COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

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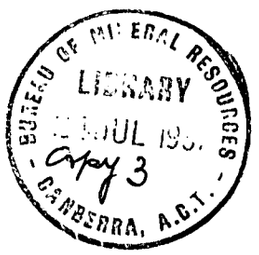

KALGOORLIE GEOCHEMICAL PROJECT REPORT, 1966.

by

J.R. Beevers

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SUMMARY

This record contains the results and interpretations of results of the trace element analysis of 239 samples from various parts of the Kalgoorlie goldfield. The main conclusion to be drawn from the analyses is that only arsenic, and possibly silver and molybdenum can be considered as indicators of gold mineralisation in the Kalgoorlie goldfield. A rapid technique for the determination of trace amounts of gold was developed during the course of this work, and the use of this technique eliminates to some extent the need for the analysis of other associated elements in the search for gold.

INTRODUCTION

The original purpose of the Kalgoorlie exercise was to obtain drill core from both lode and wall rock, country rock from near the mines, and a suite of ore samples from different mines, in order to study the trace element distribution around the gold deposits at Kalgoorlie. This project was a co-operative venture with the staff of the various Kalgoorlie mines.

This report summarizes the work done by the Bureau of Mineral Resources since the withdrawal of N.W. Le Roux from the project in 1965.

THE PROBLEM

J.F.Ivanac and A.L. Mather started the problem early in 1964. The main points of study (taken from Ivanac and Mather, 1964) are:

(i) The extent and nature of trace element haloes around high grade and low grade gold lodes. This should give a guide to the juxtaposition of gold mineralization with reference to associated trace element haloes.

(ii) The extent and nature of trace element haloes around gold mineralization in the Kalgoorlie Goldfield - Regional Geochemical.

(iii) Develop techniques for the analysis of samples for Te, Au, Hg and As.

No change in the programme has been made since that time and in fact in October 1965, the Bureau said ".....the most value should accrue from our work if we continue along the same lines as previously planned".

GEOLOGY OF THE KALGOORLIE GOLDFIELD.

The most recent publication on the geology of the Kalgoorlie Goldfields is by R.W. Woodall (1965) and the following brief summary is essentially from that reference.

Woodall considers the rock succession at Kalgoorlie to be as in Table 1.

Table 1. (Rock succession at Kalgoorlie (after Woodall, 1965).

Rock unit	Thickness	Lithology
Black Flag Beds	10,000 feet	Tuff, acid to intermediate lavas and agglomerate, sandstone, shale, slate and quartzite.
Golden Mile Dolerite	1000-2500 feet	Sill of meta-quartz dolerite and meta-quartz gabbro with minor more basic sections.
Paringa Basalt	1000-3000 feet	Meta-basalt lavas, in part pillow lavas, with minor interbedded slates.
Williamstown Dolerite	500-1000 feet	Sill of meta-dolerite and meta-gabbro transitional to meta-quartz dolerite near the top and to hornblendite near the base.
Kapai Slate	10 feet	Graphitic slate.
Devon Consols Basalt	200 -500 feet	Meta-basaltic lavas, typically pillow lavas.
Hannans Lake Serpentinite	1000-3000 feet	Massive fine grained serpentinite.

The doleritic rocks are broadly concordant and probably are sills. Where the basic igneous members of the rock succession have not been affected by subsequent metasomatism, they are composed of albite and pale green hornblende. Quartz, saussurite, ilmenite, leucoxene, epidote and zoisite are common in varying amounts. The mineralogy indicates the albite-epidote-amphibolite facies of regional metamorphism. Quartz dolerite amphibolite is a term used to describe the unmetasomatised doleritic and basaltic rocks.

The basic and ultrabasic igneous rocks are extensively chloritized and carbonatized on a regional scale. The chloritized doleritic rocks are referred to as "quartz dolerite greenstone" and the chloritized basalt as "fine-grained greenstone". In the main productive area of the Golden Mile, the Paringa Basalt is bleached to a quartz-carbonate-sericite rock, and is known locally as "calc-schist".

The regional structure of the Kalgoorlie goldfield is a series of steeply dipping isoclinal folds with which are associated several major strike faults. Oblique faults have segmented some sections of the fold structures. The Kalgoorlie productive area is shown in plan in Figure 1.

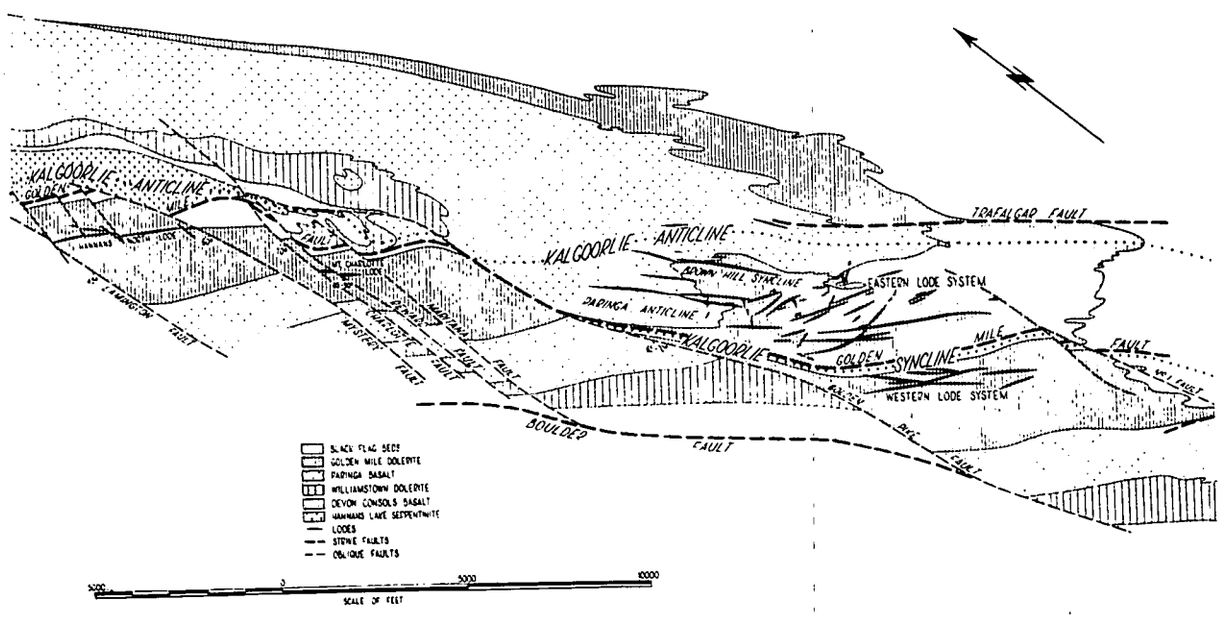


Figure 1: Geological plan of Kalgoorlie Productive area (after Woodall, 1965).

MINERALIZATION

The most productive rock in the Kalgoorlie goldfield has been the Golden Mile Dolerite, but important gold mineralization also occurs in the Paringa Basalt especially near its upper contact, with the Golden Mile Dolerite.

Two types of gold mineralization occur in the Kalgoorlie goldfield. The first, from which most of the gold production at Kalgoorlie has come, is a pyritic emplacement along steeply dipping shears and fractures, carrying free gold and gold tellurides. This type of mineralization extends for approximately three miles along the Kalgoorlie Syncline (Woodall, 1965, see Figure 1.)

The second type, in contrast to the gold telluride mineralization, is free of tellurides, while the associated pyrite is commonly coarser in grain size and contains insignificant amounts of gold. This type of mineralization is exploited only at the northern end of the field, e.g. at Hannans North Mine where the ore occurs as replacement type lodes along shears, and at Mount Charlotte where it occurs as stockworks of quartz veins. (Woodall, 1965).

The second type of ore is described, for convenience, as gold-quartz mineralization to distinguish it from the gold-telluride type. It is localized in the Golden Mile Dolerite on the western limits of the Kalgoorlie Syncline.

The important point to note from the geology is that both gold-telluride and gold-quartz mineralization occur only in chloritized host rocks which are usually bleached adjacent to the lode or vein. The width of bleaching may vary from a few inches to many feet (Woodall, 1965).

LOCATION OF SAMPLES

The samples were obtained from only two of the companies operating in the Kalgoorlie goldfield. Numbers BMR 012007 - 012029 are from No.4 lode of a lease of Lake View and Star Limited. The remainder, Numbers BMR 012030 - 012245, are from Gold Mines of Kalgoorlie (Aust.) Ltd., leases. The range of samples covered only six sections at various levels as described in Tables 2 - 7, and consist of lode material, Golden Mile Dolerite and Paringa Basalt.

Figures 2 - 10 show the sample locations and were prepared from mine-maps provided by Gold Mines of Kalgoorlie (Aust.) Ltd., and Lake View and Star Limited.

EXPERIMENTAL

Elemental analyses on the samples numbered ten. Of these Au and As values were supplied by Western Mining Corporation. Ni, Co, Cu and Zn values were obtained using an aqua regia digestion followed by atomic absorption spectrophotometry, and the remaining elements (Mo, V, Ag and Pb) were determined by emission spectrography.

RESULTS

The complete list of analyses available on the samples, irrespective of the method used to obtain them, are given in Tables 2 - 7, Figures 2 - 10 show the sampling sites, sample points, and the elemental analyses showing anomalous values. Average values and ranges are given in Table 8.

DISCUSSION

Before any attempt is made to assess the results as a whole, the results for the six sample traverses are considered separately.

Golden Horseshoe No.4 Lode 700-foot level - Golden Mile Dolerite.

As, Cu and Zn (Figure 2) are the only elements showing sufficient variation for individual values to be considered anomalous. Of the samples taken, only three contained gold, and these also contained anomalous arsenic. Some samples, taken between two samples containing gold, contained anomalously high arsenic, which shows that arsenic is not physically associated with the gold although the two elements commonly occur together. There was also a tendency for gold-bearing samples to be anomalously high in copper, although some samples anomalously high in copper contained no gold. High zinc values were not directly associated with high gold values, but a high zinc value was obtained on a sample only four feet to the west of the sample containing 8.8 dwts/ton gold.

Some samples contained Ag, Pb, or Mo, but these three elements will be discussed later.

"B" Lode and D.D.H. P447 from 934 foot level - Paringa Basalt.

As, Cu, Ni, Zn and V values (Fig.3.) have sufficient range for some values to be considered anomalous. The high gold-content samples have only weakly-anomalous arsenic values associated with them. The main arsenic anomalies straddle the north Kalgurli Fault, as do the very high Ni and Zn values. The anomalous copper, nickel and zinc values are generally not associated with the high gold-content samples. Of interest with nickel is the relatively higher background values to the east of the North Kalgurli Fault, suggesting differentiation of the Paringa Basalt.

Vanadium behaves quite differently by showing a marked increase in values in the zone of gold mineralization, that is to the west of the datum point, although there does not appear to be any direct correlation between gold and vanadium. No change in vanadium values occurs when moving across the North Kalgurli Fault, and this element does not appear to offer any guide to differentiation. Silver and molybdenum are commonly, but not invariably, associated with gold mineralization, and it would appear from this traverse that only V, Ag and Mo could be considered to be indicative of gold mineralization. Gold mineralization occurs primarily in the differentiate that is intrinsically low in Ni and Zn. In this section there is no apparent relationship between Au and As.

Samples taken across this lode 270 feet to the north of the above, did not show any trace element analyses of interest. Nor did the values (Fig. 4) differ from those obtained on the samples further south in the same lode.

"B" Lode, D.D.H. P448 from 934-foot level - mainly Paringa Basalt.

Only As, Cu and Zn (Fig. 5) have sufficient variation for individual values to be considered anomalous. Background arsenic values along the drill-hole are very low, and anomalous arsenic values occur in the Paringa Basalt, in the mineralized basalt and in the siliceous lode. Nearly always these arsenic anomalies are associated with high grade gold mineralization. In other words, the gold-telluride mineralization appears to be very closely related to the phase of arsenic-pyrite mineralization. Average arsenic values

in the mineralized basalt and the mineralized siliceous lode are much higher than in the adjacent virtually unmineralized Paringa Basalt. Only one sample along the drill-hole contains anomalous copper and this also contains appreciable gold mineralization. Many other samples containing gold do not have clear-cut anomalous copper values associated with them. The siliceous lode has a very low copper content. The anomalous zinc values generally occur with gold-bearing samples; a notable exception occurs about 25 feet into the Paringa Basalt to the north-west of the strong fault zone. There is a tendency throughout this drill-hole to get high Cu, Zn and As in the same samples, and for these samples generally to contain gold.

Many of the samples contain Pb, Ag and Mo, either together or separately, but there seems to be no clear-cut association of these elements with gold. They will be considered further when the results as a whole are considered.

Doolette Lode, 470-foot level D.D.H. NNB18 - Paringa Basalt.

Only As, Cu and Zn (Fig. 6) have sufficient variation for some values to be considered anomalous. In all cases where anomalous arsenic values are obtained there is some gold mineralization but there is no direct correlation between the gold content and the arsenic content. The background arsenic values are very low. Two copper anomalies are associated with economic grade gold ore-but-one other copper anomaly to the west of the lode has no associated gold. All the anomalous zinc values are associated with economic gold mineralization. There are some sporadic Ag, Pb and Mo values but these do not appear, from these results, to be intimately associated with gold mineralization. They are considered later when the results as a whole are considered.

Hannans North, 124-foot level: Golden Mile Dolerite.

Figure 7 shows the relative positions of the two sampling traverses.

Only As, Cu and Zn (Figures 8 and 9) values have sufficient variability for any single values to be considered anomalous.

Western Traverse (Fig.8.)

Rather than being directly associated with gold, arsenic seems to be anomalously high in the narrow shear zone to the west of the lode. Zinc values show a steady increase in value as one moves west from the lode. The two anomalous copper values are not associated with gold mineralization at all but rather straddle the quartz vein, which itself predates the faulting and shearing.

Eastern Traverse (Fig.9.)

As with the western traverses, arsenic highs tend to be in the shear zone rather than in the lode. Of the two high zinc values, one is associated with gold, the otheris not. Copper shows no significant variation.

The very low average nickel content of the samples, compared with other samples from the Golden Mile Dolerite, e.g., the Golden Horseshoe No.4 lode 700-foot level and the Perseverance lode, could indicate differentiation. On the other hand, considering that in the Hannans North area the mineralization is of the gold-quartz type with presumably a different mineralizing fluid to the Au-Te, removal of nickel could have taken place by the mineralizing fluid or during chloritization or bleaching. One cannot be sure from chemical results alone.

Some samples contained Pb, Ag and Mo, and these samples generally, if not always contained gold. One sample that was particularly high in Mo content (1000 ppm) was examined in detail (Pontifex, pers. comm.) but no Mo minerals were found. Mo, Ag and Pb values will be considered further when considering the samples as a whole.

Perseverance Lode, 342-foot level - Golden Mile Dolerite.

Of the elements determined, only As, Cu, Zn and V (Figure 10) have sufficient variation for any single determination to be considered anomalous. Within the lode, As values are relatively high and they parallel the gold values. Although there is a wide spread of copper values both within and outside the lode, there is no correlation between copper content and gold content. This is true for zinc and gold also, although there is a greater range of zinc values within the lode than outside it.

Despite the widespread vanadium values both within and without the zone of gold mineralization, there is no apparent correlation between V and Au values. The few Ag and Mo values given appear to parallel fairly well the gold mineralization.

GENERAL DISCUSSION

The results reported herein are insufficient for a true geochemical picture of the Kalgoorlie goldfield to be made. They can do nothing more than give indications and caution must be exercised in their use, lest they give misleading or erroneous indications. Of the 239 samples, 80 are taken in the Golden Mile Dolerite with a sample coverage of only 152 feet, and 159 are taken in the Paringa Basalt with a sample coverage of 383 feet.

Looking at the results generally, from the six different sampling sites within the Kalgoorlie Goldfield, only arsenic could be considered to be at all indicative of gold mineralization. In some cases there is a strong suggestion that arsenic-pyrite mineralization took place from a closely related, (if not the same) phase of mineralization as gold telluride mineralization. In the "B" lode 934-foot level of the Paringa Basalt, there were no arsenic anomalies associated with gold mineralization, but here, the level of arsenic along the sampling strips was generally high, in fact roughly a factor of five higher than in other parts of the Paringa Basalt.

In certain cases, there are indications that Cu, Zn and V, together or singly, are anomalously high in areas of gold mineralization, but this is by no means general. The quite sporadic high Cu, Ni, Zn etc., values suggests that some, if not all of these metals are introduced, rather than being part of the original rock; in one sample, sphalerite was in fact observed as a small vein. Cu, Ni, Zn etc., could conceivably have come initially from the same mineralizing fluid as the gold.

One interesting geochemical fact that has emerged from the result is that the Paringa Basalt has a higher zinc, copper and nickel content than the Golden Mile Dolerite. Furthermore, differentiation of the Paringa Basalt is suggested from the trace element assemblage.

So far, very little attention has been paid to the Ag, Pb and Mo values obtained. To study these, the Kalgoorlie field was considered as one unit, best rock types were disregarded and no attention was paid to whether or not the samples were from a gold-quartz type mineralization or a gold telluride.

Silver

The values of gold for all samples containing gold or silver or both, were arranged in increasing magnitude and these gold values, plus the corresponding silver value were plotted as shown in Figure 11. Although there is no definite conclusion to be drawn, there is a general tendency for an increase in silver content with increasing gold. This is not surprising when one considers that the atomic radii of gold and silver are very similar, and both have a co-ordination number of 12, which enables the two metals to form a continuous series of solid solutions, for example in telluride minerals.

Lead

All lead and gold values on samples containing either or both of these elements were plotted in the same way as the gold and silver values. They are shown in Figure 12. Quite clearly there is no correlation between the lead and gold content of the samples taken. Many samples containing gold do not contain any detectable lead although the samples particularly rich in gold, do contain a few hundred parts per million lead. It is possible therefore that in the cases where lead mineralization occurs with the gold, they are genetically related.

Molybdenum.

Molybdenum and gold values were plotted as for silver and gold (Fig. 13). Of the samples containing gold, 23% did not contain any detectable Mo (27% did not contain detectable Ag and 60% did not contain detectable Pb), but there was still a general overall increasing Mo content with increasing gold content. It is interesting to note that only two samples contained Mo yet did not contain gold, and there certainly is a suggestion from these results of a correlation between Mo and Au. Molybdenum telluride is known as a laboratory product, but so far (Goldschmidt 1954) has never been observed as a product of nature. One wonders now whether it is present in the Kalgoorlie field.

CONCLUSIONS

Of the elements determined, arsenic and possibly silver and molybdenum can be considered as indicators of gold mineralization in the Kalgoorlie goldfield. This need for indicator elements has arisen partly because there was no rapid method available for the determination of trace amounts of gold in geological materials. During the course of this study, a method has been developed for the determination of trace amounts of gold in geological material, making possible the task of rapid assaying of large numbers of samples for gold (Beevers, 1966, in prep.) Using this new technique, over one hundred samples per man-day can be assayed for gold down to 0.2 p.p.m. (0.13 dwts/long ton) at a fraction the cost of fire-assaying. This compared very favourably with the output of forty fire-assays per man-day by Western Mining Corporation at approximately 6/- per sample (Woodall, pers. comm.).

RECOMMENDATIONS

It is extremely difficult to interpret data from samples that are in themselves not strictly comparable. For instance, if one wants to compare chemical elements (trace and major) within the Kalgoorlie field, one should compare these elements from similar rocks or minerals, e.g., hand-picked run-of-mine ore or pyrite from both mineralized and unmineralized parts of the field, or any other "pure" rock or mineral. It is exceedingly difficult to interpret chemical results from samples that themselves are admixtures of minerals and rocks in unknown proportions. In some cases, for example, veins of sphalerite, are included in samples that are required for trace element zinc content, when the trace element zinc content of the rock (minus sphalerite) could be quite interesting.

If the problem at Kalgoorlie is a study of the geochemistry proper of the goldfield, then it should be carried out on a much larger and more controlled scale than hitherto attempted. On the other hand, if the problem is merely to find gold, the recommendation is to look only for gold in areas previously defined by geology or geophysics.

REFERENCES

BEEVERS, J.R., - A rapid method for the determination of gold in geological materials by Atomic Absorption Spectrophotmetry - In prep.

GOLDSCHMIDT, V.M., 1954 - Geochemistry, Clarendon Press, Oxford 1954.

WOODALL, R.W., 1965 - Structure of the Kalgoorlie Goldfield, 8th Commonwealth Mining and Metallurgical Congress, Australia and New Zealand, Volume 1, p.71.

TABLE 2 : No.4 LODE 700-FOOT LEVEL - GOLDEN HORSESHOE.

(All values in parts per million, except Au)

Sample No.	Ni	Co	Cu	Pb	Ag	Au dwts/ton	Mo	V	Zn	As
012007	44	34	46	-	-	-	-	250	78	151
8	58	36	125	-	0.6	-	-	130	74	142
9	48	28	20	-	-	-	-	180	62	71
10	48	36	20	-	-	-	-	250	58	96
11	54	31	42	-	0.3	-	-	130	58	90
12	76	40	58	-	0.6	8.8	20	400	35	268
13	54	28	27	-	-	-	-	180	62	62
14	54	31	9	-	-	-	-	250	88	36
15	58	31	12	-	-	-	-	250	65	40
16	66	34	9	-	-	-	-	180	65	46
17	66	36	5	-	-	-	-	180	58	41
18	54	31	14	-	-	-	-	180	47	48
19	58	40	33	-	-	-	-	250	39	108
20	58	36	25	-	-	-	-	250	47	103
21	54	40	29	10	-	-	-	250	54	119
22	66	40	34	-	-	-	-	250	43	139
23	52	39	17	-	-	-	-	180	48	50
24	60	60	22	-	-	-	-	250	43	140
25	60	67	36	-	-	0.45	-	300	36	400
26	48	47	29	-	-	0.20	-	300	54	215
27	36	43	19	-	-	-	-	300	36	108
28	52	43	65	-	-	-	-	300	43	92
29	52	55	87	-	-	-	-	180	58	248

TABLE 3 : "B" LODE AND P447 D.D.H. PARINGA No.9. 934-FOOT LEVEL

(All values are in parts per million - except Au)

Sample No.	Ni	Co	Cu	Pb	Ag	Au dwts/ton	Mo	V	Zn	As
012030	48	36	71	-	0.6	1.0	6	100	110	42
31	68	43	59	13	-	-	-	250	143	21
32	56	43	65	-	-	-	-	180	103	31
33	56	43	77	10	-	-	-	180	73	50
34	64	40	80	10	-	-	-	180	87	42
35	64	43	77	-	-	-	-	180	116	67
36	80	52	264	30	0.6	Tr	4	250	1062	100
37	60	42	102	10	-	-	-	250	87	72
38	56	43	83	10	-	-	-	250	53	38
39	200	40	67	-	0.6	-	-	250	175	32
40	90	44	62	-	0.6	Tr	-	250	255	199
41	93	44	48	-	0.6	-	-	250	775	57
42	138	44	81	-	-	-	-	300	181	107
43	98	50	113	-	0.6	-	-	250	315	177
44	98	40	40	-	-	-	-	80	300	78
45	144	54	59	-	-	-	-	180	168	132
46	144	65	95	-	0.3	-	-	250	162	142
47	138	54	85	-	-	-	-	250	128	118
48	114	64	65	-	0.3	-	-	250	123	180
49	92	60	86	-	0.6	0.8	-	250	104	204
50	130	60	60	-	0.6	-	-	300	155	91
51	108	54	60	-	-	-	-	250	148	94
52	114	50	67	-	0.6	-	-	250	137	87
53	154	44	50	-	0.6	-	-	300	155	70
54	114	44	81	-	0.3	-	-	300	235	72
55	108	36	83	18	-	-	-	250	137	65
56	89	40	89	10	1	1.0	20	300	62	68
57	40	25	56	-	1	1.05	30	250	62	36
58	37	21	94	10	2	0.8	30	250	58	52
59	22	17	54	10	1	1.15	30	250	48	48
60	32	25	62	100	4	28.2	20	1000	89	75
61	40	25	97	600	10	248.5	30	400	53	82
62	50	25	78	1000 +	60	460.0	30	600	85	107
63	22	13	72	13	2.5	18.4	25	600	20	42
64	40	21	83	18	3.	41.5	25	800	255	65
65	40	21	92	-	2.5	5.3	15	300	80	70
66	37	21	83	-	1	1.25	20	400	123	66
67	45	21	106	-	2	1.4	30	600	123	65
68	40	32	94	-	1	1.05	15	400	132	64
69	54	32	78	-	1	2.55	10	250	132	42
70	70	36	68	-	2	2.65	10	300	98	57
71	30	31	147	-	1	1.5	-	250	120	41
72	34	28	140	-	1	0.9	10	400	100	101
73	44	33	98	-	1.5	1.75	-	400	100	85
74	40	31	125	-	2	5.0	80	600	140	125
75	37	33	128	-	0.6	1.2	-	400	85	78
76	47	28	100	-	-	1.65	-	250	75	108
77	54	31	57	-	1.5	1.7	40	300	65	112
78	47	25	62	-	1.5	-	25	400	48	69
79	34	20	52	18	4	1.7	25	400	48	39
80	40	31	68	25	1.5	0.95	15	400	48	35
81	51	36	168	30	2.5	2.2	60	300	65	51

TABLE 4 : "B" LODE D.D.H. P.448. FROM No.9 LEVEL.

(All values in parts per million, except Au).

Sample No.	Ni	Co	Cu	Pb	Ag	Au dwts/ton	Mo	V	Zn	As
012082	33	28	80	18	-	-	-	400	60	9
83	54	36	83	18	-	-	-	250	95	13
84	44	31	98	10	-	-	-	300	80	10
85	33	25	72	10	-	-	-	400	60	8
86	33	26	88	13	-	-	-	300	70	8
87	28	23	77	10	-	-	-	300	70	8
88	33	28	80	10	-	-	-	400	65	6
89	44	25	86	10	-	-	-	400	75	7
90	51	33	110	10	-	-	-	400	80	7
91	44	31	112	-	-	-	-	300	65	7
92	40	28	80	-	-	-	-	400	65	6
93	34	28	98	-	-	-	-	400	65	5
94	50	33	118	-	-	0.8	-	300	115	65
95	34	31	103	-	-	-	-	400	65	6
96	34	28	72	-	-	-	-	400	60	25
97	34	28	80	-	-	-	-	300	65	5
98	34	31	77	-	-	-	-	300	65	5
99	28	33	100	-	-	-	-	400	57	7
100	24	28	98	-	-	-	-	300	60	3
101	24	31	90	-	-	-	-	400	57	17
102	34	36	90	-	-	-	-	300	75	11
103	27	28	77	18	-	-	-	400	65	11
104	27	23	69	18	1	0.5	10	400	75	56
105	25	17	90	18	1	0.7	30	600	38	13
106	37	28	18	18	1	0.6	-	600	25	3
107	37	33	18	18	1	0.1	20	600	25	8
108	4	2	12	10	-	Tr	3	40	12	2
109	25	20	12	18	1	0.8	60	400	17	9
110	28	28	40	18	1	0.8	20	800	20	11
111	25	23	42	18	1	0.7	60	600	20	25
112	30	25	72	18	1.5	1.2	40	600	20	63
113	30	17	74	18	2	1.1	130	400	25	86
114	37	25	564	18	8	2.6	80	400	110	167
115	44	28	74	18	1	1.0	8	600	148	31
116	50	31	74	-	-	0.1	-	400	137	7
117	54	36	80	-	-	Tr	-	400	167	32
118	54	42	74	-	-	0.2	-	400	75	20
119	47	31	110	-	-	1.8	25	400	185	91
120	58	33	74	-	-	0.1	-	400	126	29
121	80	31	74	-	-	Tr	3	400	70	7
122	68	42	80	10	-	Tr	-	400	85	12
123	62	36	74	10	-	Tr	-	300	65	16
124	58	31	66	10	-	Tr	-	400	56	23
125	54	28	70	10	-	Tr	-	300	52	5
126	62	31	89	10	-	-	-	300	52	3
127	72	42	92	-	-	-	-	300	61	5
128	50	42	128	-	-	-	-	400	56	2
129	62	40	92	-	-	-	-	180	218	1
130	76	50	95	-	-	-	-	400	70	5
131	62	36	95	-	-	-	-	300	57	5
132	47	36	80	-	-	-	-	400	52	6
133	50	42	106	-	-	-	-	400	43	9
134	40	37	94	-	-	-	-	400	30	8
135	50	31	64	-	-	-	-	300	59	5
136	44	31	78	-	-	-	-	250	81	4
137	61	34	89	-	-	-	-	400	104	4
138	65	29	78	-	-	-	-	300	47	3
139	72	34	80	-	-	-	-	400	86	2

TABLE 5 : DOOLETTE LODE D.D.H. NNB 18. NEW NORTH BOULDER No.7.
470-FOOT LEVEL.

(All values are in parts per million - except Au).

Sample No.	Ni	Co	Cu	Pb	Ag	Au dwts/ton	Mo	V	Zn	As
012140	87	40	58	-	1	-	-	600	137	2
141	91	42	66	-	1	-	-	600	118	4
142	83	40	46	-	1	-	-	400	156	5
143	80	40	50	-	-	-	-	400	85	5
144	91	40	48	-	-	-	-	600	123	4
145	87	37	40	-	1	-	-	400	137	1
146	83	37	69	-	-	-	-	400	95	2
147	99	42	72	-	1	-	-	600	132	3
148	80	40	58	-	-	-	-	400	127	2
149	87	48	125	-	1	-	10	400	150	4
150	83	37	66	-	-	-	-	400	113	2
151	83	42	50	-	-	-	-	400	100	3
152	80	37	66	-	-	-	-	400	104	3
153	87	37	64	-	-	-	-	400	127	1
154	87	42	50	-	-		-	400	123	- 1
155	91	45	66	-	-	-	-	300	113	2
156	76	42	66	-	-	-	-	400	105	3
157	95	37	86	-	-	-	-	130	143	3
158	80	37	44	-	-	-	-	400	132	4
159	72	40	40	-	-	-	-	400	127	2
160	91	40	55	-	-	-	-	400	218	5
161	80	40	151	130	-	6.2	250	400	850	315
162	80	31	72	25	-	-	-	400	237	15
163	83	34	61	30	-	-	-	300	123	15
164	72	34	64	18	-	-		300	137	9
165	80	45	216	40	-	3.3	100	250	475	168
166	80	31	48	18	-	-	-	250	224	12
167	76	37	46	-	-	-	-	250	118	9
168	87	37	61	-	-		-	250	178	5
169	87	58	110	-	-	0.2	40	250	250	78
170	95	37	64	-	-	-	-	250	143	4
171	80	45	64	-	-	-	-	300	90	4
172	83	42	58	-	-	-		300	104	11
173	99	40	66	-	-	-	-	300	127	6
174	95	42	92	-	-	-	-	300	127	9
175	115	42	61	-	-	-	-	300	170	7
176	76	45	55	-	-	-	-	250	95	4
177	87	45	78	-	-	-	-	300	118	3
178	91	48	69	-	-	-	-	180	142	8
179	91	40	55	-	-	-	-	180	127	6
180	91	42	69	-	-	-	-	250	104	6
181	91	42	61	-	-	-	-	250	108	6
182	95	42	58	-	-	-	-	300	114	5
183	91	42	75	-	-	-	-	300	100	3
184	91	42	64	-	-	-	-	300	127	- 1
185	95	40	55	-	-	-	-	300	132	3
186	65	54	69	-	-	Tr.	-	180	110	107
187	87	37	46	-	-	-	-	250	164	4
188	83	37	64	-	-	-	-	250	137	4

TABLE 6 : HANNANS NORTH (WESTERN AND EASTERN TRAVERSE)
STAR SHAFT, 124-FOOT LEVEL

(All values are im parts per million except Au)

Sample No.	Ni	Co	Cu	Pb	Ag	Au dwts/ton	Mo	V	Zn	As
012189	9	61	53	60	-	-	-	400	123	7
190	12	58	53	-	-	-	-	300	114	11
191	9	58	64	30	-	-	-	400	123	10
192	12	45	44	-	-	-	-	250	127	13
193	12	54	44	-	-	-	-	300	150	24
194	9	45	46	-	-	-	-	300	114	30
195	5	54	67	-	-	-	-	300	109	36
196	5	26	50	-	10	12.0	130	300	178	7
197	15	54	67	-	-	0.65	-	300	100	1
198	20	56	35	-	-	0.4	10	400	173	6
199	13	53	44	-	-	5.75	25	800	54	16
200	6	34	4	-	-	0.25	8	25	25	2
201	10	31	22	40	25	5.2	1000	400	62	26
202	13	53	38	-	-	0.4	10	400	115	5
203	20	53	44	-	-	-	-	800	130	49
204	17	56	37	-	-	1.3	130	400	106	47
205	10	50	50	18	2	13.7	250	800	102	12
206	17	60	48	-	-	-	-	800	97	21
207	13	53	48	-	-	-	-	800	97	26
208	27	53	132	-	-	-	-	800	107	10
209	30	53	117	-	-	-	-	800	130	3
210	20	50	55	*	-	-	-	400	140	3
211	13	40	42	-	-	-	-	180	135	1
212	10	46	40	-	-	-	-	250	140	- 1
213	13	46	48	-	-	-	-	400	130	- 1
214	20	50	48	-	-	-	-	400	145	- 1

TABLE 7.

PERSEVERANCE LODE MORTY No.3. 342-FOOT LEVEL

(All values are in parts per million except Au).

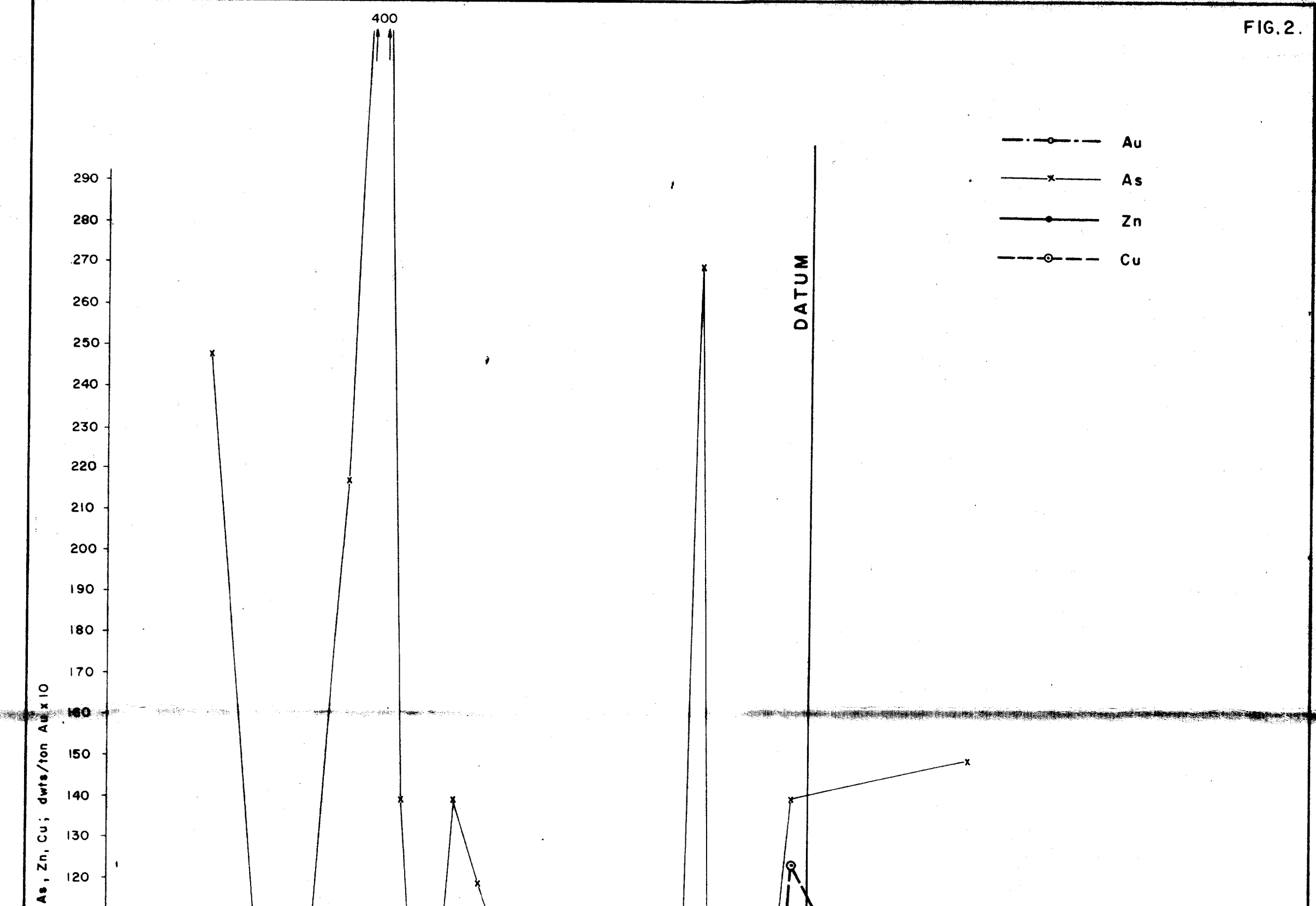
Sample No.	Ni	Co	Cu	Pb	Ag	Au dwts/ton	Mo	V	Zn	As
012215	33	34	72	-	2	1.6	-	400	88	38
216	36	34	66	-	-	0.24	-	130	92	15
217	36	34	95	-	-	0.34	-	130	102	10
218	40	36	48	-	-	-	-	300	97	11
219	40	36	58	-	-	-	-	300	83	13
220	40	36	80	-	-	-	-	300	102	10
221	40	40	66	-	-	-	-	400	102	13
222	40	36	35	-	-	-	-	300	88	11
223	48	40	53	-	-	-	-	250	88	10
224	48	40	44	-	-	-	-	300	88	14
225	44	40	53	-	-	-	-	300	88	11
226	44	36	25	-	-	-	-	180	88	11
227	44	40	40	-	-	-	-	250	102	16
228	44	34	16	-	-	-	-	300	125	1
229	44	36	44	-	-	-	-	180	110	14
230	44	42	61	-	-	-	-	400	97	23
231	33	36	69	-	-	-	-	300	88	11
232	33	36	27	-	-	-	-	130	83	7
233	44	36	18	-	-	-	-	180	83	9
234	40	36	50	-	-	-	-	250	88	17
235	40	40	64	-	-	-	-	130	102	23
236	40	36	20	-	-	-	-	180	93	6
237	30	36	22	-	3	6.7	40	300	54	91
238	23	23	64	-	3	4.7	100	400	39	112
239	30	31	114	-	2.5	4.4	20	300	54	68
240	30	28	75	-	2.	2.4	-	180	70	77
241	27	23	61	-	3.	3.8	60	300	28	77
242	36	31	33	-	1	-	-	250	83	22
243	17	23	31	-	2	5.3	10	250	25	94
244	36	34	35	-	-	-	-	130	97	25
245	36	34	75	-	-	-	-	130	102	27

TABLE 8 : AVERAGE TRACE ELEMENT CONTENT OF SIX LODES, COMPUTED FROM THE ANALYSES IN TABLES 2 - 7.

Location	No.of Samples	Cobalt (ppm) Av Range	Nickel (ppm) Av (Range)	Copper (ppm) Av Range	Zinc (ppm) Av (Range)	Vanadium (ppm) Av (Range)	Arsenic (ppm) Av.(Range)		Type Gold Mineralization
No.4 Lode 700' level Golden Mile Dolerite	23	39 (28-67)	55 (36-76)	34(5-125)	54(35-88)	233(130-400)	122(40-400)	-	Gold Telluride
"B" Lode 934' level Paringa Basalt	52	37 (13-65)	72 (22-200)	85(40 -264)	150(20-1062)	324(80-1000)	80(21-204)	-	Gold Telluride
"B" Lode DDH P448									
(a) Paringa Basalt	23	30 (23-36)	36 (24-54)	90(72-118)	70(57-115)	354(250-400)	13(3 -65)	-	Gold Telluride
(b) Siliceous	10	22 (2 -28)	27 (4 -37)	45(12-90)	28(12 -75)	516(40-800)	24(2 -86)	-	
(c) Mineralized Basalt	6	33 (25 -42)	56 (37-80)	116(66-564)*	106(52-185)	400(300-600)	37(5 -167)	-	
(d) Paringa Basalt	19	37 (29-50)	58 (40-76)	90(64-218)	73(30-128)	338(180-400)	4(1 - 9)	-	
Doolette Lode 470' level	49	39 (31-58)	86 (65-115)	67(40-216)	154(85-850)	337(130-600)	18(< 1-315)	-	Gold Telluride
DDH NNB18 Paringa Basalt									
Hannans North Start shaft 124' level Golden Mile Dolerite	26	50 (26-61)	14 (5- 30)	51(4-132)	116(25-278)	450(25 -800)	14(< 1-49)	-	Gold quartz
Perseverance Lode Morty No.3 (342' level.Golden Mile dolerite	31	34 (23 - 42)	37 (17-48)	50(16-114)	85(25-125)	253(130-400)	29(1 -112)		Gold Telluride

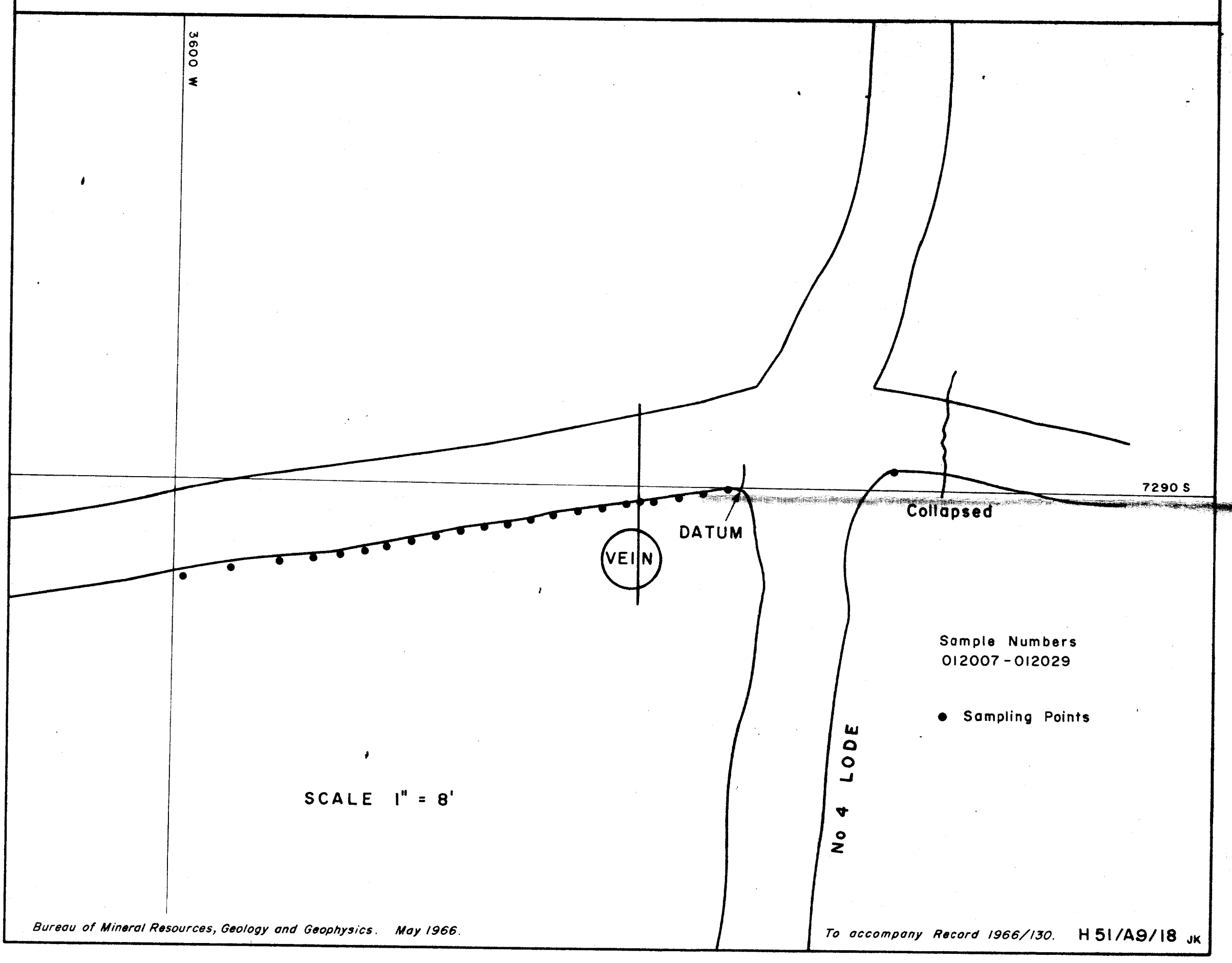
* Excluding this sample (564 ppm Cu) average becomes 77.

FIG. 2.



No 4 LODE - GOLDEN HORSESHOE

700' Level



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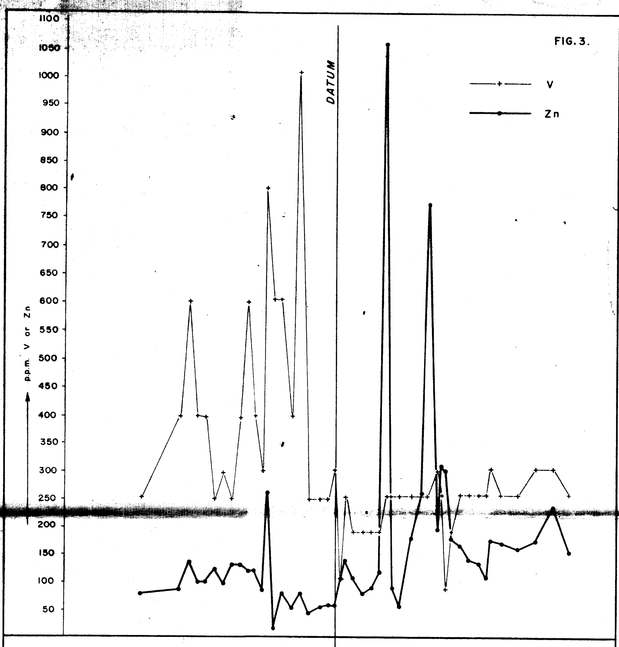
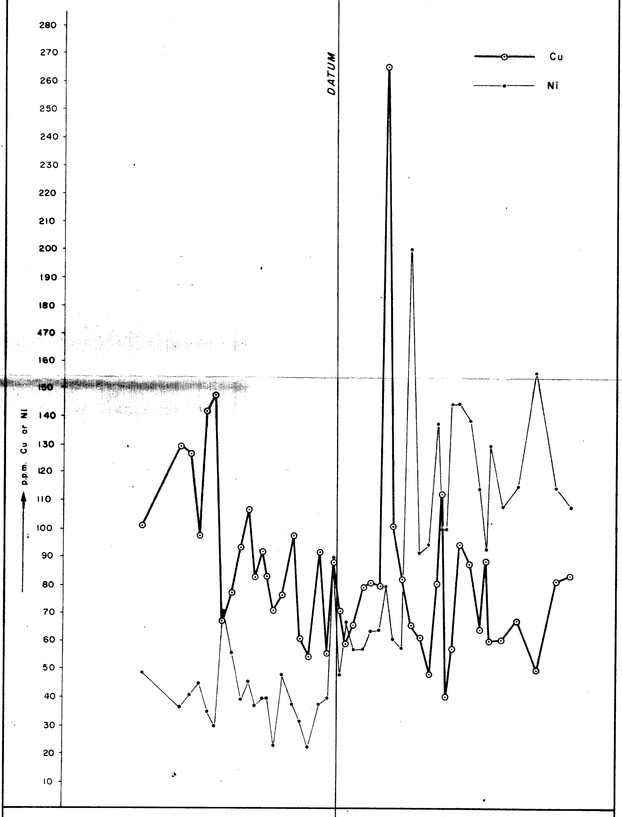
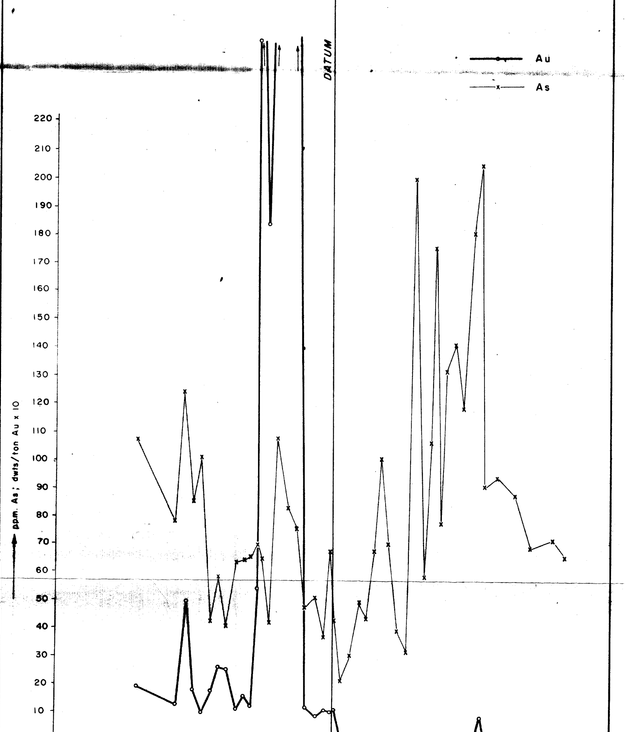
To accompany Record 1966/130. H 51/A9/18 JK

FIG. 3.

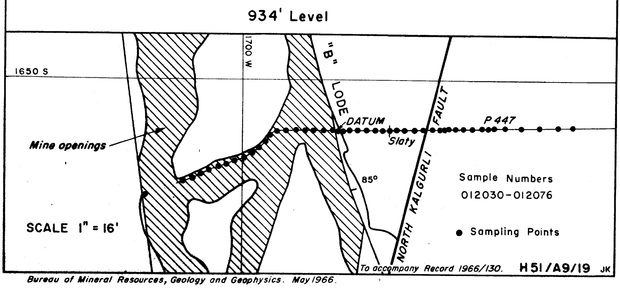






"B" LODE PARINGA No 9

934' Level



To accompany Record 1966/130. H51/A9/19 JK

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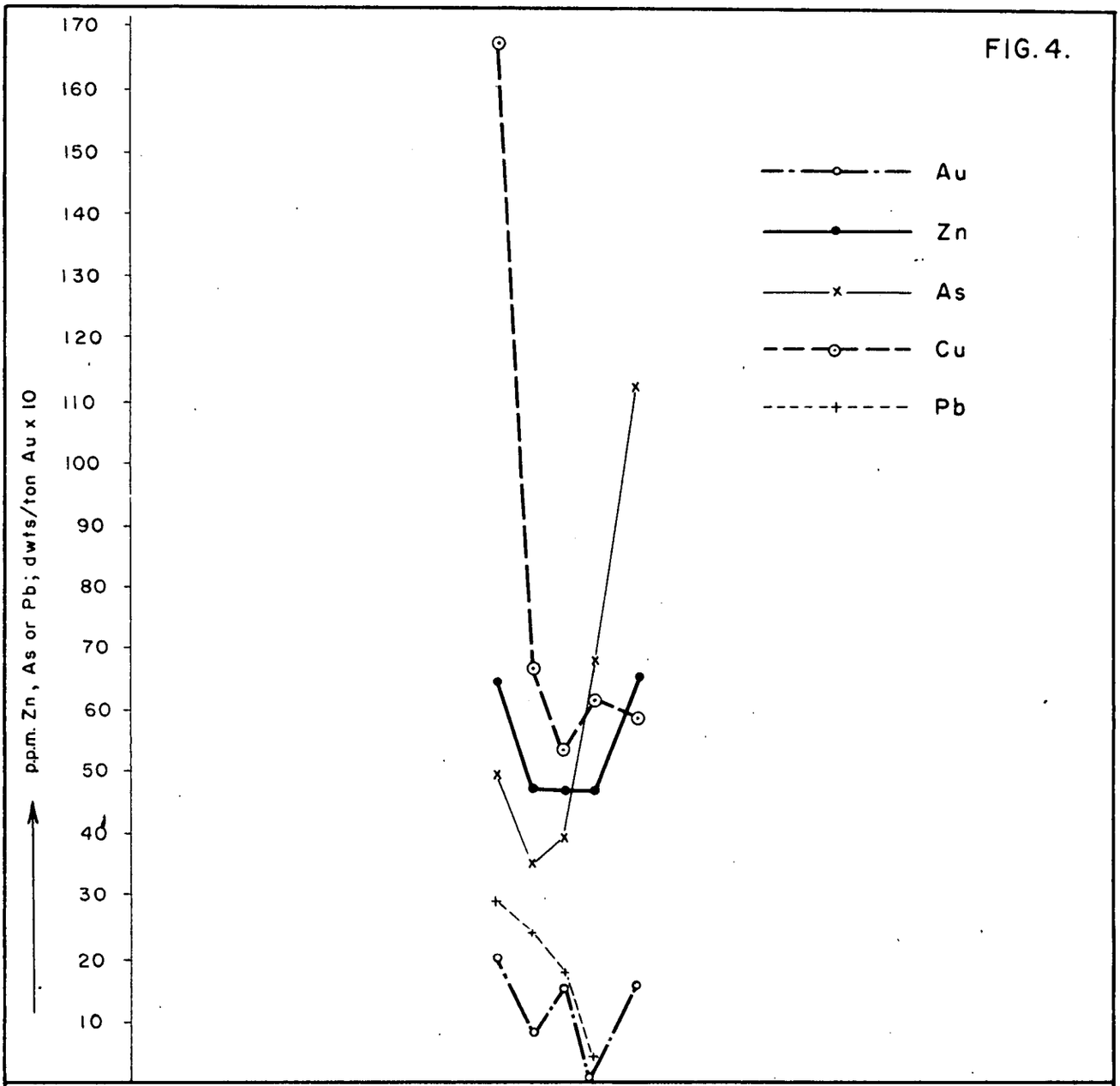
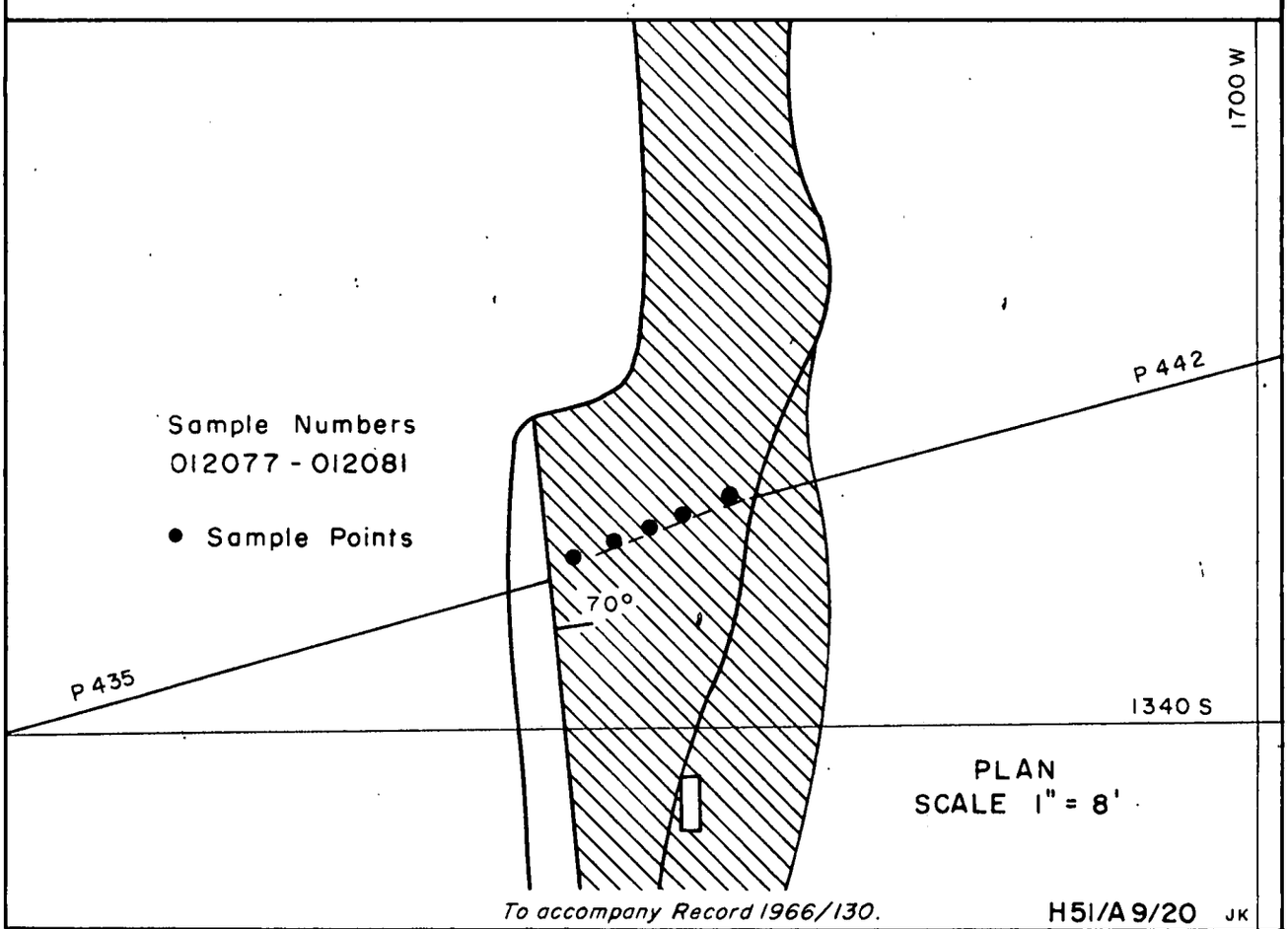
FIG. 4.



"B" LODE PARINGA No 9



To accompany Record 1966/130. H51/A9/20 JK

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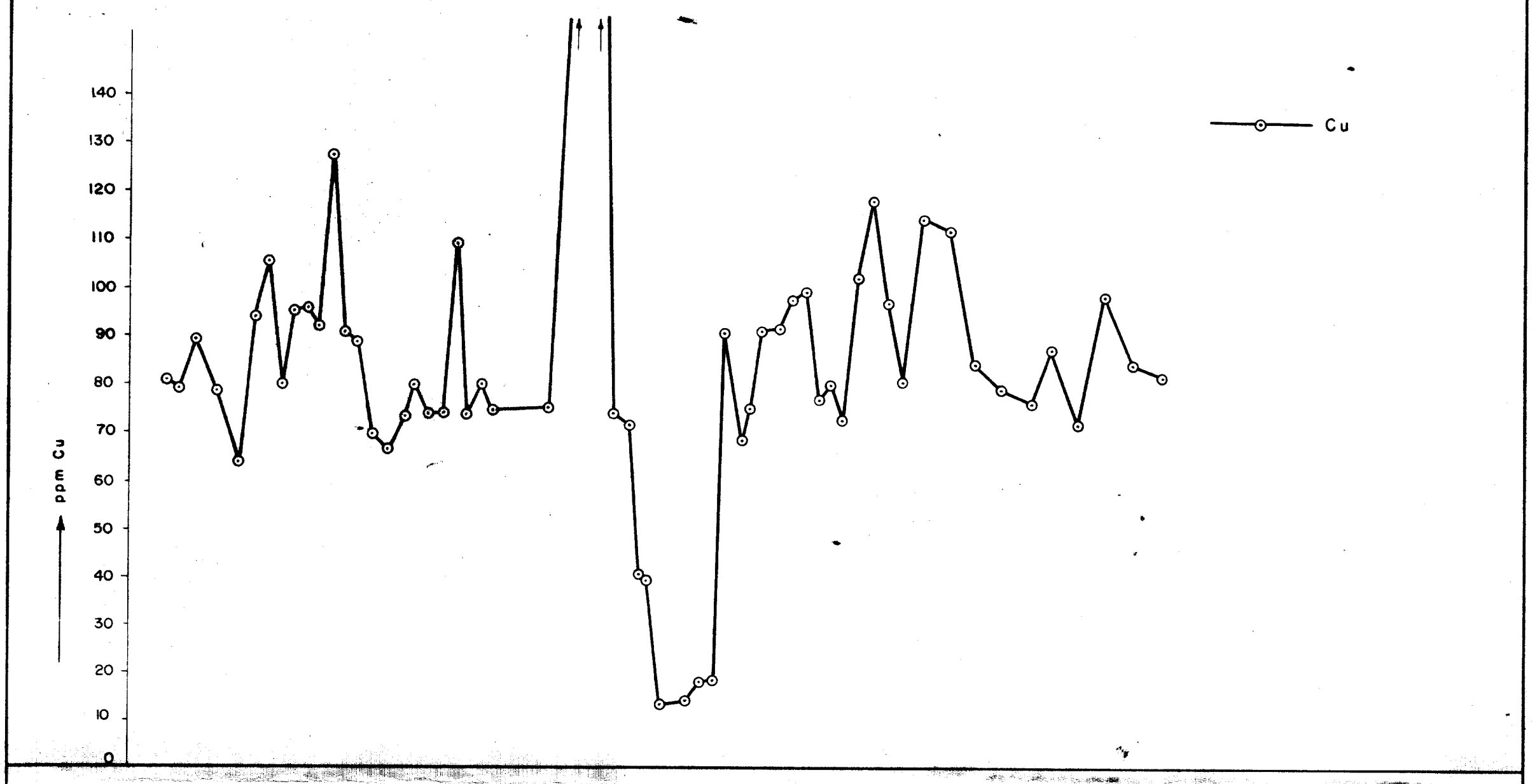
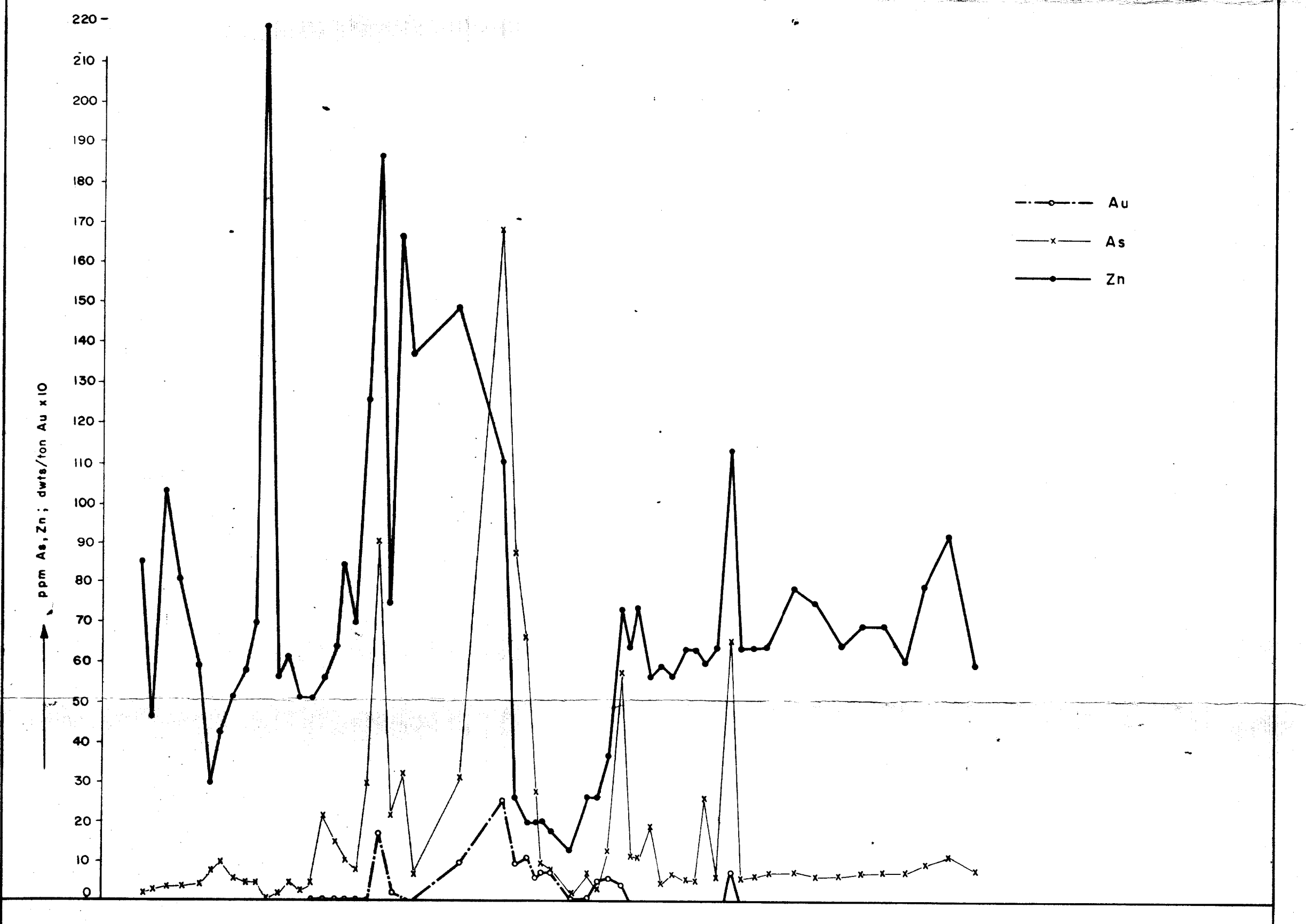
FIG. 5.





"B" LODE D.D.H. P448 CROSS SECTION AT 900 S

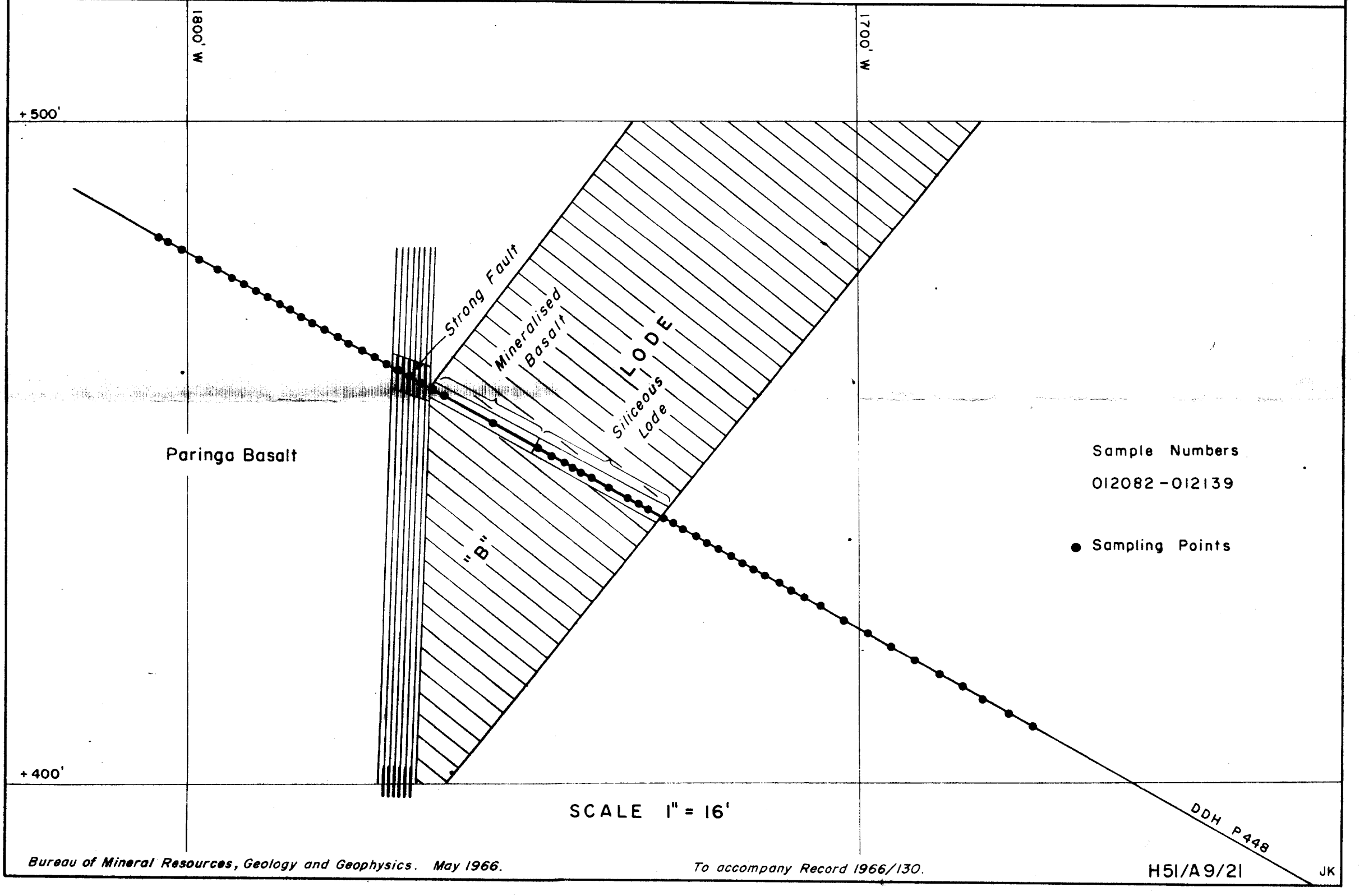


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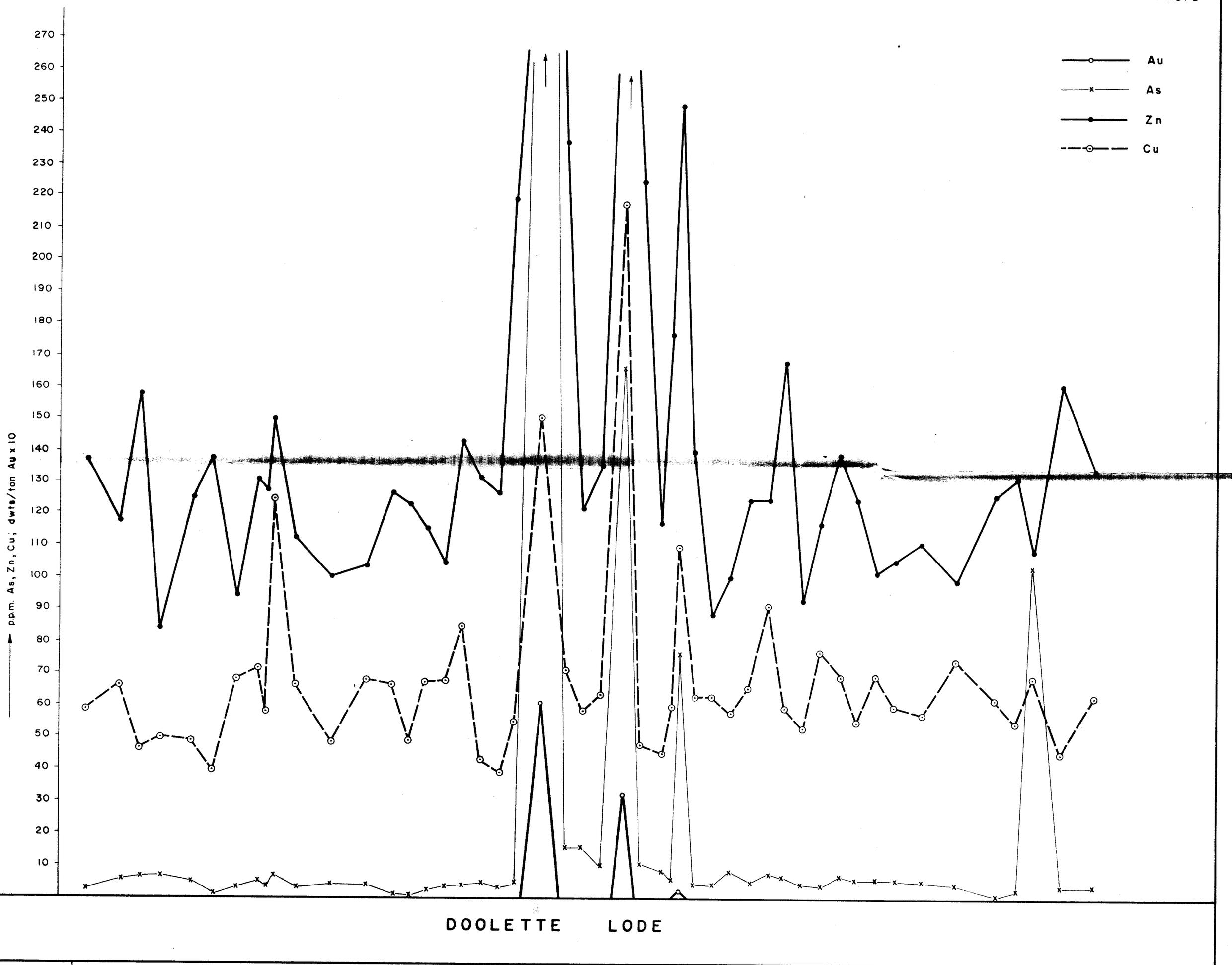
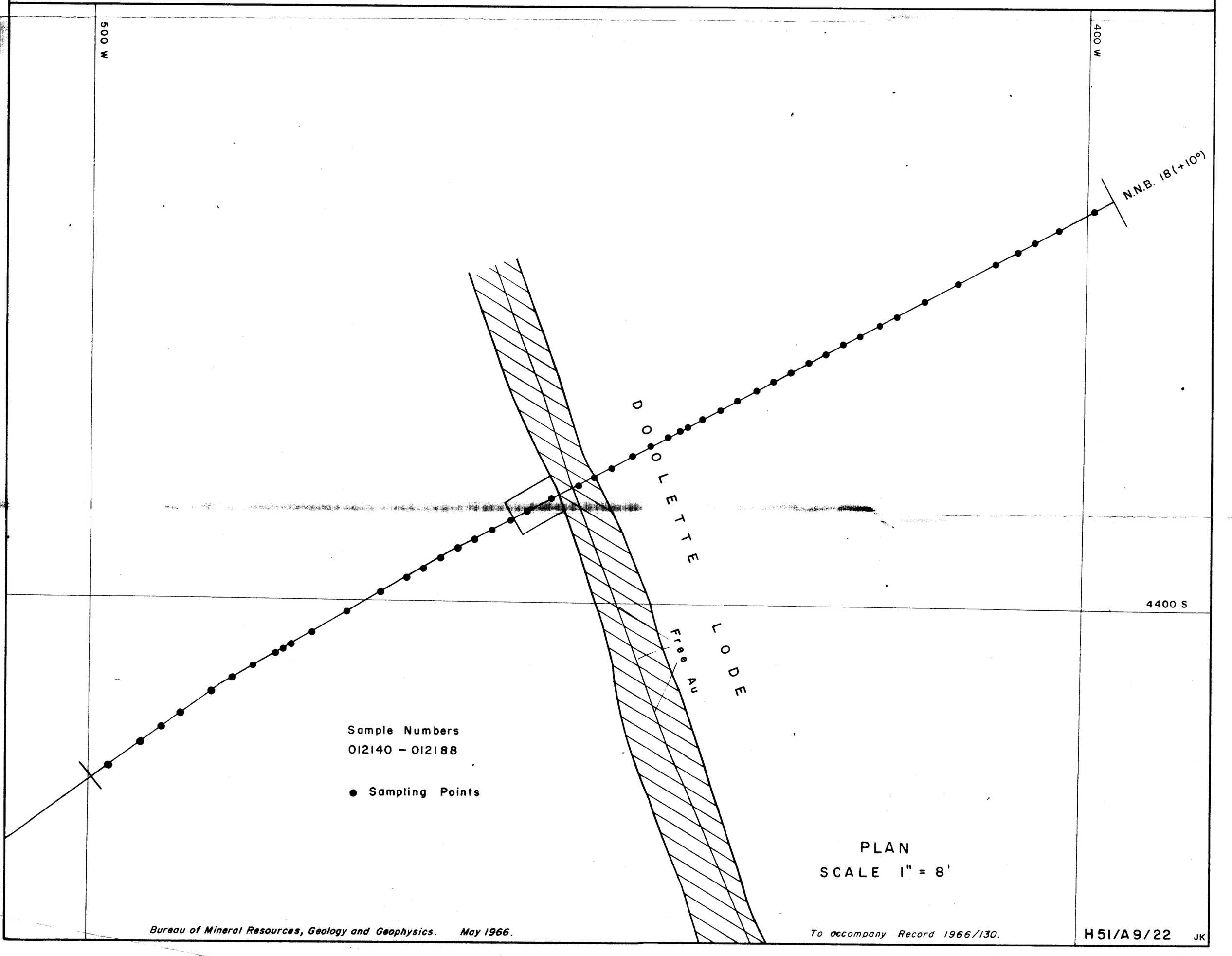
FIG. 6


Au
As
Zn
Cu
p.p.m. As, Zn, Cu; dwts/ton Au x 10
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
DOOLETTE LODE


500 W
400 W
N.N.B. 18 (+10°)
D
O
O
L
E
T
T
E
L
O
D
E
Free Au
4400 S
Sample Numbers
012140 – 012188
● Sampling Points
PLAN
SCALE 1" = 8'
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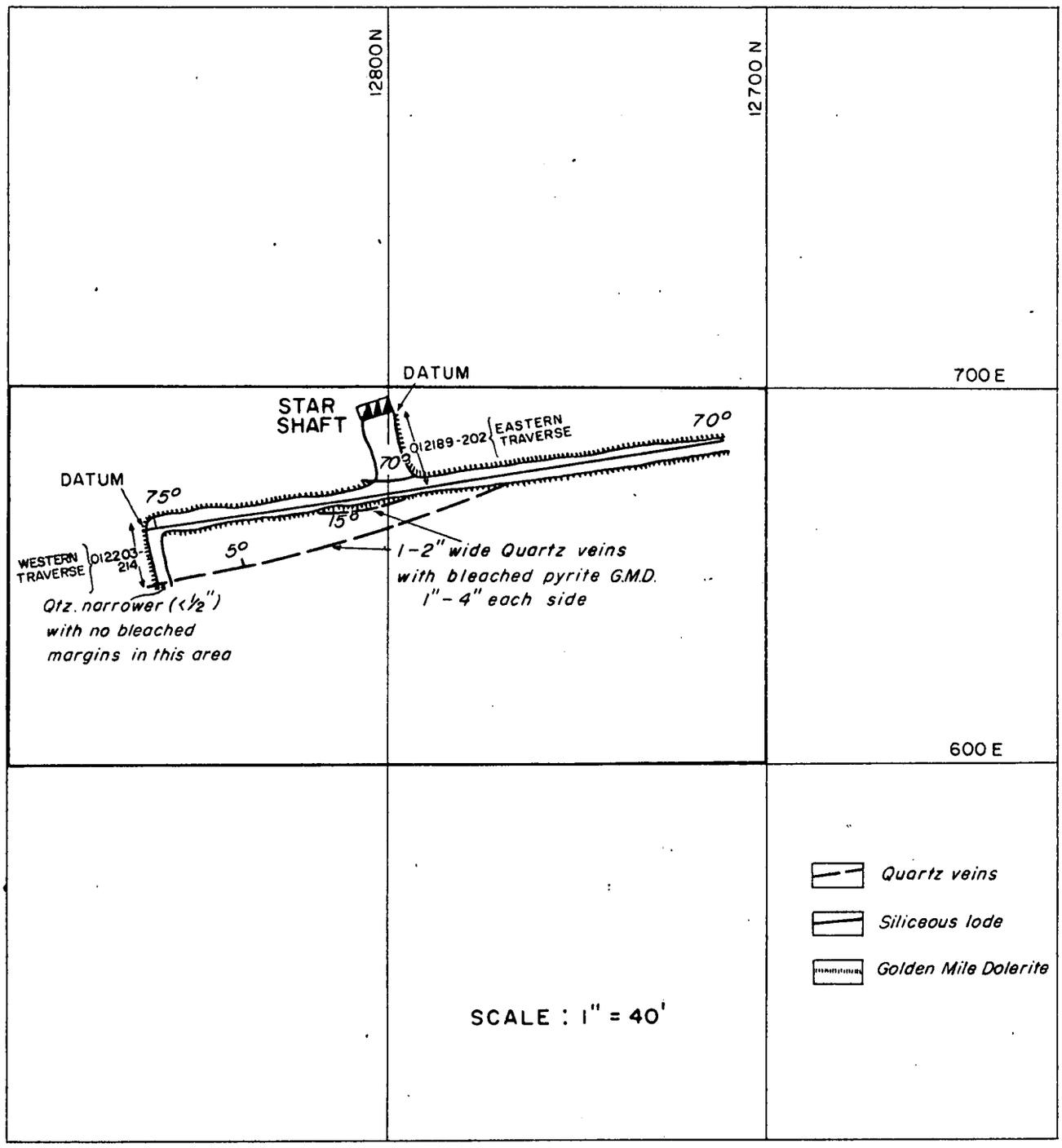
To accompany Record 1966/130.
H51/A9/22 JK

FIG. 7.



STAR SHAFT 124' LEVEL - HANNANS NORTH LODE

To accompany Record 1966/130.

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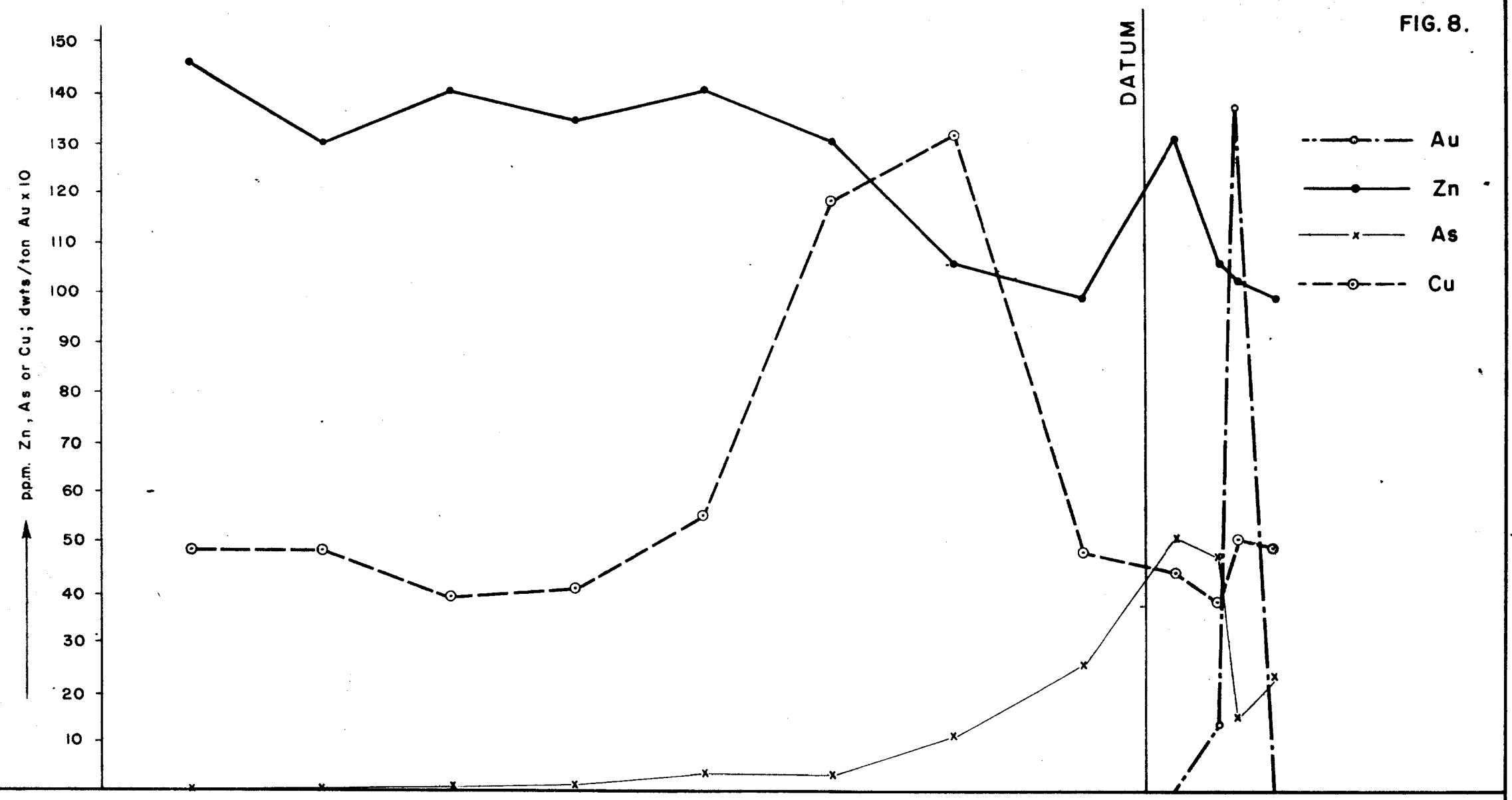
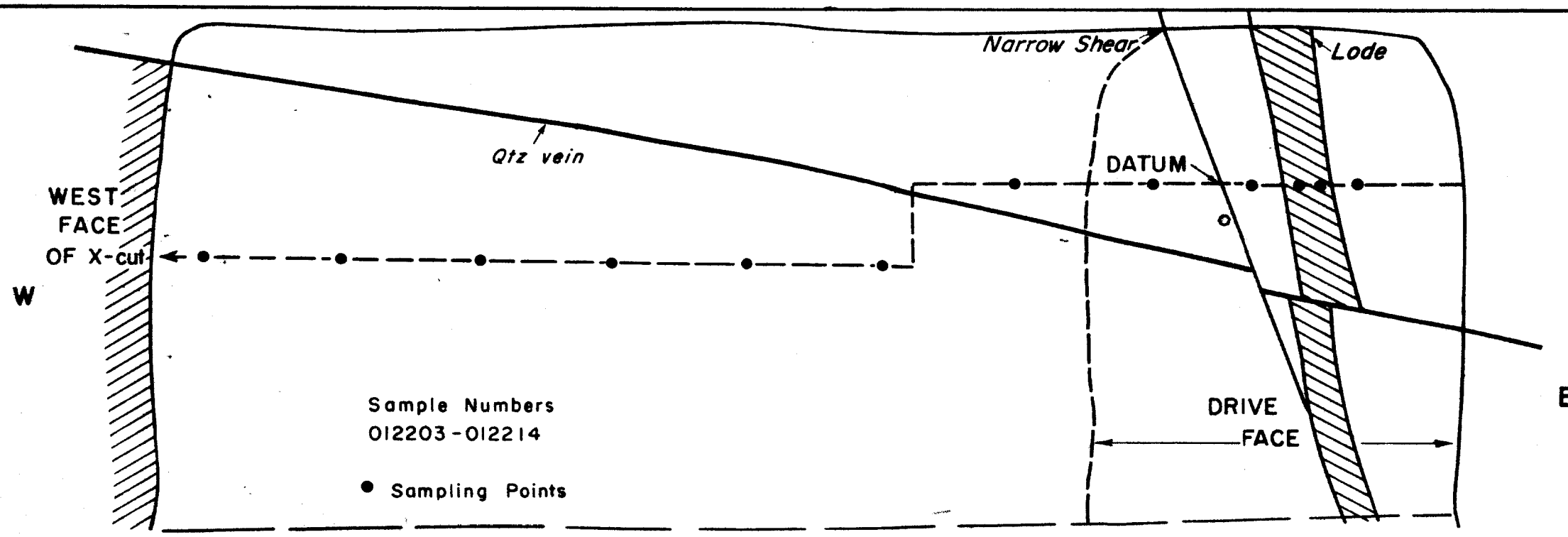
H51/A9/23 JK

FIG. 8.



HANNANS NORTH LODE — WESTERN TRAVERSE

SKETCH OF NORTH WALL OF CROSSCUT, STAR SHAFT, 124' LEVEL



SCALE : 1" = 2'

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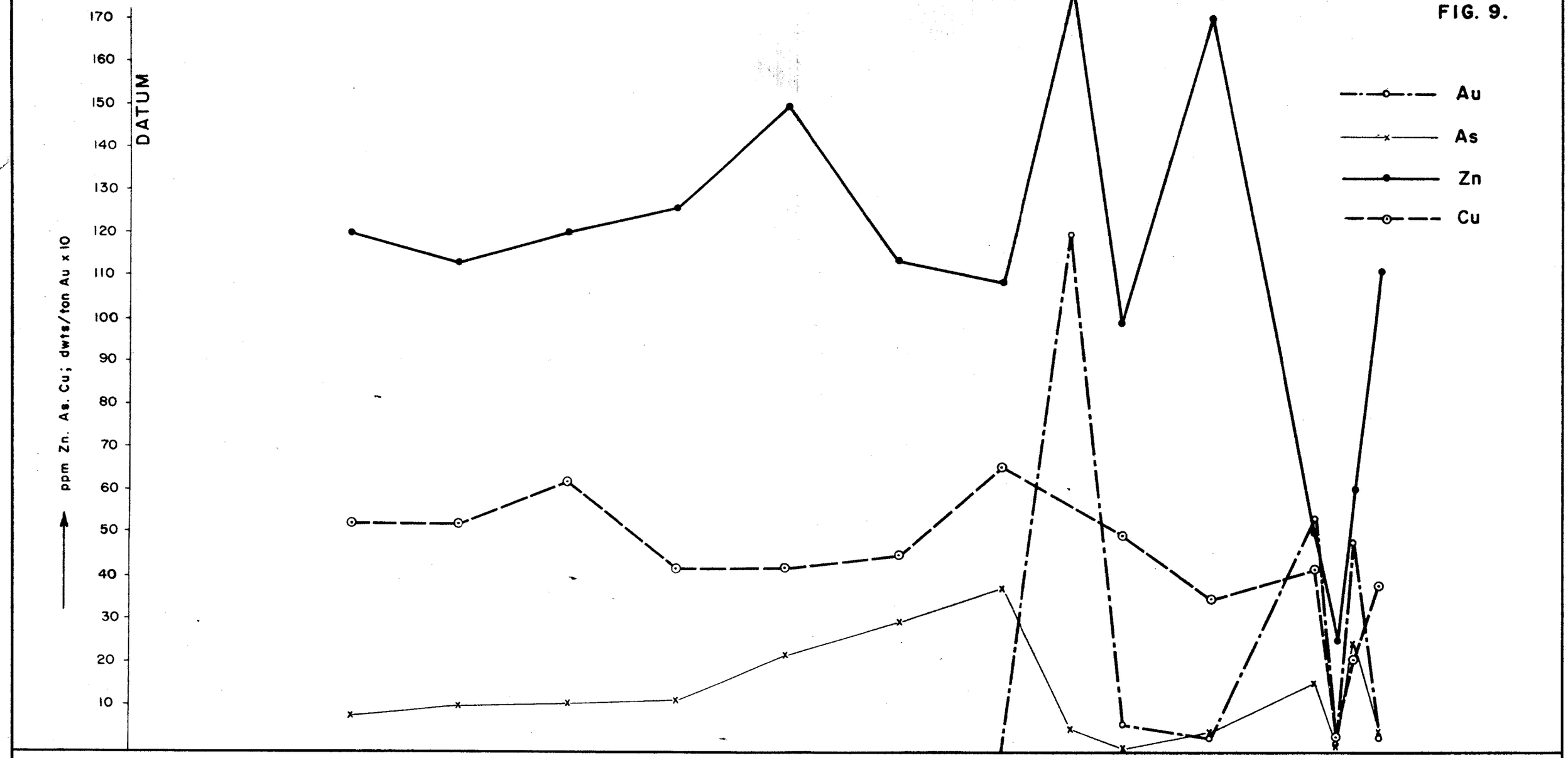
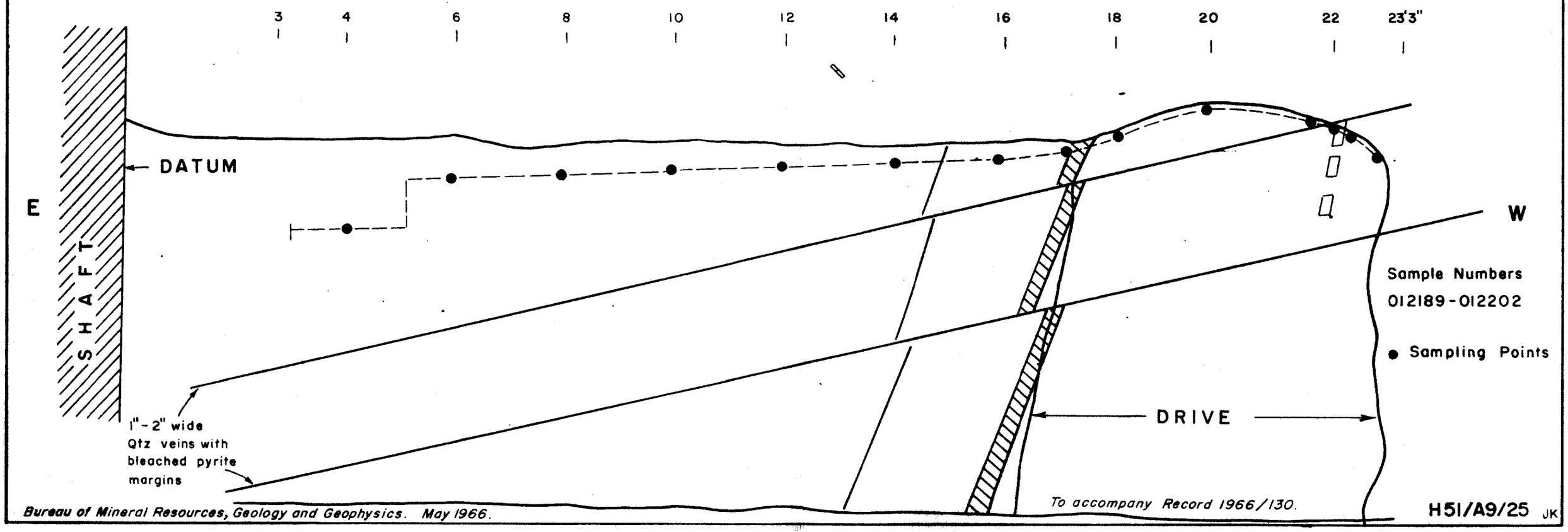
To accompany Record 1966/130.

H51/A9/24 JK

FIG. 9.



HANNANS NORTH LODE – EASTERN TRAVERSE
SKETCH OF SOUTH WALL OF CROSSCUT, STAR SHAFT, 124' LEVEL

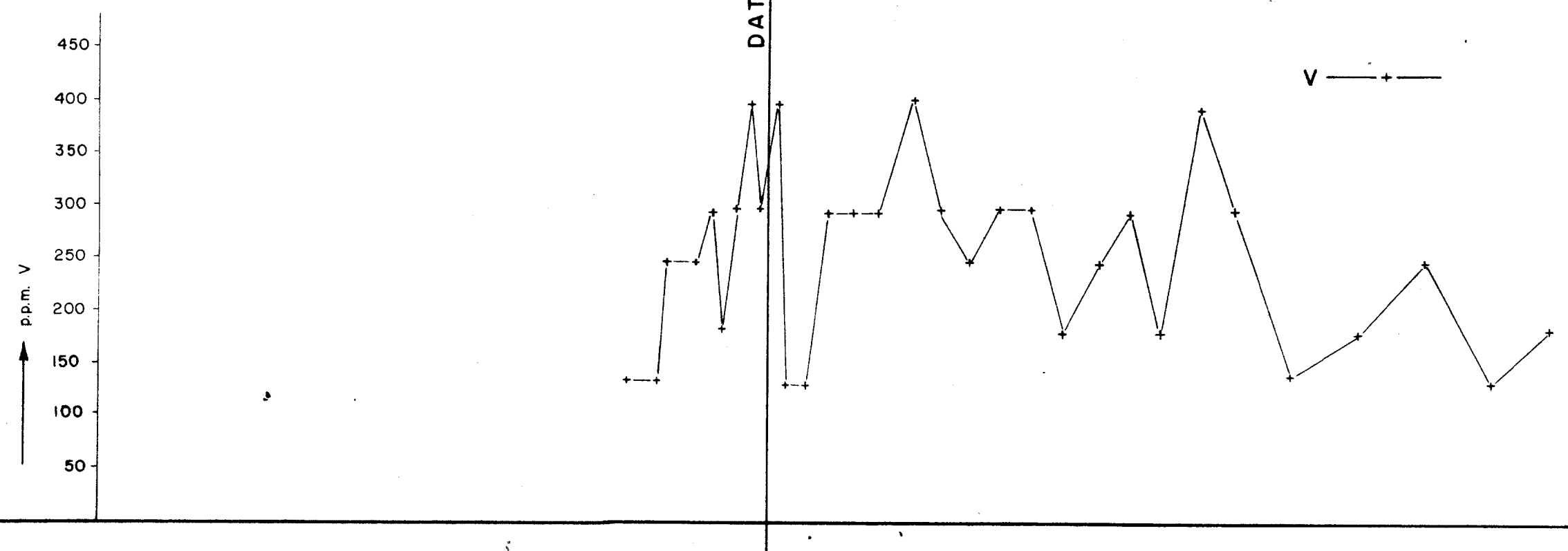


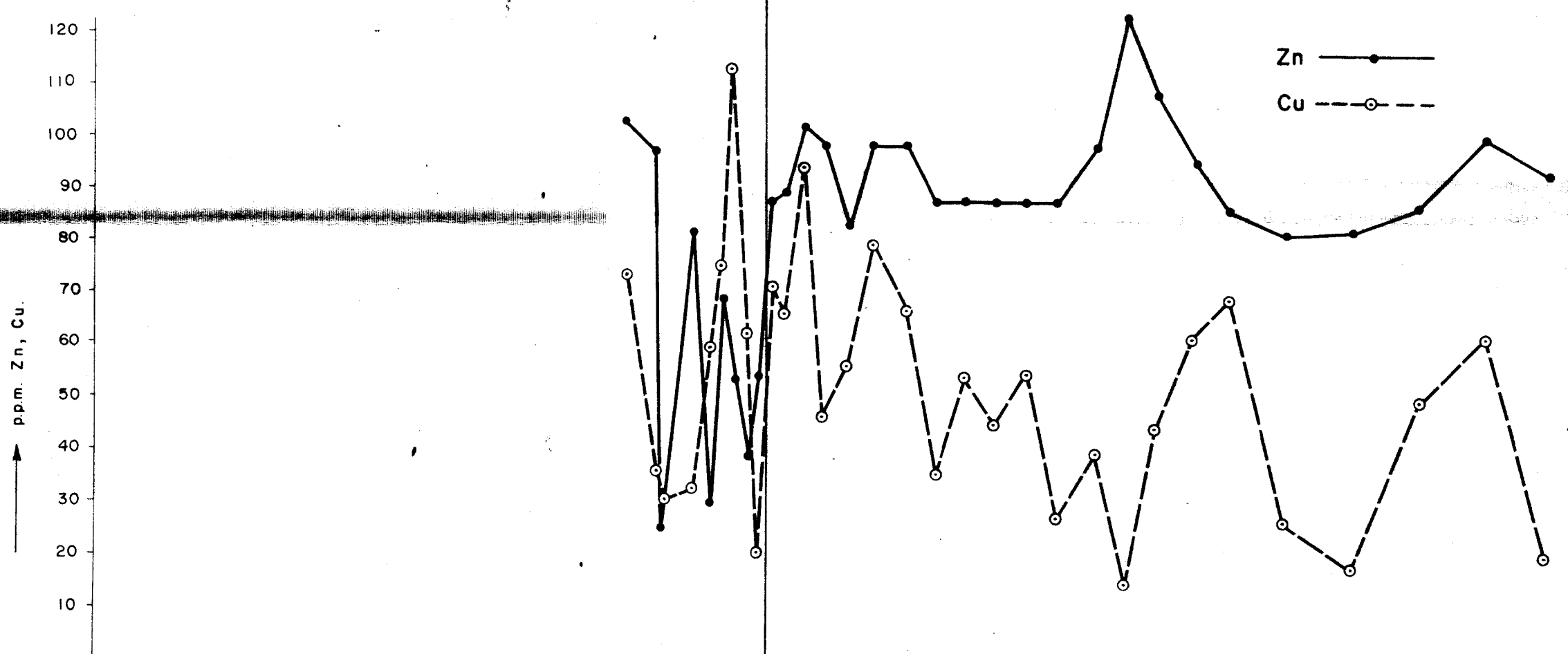
Bureau of Mineral Resources, Geology and Geophysics. May 1966.

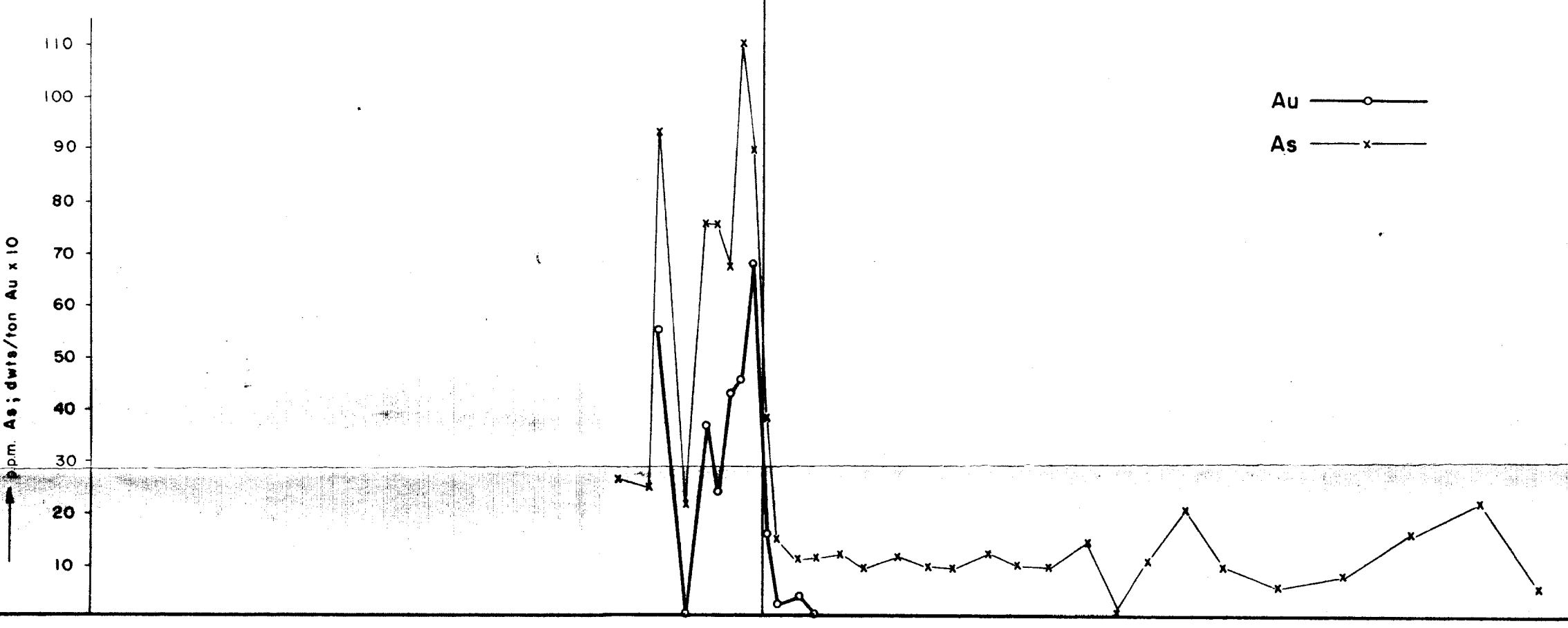
To accompany Record 1966/130.

H51/A9/25 JK

FIG. 10.

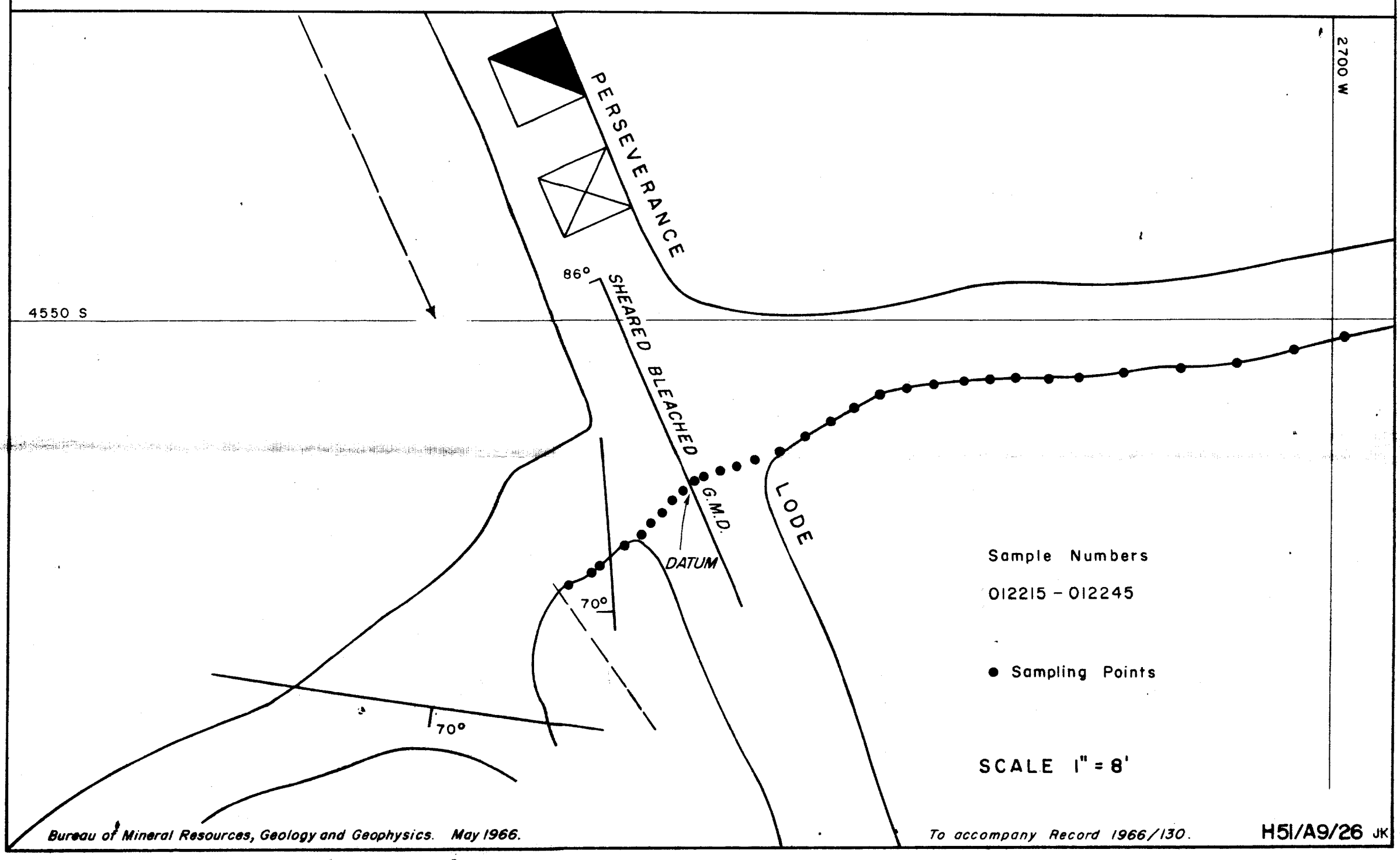






PERSEVERANCE LODE MORTY No 3

342' Level



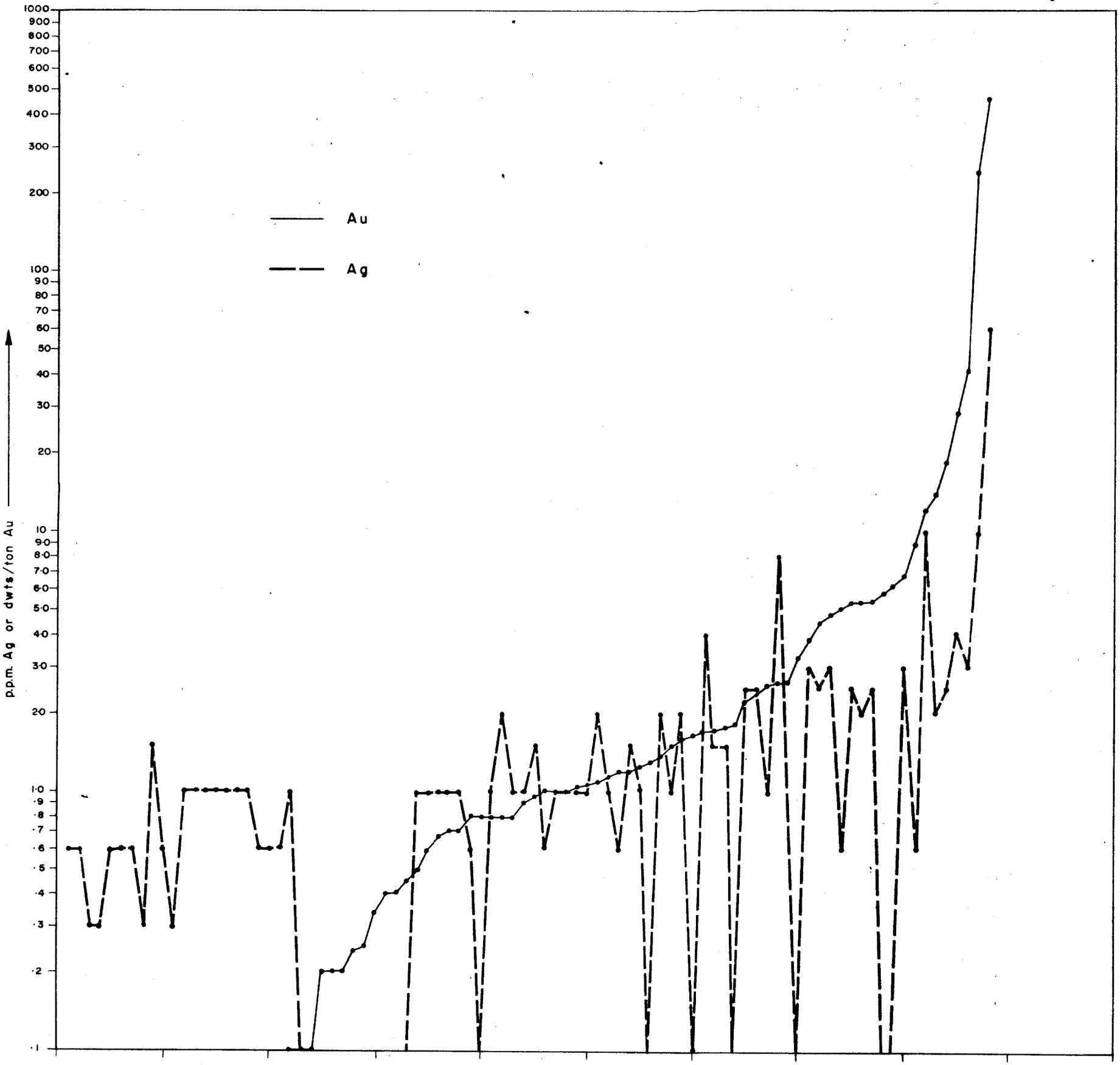
Bureau of Mineral Resources, Geology and Geophysics. May 1966.

To accompany Record 1966/130.

H51/A9/26 JK

Ag and Au values from various parts of the Kalgoorlie gold field

Fig.11.

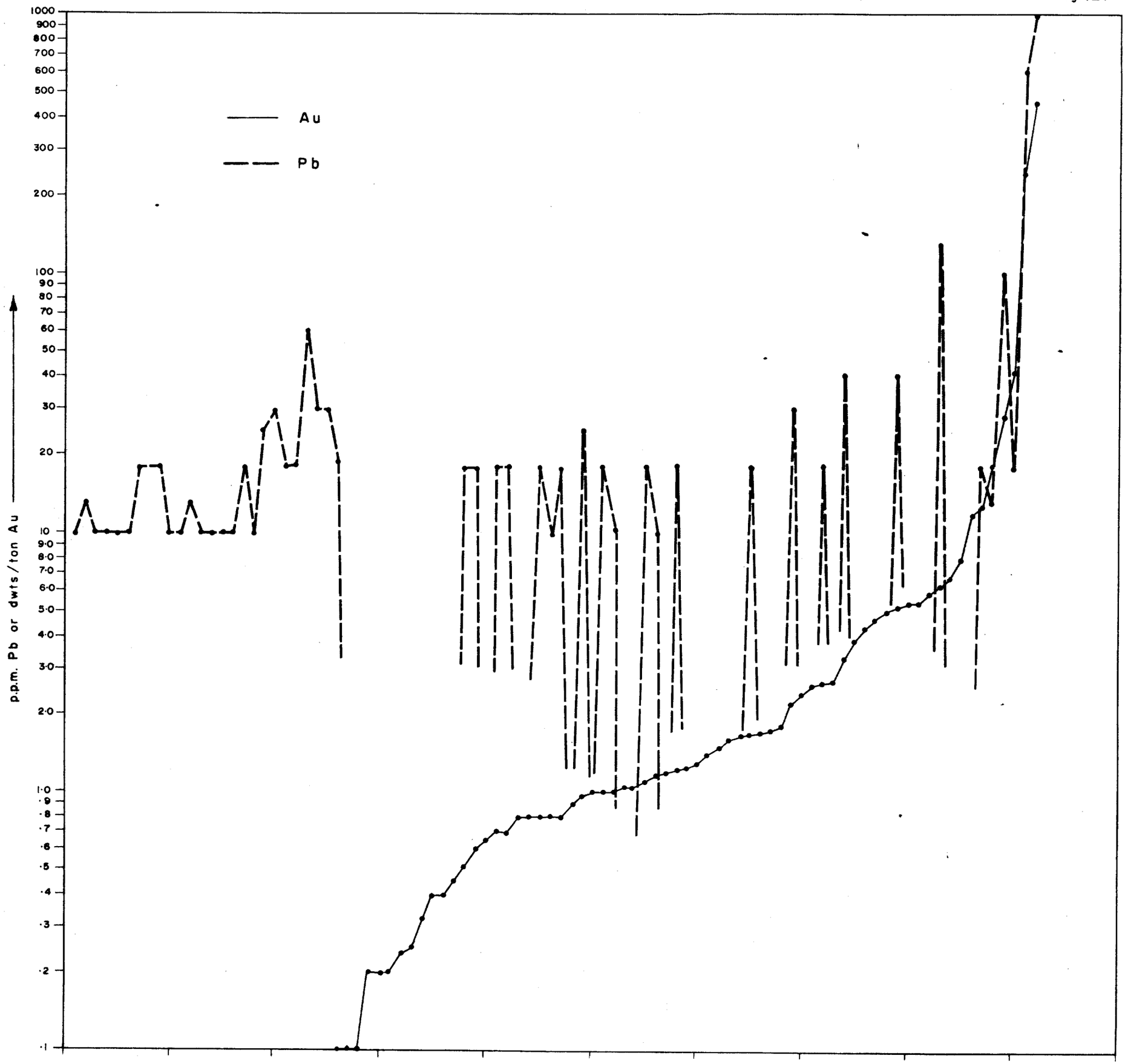


Bureau of Mineral Resources, Geology and Geophysics. May 1966. To accompany Record 1966/130.

H51/A/24 JK

Pb and Au values from various parts of the Kalgoorlie gold field

Fig. 12.

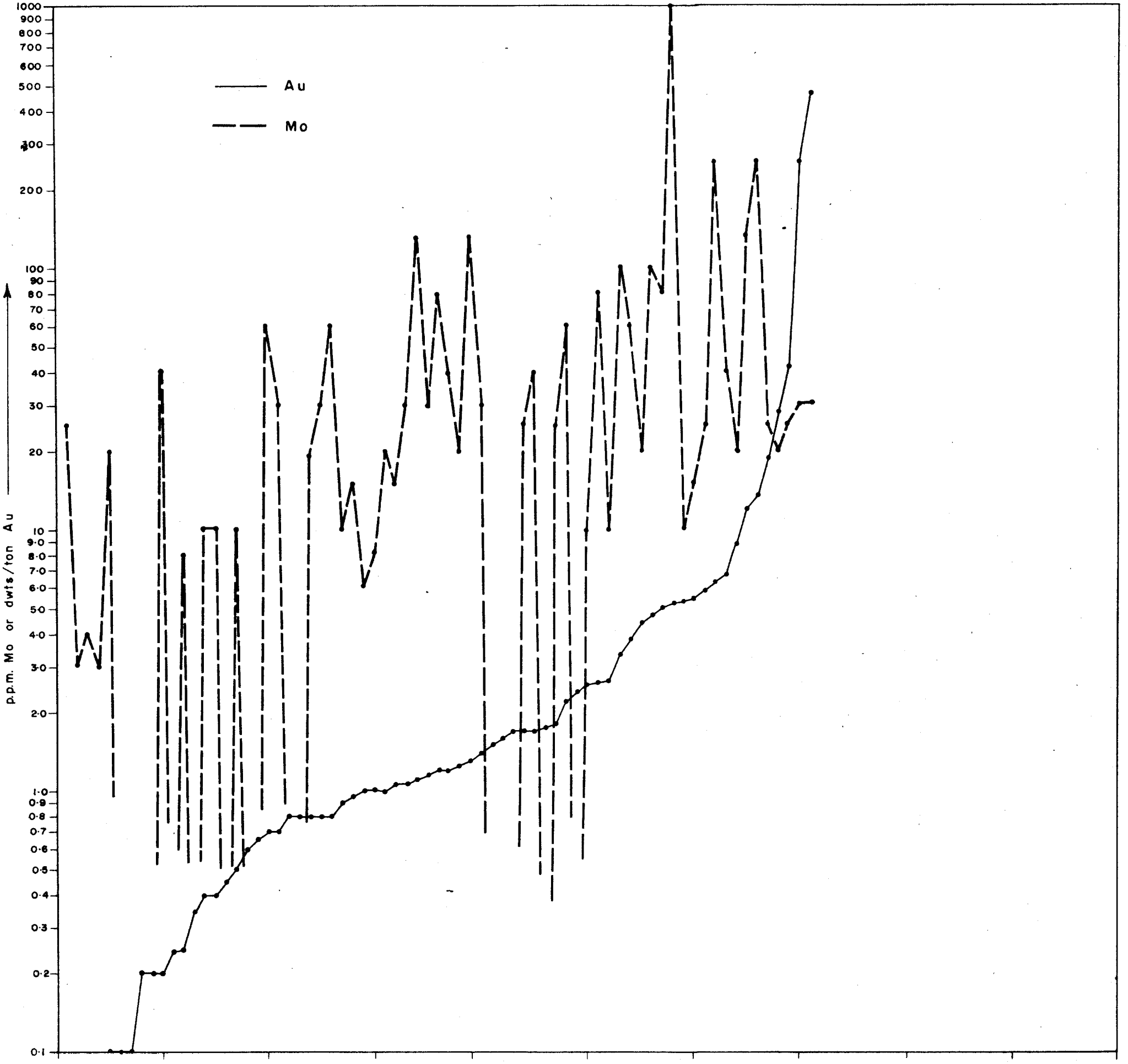


Bureau of Mineral Resources, Geology and Geophysics. May 1966. To accompany Record 1966/130.

H51/A/25 JK

Mo and Au values from various parts of the Kalgoorlie gold field

Fig.13.



Bureau of Mineral Resources, Geology and Geophysics. May 1966. To accompany Record 1966/130.

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