contours and to the observed magnetic data. Therefore, it is upgraded to fair from an otherwise poor anomaly.
3-G	Sheet 4	The anomaly is consistently expressed on the observed data and is corroborated by an erratic southeastern nosing on the derivative map. It is graded

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

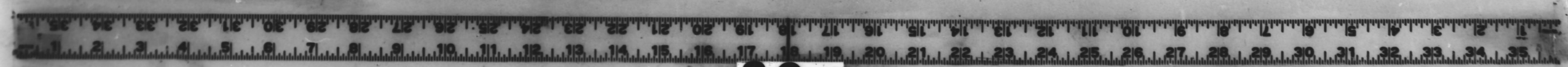
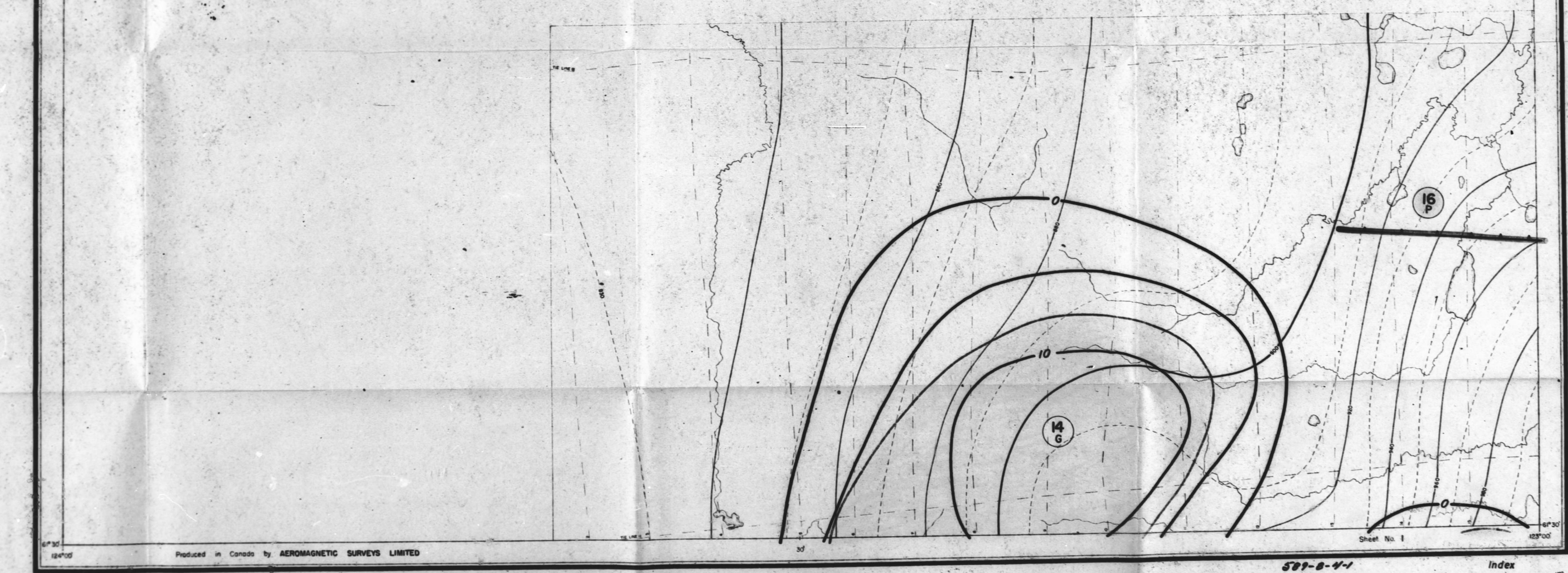
<u>Number</u>	<u>Location</u>	<u>Remarks</u>
		good also because of its northwesterly orientation and because of its position on the large observed magnetic feature.
4-F	Sheet 4	This is another nosing from the large magnetic anomaly as can be most easily seen on the derivative map. The anomaly is too small to be graded good, and is really one of the poorer of the fair anomalies.
5-G	Sheet 3	Again, this is a nosing from the large observed magnetic anomaly to the northwest, which is very apparent on the derivative map.
6-P	Sheet 3	There is no confirmation of this feature on the derivative map.
7-F	Sheet 3	The anomaly is entirely dependent on the observed data where it is very conspicuous as a residual feature. However, it is on the extreme edge of the survey and must be downgraded to fair.
8-P	Sheet 3	The derivative map shows this feature to be the eastern high on a large northwestern positive nosing from a large derivative anomaly. The feature is graded poor because, as it is drawn, it is too narrow to come from the basement at a depth of -12,000 ft. It may be that the outline of the area of interest should be extended westward to include the positive derivative feature shown between 7-F and 8-P. This would mean that the entire derivative anomaly, which is the northwestern nosing, is caused by a suprabasement effect. This is not probable.
9-F	Sheet 3	A very conspicuous residual feature continues over one-half of the northern part of Sheet 3 but is too flat to be shown consistently as a derivative feature. The anomaly is considered fair because the east-west orientation is not considered advantageous from a structural standpoint.
10-F	Sheet 3	This is more or less a continuation of 9-F, and the separation of the two is not dependable.

<u>Number</u>	<u>Location</u>	<u>Remarks</u>
11-F	Sheet 2	The anomaly has excellent indications, both as a residual and derivative anomaly, but it is on the eastern boundary of this report. If it is corroborated by the analysis to the east, it will probably be upgraded to good.
12-P	Sheet 2	This is an areally large anomaly, but of low and inconsistent amplitude. The derivative does not confirm the anomaly. It is probably the poorest anomaly that has been selected.
13-G	Sheet 2	This is the best of the anomalies in the northern portion of the survey where a rather prominent westward nosing on the observed contours is accentuated by the derivative calculation. An estimate of the basement depth is made on the northern flank of this anomaly and shows that the sedimentary thickness is approximately 16,000 ft.
14-G	Sheets 1 and 2	The derivative confirms the residual resolution with an erratic, positive anomaly. The feature is broad and not consistently evident on the data throughout its area. It is not considered as good as 13-G, for example.
15-P	Sheet 2	The anomaly has an excellent derivative confirmation in its extreme western portion, but it will have to be corroborated by the analysis to the east before it can be upgraded to a more dependable anomaly.
16-P	Sheet 1	The residual anomaly could be caused by displacement of the basement, down-dropped to the north, as shown. However, it cuts across its corresponding derivative anomaly. Furthermore, its usefulness, from a structural standpoint, is remote.

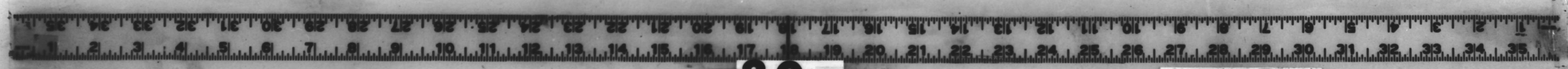
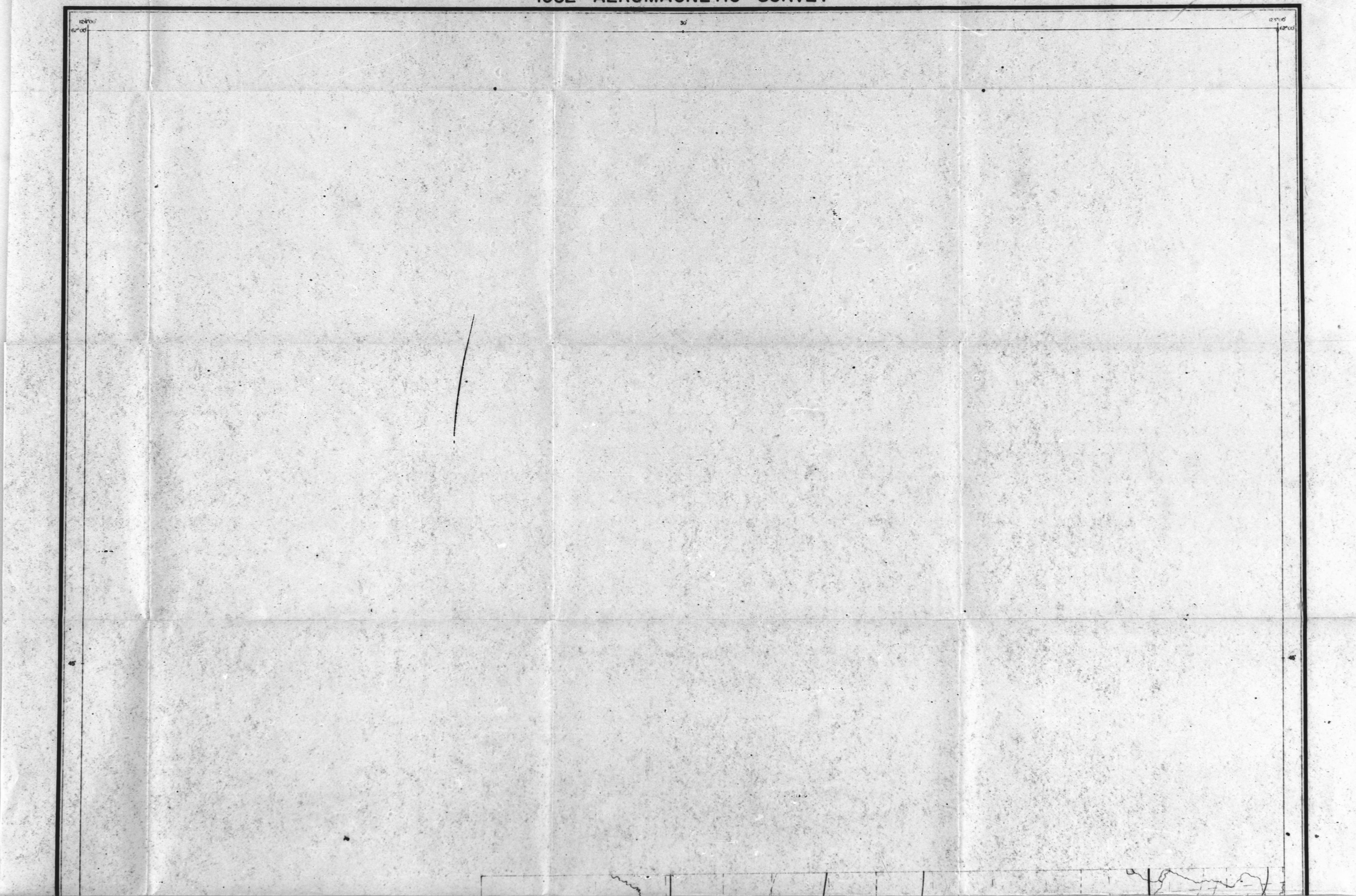
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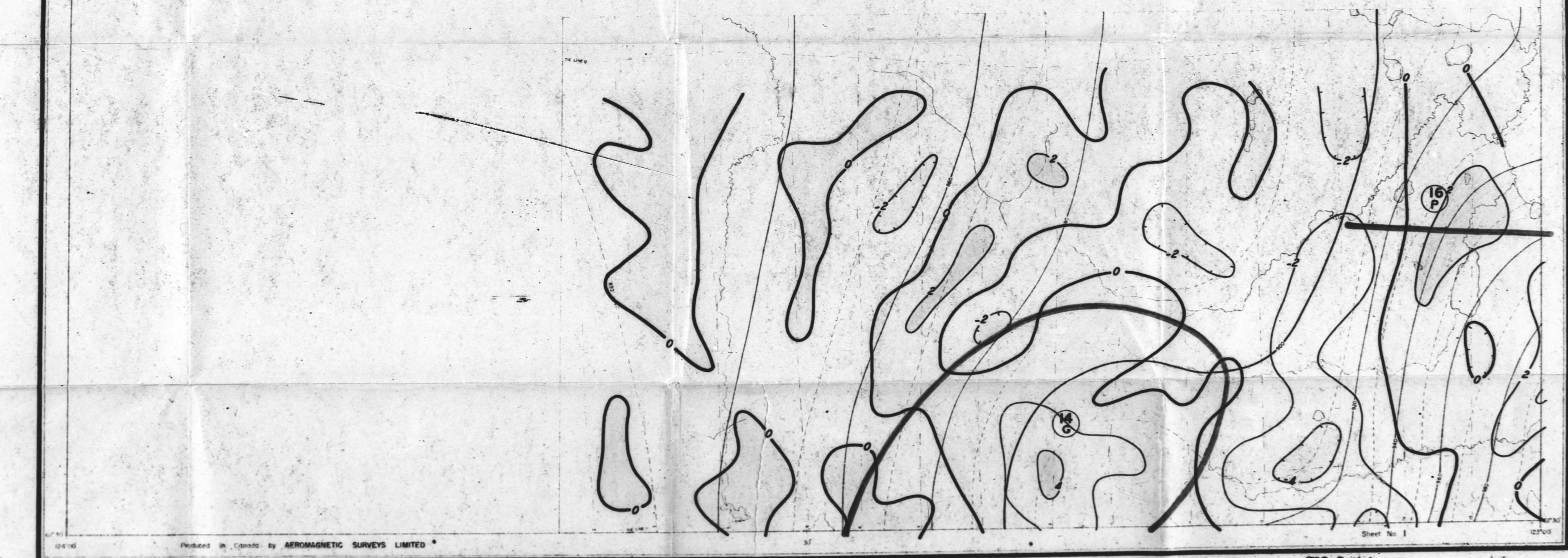
By: _____

Nelson C. Steenland



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1952 AEROMAGNETIC SURVEY





NEW FLIGHT LINE SPACING 15 MILES
ALTITUDE 5000 FT ABOVE SEA LEVEL
THE CLOUD LIMIT
1000' ABOVE GROUND
2000' ABOVE GROUND
3000' ABOVE GROUND
4000' ABOVE GROUND
5000' ABOVE GROUND

SCALE
1 INCH = 1 MILE

SECOND VERTICAL DERIVATIVE MAP
CONTOUR INTERVAL 2×10^{-5} CGS

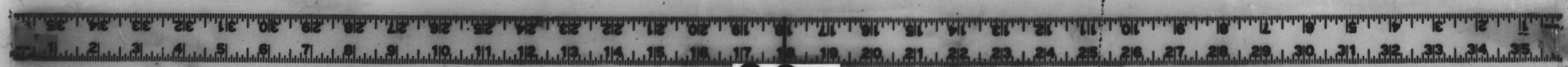
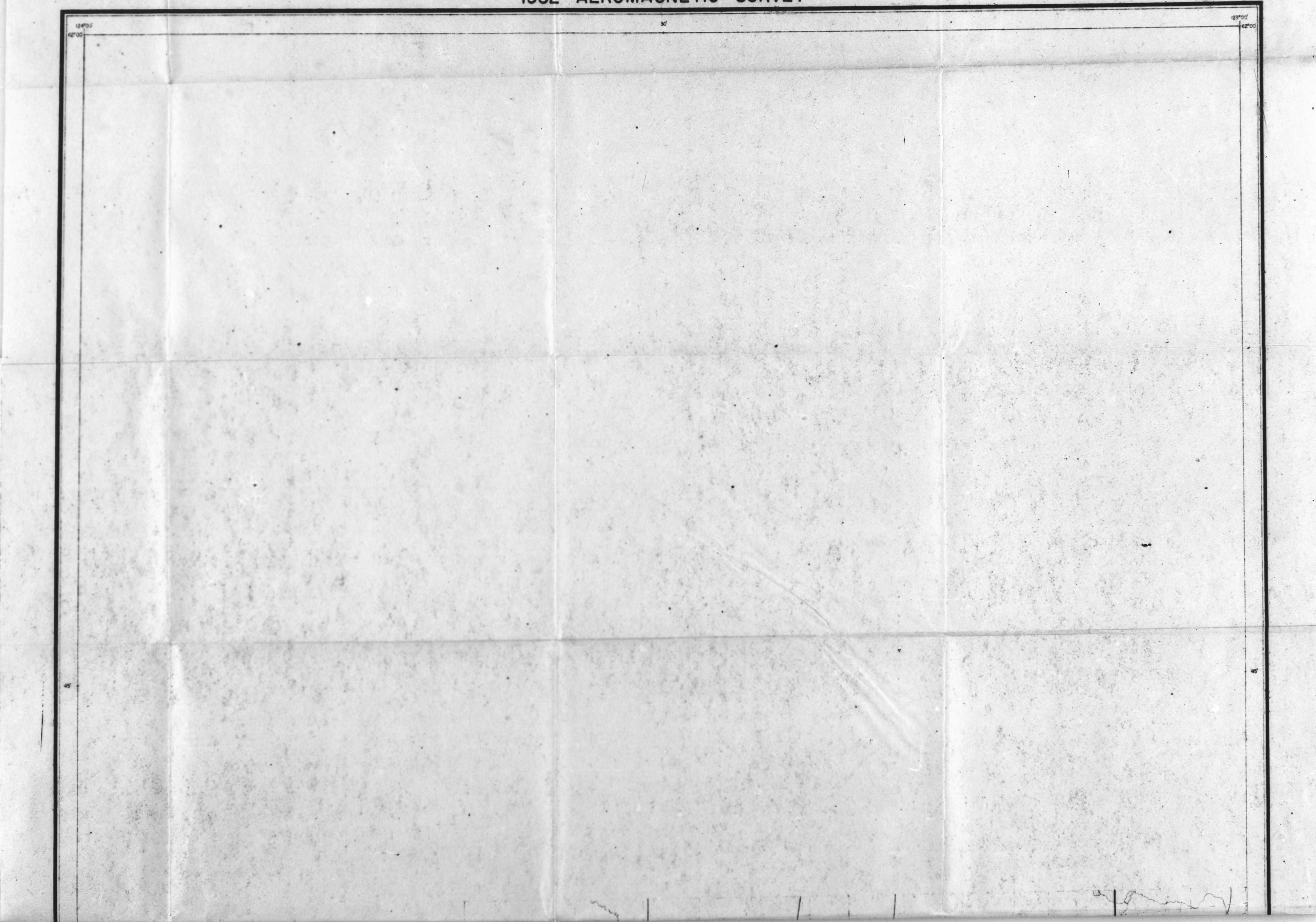
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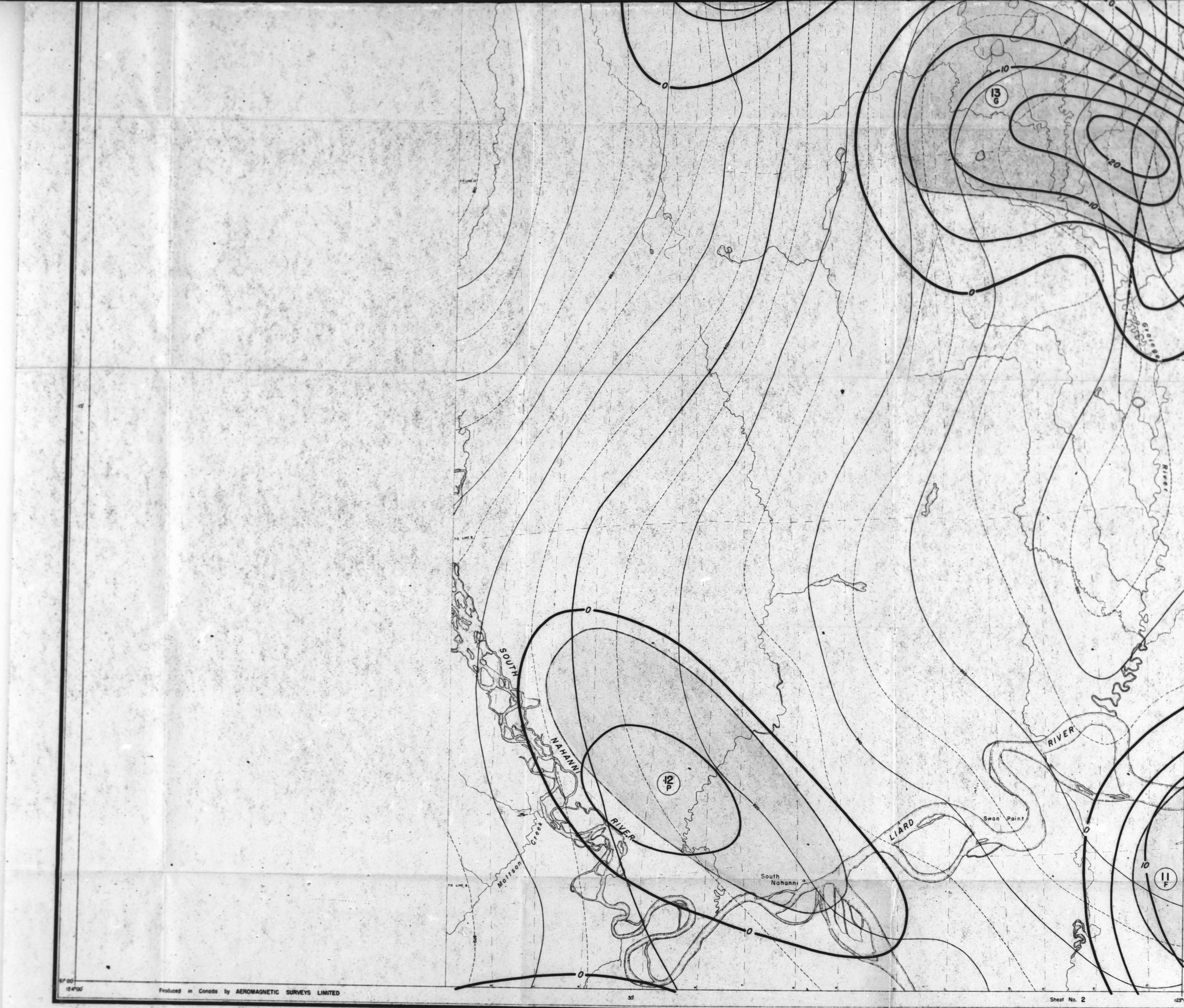
1	2	3	4
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4	5	6	7

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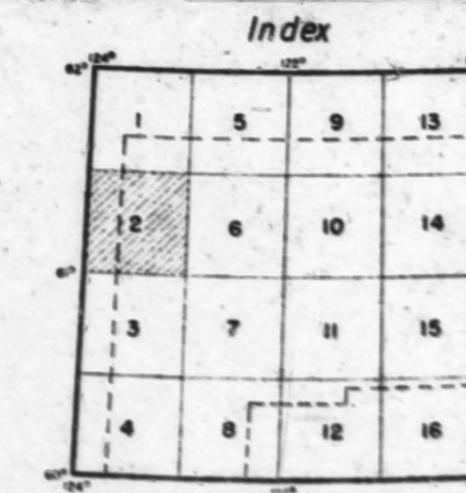
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Sheet No. 2

MEAN FLIGHT LINE SPACING 1/2 MILES
 ALTITUDE 5500 FEET ABOVE SEA LEVEL
 500 GAMMA CONTOUR 
 400 GAMMA CONTOUR 
 300 GAMMA CONTOUR 
 200 GAMMA CONTOUR 
 100 GAMMA CONTOUR 
 MAGNETIC LOW 
 FLIGHT LINES 

SCALE
0 1 2 3 4
MILES
1 inch to 1 mile

RESIDUAL MAGNETIC ANOMALIES
CONTOUR INTERVAL 5 GAMMAS
LOCAL AREA OF INTEREST
FAULT
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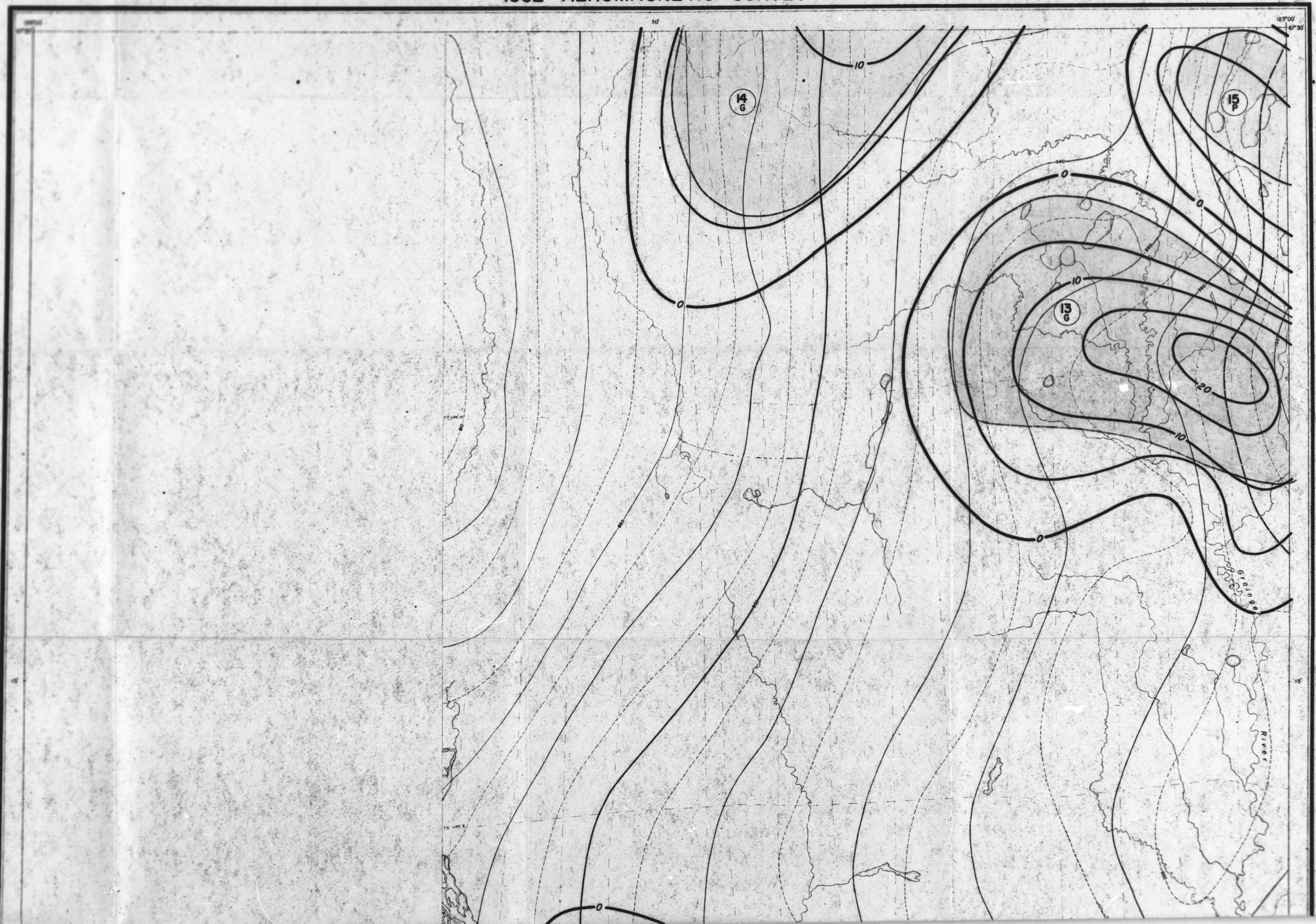


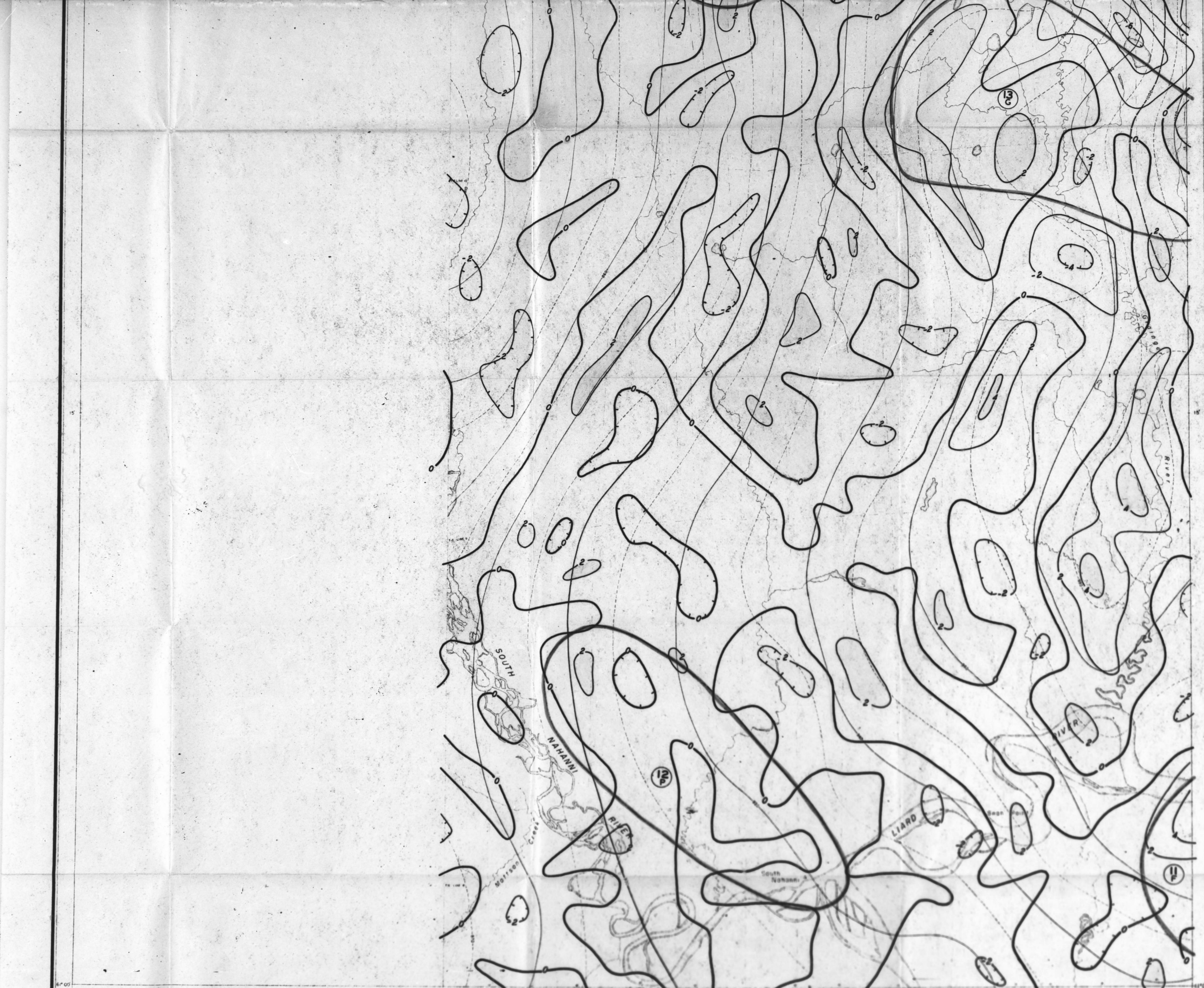
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MEAN FLIGHT LINE SPACING .15 MILES
 ALTITUDE 5500 FEET ABOVE SEA LEVEL
 500 GAMMA CONTOUR
 100 GAMMA CONTOUR
 20 GAMMA CONTOUR
 10 GAMMA CONTOUR
 MAGNETIC LOW
 FLIGHT LINES

SCALE 1 MILE TO 10 MILES

SECOND VERTICAL DERIVATIVE MAP
 CONTOUR INTERVAL 2×10^{-6} GGS
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
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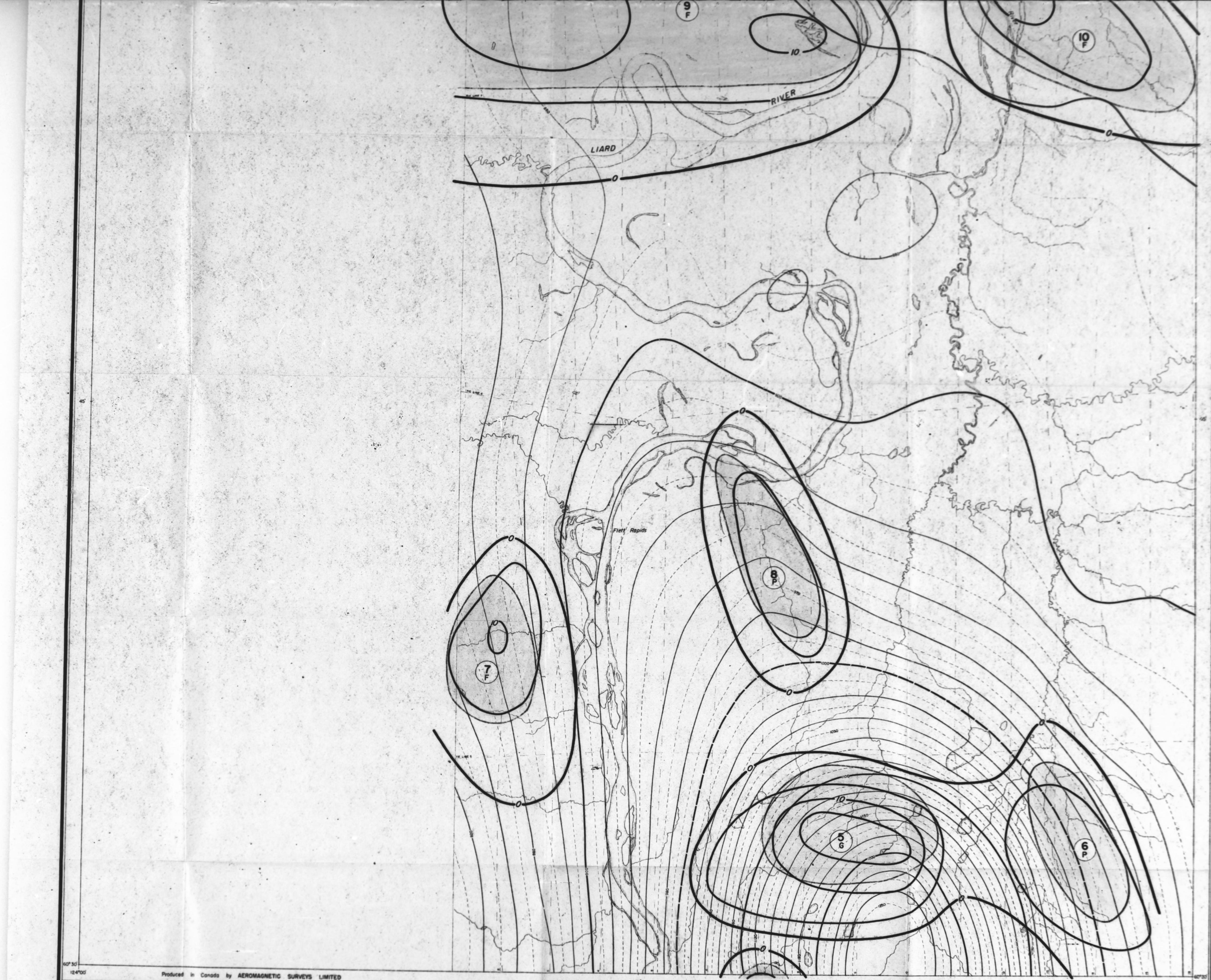
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Sheet No 3

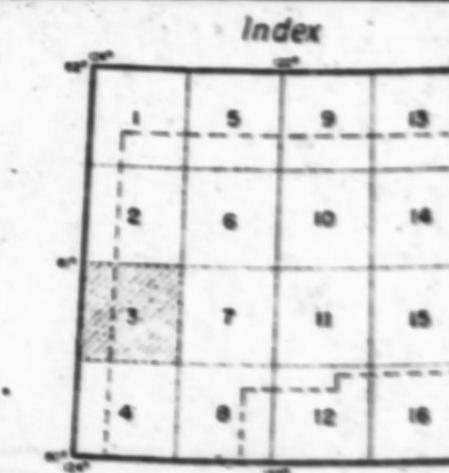
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 20 GAMMA CONTOUR
 10 GAMMA CONTOUR
 MAGNETIC LOW
 FLIGHT LINES _____

SCALE
0 1 2 3 4
MILES
1 Inch to 1 Mile

58-8-11
RESIDUAL MAGNETIC ANOMALIES
CONTOUR INTERVAL 5 GAMMAS

LOCAL AREA OF INTER-
FAULT

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HOUSTON, TEXAS REPORT: FEB. 26, 1953



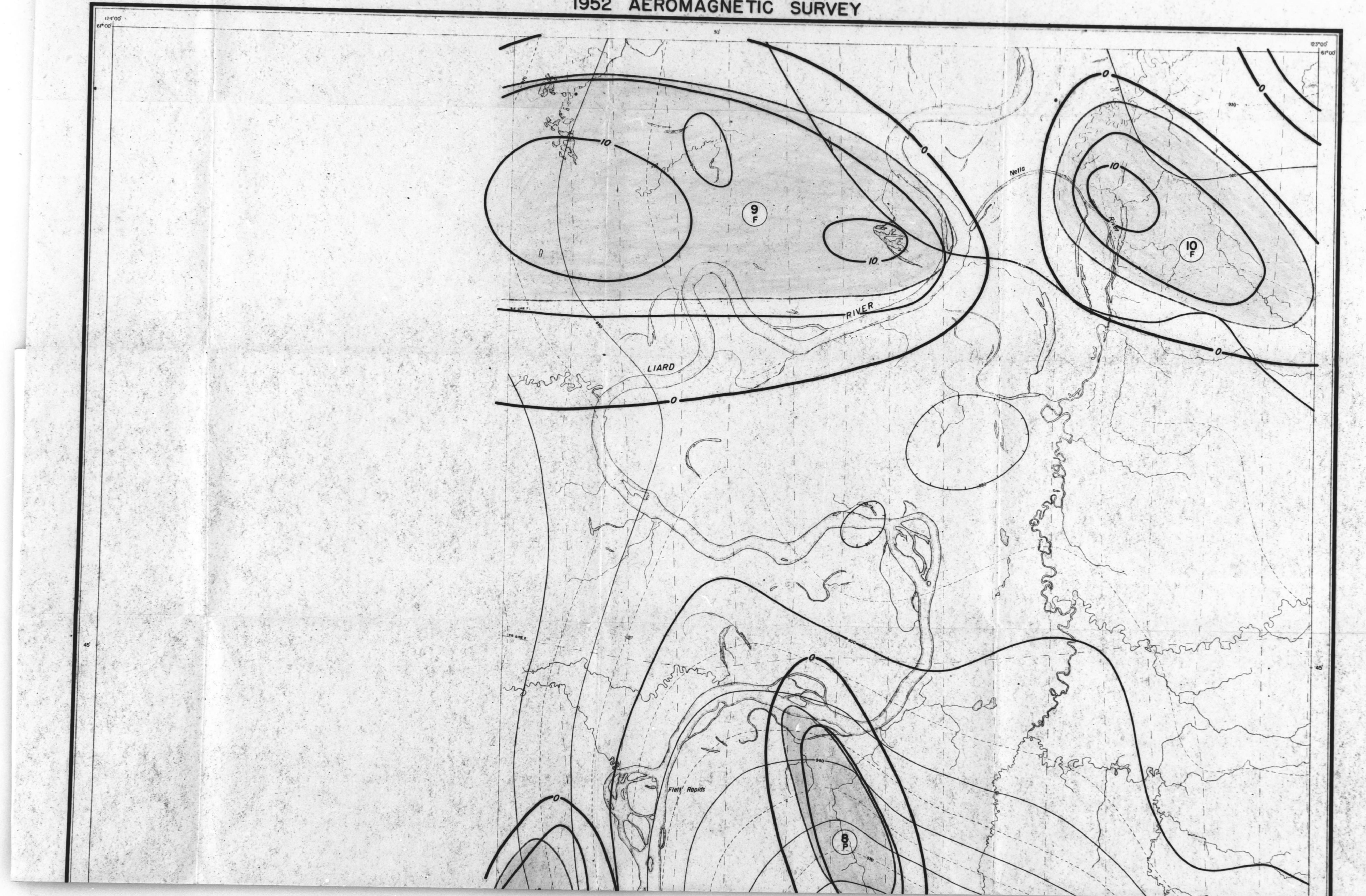
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A metric ruler is shown horizontally, with markings every 1 millimeter. The numbers are printed in a bold, black, sans-serif font. The ruler starts at 1 mm on the left and ends at 35 mm on the right. The background is a light, neutral color.

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MAP 1000
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MEAN FLIGHT LINE SPACING 1.5 MILES
ALTITUDE 3000 FEET ABOVE SEA LEVEL

100' GRAVITY CONTOUR
200' GRAVITY CONTOUR
300' GRAVITY CONTOUR
400' GRAVITY CONTOUR
500' GRAVITY CONTOUR
MAGNETIC LINE
FLIGHT LINES

SCALE
1 Inch to 1 Mile

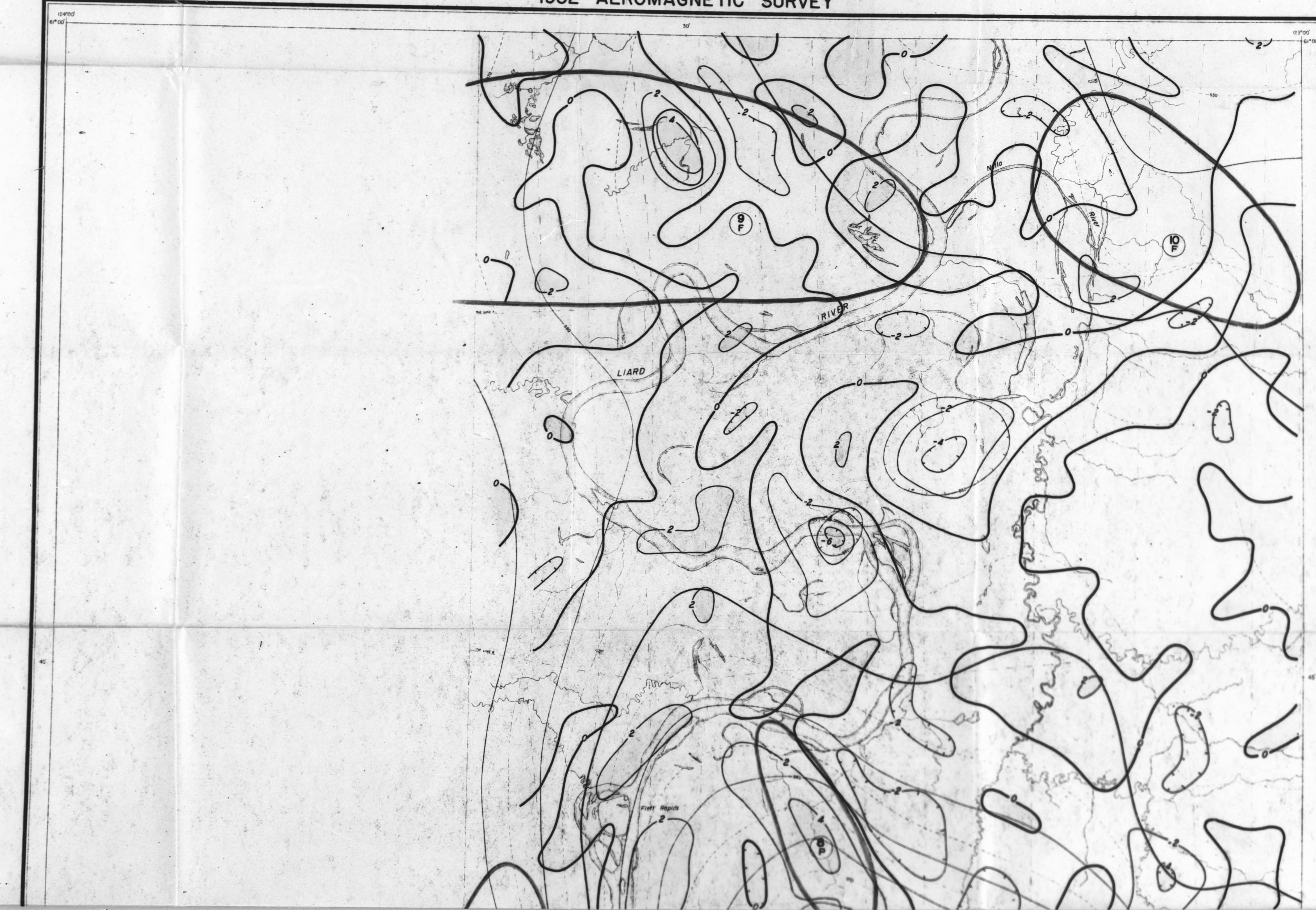
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CONTOUR INTERVAL 2×10^{-5} CGS

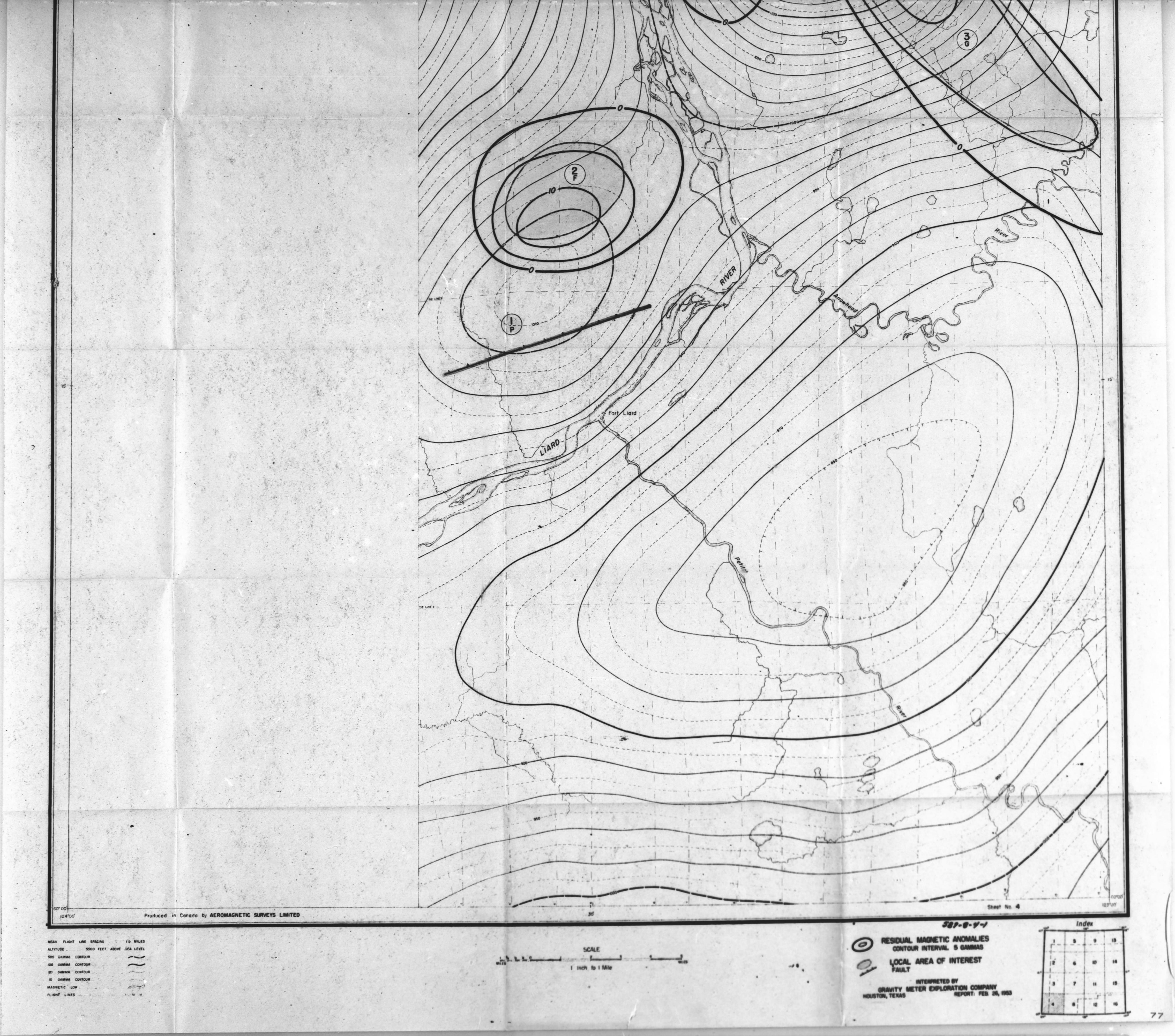
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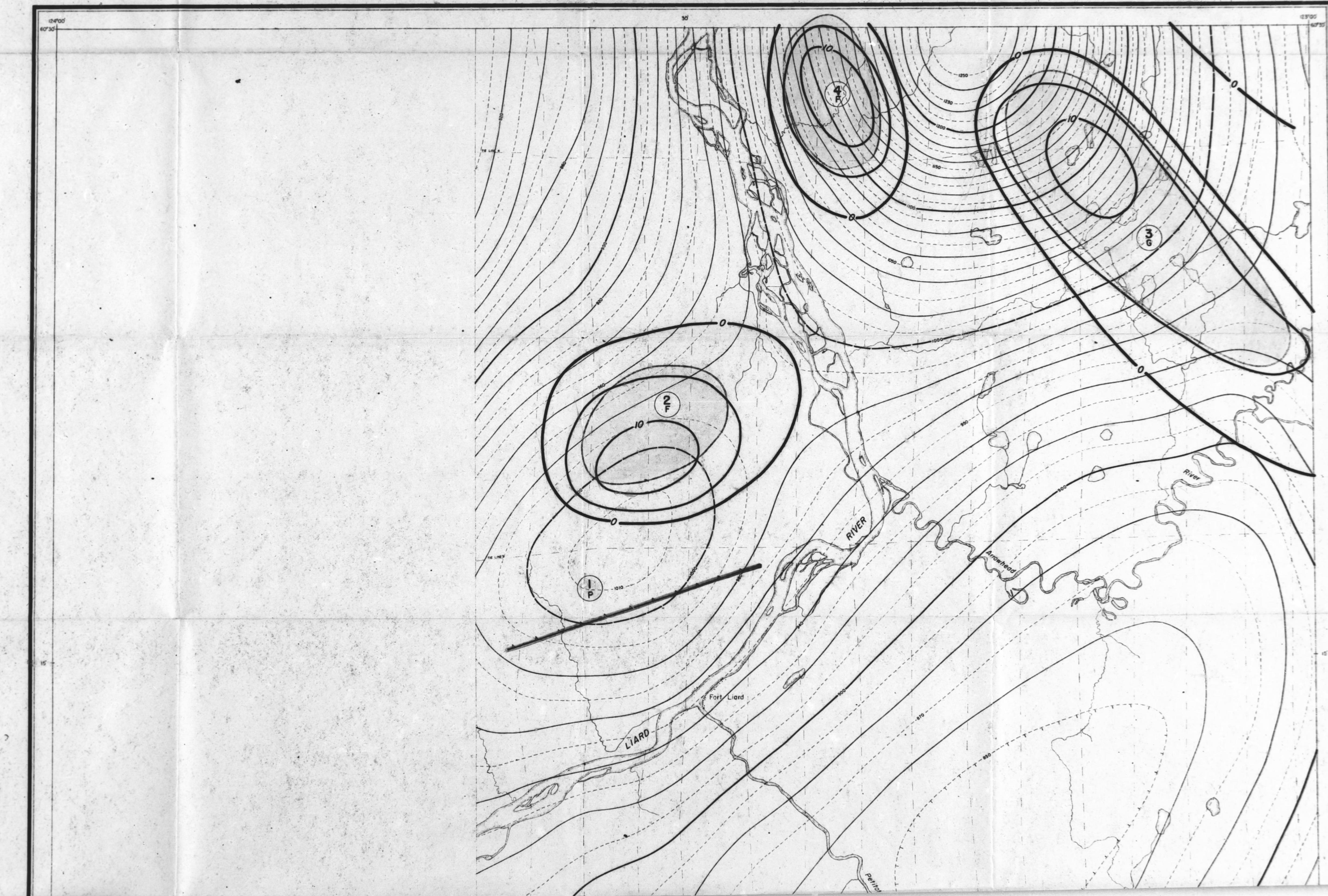




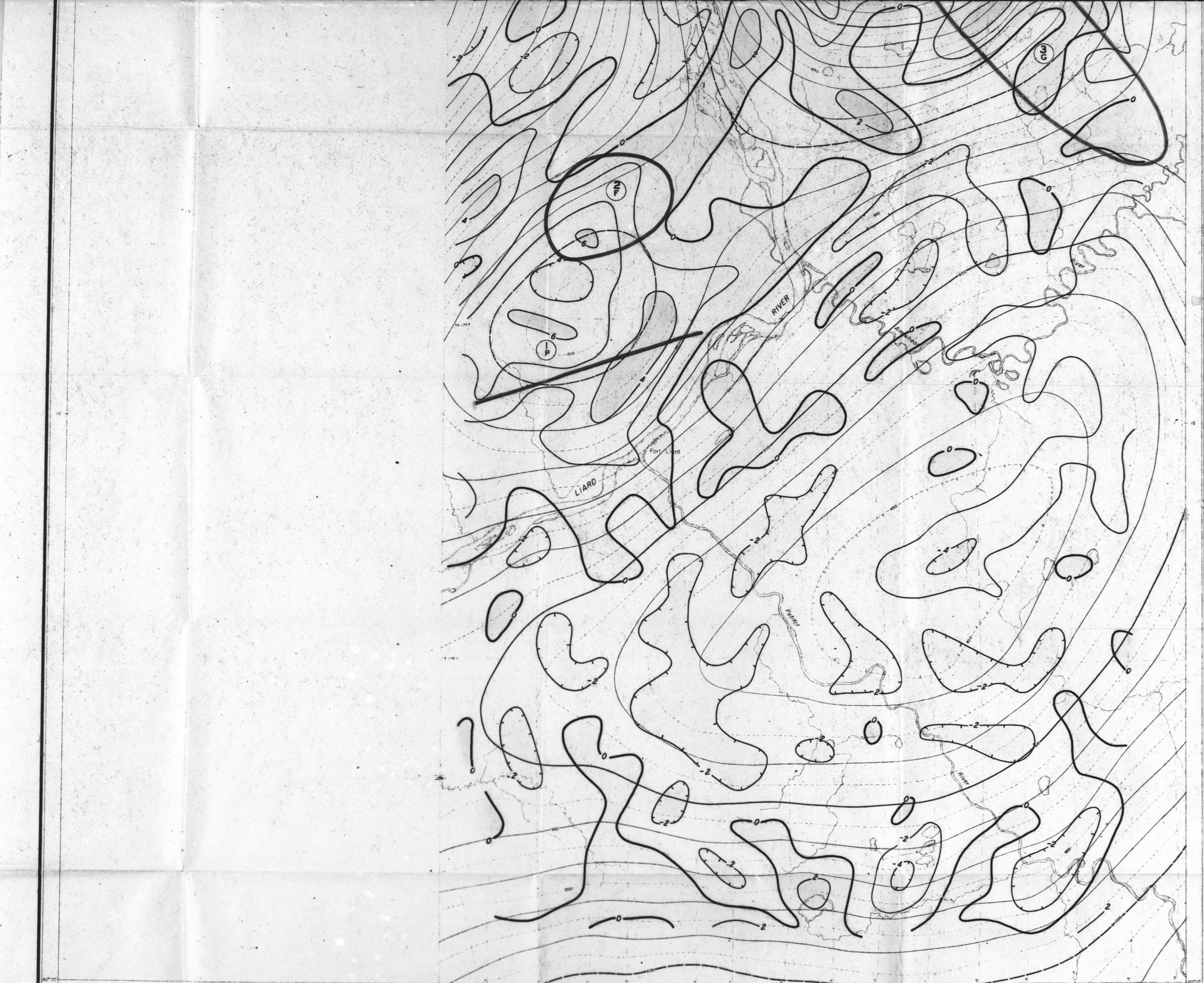
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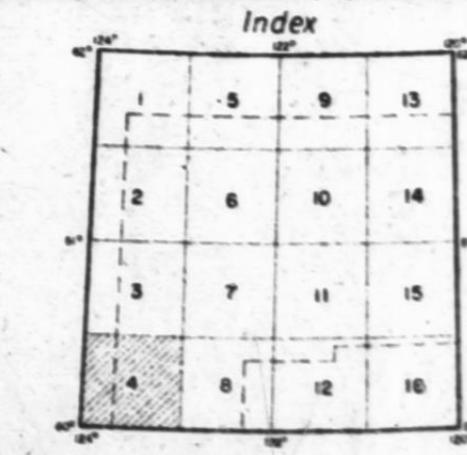


MEAN FLIGHT LINE SPACING 1/2 MILES
 ALTITUDE 5500 FEET ABOVE SEA LEVEL
 500 GAMMA CONTOUR
 100 GAMMA CONTOUR
 20 GAMMA CONTOUR
 10 GAMMA CONTOUR
 MAGNETIC LOW
 FLIGHT LINES

SCALE
 1 mile
 1 inch to 1 mile

SECOND VERTICAL DERIVATIVE MAP
 CONTOUR INTERVAL 2×10^{-15} CGS

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