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Råstofftype	**Emneord**	
Malm/metall	Cu Zn Pb	

Sammendrag

A/S SULFIDMALM

PROJECT 905 - 15

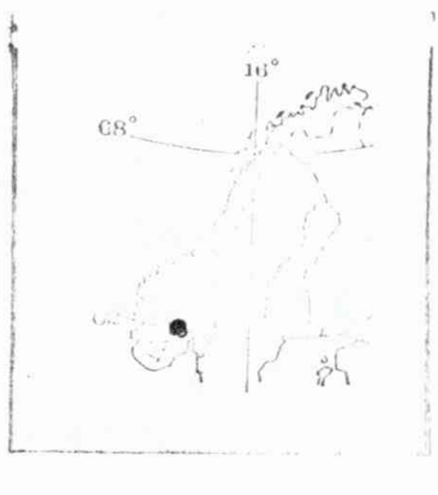
STREAM SEDIMENT GEOCHEMISTRY

HOVIN, TELEMARK

AUTUMN, 1973

by

D. ELLEN



Report Nr. 283/73/15

INTRODUCTION

This report deals with a stream sediment survey carried out in the Hovin area of Telemark, South Norway. The area contains a number of old showings, and it was hoped to discover whether there were further indications of mineralization.

LOCATION, ACCESS ETC.

The Hovin area lies in Telemark i southern Norway, to the east of Lake Tinnsjø. The nearest towns are Rjukan and Kongsberg. Access to the area is good, with highway 37 (Kongsberg - Rjukan) passing through the area. The area itself contains a number of private forestry roads, making access easy. Topography throughout much of the area consists of tree-covered hills, generally not excessively steep. Samples were taken at heights varying between 200 m and 850 meters.

GENERAL GEOLOGY

The area lies in the Pre-Cambrian Telemark Supracrustals, and the rocks are generally amphibolites and quartzites. Strike is approximately N - S with steep dips both E and W. A number of showings have been noted in the area, mainly Cu.

MINERALIZATION

Bornite, chalcocite and chalcopyrite are the main ore minerals. Bornite and chalcocite contain silver. Ore horizons are mainly quartz-veins in quartzites and calcite-quartz veins in amphibolites. Weak impregnation occurs in both types.

SURVEY

The survey was carried out in October 1973 as an orientation survey to find what response there was in an area of known showings, and pick up other areas with mineralization if possible. The area in which the survey was carried out was a rectangle of about 200 sq.kms (28 kms N-S, 7 kms E-W), centred about Hovin.

SAMPLING TECHNIQUE

133 samples were taken and wet seived to collect the - 80 fraction. As far as possible samples were taken from active sediment in the centre of streams, avoiding organic material. Each sample was taken within a stream length of 20 meters. They were assayed by F.N.L. Vancouver for Cu, Zn. Pb, Ag and Mn.

TREATMENT OF DATA

The assay results were generally rather low, and so three methods have been applied in an attempt to outline areas with anomalies. The three methods used were:

1. Tabular frequency distribution
2. Cumulative frequency distribution plotted on probability paper.
3. The method described by I. De Geoffroy, S.M.Wn, and R.W. Heins in Economic Geology Vol. 63, No. 7 (November 1968).

1. TABULAR FREQUENCY DISTRIBUTION

Tables A, B and C show the tabular frequency distribution of Cu, Zn and Pb respectively. (It should be noted at this point that Ag has not been treated, as all Ag values were either 0.1 ppm or 0.2 ppm).

TABLE A - FREQUENCY DISTRIBUTION OF Cu

	f	% f	$\leq$% f
1 - 5 ppm	108	81.2 %	81.2 %
6 - 10 "	23	17.3 %	98.5 %
11 - 15 "	2	1.5 %	100 %
Total	133	100 %	

TABLE B-- FREQUENCY DISTRIBUTION OF Zn

	f	% f	≤ % f
0 - 10 ppm	21	15.8 %	15.8 %
11 - 20 "	54	40.6 %	56.4 %
21 - 30 "	24	18.0 %	74.4 %
31 - 40 "	21	15.8 %	90.2 %
41 - 50 "	6	4.5 %	94.7 %
50 "	7	5.3 %	100 %
Total	133	100 %	

TABLE C - FREQUENCY DISTRIBUTION OF Pb

	f	% f	≤ % f
0 - 10	114	85.6 %	85.6 %
11 - 20	19	14.4 %	100 %
Total	133	100 %	

From these tables, the following critical data were selected:

Cu possibly anomalous	6 - 7 ppm	(80 % - 90 %)
probably "	8 - 9 "	(90 % - 98.5 %)
"	> 9 "	(> 98.5 %)
Zn possibly anomalous	31 - 40 ppm	(75 - 90 %)
probably "	41 - 50 "	(90 - 95 %)
"	> 50 "	(> 95 %)
Pb possibly anomalous	10 - 15 ppm	(80 % - 93 %)
probably "	> 15 "	(> 93 %)

As can be seen, the Cu and Pb values which are considered "anomalous" are extremely low, and it is somewhat presumptious to describe them as being "anomalous". The zinc values, on the other hand, show higher levels, and it is more realistic to consider them as truely anomalous.

2. CUMULATIVE FREQUENCY DISTRIBUTION

The cumulative frequency distribution plots were constructed on probability paper using a log interval of 0.1. Cumulation was taken from the highest to the lowest frequencies.

The Cu and Pb show a straight line - i.e. log normal distribution. However, the Zn shows a positive skew, the break occurring at about the 4% level, indicating an excess of high values in the population.

For Cu, the background value is taken as the intersection of the line with the 50% ordinate. The first anomaly class lies between this and the 16% ordinate, the second between the 16% ordinate and the 2.5% ordinate, and the third under the 2.5% ordinate.

For Zn the intersections at 50% and 10% define the first class, but for the second and third classes the dividing point is taken as the break in slope at the 4% level.

For Pb, the 50% and 16% ordinates again define the first class, and the second lies under 16%. The Pb line does not extend below the 2.5% ordinate within the range of values used, and there is no third anomaly class.

Thus with this method the following are taken as the anomaly classes:

Cu	High background	4 - 7 ppm
	Significant	8 - 11 "
	Highly significant	>11 ppm
Zn	High background	24 - 44 ppm
	Significant	45 - 73 "
	Highly significant	>73 ppm
Pb	High background	7 - 12 ppm
	Significant	>12 ppm

3. The third method suggests that all the values of the assays consist of three components:

(i) a regional or 'trend' component, T
(ii) a local or 'anomaly' component, A
(iii) a residual component, R.

Thus the observed value 'O' is given by

$$O = T + A + R$$

T is the arithmetic mean of field observations within a unit of reference called a 'section'.
A is the arithmetic mean of the deviates on the trend, T, taken within a smaller unit of reference called a 'cell'.
R is the positive deviate on the anomaly. The presence of residual components identifies significant data.
In this case, the cell size is taken as 1 sq. km, and the section size a 16 sq. kms.

The trend component T is the first component calculated. First the mean of the observed values in each cell is plotted at the centroid of that cell. When this has been done, it is possible to calculate the coordinates (x, y) of the centroid of the section with reference to the centre of the section by the following formulae: -

$$x = \frac{\leq x_i z_i}{\leq z_i} \quad ; \qquad y = \frac{\leq y_i z_i}{\leq z_i}$$

where (x_i, y_i) are the coordinates of each individual cell centroid.within that section, and z_i is the mean metal value of the each individual cell.
The trend value T is given by

$$T = \frac{\leq z_i N_i}{\Sigma N_i}$$

where z_i is as before, and N_i is the number of data in each individual cell.

The trends plotted in contiguous sections are contoured, and this is extended throughout the whole area. These trends are calculated for the different metals separately (See enclosure 15-74-C3).

The next step is to obtain deviates. This is done by subtracting trend values T from observed values O (i.e. deviates = O - T = A + R). Only positive deviates are plotted (see enclosure 15-74-C4), those dots without values represent negative or zero deviates).

The mean of the deviates of each cell are then plotted at the centroid of the cell. This is the anomaly component, A. These are then contoured (enclosure 15-74-C5). It should be noted that as we wish to generate only positive anomalies, negative deviates are given a zero value when calculating A.

Residual components, R, are obtained by subtracting the anomaly component A from the positive deviates. Positive residuals are residual components which identify significant data.

If several residual components occur in a small area they are considered a cluster, and clusters considered as single pieces of significant data. The residual components are plotted on enclosure 15-74-C6.

A rating index is developed consisting of a local factor and a regional factor based on cells and sections, i.e. representing local and regional geochemical conditions. To give each factor a similar weight, the regional factor is multiplied by 1/16 (the reciprical of the area it represents). The local factor is designed to give more weight to clusters which have more than one bit of significant data.

The local factor is $(2N_c - 1)M_c$, where N_c is the number of residuals in the cluster, and M_c the mean of the residuals in the cluster.
The regional factor is given by $1/16\ T_S N_S$ where T_S is the trend value of the section and N_S the total number of residuals in the section.

The expression is thus

$$\text{Index rating } K = ((2N_c-1)M_c + 1/16\ (T_S N_S))$$

This is multiplied by 100 to reduce the number of figures after the decimal point, so

$$K = 100\ ((2N_c - 1)M_c + (1/16\ T_S N_S))$$

K is calculated for each cluster.
K indices are also plotted on enclosure 15-74-C6.

The following tables show the K values for the different clusters.

Table D - K values for clusters on the Cu map

Reference No. of cluster	$(2N_c-1)M_c$	$\frac{T_sN_s}{16}$	K
1	1.215	0.922	221.7
2	1.311	0.922	222.3
3	0.705	0.897	160.2
4	3.47	0.897	436.7
5	2.94	0.635	357.5
6	2.042	0.359	240.1
7	2.952	0.759	371.1
8	0.475	0.759	123.4
9	0.062	0.359	42.1
10	2.142	1.708	385
11	1	1.708	270.8
12	3.666	1.708	537.4
13	0.047	1.708	175.5
14	0.584	0.195	77.9
15	2.061	0.325	238.9
16	1.0	0.195	119.5
17	2.2	0.212	241.2
18	2.0	0.25	225

The mean of the K values is calculated, and those with values over the mean are considered especially significant. In this table, nos. 4, 5, 7, 10, 11, and 12 are over the man.

(Reference nos. refer to enclosure 15-74-C6)

Table E - K values for Zn clusters

Ref. No. of cluster	$(2N_c - 1)M_c$	$T_sN_s/16$	K
1	15.81	3.221	1903.1
2	7.5	3.221	1072.1
3	45	4.32	882
4	35.913	4.32	4023.3
5	9	9.562	1856.2
6	38.25	9.562	4781.2
7	48.445	5.362	5380.7
8	8.275	5.362	1363.7
9	33.030	2.140	3517
10	33.273	4.621	3789.4
11	8.9	4.621	1352.1
12	7.5	1.234	873.4
13	7.875	2.468	1034.3
14	1.5	0.843	234.3
15	5.67	0.937	660.7

Nos. 4, 6, 7, 9 and 10 are above the mean K value.

Table F - K values of Pb clusters

Ref. No. of cluster	$(2N_c - 1)M_c$	$T_sN_s/16$	K
1	6.244	0.783	702.7
2	2.365	0.783	314.8
3	0.295	1.852	214.7
4	2.31	1.057	336.7
5	12.708	1.852	1456.1
6	6.834	0.484	731.8
7	0.5	1.852	235.2
8	13.92	1.302	1522.2
9	3.395	1.302	469.7
10	0.37	1.643	201.3
11	8.94	1.643	1058.3
12	1.16	1.643	280.3
13	1.0	0.281	128.1
14	4.5	0.625	512.5
15	6.4	0.462	686.2

Nos. 1, 5, 6, 8, 11 and 15 are above the mean K value.

Discussion of Results

Due to the low nature of the results, it was decided to use the three methods described in interpretation of the data.

The following table (G) shows a comparison of the number of points obtained for each metal from each method -

Table G - Comparison of methods

	Method 1	Method 2	Method 3
Cu	(20+3+2) = 25	(34+4+1) = 39	28
Zn	(24+6+8) = 38	(36+9+4) = 49	23
Pb	(16 + 9) = 25	(29 +12) = 41	22

Figures in brackets = (possibly anomalous + probably anomalous + anomalous).

Thus it is clear that the second method gives the most points.

Comparison of the results for Cu

Method 1 is illustrated on enclosure 15-74-C1A. From this it is obvious that there are very few data points with anomalous values, and that it is only in the western part of the area, north of Hovin, that we find points consistently which are possibly anomalous.

Local people informed us of a showing about 2 - 3 kms SE of Holmevann, in the south. There is one "probably anomalous value near here, but no other indications. It would appear that this showing is not really picked up.

Method 2 shows virtually the same picture, only with more possibly anomalous values (Enclosure 15-74-C1B).

Method 3 is illustrated in enclosures 15-74-C2. Enclosure 15-74-C2 shows cells contoured, indicating two areas of high (relatively) Cu. Enclosure 15-74-C3 shows contoured section trends, reflecting regional geochemistry, with higher Cu values in the west and lesser in the east. This would seem to reflect the N-S strike, with rocks in the west which have higher background values than those in the east.

Deviates are shown on enclosure 15-74-C4, and anomaly components are centoured on enclosure 15-74-C5. The anomaly components are rather small, but seem to define some areas.

The residual components in their clusters, with K values, are plotted on enclosure 15-74C6. This indicates an anomalous Cu area in the centre, central western and northwestern areas on the high K values. The two highest values occur in areas where the other methods pick out only possibly anomalous values. It is questionable whether the areas of high values are of use in the case of Cu.

In view of the all round low Cu values, it seems likely that none of of these methods has picked up any significant information.

Comparison of the results for Zn

Methods 1 and 2 (enclosures 15-74-C1C and 15-74-C1D) give very nearly the same picture, so it is convenient to take them together. Both suggest an area of anomaly in the north-west and centre-west parts of the surreyed area. The values for Zn are much higher, reaching 103 ppm. Method 3 outlines the same area, and has a high K value just to the south of it (enclosure 15-74C6). It does cut off part of the nortwest section, however, suggesting that this is due to a regional variation in background levels.

There are clusters in a number of other areas, but it is unlikely that these are of economic significance, having values of under 50 ppm in the assays.

Method 3 is illustrated in enclosure 15-74-C2 to 15-74-C6).

Comparison of the results for Pb

Methods 1 and 2 indicate the same anomaly points. In both it was possible to define only two classes for Pb. Most of the points occur across the northern part of the area, with very few in the south (enclosure 15-74-C1E, 15-74-C1F).

Method 3 (enclosures 15-74-C2 to 15-74-C6) shows similar high K value cluster areas to Cu and Zn, with perhaps less from the north-west than with Cu and Zn. There is no great concentration of points, and the likelihood of there being Pb mineralization is very slight, with maximum assay values being 18 ppm.

The enclosure 15-74-C6 showing clusters and K index values shows great similarity with the different metals. The generally higher values of the western areas, the sectional trend values and their contour diagrams all suggest that the west of the area in the northern 2/3 is made up of a different rock type with higher background values.

CONCLUSIONS:

1. The stream sediment survey undertaken in the Hovin area has returned generally very low assay values for Cu and Pb, with a few higher Zn values.

2. Tabular Frequency and cummulative frequency/probability methods used in in analysing the results pick out one area of interest in the north-western part of the region.

3. The method taking regional factors into account suggests that the north-western area picked out by the first two methods is due to a regional variation in the background levels.

4. It is likely that the area of higher values is a rock type anomaly.

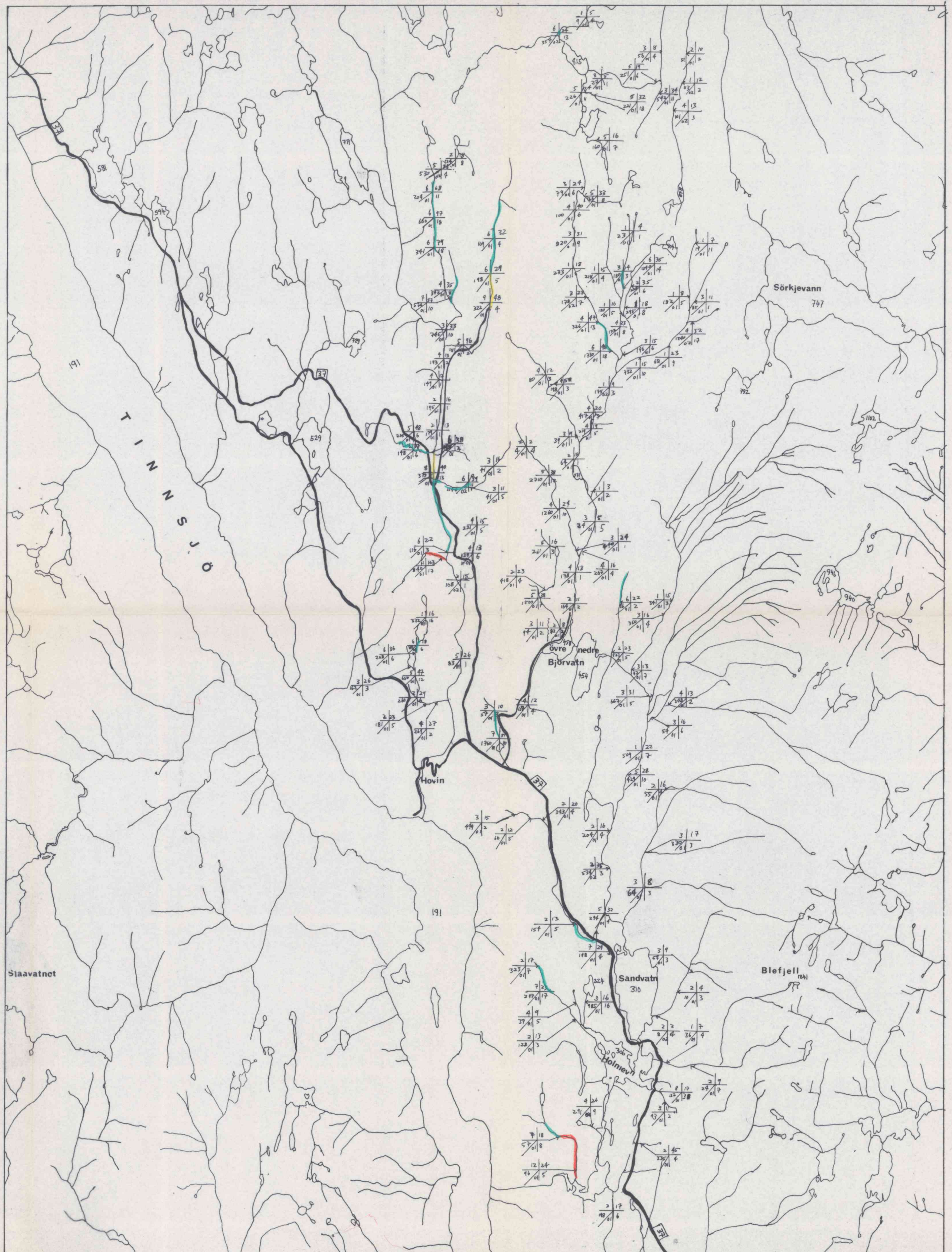
5. The other areas of interest picked up by the third method are unlikely to be of interest, as the values of the assays are so low.

6. A possible showing was not picked out.

7. The survey suggests no areas of striking interest.

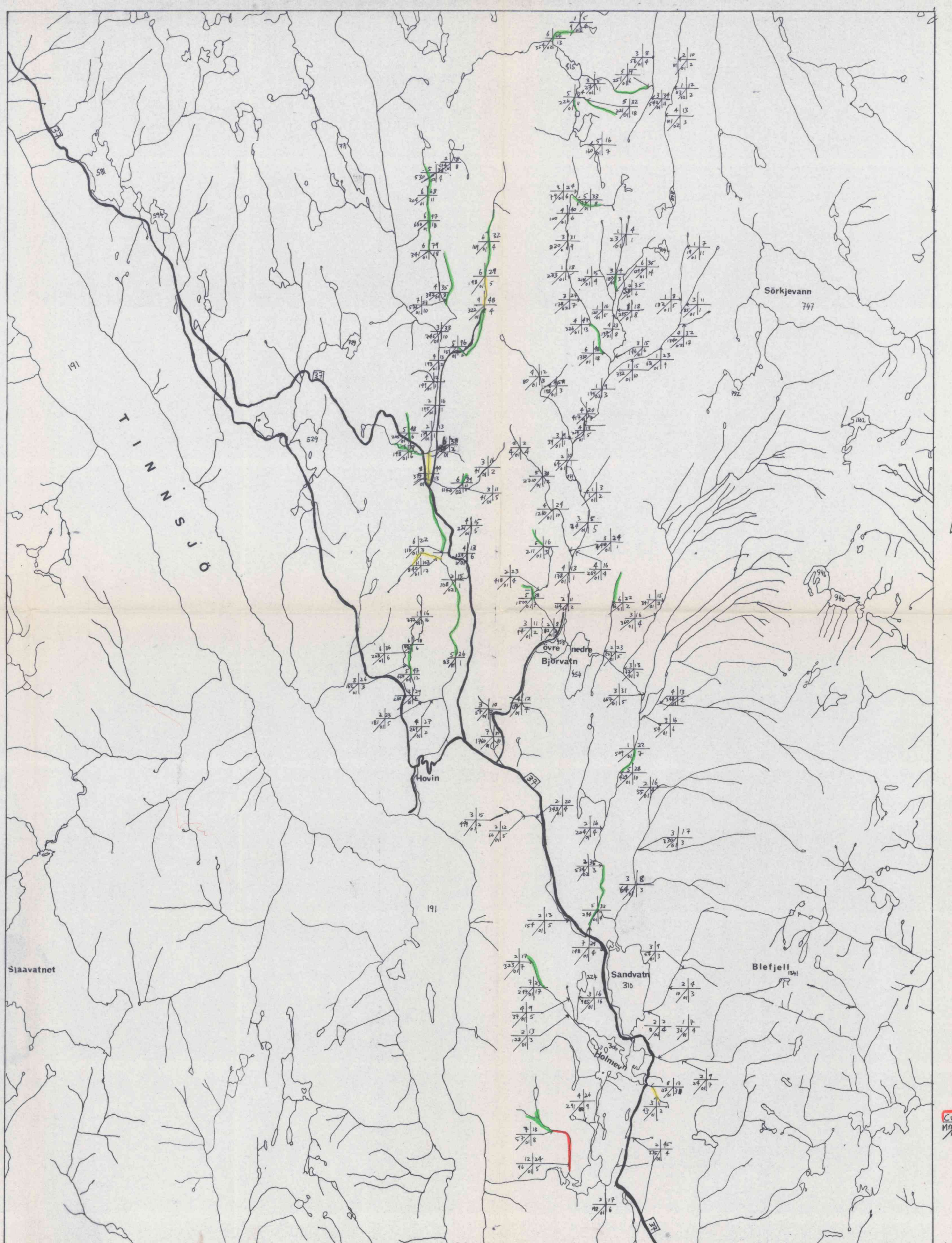
8. It is recommended that a short ground check is made in the north-western area to check the rock types, see if there is a difference, and to check for signs of Zn mineralization.

LIST OF ENCLOSURES



POSSIBLY ANOMALOUS
PROBABLY ANOMALOUS
ANOMALOUS

REGIONAL GEOCHEMISTRY	SCALE	OBS. DE.OH	9-73
HOVIN, TINN I TELEMARK	1:50000	DRAW. DE.	1-74
		TRAC. DE.	
		CHK.	
℅ SULFIDMALM	MAP NO. 15-74-C1A		
	MAP SHEET TINNSJØ 16141		



HIGH BACKGROUND
SIGNIFICANT
HIGHLY SIGNIFICANT

REGIONAL GEO

HOVIN, TINN

⅓ SULF

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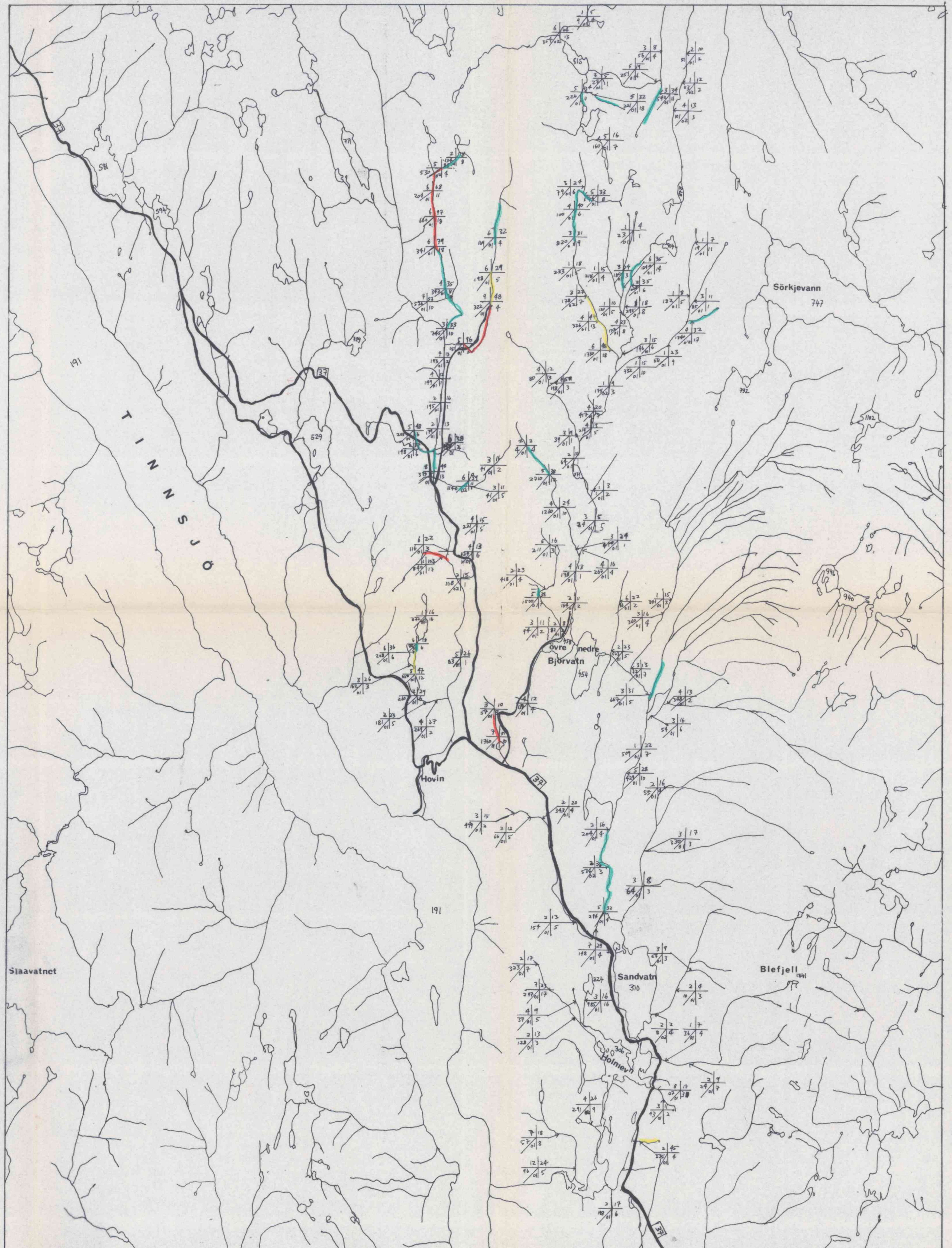

POSSIBLY ANOMALOUS

PROBABLY ANOMALOUS

ANOMALOUS

Cu | Zn
Mo | Ag | Pb

REGIONAL GEOCHEMISTRY HOVIN, TINN I TELEMARK	SCALE 1: 50000	OBS. DE.OH DRAW. DE. TRAC. DE. CHK.
A/S SULFIDMALM	MAP NO. 15-74-C	
	MAP SHEET TINNSJØ 1	

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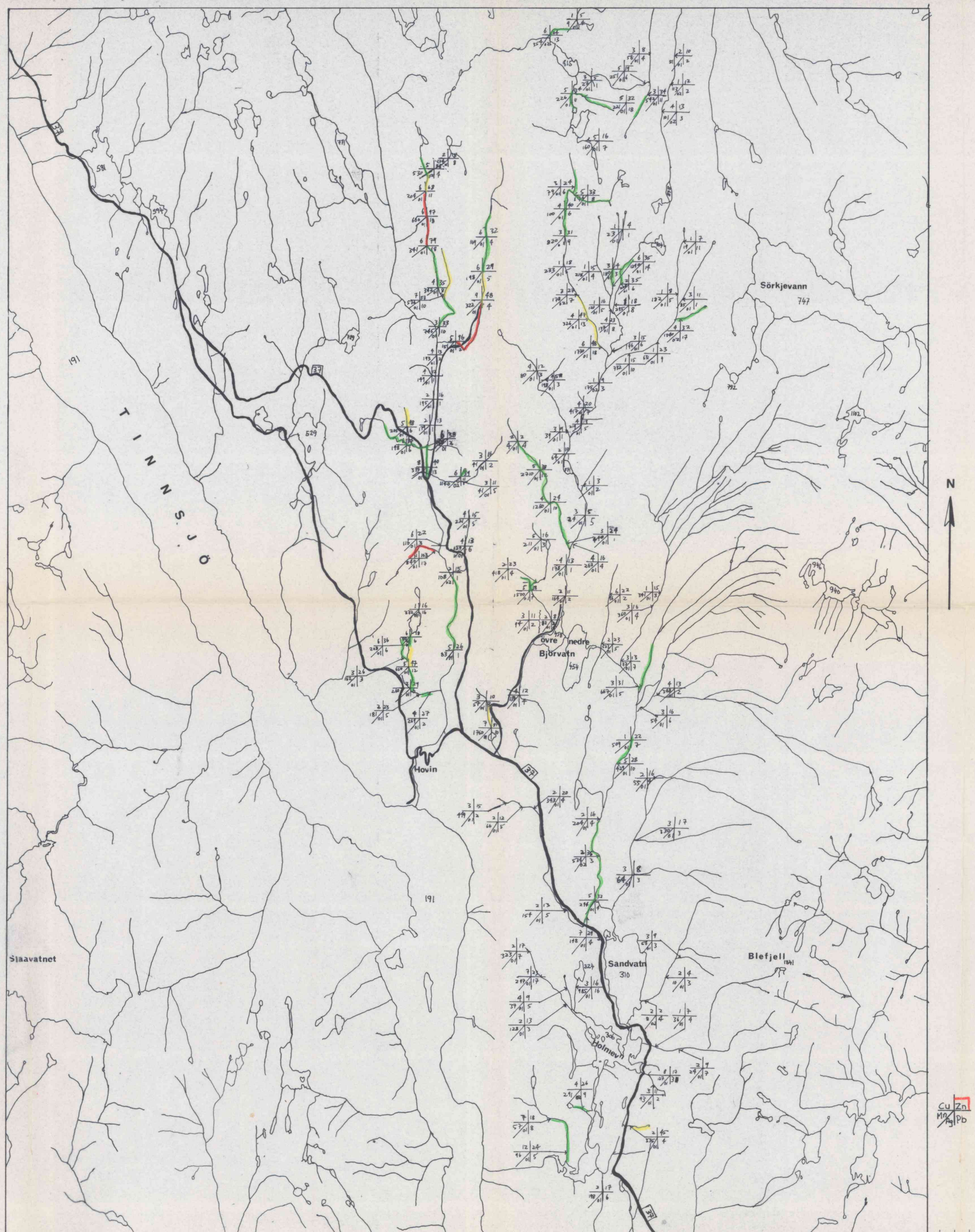

HIGH BACKGROUND
SIGNIFICANT
HIGHLY SIGNIFICANT

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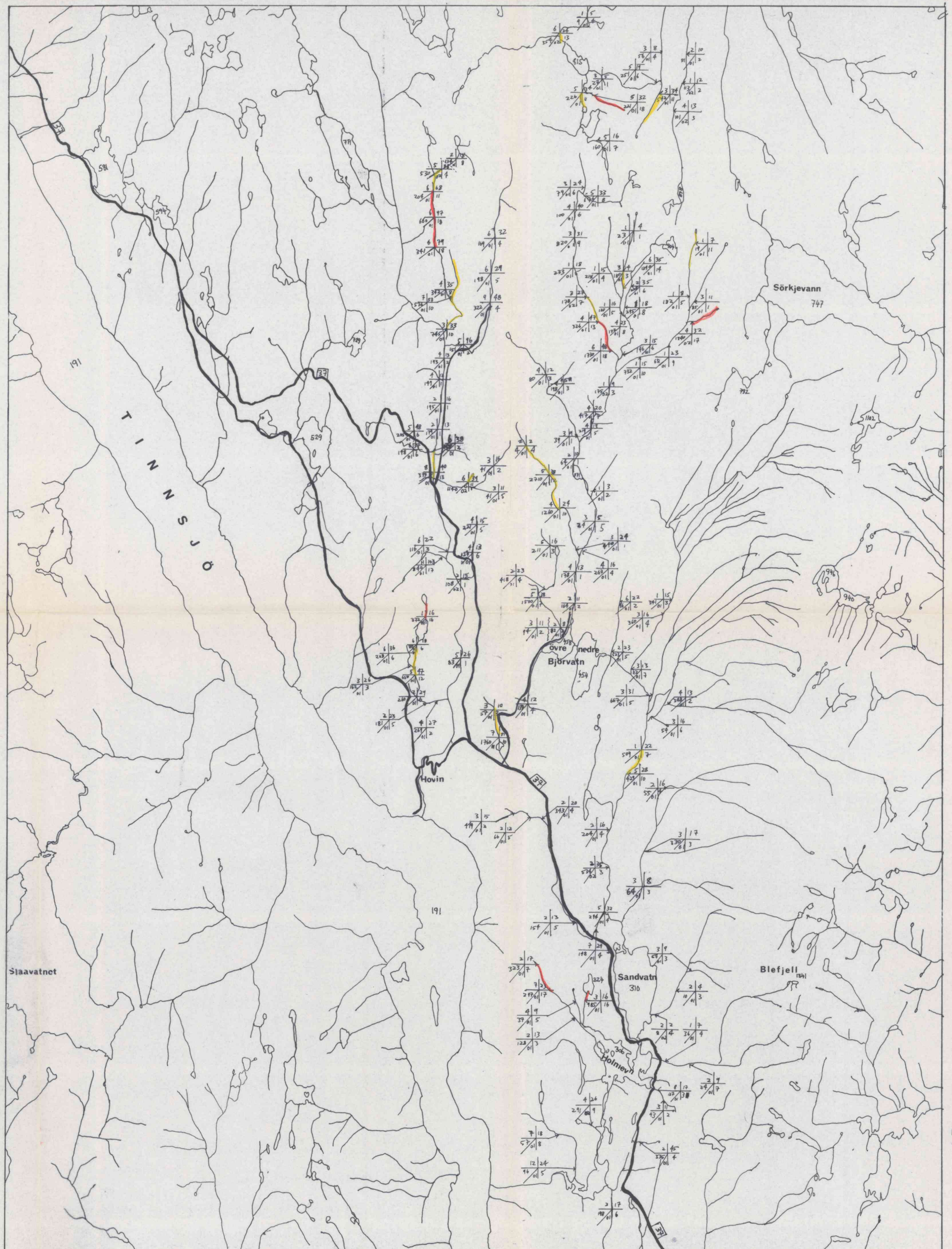
1/27



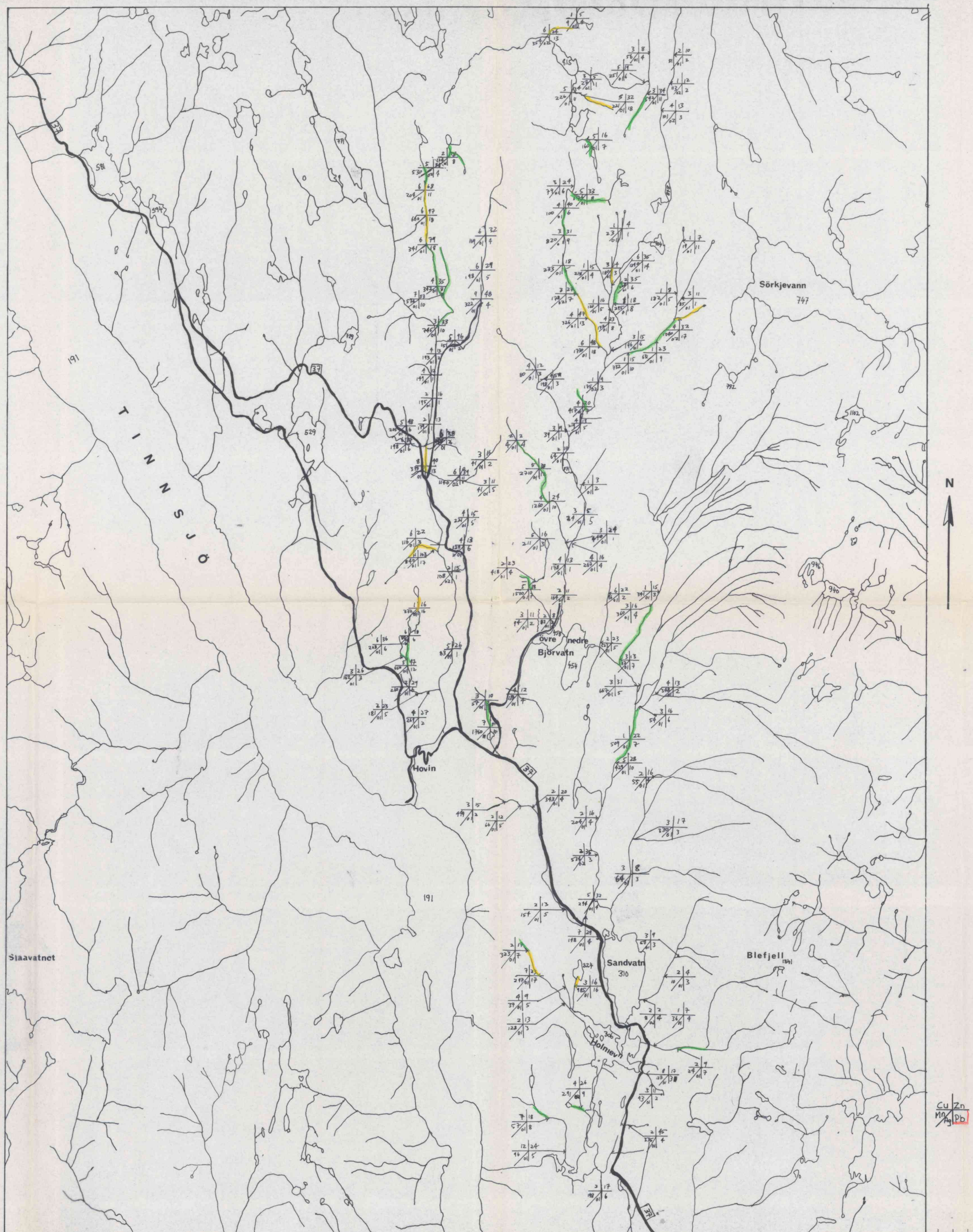
POSSIBLY ANOMALOUS

PROBABLY ANOMALOUS

Cu Zn
Mo Ag Pb

REGIONAL GEOCHEMISTRY	SCALE	OBS. DE.OH	9-73
HOVIN, TINN I TELEMARK	1: 50000	DRAW. DE.	1-74
		TRAC. DE.	
		CHK.	
A/S SULFIDMALM	MAP NO. 15-74-C1E		
	MAP SHEET TINNSJØ 16141		

1/27

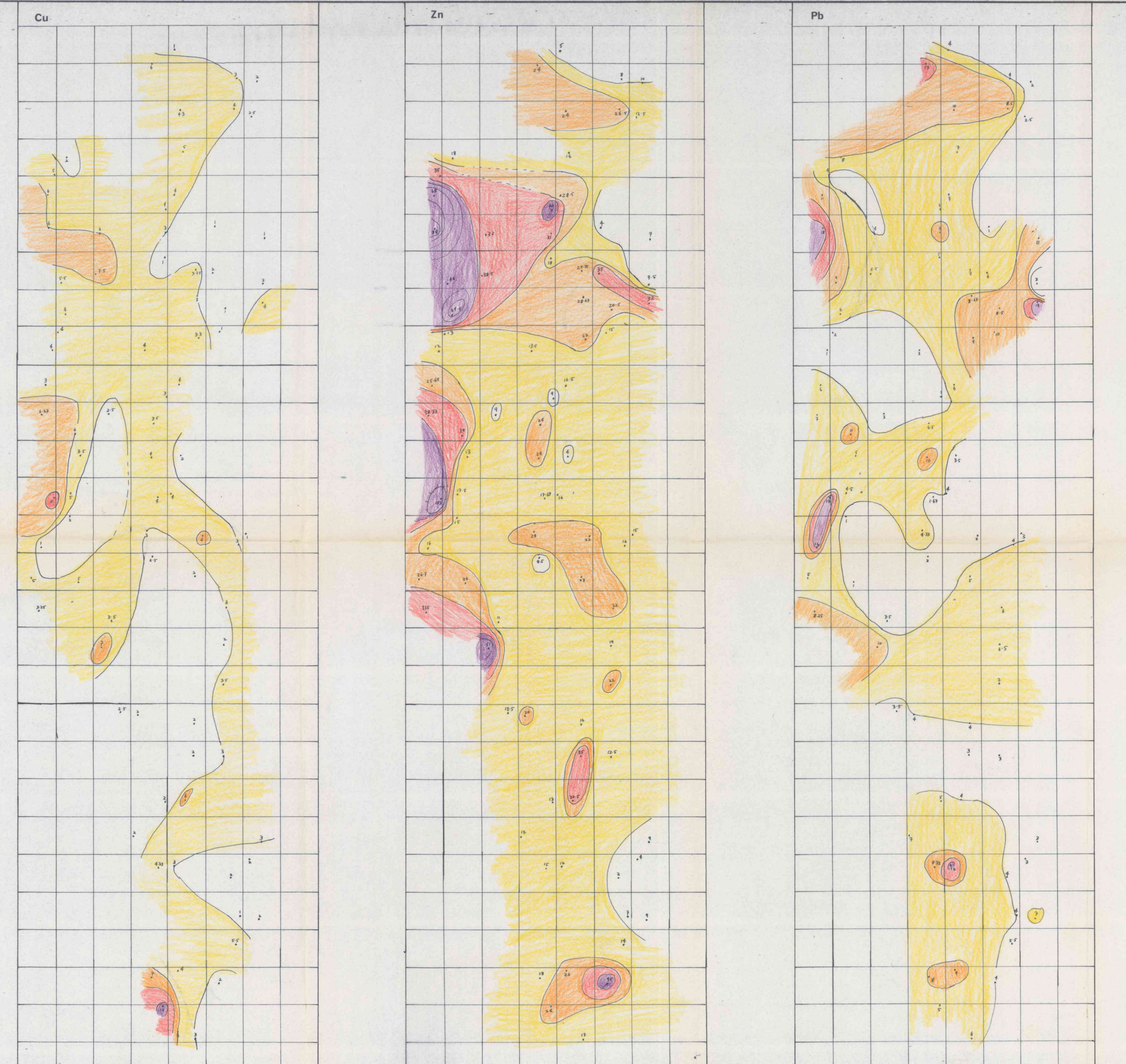


HIGH BACKGROUND

SIGNIFICANT

REGIONAL GEOCHEMISTRY **HOVIN, TINN I TELEMARK**	SCALE 1: 50000	OBS. DE.OH	9-
		DRAW. DE.	1-
		TRAC. DE.	
		CHK.	
A/S SULFIDMALM	MAP NO. 15-74-C1		
	MAP SHEET TINNSJØ 1614 I		

1/27



Cu ppm
0-3
3-6
6-9
9-12
12

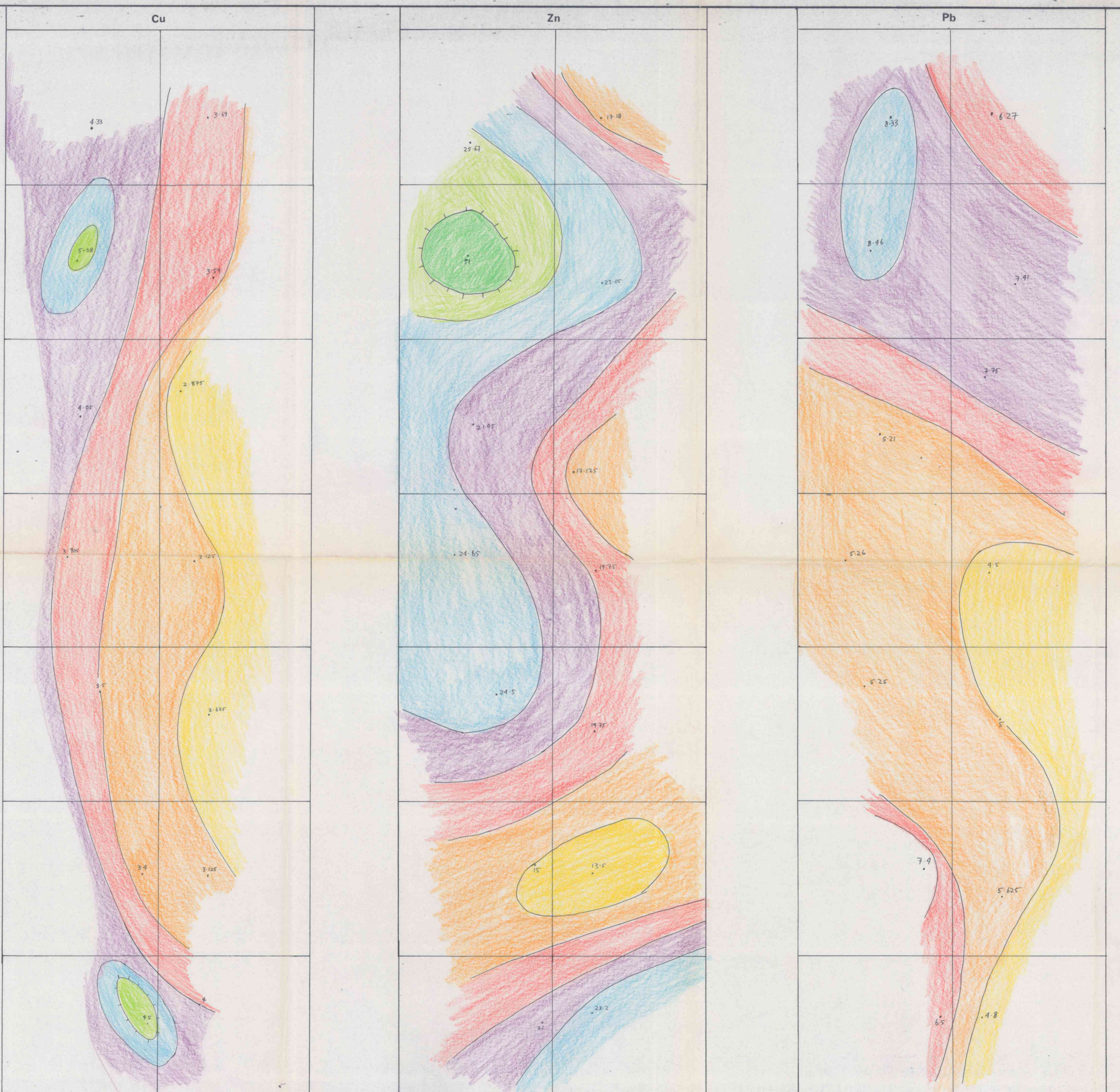
Zn ppm
0-10
10-20
20-30
30-40
>40

Pb ppm
0-4
4-8
8-12
12-16
>16

CELLS CONTOURED FOR Cu, Zn, Pb. STREAM SEDIMENT GEOCHEMISTRY HOVIN, TELEMARK, NORWAY	SCALE 1:50000	OBS.	DE
		DRAW.	DE
		TRAC.	DE
		CHK.	
A/S SULFIDMALM	MAP NO. 15-74-C		
	MAP SHEET TINNSJÖ		

A.s Terrkopi. 3000. A 1. E 9 gl. 10-71. Sentrum Trykkeri.

1/38



Cu ppn
<3
3 - 3·5
3·5 - 4
4 - 4·5
4·5 - 5
>5

Zn ppm
<15
15-17·5
17·5-20
20-22·5
22·5-25
25-27·5
>27·5

Pb ppm
<5
5 - 6
6 - 7
7 - 8
>8

SECTION TRENDS CONTOURED FOR Cu, Zn, Pb. STREAM SEDIMENT GEOCHEMISTRY HOVIN, TELEMARK, NORWAY.	SCALE 1:50,000	OBS. DE DRAW. DE TRAC. DE CHK.
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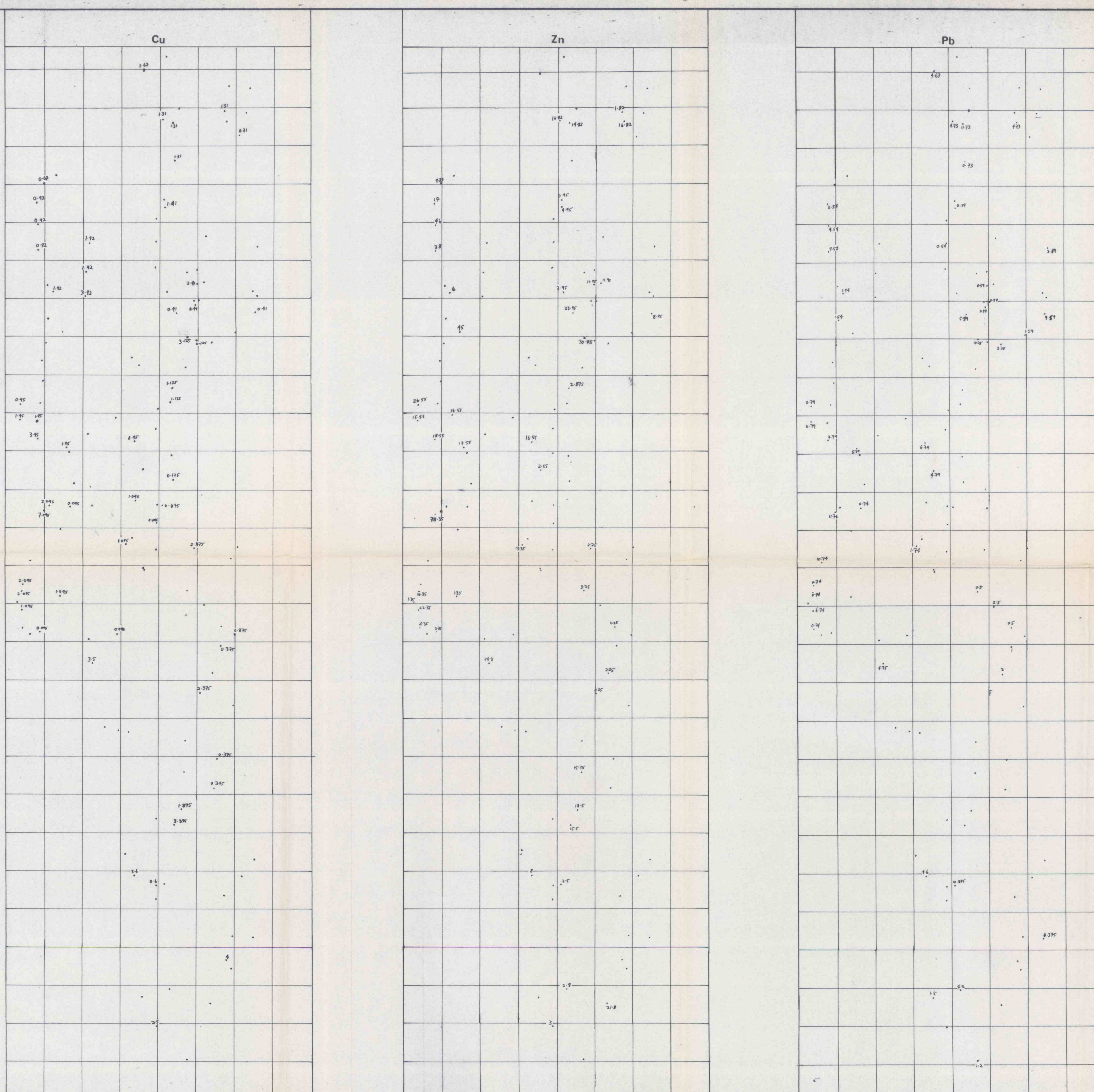
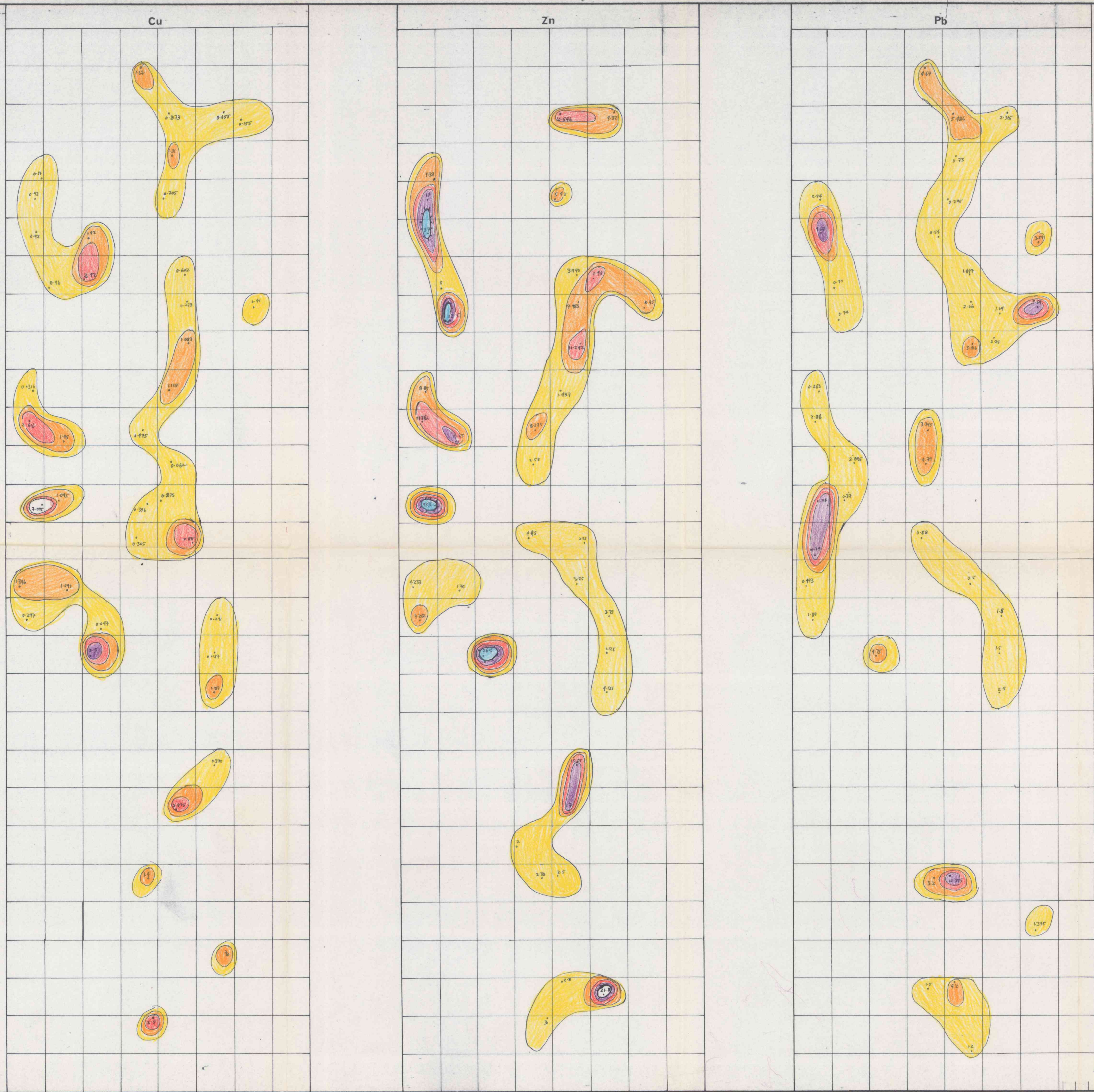


Cu, Zn, Pb DEVIATES STREAM SEDIMENT GEOCHEMISTRY HOVIN, TELEMARK, NORWAY.	SCALE 1:50,000	OBS. DE 10-73 DRAW. DE 1-74 TRAC. DE 1-74 CHK.
A/S SULFIDMALM	MAP NO. 15-74-C4	
	MAP SHEET TINNSJÖ 1614 I	



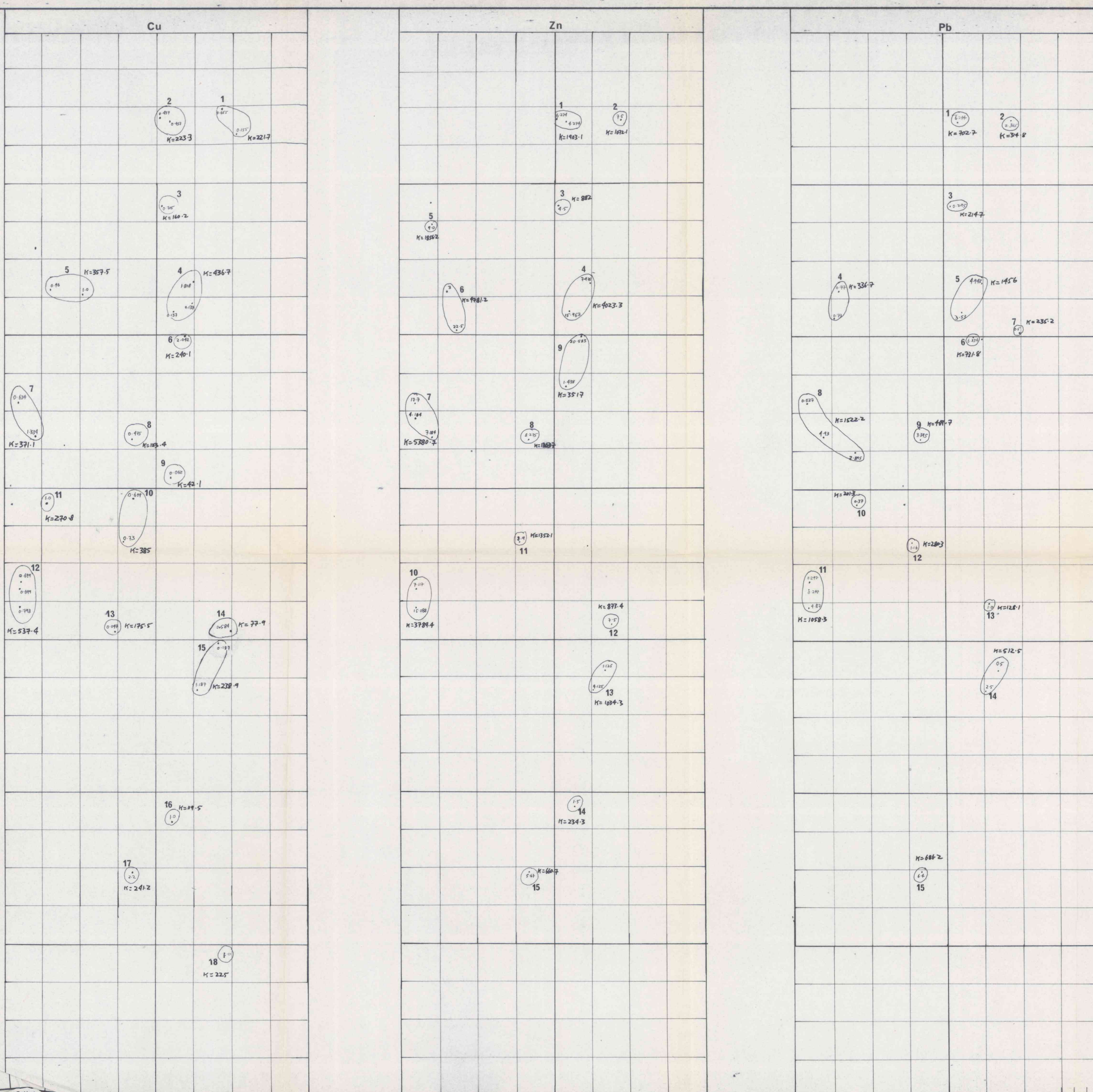
ppm
Cu 0 - 1
1 - 2
2 - 3
> 3

ppm
Zn 0 - 5
5 - 10
10 - 15
15 - 20
> 20

ppm
Pb 0 - 3
3 - 6
6 - 9
> 9

ANOMALY COMPONENT CONTOURED FOR Cu, Zn, Pb. STREAM SEDIMENT GEOCHEMISTRY. HOVIN, TELEMARK, NORWAY	SCALE 1:50000	OBS. DE	10-73
		DRAW. DE	1-74
		TRAC. DE	1-74
		CHK.	
A/S SULFIDMALM	MAP NO. 15-74-C5		
	MAP SHEET TINNSJÖ 1614 I		

3000. A 1. E 9 gl. 10-71. Sentrum Trykkeri.



RESIDUAL COMPONENTS AND RATING INDICES FOR Cu, Zn, Pb. STREAM SEDIMENT GEOCHEMISTRY HOVIN, TELEMARK, NORWAY.	SCALE	OBS. DE 10-73 DRAW. DE 1-74 TRAC. DE 1-74 CHK.
A/S SULFIDMALM		MAP NO. 15-74-C6 MAP SHEET TINNSJÖ 1614 I