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J194

REPORT ON

MAGNETOMETER DATA INTERPRETATION

SOUTH PASUIK, NORWAY

SHEET 7

For

FALCONBRIDGE NICKEL MINES LIMITED

By

ALLAN SPECTOR AND ASSOCIATES LIMITED
TORONTO CANADA

October, 1979

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** In Pocket

1. INTRODUCTION

1.1 Project Area

This report contains the results of a study of ground magnetometer data from a surveyed area in Norway. Requirements of this study are to determine the depth, structure and lithology of largely concealed Precambrain rocks for purposes of base metal exploration.

1.2 The Magnetometer Data

Using a McPhar M700 fluxgate magnetometer, readings were taken at intervals of 12.5 meters on lines 100 meters apart. All lines were run east-west. The data was compiled at 1:2500 scale and presented as contour maps (interval 100 gammas) and maps showing annotated magnetic intensity values.

The survey data was presented in 9 map sheets of which only sheet 7 is included in this report.

The magnetic data was manually plotted to produce profiles of magnetic intensity for each line at a vertical scale of 1 cm = 100 gammas and a horizontal scale of 1:2500.

1.3 Geology

The area is largely composed of gneissic material with interbeds or slivers of peridotitic and pyroxenitic rocks. Five drill holes are located along line 11400 N. Mineralization is largely associated with the ultramafic horizons.

2. INTERPRETATION METHOD

In the analysis of the magnetic data, described below, emphasis was placed on ensuring that the data was thoroughly assessed - in order to avoid disregarding features of possible significance in terms of structure, rock type and depth. The accomplish this, the analysis involved an assessment of the magnetic data in profile or analog form.

2.1 Profile Analysis

The profiles were assessed firstly, to identify each anomaly and its amplitude; and secondly, each anomaly was analyzed to determine depth to basement and also to locate contacts of the magnetic source. Anomalies that exhibited an asymmetry indicative of a dipping attitude were also identified.

A basis for obtaining some of this information was derived from model curves. A computer program was used to generate synthetically, the anomaly of a prism (vertical contacts, horizontal top, rectangular cross-section) for a 75° magnetic field inclination.

The computer program uses a mathematical expression developed by Bhattacharyya (1964)*. Profiles across magnetic anomalies generated for prisms with various sizes are shown in Figure 1. Prism horizontal dimensions 2a and 2b are given in units of depth to burial, i.e., H = 1.0. Anomaly amplitudes are all normalized to 1,000 gammas.

The synthetic curves are seen to provide a valuable basis for the location of contacts (or faults) on the observed magnetic curves. They also provide an empirical basis for determining depth to source, i.e., the width of the interval of maximum anomaly gradient to either the north or south side of the anomaly maximum is a fraction of the depth of burial: 0.50 to 0.60H depending on prism width; 0.55H was taken as average.

* BHATTACHARYYA, B.K. (1964). "Magnetic Anomalies due to Prism-shaped bodies with arbitrary Polarization"; GEOPHYSICS Vol. 21, pp. 517-531.

Information obtained from the profile analysis was transferred to an overlay of 1:2500 scale contoured magnetic intensity map.

Basement depth estimates were calculated using the following formula:

$$H = S \cdot \frac{208}{.55}$$

where S is the measured horizontal width of the maximum anomaly gradient in inches (measurement accuracy ±0.01 inches)

208 is the scale of the maps, 1 inch = 208 feet

0.55 is the selected ratio between the horizontal width of maximum model anomaly gradient and depth, i.e., s = 0.55H.

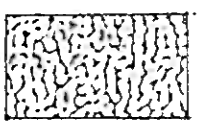
An overlay showing the location of magnetic contacts, anomaly amplitude and, in particular, the determinations of basement depth was then compiled.

3. MAGNETIC INTERPRETATION

Figure 2 presents the magnetic interpretation results for the project area.

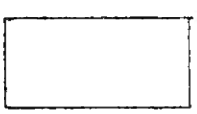
3.1 Magnetic-Lithologic Units

Three categories of rock units were distinguished in the magnetic data, according to intensity of magnetization. They are given a tentative identity primarily based on the correlation with the location and information of the drill holes.



highly magnetized rocks associated with 500 to 1500 gamma magnetic relief. The peridotites and pyroxenites appear to be the main constituent of these magnetic zones. The magnetic relief associated with these zones is indicative of a magnetic content in the range of 1% to 2%.

moderately magnetic rock type associated with 50 to 400 gamma magnetic relief. These zones include the gneissic material.



poorly magnetized or non-magnetic zones. These zones may be attributed to altered gneiss and schist.

3.2 Structures

Magnetic Bedding Strike and Dip

Magnetic bedding strike is observed to change from a northerly to a northeasterly direction. This change in strike is interpreted as being due to displacement by northeast trending faults.

In most of the map area, magnetic bedding dip is observed to be either near vertical to westerly. However, minor reversal of dip direction might indicative of localized fold structures.

Fault Structures

(a) NE=SW cross faults are predominant throughout the map sheet, causing noticeable displacement of magnetic lithologies.

(b) NW-SE faults are apparent in the east central portion. They are defined by prolonged lineation of magnetic gradient.

(c) N-S to NE-SW fault is defined in the west portion of the area.

3.3 Depth to Basement

Depth to crystalline basement rocks were found to vary from 10 to 75 feet. Average depth was found to be about 25 feet. Depths in excess of 50 feet are developed in the northwest corner of the map sheet. Areas less than 25 feet are found in a northerly trending ridge in the eastern portion of the map sheet along with a roughly circular zone in the central portion and localized basement "highs" in the southern portion of the map sheet.

3.4 Sites Recommended for Follow-up

Since mineralization is largely associated with the ultramatic zones, further follow-up should concentrate on the most highly magnetic zones. Eight of these units are outlined on the interpretation map and have been assigned a priority rating based on their concentration of magnetite. Zone one is particularly interesting because it is partly defined by remanent or reversed magnetization, 1500 gammas in amplitude.

The analysis of the survey data embodied in this report is essentially a geophysical appraisal of the area; as such, it can incorporate only as much geological and geophysical information as the interpreter has available at the time. It should be judiciously used, therefore, as a guide only, by geologists thoroughly familiar with the area and who are in a better position as time passes to evaluate the geological significance of any particular feature. With additional drilling information, it may be possible to down- or up-grade features discussed or identified in this report.

Respectfully submitted,

ALLAN SPECTOR AND ASSOCIATES LIMITED

Raymond Pichette

Raymond Pichette, B.Sc.

J194/1

REPORT ON
MAGNETOMETER DATA INTERPRETATION
SOUTH PASIUK, NORWAY
SHEET 2 and 5

For

FALCONBRIDGE NICKEL MINES LIMITED

By

ALLAN SPECTOR AND ASSOCIATES LIMITED
TORONTO CANADA

December, 1979

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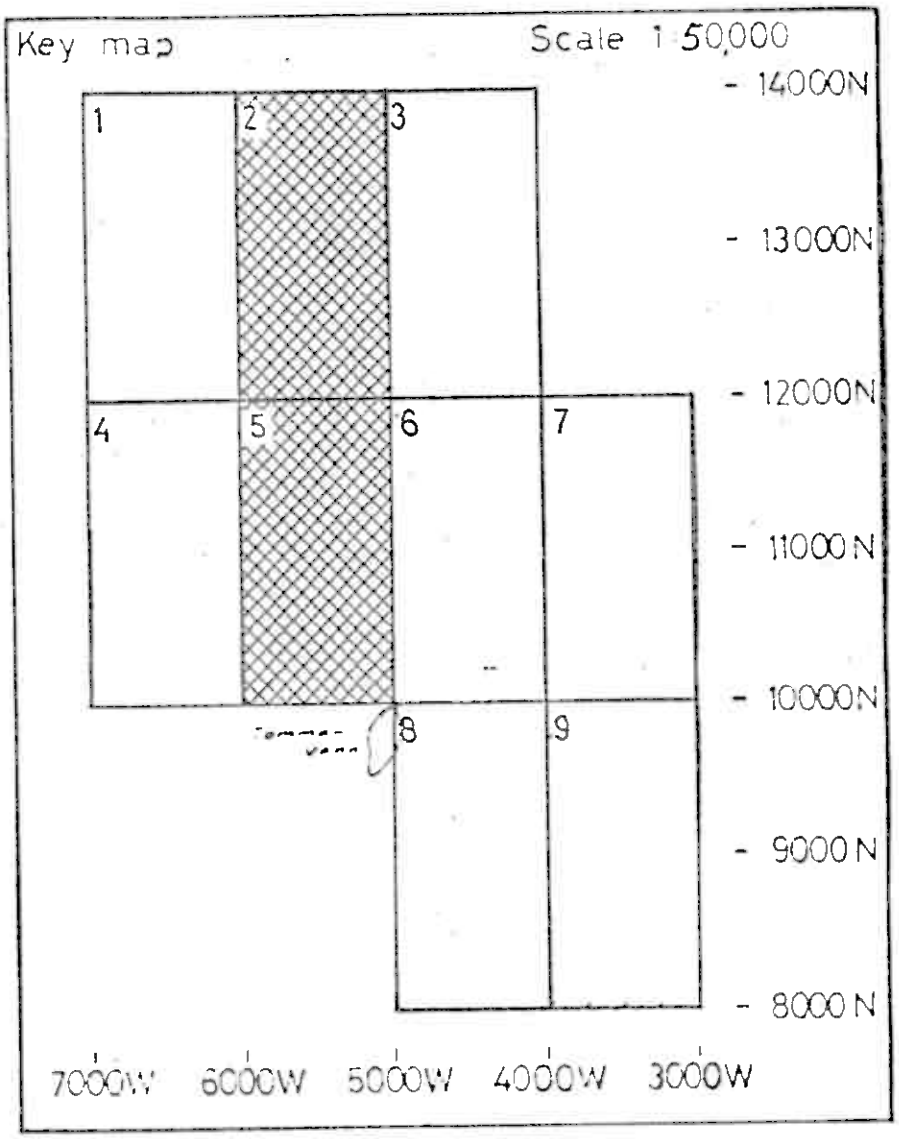

Figure 1: Index Map

1. INTRODUCTION

1.1 Project Area

This report contains the results of a study of ground magnetometer data from a surveyed area in Norway. Requirements of this study are to determine the depth, structure and lithology of largely concealed Precambrian rocks for purposes of base metal exploration.

1.2 The Magnetometer Data

Using a McPhar M700 fluxgate magnetometer, readings were taken at intervals of 12.5 meters on lines 100 meters apart. All lines were run east-west. The data was compiled at 1:2500 scale and presented as contour maps (interval 100 gammas) and maps showing annotated magnetic intensity values.

The survey data was presented in 9 map sheets (Figure 1) of which only sheets 2 and 5 are included in this report.

The magnetic data was manually plotted to produce profiles of magnetic intensity for each line at a vertical scale of 1 cm = 100 gammas and a horizontal scale of 1:2500.

1.3 Geology

The majority of the nickel mined in the past came from two areas in southern Norway, Evje and Erteli, both associated with Precambrian metamorphosed mafic rocks. Recent investigations in Norway have concentrated west of the Caledonide front, within rocks deformed during the lower Paleozoic Caledonian orogeny. These rocks are largely lower Paleozoic with the exception of the coastal gneiss region in southwest and northwest Norway, both of which are dominated by Precambrian rocks with supracrustals of Caledonian age. (Naldrett, et al, 1977). The Caledonide structures are dominated by a sequence of nappe units showing evidence of large-scale transport from the east.

2. INTERPRETATION METHOD

In the analysis of the magnetic data, described below, emphasis was placed on ensuring that the data was thoroughly assessed - in order to avoid disregarding features of possible significance in terms of structure, rock type and depth. To accomplish this, the analysis involved an assessment of the magnetic data in profile or analog form.

2.1 Profile Analysis

The profiles were assessed firstly, to identify each anomaly and its amplitude, and secondly, each anomaly was analyzed to determine depth to basement and also to locate contacts of the magnetic source. Anomalies that exhibited an asymmetry indicative of a dipping attitude were also identified.

A basis for obtaining some of this information was derived from model curves. A computer program was used to generate synthetically, the anomaly of a prism (vertical contacts, horizontal top, rectangular cross-section) for a 75° magnetic field inclination.

The computer program uses a mathematical expression developed by Bhattacharyya (1964). Profiles across magnetic anomalies generated for prisms with various sizes are shown in Figure 2. Prism horizontal dimensions 2a and 2b are given in units of depth to burial, i.e. H = 1.0. Anomaly amplitudes are all normalized to 1000 gammas.

The synthetic curves are seen to provide a valuable basis for the location of contacts (or faults) on the observed magnetic curves. They also provide an empirical basis for determining depth to source, i.e. the width of the interval of maximum anomaly gradient to either the north or south side of the anomaly maximum is a fraction of the depth of burial: 0.50 to 0.60H depending on prism width; 0.55H was taken as average.

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Basement depth estimates were calculated using the following formula:

$$H = S \cdot \frac{208}{.55}$$

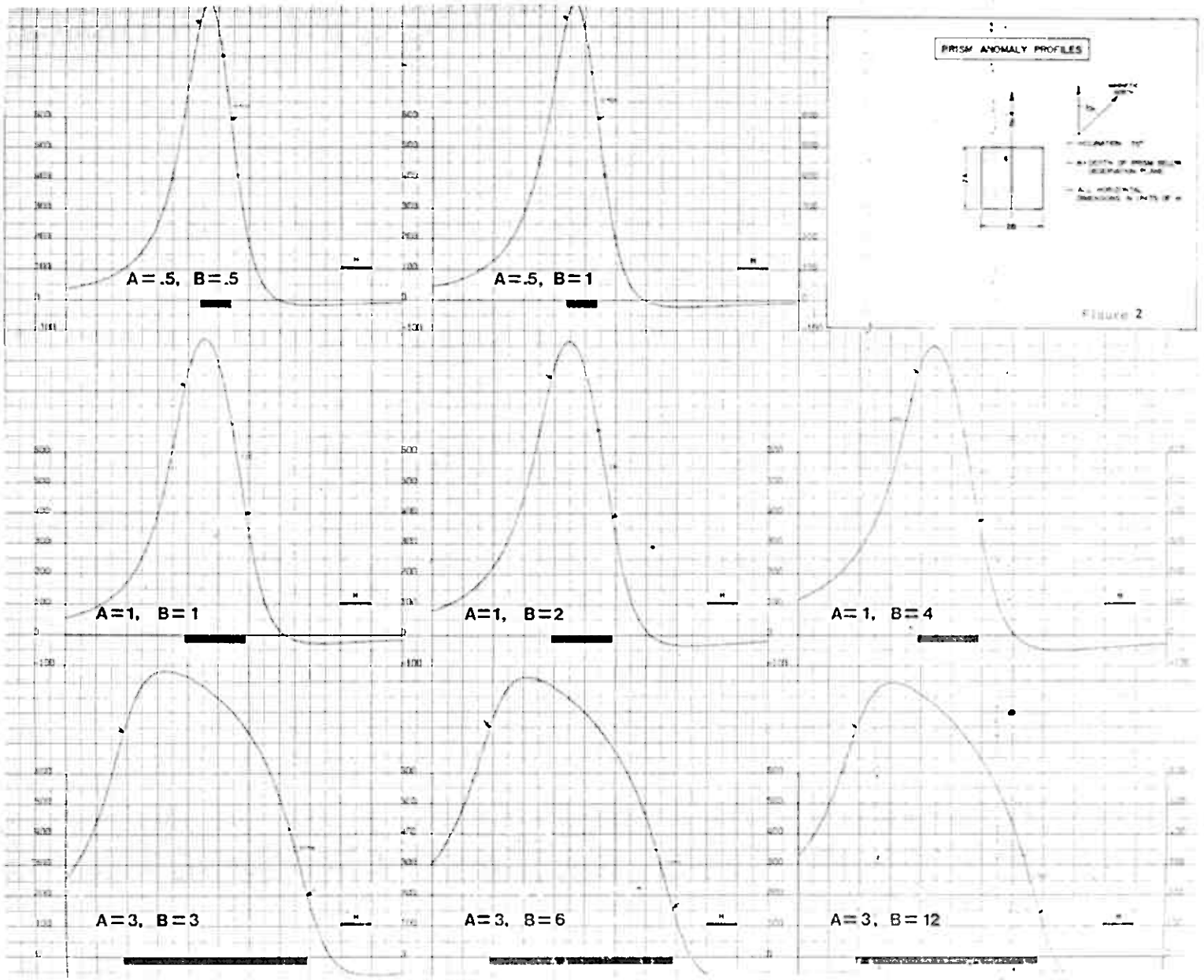

PRISM ANOMALY PROFILES
A=.5, B=.5
A=.5, B=1
A=1, B=1
A=1, B=2
A=1, B=4
A=3, B=3
A=3, B=6
A=3, B=12

Figure 2

where S is the measured horizontal width of the maximum anomaly gradient in inches (measurement accuracy ±0.01 inches)

208 is the scale of the maps: 1 inch = 208 feet

0.55 is the selected ratio between the horizontal width of maximum model anomaly gradient and depth, i.e. s = 0.55H.

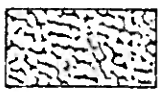
An overlay showing the location of magnetic contacts, anomaly amplitude and, in particular, the determinations of basement depth was then compiled.

3. MAGNETIC INTERPRETATION

Figure 3 presents the magnetic interpretation results for the project areas.

3.1 Magnetic/Lithologic Units

Three categories of rock units were distinguished in the magnetic data, according to intensity of magnetization. They are given a tentative identity ba on work previously completed on sheet 7.



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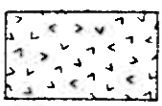
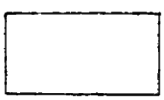


moderately magnetic rock type associated with 50 to 300 gamma magnetic relief. These zones include the gneissic material.



poorly magnetized or non-magnetic zones. These zones may be attribute to altered gneiss and schist.

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Magnetic bedding strike is observed to have a northerly direction. In both map areas, magnetic bedding dip is observed to be either near vertical to wester

Fault Structures

(a) NE-SW cross faults are predominant throughout the map sheets causing notice displacement of magnetic lithologies.

(b) N-S faults are observed on sheet 2. They are defined by displacement of magnetic units and linear zones of negligible magnetization, i.e. alteratio

3.3 Depth to Basement

Depth to crystalline basement rocks were found to vary from 10 to 80 feet. Average depth was found to be about 35 feet. Depths in excess of 50 feet are developed in the east central and the south west portion of sheet 5. Areas less than 25 feet are found in the central, north east and south central portions of sheet 2 and a ridge-like structure in the north portion of sheet 5.

3.4 Sites Recommended for Follow-up

Since mineralization is largely associated with the ultramafic zones, further follow-up should concentrate on the most highly magnetic zones. Possible target areas for follow-up investigation are marked by a ★ symbol. Six target areas are found on sheet 2 and two target areas on sheet 5.

The interpretation of the survey data embodied in this report is essentially a geophysical appraisal of the area; as such, it can incorporate only as much geological and geophysical information as the interpreter has available at the time. It should be judiciously used, therefore, as a guide only, by geologists thoroughly familiar with the area and who are in a better position, as time passes, to evaluate the geological significance of any particular feature. With additional information such as that provided by more detailed forms of prospecting and eventually drilling, it may be possible to down- or up-grade features discussed or identified in this report.

Respectfully submitted,

ALLAN SPECTOR AND ASSOCIATES LIMITED

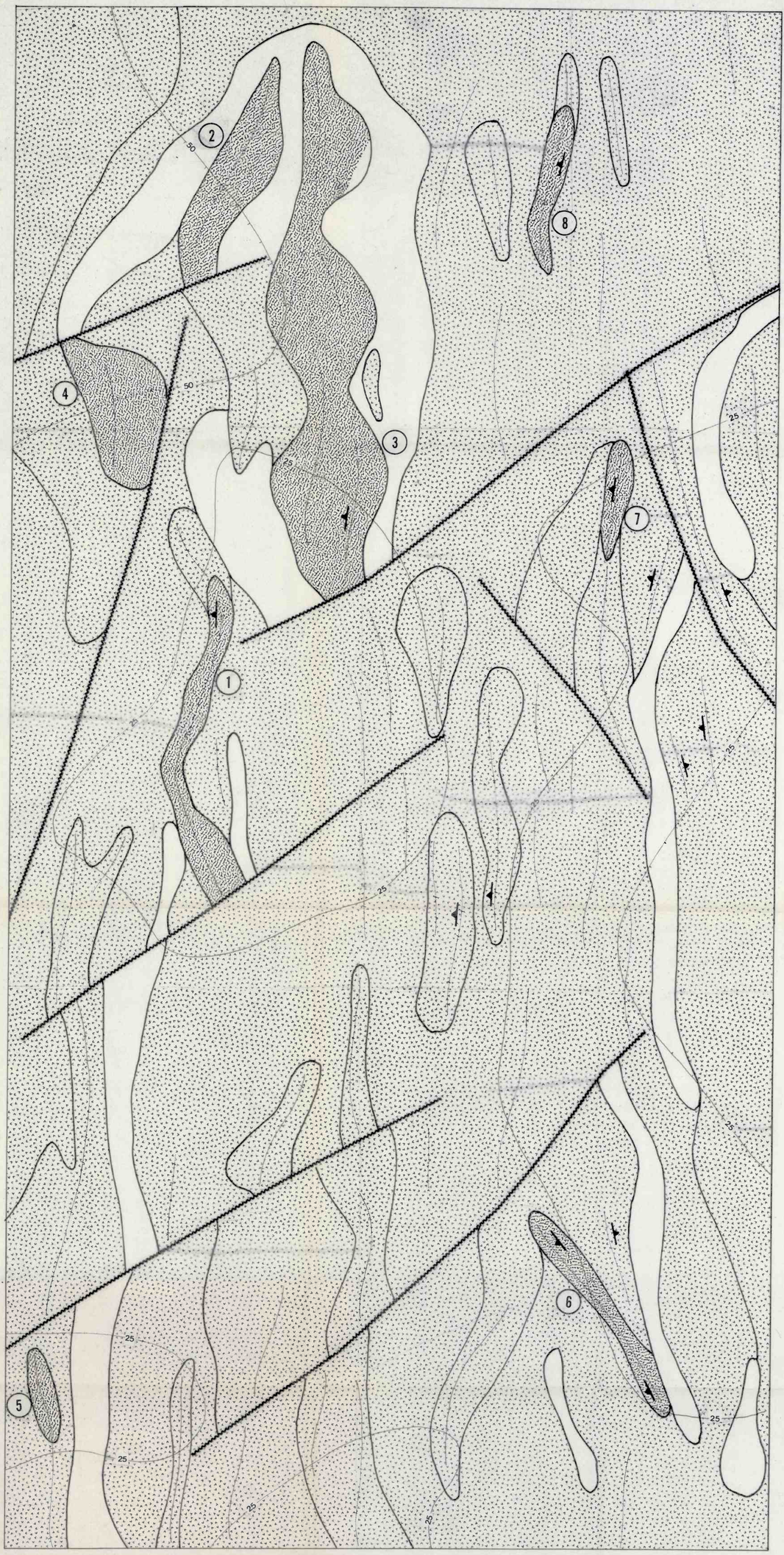
Raymond J. Pichette

Raymond J. Pichette, B.Sc.

4. REFERENCES

BHATTACHARYYA, B.K. (1964). "Magnetic Anomalies due to Prism-shaped bodies with arbitrary Polarization"; GEOPHYSICS Vol. 21, 517-531 pp.

NALDRET, A.J., ARNDT, N.T., BARNES, S.J., DUKE, J.M., GREEN, A.H., HOFFMAN, E. THOMPSON, J.F. (1977). Nickel Sulphide Deposits, Ore Deposit Workship, Depart of Geology, University of Toronto, page 4 - 106 to 4 - 111.



INTERPRETATION LEGEND

MAGNETIC-LITHOLOGIC UNITS

UNIT	MAGNETIZATION
	high
	moderate
	nil

- magnetic / lithologic contact
- interpreted fault
- axis of magnetic anomaly
- attitude of magnetic bed
- magnetic basement depth contour interval 25 feet

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BASEMENT DEPTH, STRUCTURE & LITHOLOGY
SOUTH PASVIK, NORWAY

scale 1:2,500

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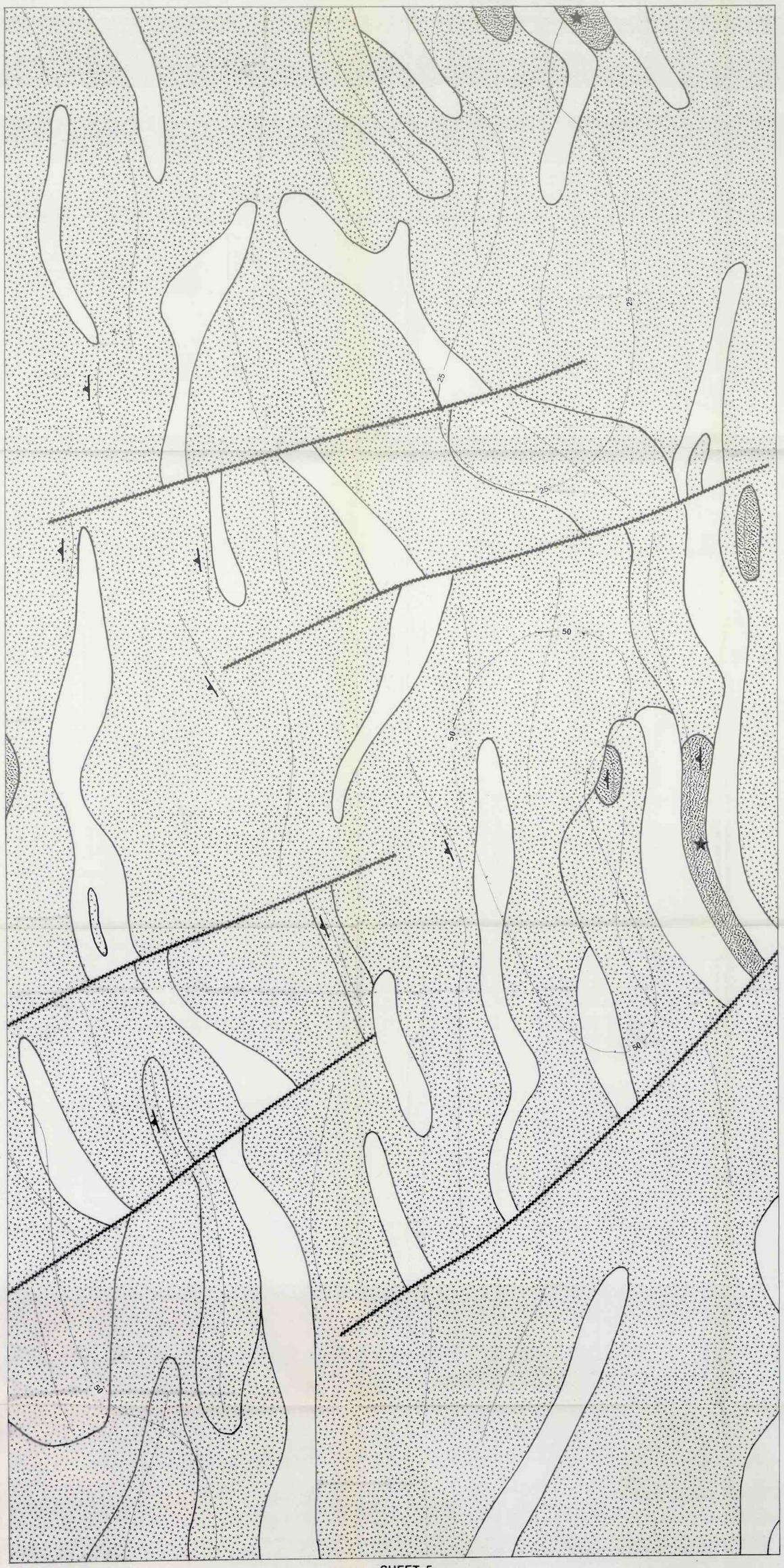
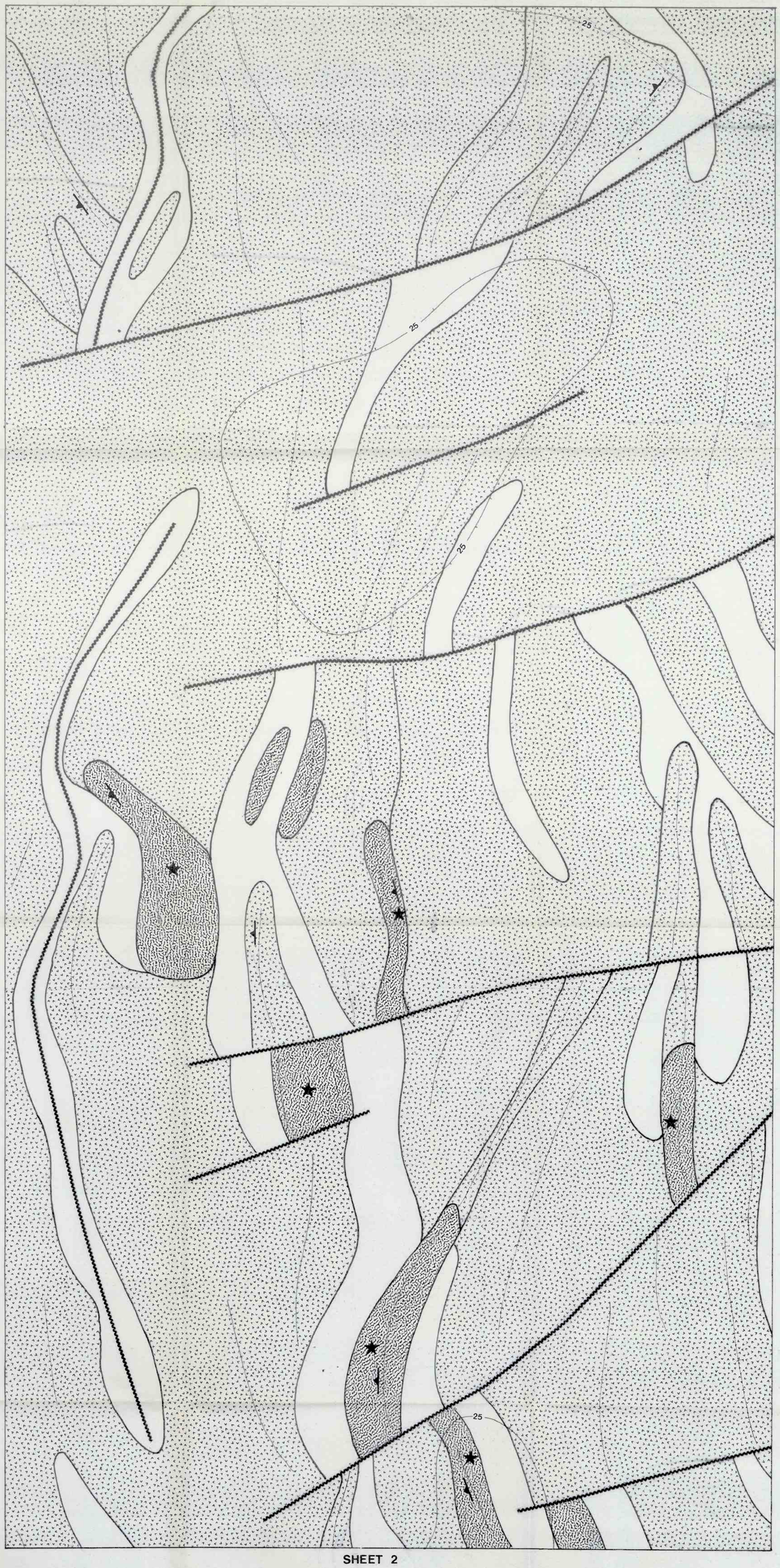
Figure 2



SHEET 5



SHEET 2

INTERPRETATION LEGEND

MAGNETIC-LITHOLOGIC UNITS

UNIT	MAGNETIZATION
	high
	moderate
	nil

- magnetic / lithologic contact
- interpreted fault
- axis of magnetic anomaly
- attitude of magnetic bed
- magnetic basement depth contour interval 25 feet

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SOUTH PASVIK, NORWAY

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Figure 3

23-79-A1