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TREND SURFACE ANALYSIS OF THE SOLOMON QUADRANGLE AND BIG HURRAH MINE

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INTRODUCTION

The last decade has seen a great increase in the use of computers by various areas of the Earth Sciences and Mineral Industries. Such uses vary from storage of data to trend surface analysis and data plotting. Since 1966 the Mineral Industry Research Laboratory of the University of Alaska has used the computer for trend surface analysis of geological data. (For the program and more detailed explanations see MIRL Reports 9 and 11.)

Grant (1957), in Esler, Smith and Davis, has defined trend surface analysis as "... a special application multiple regression." It is based on the belief that any surface that can be contoured can also be expressed by an equation of some degree.

This time saving method can be used as a tool by the exploration and field geologist, whether looking for oil reserves, heavy metals or stratigraphic correlations. It is a statistical means of separating a contour map based on observed data into two components: (1) regional trends and, (2) departure from these regional trends; the observed or actual surfaces represent the regional trend and residual values obtained by subtracting observed data from this surface represent local fluctuations or anomalies.

Use of the computer allows the geologist to examine regional trend surfaces of different degrees of complexity and provides statistical measures indicating how well each regional surface fits the observed data. This in turn allows for differentiation between trends on large scale effects which influence an entire region and anomalies or small effects influencing only small parts of a region.

Thus, as in the case of this paper, the geologist can collect a large number of samples in the field, have them analyzed for various elements (or structual features, etc.) and then have trend surfaces prepared by the use of a computer. Contour maps and residual values to various degrees (six in this case) can then be plotted and ready for interpretation within hours instead of days as is required by manual computation and plotting of the same data.

The use of the results of these analysis is up to the individual and his prime purpose of study. The computer and trend analysis is not an end in itself, but is a ready tool to aid in the interpretation of data. It also provides rapid anomaly maps and, in the case of geochemical analysis, variable background due to different geologic units is automatically taken into consideration; for example, the nickel surface over an ultramafic will be higher than over an acidic rock. A moderate nickel residual in the area of an acidic rock may then have negative residual value if it were to occur in a greenstone.

TREND ANALYSIS: SOLOMON QUADRANGLE

In the summer of 1968, Mr. Roderick R. Asher, geologist for the Alaska State Division of Mines and Geology, collected stream sediment samples in the Solomon Quadrangle (USGS, Map C-5). These samples were analyzed for various elements. The zinc values were selected as tracers for gold deposits and the M.I.R.L. Trend Program was then used to determine the existance of possible relationships between the zinc content and the various mines in the Quadrangle, in particular, the Big Hurrah Mine. Both regional trends and residual values were computed to the sixth degree and plotted on the Solomon map. (Figures 1-8, Map I) One localized zone of highs and two possible linear features are implied by the plots.

A localized zone of highs lies near the center east border of the map and is persistant on all degrees of residuals. This zone is also contained within the highest regional contours of the fourth, fifth and sixth degree maps and is within one of the linear trends discussed later in this paper. Within the zone of highs, there are two cases of two or more highs from the same drainage, which could be indicative of an ultimate source of equally high value.

Two linear trends are shown in Figure 1. Though data points do not line up from point to point, they, as a whole, display a NW-SE lineation. It must be remembered that points occur only where samples were taken, thus these lineations could either be stronger or weaker on a regimented traverse.

These linear features may parallel the general regional trend surface contours

(Figures 6, 7, and 8). Though neither the linearity of residuals, nor the directions of regional trends are individually strong, the two features together could be of some significance.

The regional trend contours also display a few possible features. The Big Hurrah Mine and Uncle Sam Mountain are always within the 90 ppm contour, although no highs are plotted at the actual mine.

The localized high noted in the center east border of the residual plots is further strengthened by the display of high contour intervals in this region. This combination of high residuals and consistently high contours warrants further study in this zone.

TREND ANALYSIS: HURRAH TRAVERSE

The Alaska State Division of Mines and Geology, under the direction of Mr. R. Asher, also ran a traverse sampling program in the general vicinity of the Big Hurrah Mine, trying to discover relationships significant of gold deposition in the area. Again, these samples were analyzed, and zinc, lead, and copper trend surface and residual maps through the sixth degree were prepared (Figures 8-12, Map II). Various interpretations of these results can be made.

The Solomon Quadrangle, as a whole, displays a zinc residual trend of NW-SE. This same trend can also be seen in the fifth degree zince residual plots for the traverse. Included in this linear trend is a major portion of the drainage in the Quadrangle.

To the southwest of this linearity is found a small zone of highs. These localized highs all occur within the slate unit, and it can be further noted that a major portion of the zinc residual highs do occur in the slate unit.

The lead residuals display a weak E-W trend, though the eight values of over 20 ppm lie in a vague NW-SE trend. The Hurrah Mine, although lacking in high values itself, would be part of this NW-SE trend.

Correlation between residuals and rock types is vague, although three groupings of three highs do occur in the schist unit (Figure 10). Other then these three groupings, the lead residuals appear fairly evenly distributed between the schist and slate.

A definite E-W trend is displayed by the copper residuals. Again the Hurrah Mine, though not an actual high, is contained within the trend. The grouping of the highs into two definite E-W trends could also be of significance.

Rock type correlation is vague, with the highs fairly well distributed between the slate and schist. The one grouping of three highs noted in Figure 11 occurs with two points in the schist and one in the slate and is of little correlative aid.

Figure 12 shows a plot of corresponding highs of zinc, lead, and copper, from which either a NW-SE or E-W trend can be implied. A definite E-W trend is seen in the three points that are highs for all three elements. Two of these three points lie within the schist and the third three-element high lies at the faulted contact of the schist and slate.

The surface contours further strengthen the possibility of a correlation between zinc and slate. The contours of 80 ppm and higher lie almost entirely within the slate unit.

Copper surface contours show little correlation with residual values. There exists one grouping of contour highs in the schist unit located on the SE border of the map.

Lead surface contours were not plotted with contour intervals of interpretative value and no correlations are possible.

Zinc values were also broken down into separate values for schist, slate, and soils. The residual plots and surface contours showed little variation from previous data, thus indicating little, if any, element mobilization in the area.

CONCLUSION

The Solomon Quadrangle as a whole displays a NW-SE trend for zinc residual plots. There is one area on the center east border of localized residual highs that is further strengthened by regional contour highs in the same area. These two features should be studied further, first by reviewing the collected data, and second, by future field work.

The Big Hurrah traverse is generally weak, both in residual values and regional trending. The relationship between small scale NW-SE regional trending of the zinc values of the Big Hurrah traverse and the NW-SE trend of the zinc values of the Solomon Quadrangle may be of significance and data should be studied with this in mind.

Due to the lack of any predominant trends for the copper-lead-zinc association, future studies should concentrate on the possibility of other mineral associations such as arsenic and antimony.

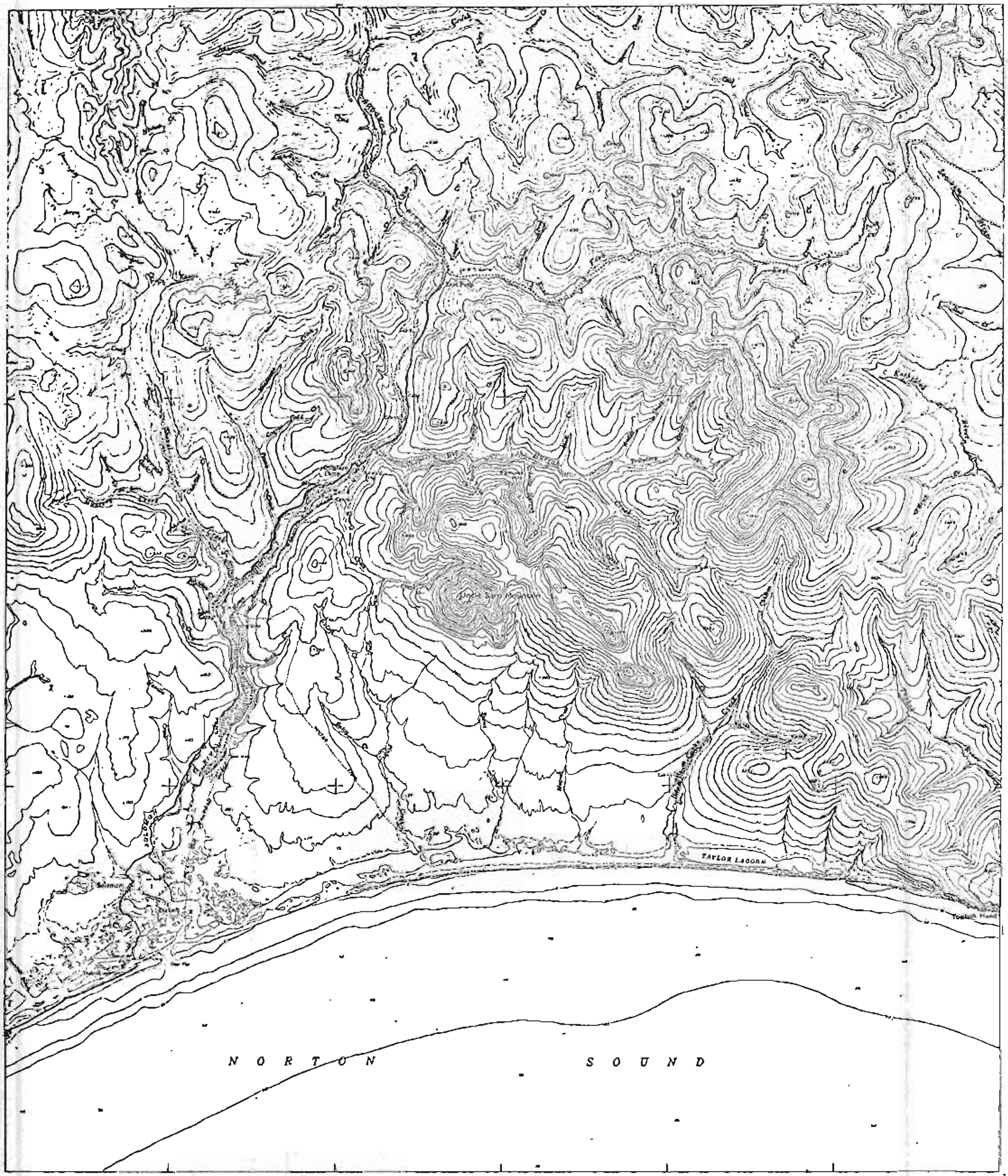
BIBLIOGRAPHY

1. Forgotson, James M., Jr., "How Computers Help Find Oil," The Oil and Gas Journal, March 18, 1963, pp. 100-109.

2. Esler, J.E., Smith, P.F., Davis, J.C., Kwiers, "A Fortran IV Program for Multiple Regression and Geologic Trend Analysis," Computer Contribution 28, State Geologic Survey, University of Kansas, Lawrence, 1968.

3. Heiner, Lawrence E., Geller, Stephen P., "Fortran IV Trend Surface Program for IBM 360 Model 40 Computer," Mineral Industry Research Laboratory, Report No. 9, University of Alaska, College, Alaska.

4. ____________, Wolff, Ernest N., "Applications of Trend Surface Analysis and Geologic Model Building to Mineralized Districts in Alaska," MIRL Report No. 11, University of Alaska, College, Alaska.



SOLOMON QUADRANGLE

Map 1

USGS Map C-5

100 ● Lineation — — —

50 ○ Localization ——

Figure 1

1st° Zn

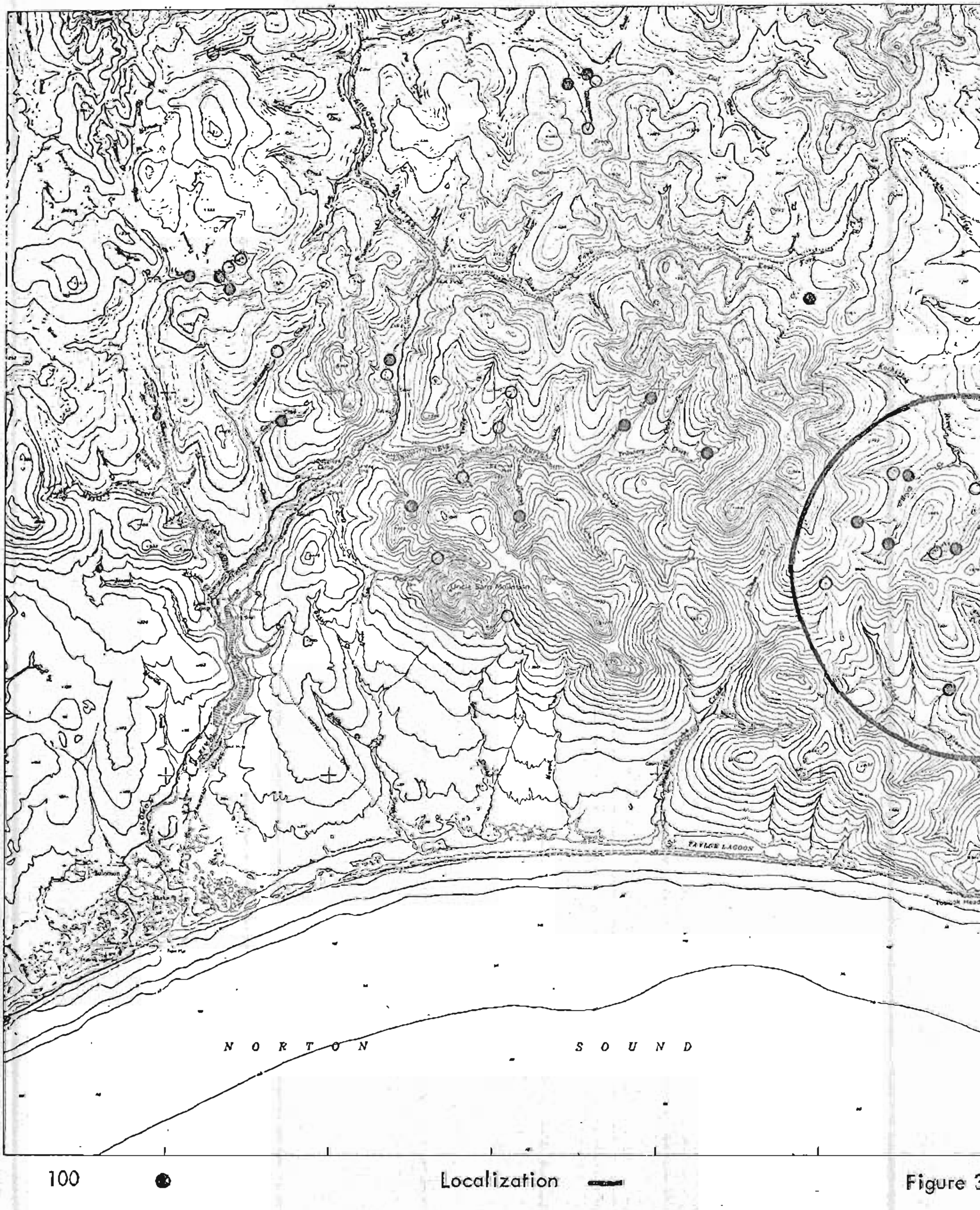
150 O

200 ●

Localization ——

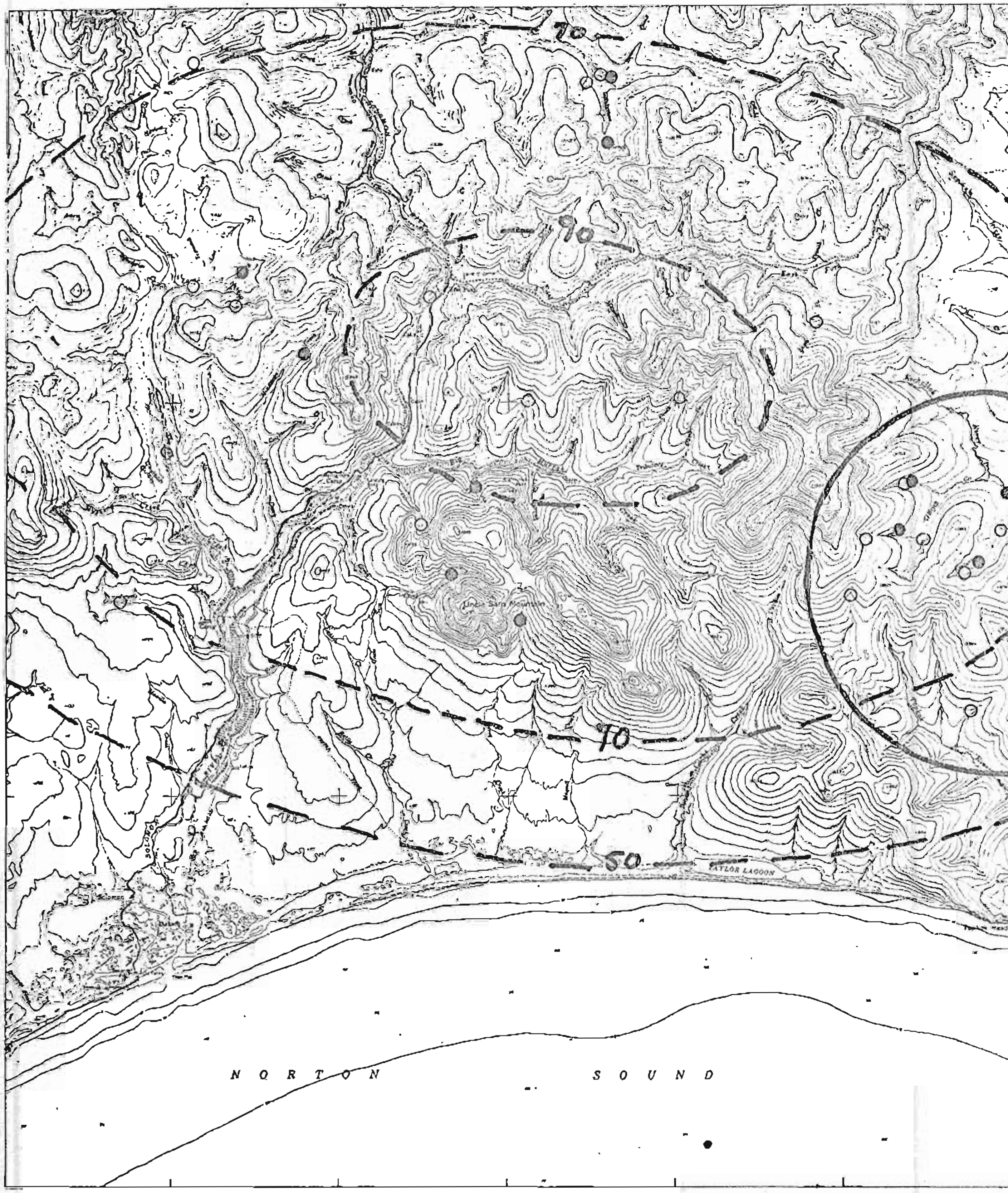
Figure 2

Original Date - Zn



100 ● Localization ▬ Figure 3

50 ○ 1st° Zn



100 ● Localization ▬▬

50 ○ Regional Contour — — —

Figure 4

2nd° Zn

100 ● Localization ▬

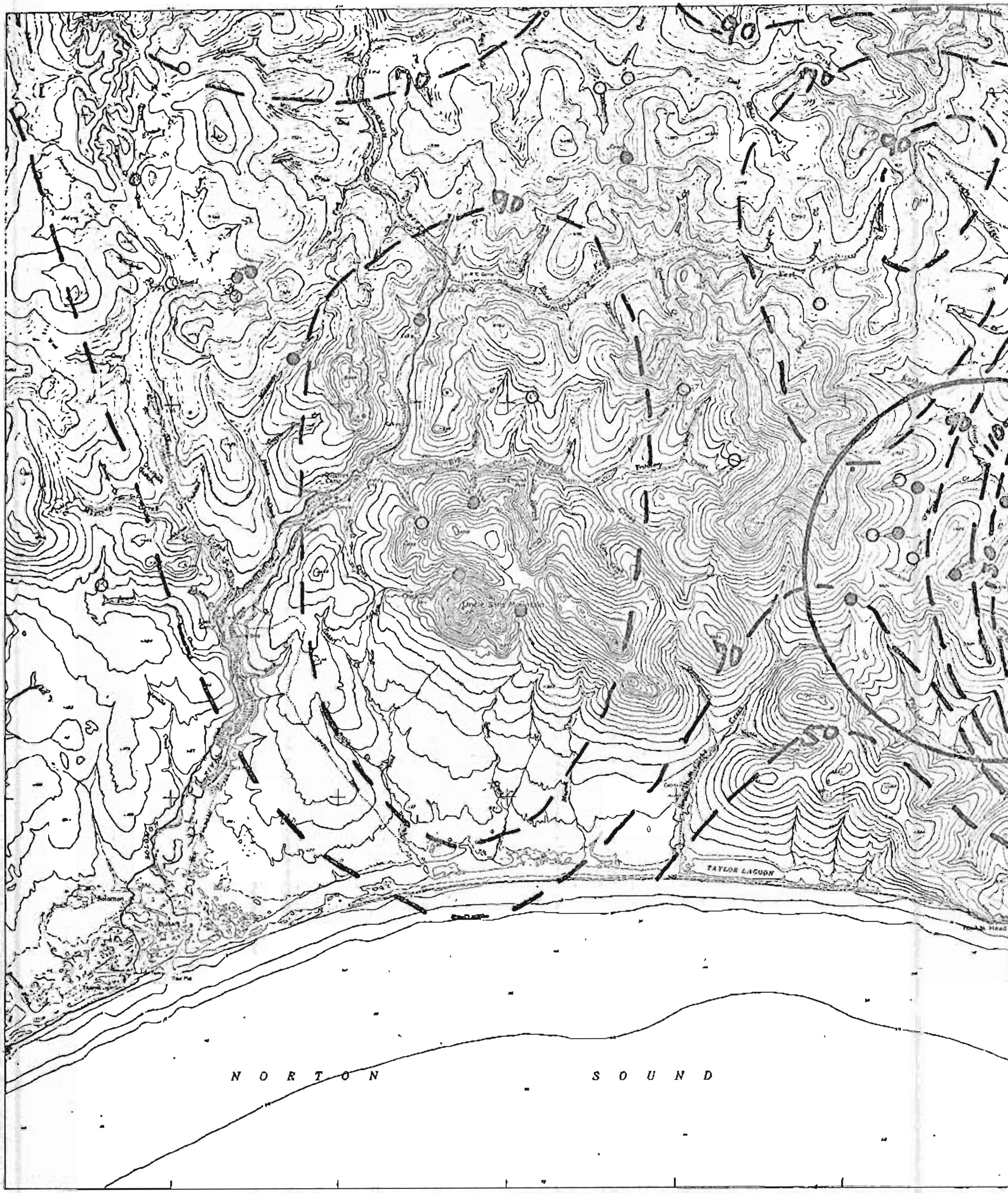
50 ○ Regional Contour ▬ ▬ ▬

Figure 5

3rd° Zn

Figure 6

4th° Zn



100 ● Localization ▬

50 ○ Regional Contour ▬ ▬

Figure 7

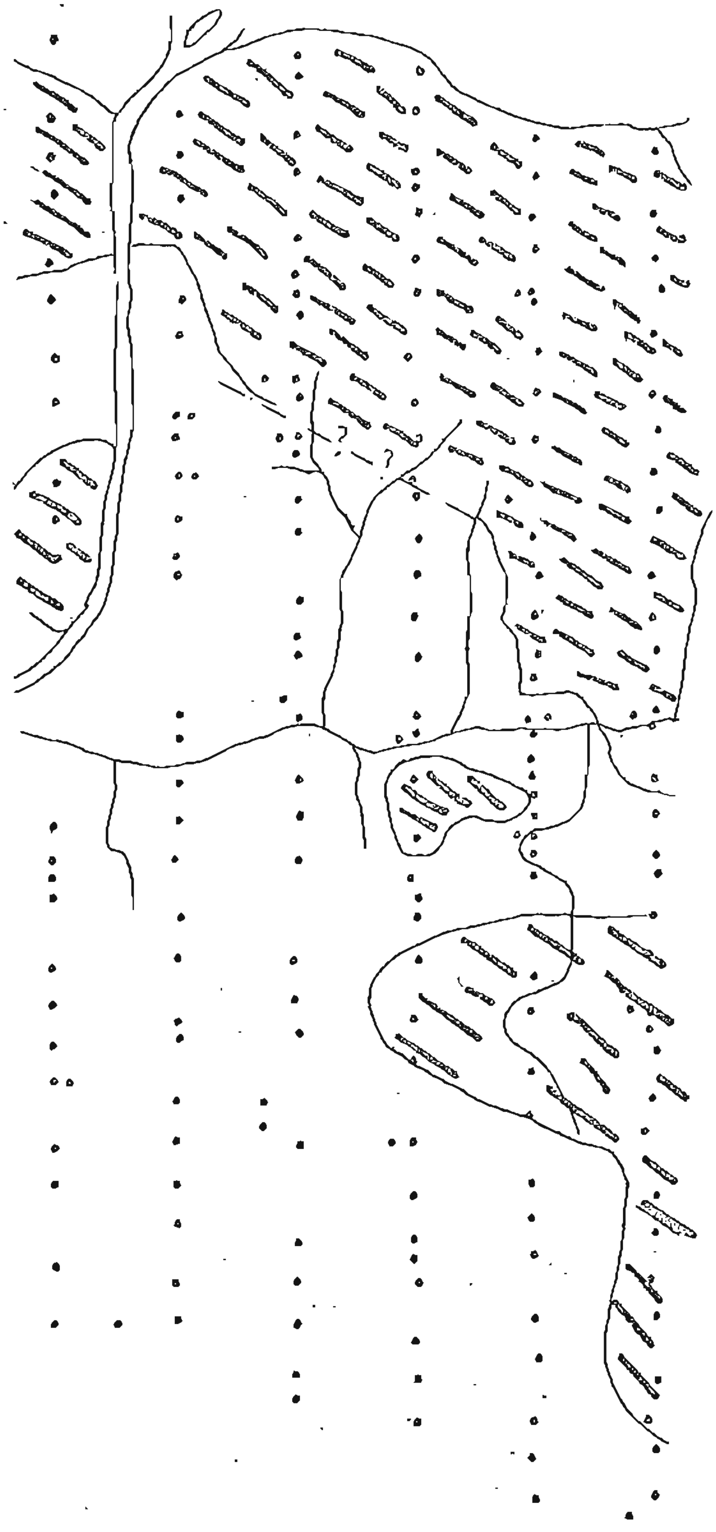
5th° Zn

100 ⊛ Localization

50 ○ Regional Contour

Figure 8

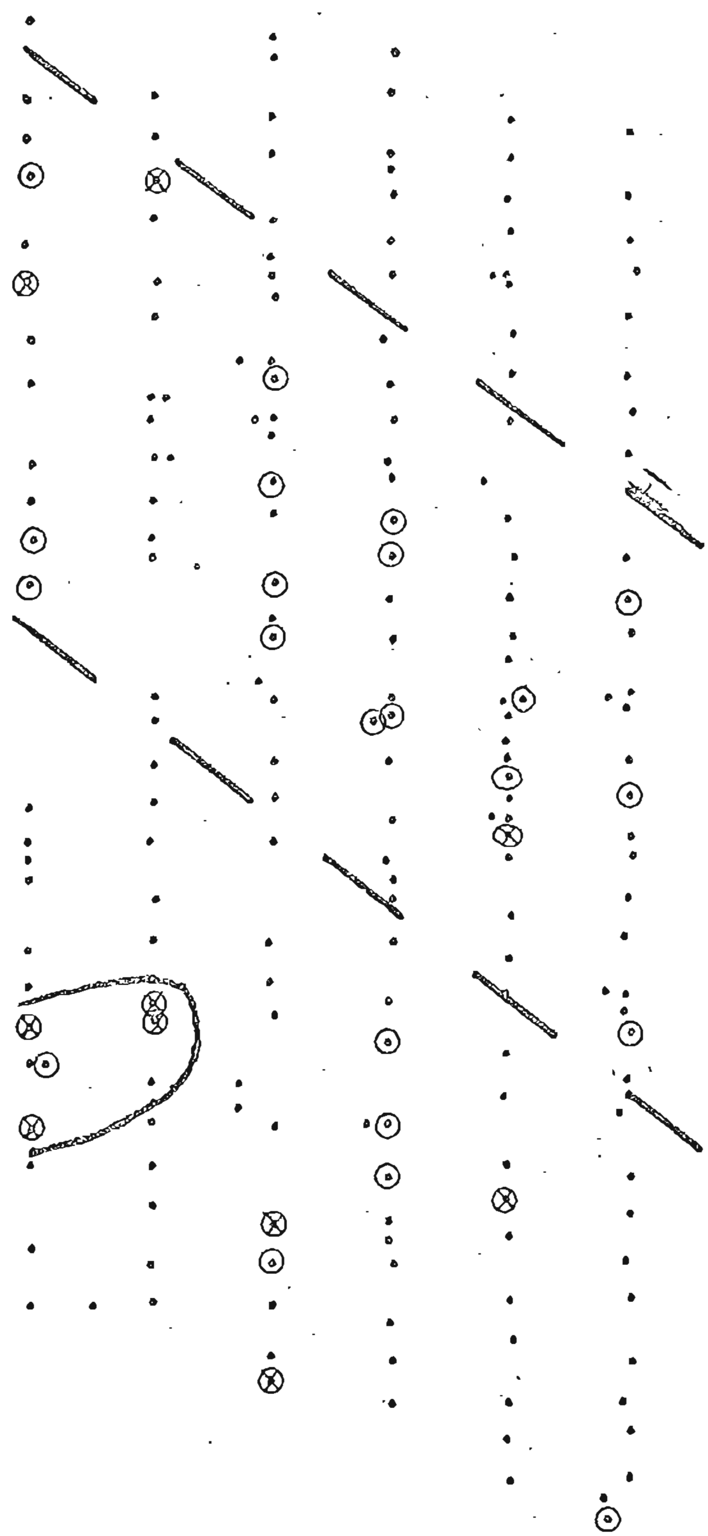
6th° Zn



Schist

Slate

Map II

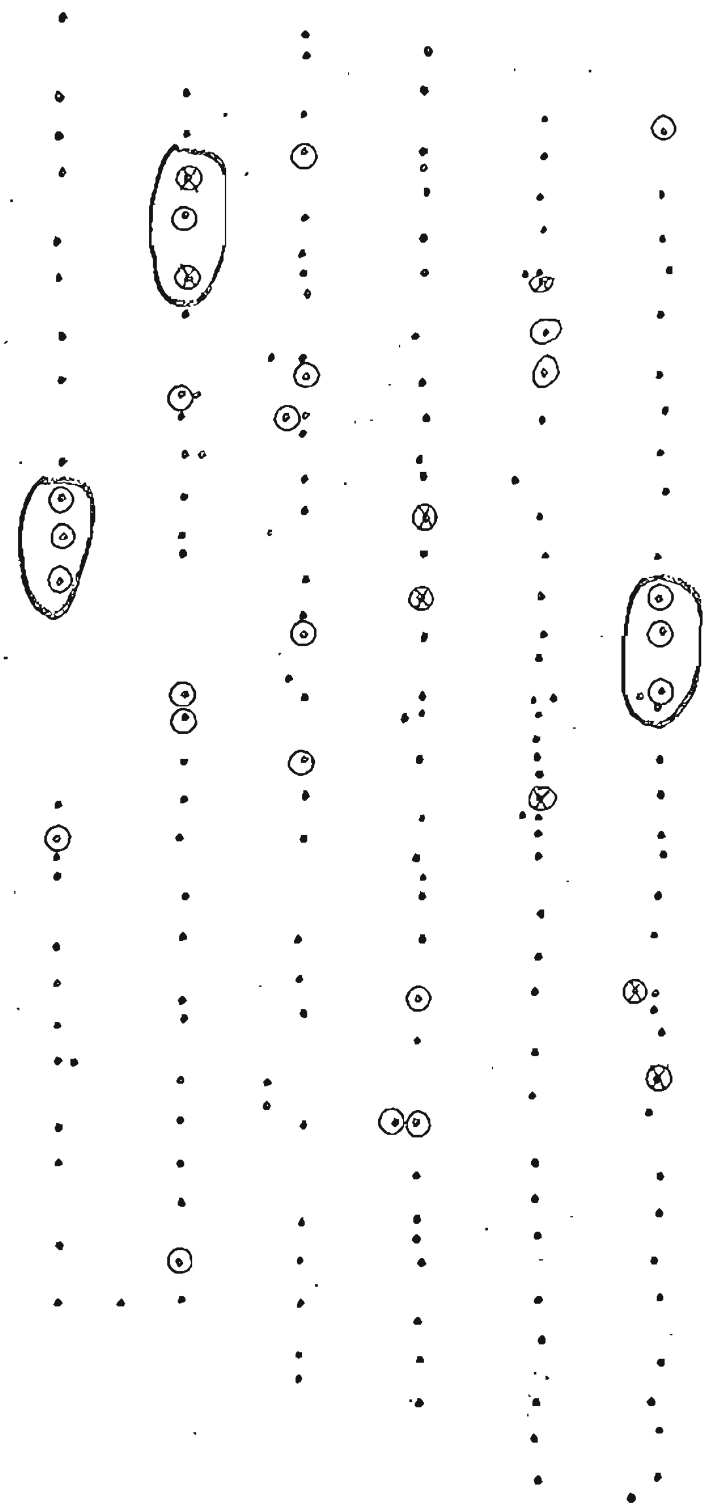


30 PPM ○ Localization

100 PPM ⊗ Lineation

Figure 9

5th° Zn



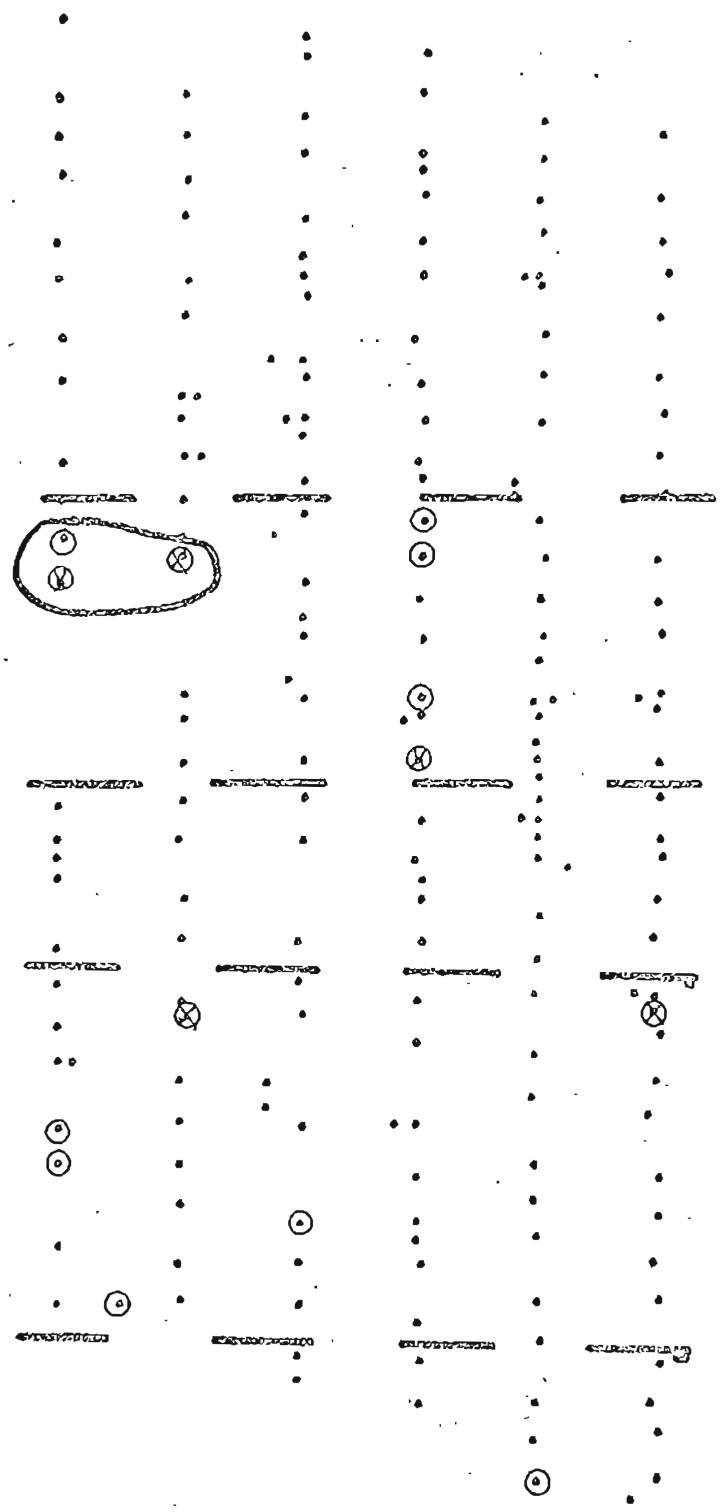
10 ○

20 ⊗

High Grouping

Figure 10

5th° Pb



75 ⊗

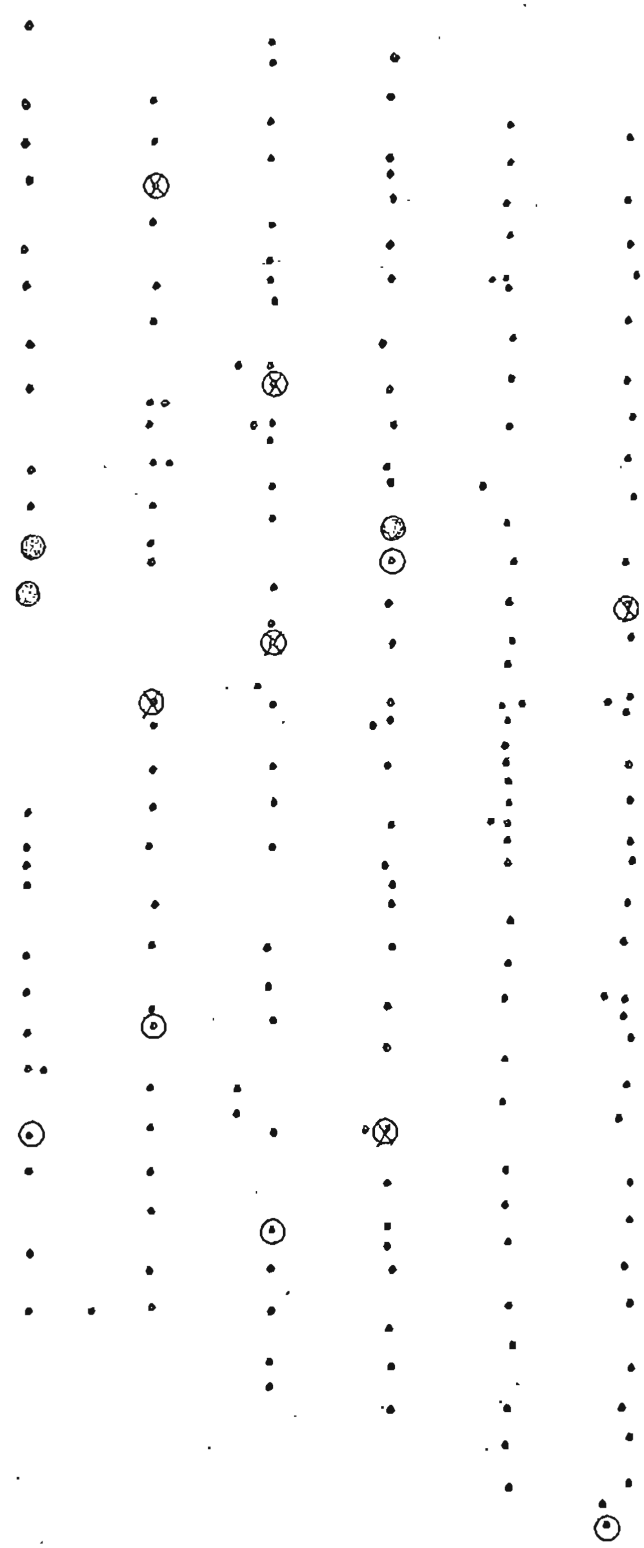
30 ○

Lineation

Localization

Figure 11

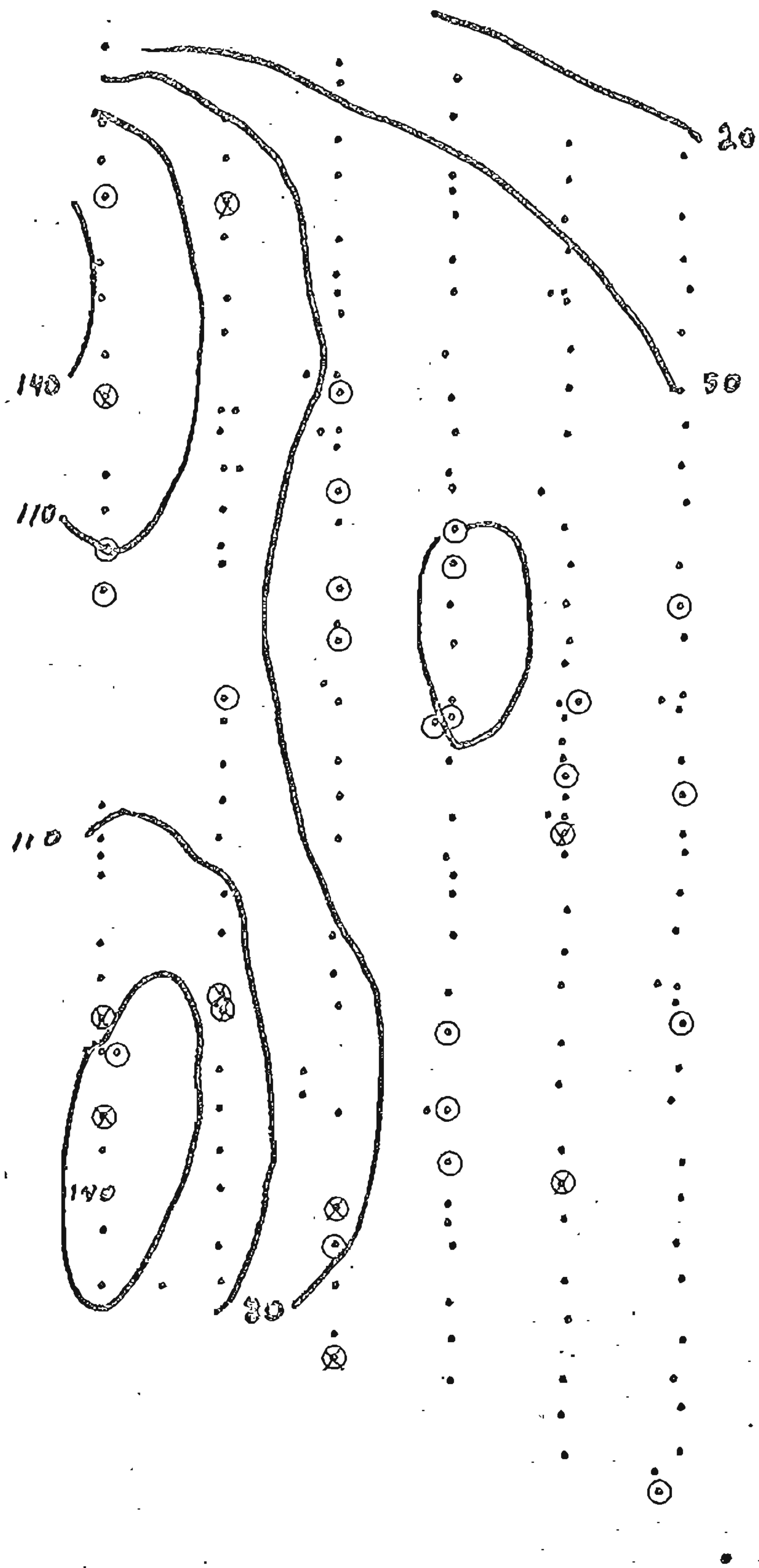
5th° Cu



Pb, Zn, Cu ⊛ Zn, Cu ○

Pb, Zn ⊗

Figure 12



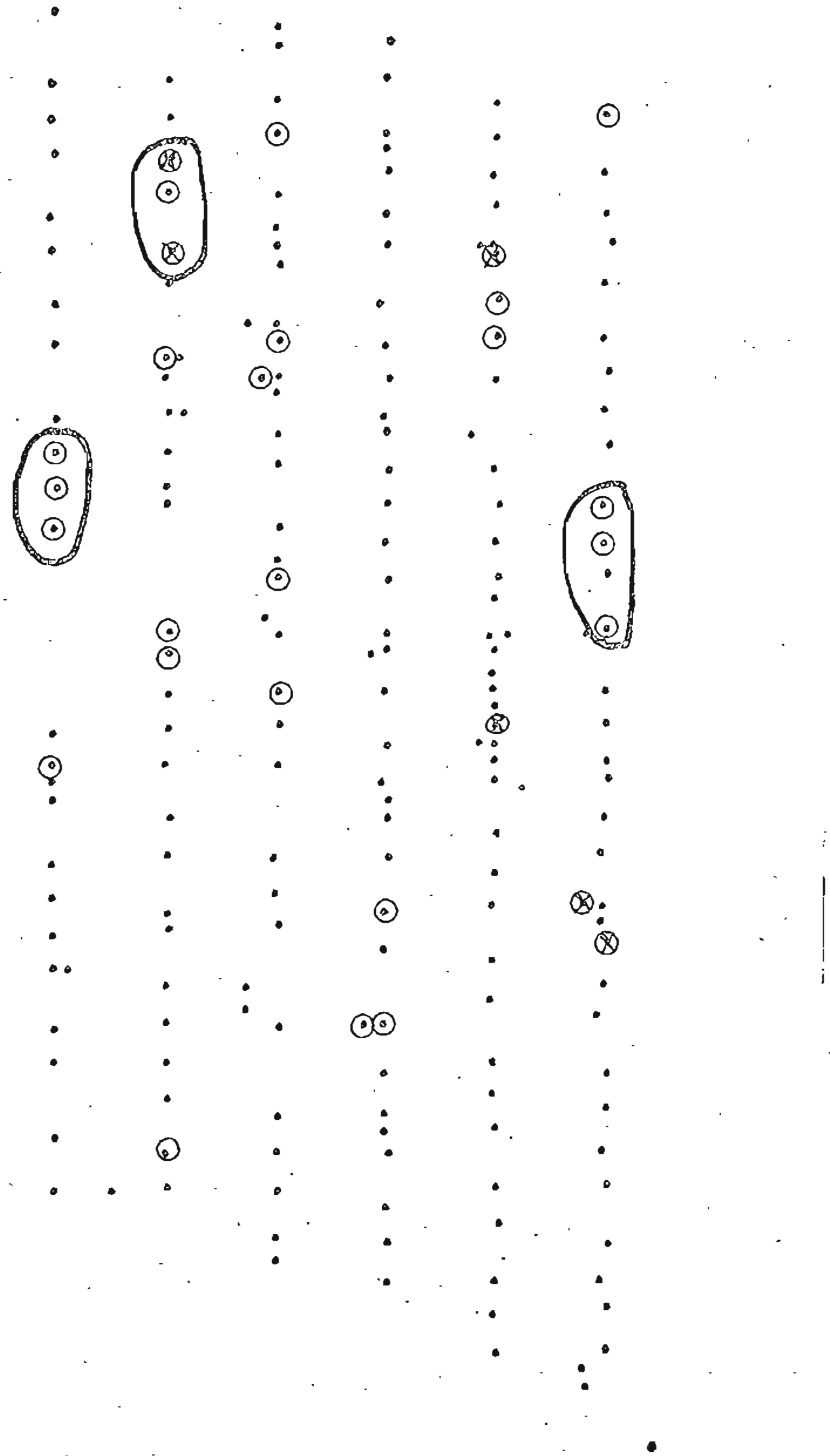
100 ⊗

30 ○

Surface Contour

Figure 13

5th° Zn



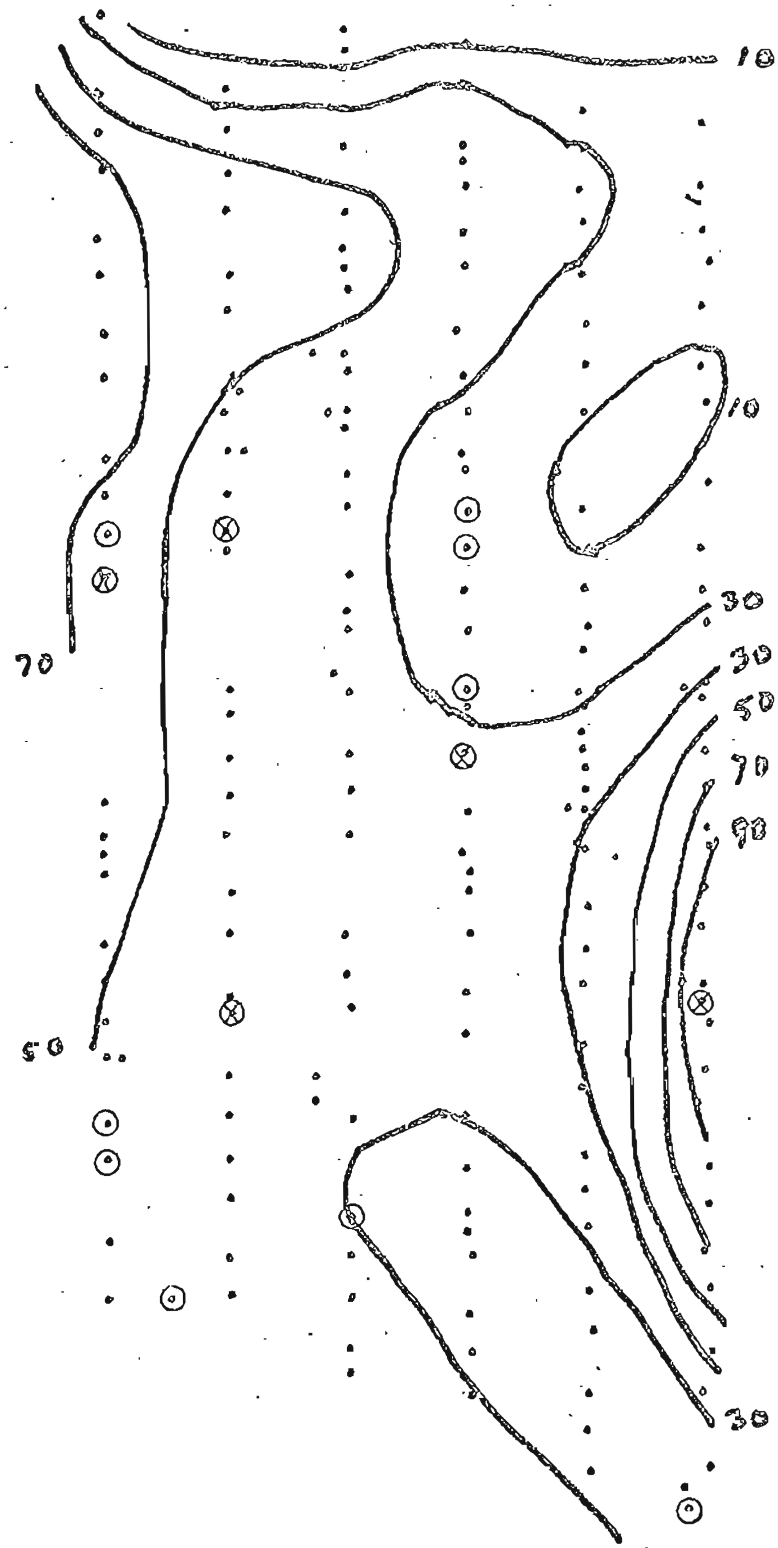
10 ○

20 ⊗

Localization ——

Figure 14

5th° Pb



75 O

30 O

Surface Contour

Figure 15

5th° Cu