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**Investigations at Lambriggan Mine, near
St Agnes, Cornwall**

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Technical Report WF/89/8

Mineral Resources Series

**Investigations at Lambriggan Mine,
near St Agnes, Cornwall**

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SUMMARY

Ground geophysical and soil geochemical surveys were employed in an attempt to define the extensions of lead-zinc mineralised veins formerly exploited in the Lambriggan Mine. The results of these surveys are described here. The investigations were not successful, with neither extensions to known mineralisation nor any new mineral veins being clearly indicated by geochemical means. Of the geophysical methods employed only the Induced Potential method offered any promise and even that yielded a somewhat speculative interpretation. It seems unlikely that a significant body of lead or zinc ore awaits discovery in the immediate area of the Lambriggan Mine.

INTRODUCTION

The available historical information indicates that the Lambriggan mining sett, about 1.5km south-west of Perranzabuloe and 4km east of St. Agnes (Fig. 1), has never been fully explored and the potential of the mine itself probably not realised before its closure in 1930. In part this is because of the ore complexity and in part because of the metal values. Given modern improvements in beneficiation techniques and increased zinc prices, some hope for re-opening could be entertained if access could be easily and cheaply won and if grades and ore bodies proved to be adequate.

An improvement of zinc prices in 1979 led St. Piran Explorations Ltd., the exploration arm of South Crofty Mine's then owners, to re-examine the potential of the Lambriggan Mine [SW 761.511]. An attempt was made to gain underground access by the clearance and re-habilitation of Main Shaft (Figs. 2 and 3) but, because of collapse since closure, this operation proved to be unduly difficult and expensive. The company approached BGS to assist with information and advice, and a short programme of geophysical and geochemical surveys was carried out under the Mineral Reconnaissance Programme. These surveys were regarded in an experimental light, that is, as controlled orientation studies conducted over an area both limited in size and one in which the mineralisation had been well plotted in recent times.

The eventual lack of success, both by St. Piran and BGS, persuaded the company to give up their attempted exploration. It was clear that to access the mineralisation would prove unacceptably costly, given the normal volatility of zinc prices.

Surface rights at Lambriggan Mine are held exclusively by the Cornwall County Council and the mineral rights are believed to belong to Tehidy Minerals, now a part of the Carnon Consolidated Group. Access to the mining site is solely by roads, many of them being narrow country routes away from the A30.

Some confusion has been introduced to the interpretation of these investigations due to the availability of two mine plan reductions showing somewhat differing positions for some of the main features.

One of these reductions comes from the archives of BGS in Exeter and is derived directly from an original mine plan numbered AM 10185, now held by the County Records Office in Truro. The other was supplied by St. Piran Explorations and is obviously derived from a plan similar to that reduced by BGS, though perhaps not the same. It is believed that the placement of shafts in the St. Piran plan was controlled by on-site inspection and, therefore, this version is generally preferred for plotting purposes.

FORMER MINING

Although only a small property, the mine has been worked on at least two occasions and under three titles. The earliest recorded working, from 1844 to 1848, seems to have been conducted initially as West Shepherds Mine and from 1846 as South St. George Mine. Under the latter name it sold 17.5 tons of lead ore in 1847: during the whole four year period the total production, reputedly, was only 240 tons of zinc blende, 9 tons of lead ore (obviously there is some divergence of information here) and 10 tons of copper ore. A.K. Hamilton Jenkin (1962) records that the drainage adit was driven and Drawing Shaft was sunk to 21 fathoms. This latter was described as 90 fms east of Engine Shaft but there is no evidence of a shaft at this position; from the later plans it seems more likely to be an earlier name for No. 2 Shaft which is shown (Figs. 2 and 3) north-east of Main Shaft. He reports the depth of the mine as 40 fms below adit (7 fms), that is down to 280 ft below surface, a level which is not mentioned in descriptions of the later working.

The later opening, from 1927 to 1930, cleared the drainage adit and deepened the Main Shaft to 410 ft below surface, developing levels at 230 and 400 ft. and also widening it into a two compartment shaft. During their re-opening attempts St. Piran reported that the collapsed upper section had the appearance of a twin shaft. It was found that the Lambriggan Lode had been extensively stoped above the 165 ft Level (21 fms below adit). Good ore shoots were reported to have been located in the new levels and the silver content of the galena was said to increase at depth. Some geophysical prospecting was attempted during this period and upon its interpretation the Elbof Shaft was sunk 106 ft in search of a lode extension.

The mine was suspended in 1930 awaiting an improvement in the price of lead. Mining press reports in 1934 suggested readiness to re-open but this seems never to have materialised.

There is some confusion as to the number of lodes identified by the workings; certainly the only one extensively worked is Lambriggan Lode. This courses some 30 degrees NE and dips at about 70 degrees SE. A parallel structure lying about 100 ft north of Main Shaft is followed by a shallow adit which lies some 20 ft above the 42 ft (Adit) Level and seems not to be connected to the main workings. This lode in some reports is confused with the Lambriggan Lode. Another parallel lode has been mentioned to the south of Lambriggan Lode but there is no statement of distance. Two other NE-trending veins were encountered in the drainage adit, one at its mouth and the other at a distance of 420 ft from the entrance; easterly extensions to these have been sought from Elbof and No. 2 shafts respectively.

Near Main Shaft two northerly trending structures were intersected and were followed for short distances. One of these passes very close to the shaft and strikes slightly west of north, dipping steeply east. About 150 ft further east a NW-SE caunter lode is shown on the plan, probably at the 42 ft Level elevation, and although it has not been followed for any distance at other horizons it is probably represented as a bifurcation in the eastern end of the 400 ft Level.

Relatively little has been recorded about the lodes. In the upper levels the Lambriggan Lode was said to be up to 18 ft wide and rich in sphalerite, with some galena and copper ores. A width of 2 to 8 ft is reported in the deeper levels (Dines, 1956) with a composition of quartz-chlorite peach with abundant sphalerite and lesser pyrite, lead and copper ores, and some arsenopyrite. The lode is commonly composed of indurated and brecciated slate fragments cemented by this veinstuff, usually with the metallic ores occupying a central position. Dump material displays this mineralisation, though it is lower in galena content. Silver assays of the galena were reputedly between 30 and 40 ounces per ton.

The crosscourse lode is said to be of similar composition and it displayed particularly rich lead and zinc contents where it was intersected and heaved (dextrally for 60-70 ft) by Lambriggan Lode. One report infers that the caunter lode also carries the same ore species. Nothing is known about the nature of the other structures except that the lode followed by the shallow adit is heavily oxidised along its whole length.

The country rock of the area is mainly a soft bluish grey, fissile slate which commonly tends to disintegrate to a powdery mass after continued exposure. It is anticipated that considerable timbering might be required for long-term underground support. Dependant on the degree and openness of fracturing, this type of host rock may give a relatively dry mine: one report on Lambriggan suggests a water make of only 200 gallons per minute.

GEOCHEMICAL INVESTIGATIONS

Geochemical soil samples were collected on two separate occasions from differing sets of traverses (Fig. 4). The first group, numbered RQS 1-61, were taken at 10m or 20m intervals along, or close to, parts of the geophysical traverses (cf. Fig 11) and the second group, RQS 62-113, at 10m intervals along short traverses to the east and north of the first group. All samples were prepared within BGS with a coarse crush in a jaw crusher followed by fine grinding of a small sub-sample in a tungsten carbide Tema mill. Analyses were carried out by the Analytical Chemistry Unit of BGS. Methods of analysis were controlled to a large extent by time considerations; XRF multi-element scanning was used for the first set whilst Atomic Absorption Spectrometry (AAS) for only Cu, Pb, Zn and Ag was used for the second batch. The results, of course, are not strictly comparable and the two sets are considered separately in the following discussion and tables; the analytical results are listed in full in Appendices 1 and 2.

Log-probability plots were prepared for the ore metallic elements which had been analysed, and for Ba (Figs 5 and 6). Unfortunately, the number of samples is usually too small to yield a distribution diagram with well-based population discriminations. In the cases of Ag and Mo the range of values is too small to permit construction of any sort of plot, and for Sb the plot (Fig. 6) is of doubtful value. In Table 1 the lower element values for the anomalous sets and the percentage of total samples contained therein are derived from these distribution plots. The Ce results for RQS 59-61 are so different to all the other samples that they must be regarded as spurious and so are not included in the statistical treatment.

Table 1. Analytical summary for RQS 1-61 (in ppm)

Element	Range	Mean	St. Dev.	Median	Anomalous
Ag	0-3	0.417	0.614	0	---
Ba	313-500	437.55	29.48	437	N-g
Ca	1110-5240	2454	807.73	2320	---
Ce*	40-82	60.81	7.90	61	---
Cu	33-92	48.15	8.61	47	57 (2%)
Fe	56750-89970	66640	4865	66370	---
Mn	890-2060	1399	270.81	1340	---
Mo	0-4	0.950	0.865	1	---
Ni	24-77	35.15	8.662	33	---
Pb	53-223	95.50	27.58	93	129 (5%)
Sb	0-8	1.68	1.99	1	4 (13%)?
Sn	23-141	77.25	30.16	81	128 (5%)
Sr	69-126	97.75	15.78	97	---
Th	10-15	12.85	1.236	13	---
Ti	6380-7320	6964	177.17	6990	---
U	1-5	3.03	0.983	3	4 (8%)
Zn	120-419	206.62	70.03	177	315 (14%)
Zr	217-349	288.12	24.93	288	---

* Ce results for RQS 59, 60 and 61 regarded as spurious and therefore not included

N-g indicates a near-gaussian distribution

Table 2. Partial correlation matrix for RQS 1-61

Ag	1.000								
Ba	0.026	1.000							
Cu	<u>0.021</u>	0.075	1.000						
Mo	<u>0.055</u>	0.126	0.100	1.000					
Pb	0.099	0.224	0.354	0.133	1.000				
Sb	0.040	<u>0.182</u>	<u>0.180</u>	<u>0.087</u>	<u>0.055</u>	1.000			
Sn	0.071	0.295	0.482	0.053	0.356	<u>0.092</u>	1.000		
U	0.115	0.079	0.076	0.120	0.023	0.031	0.025	1.000	
Zn	0.072	0.180	0.350	0.091	0.855	0.048	0.231	0.131	1.000
	Ag	Ba	Cu	Mo	Pb	Sb	Sn	U	Zn

Correlation coefficients were calculated for the same selected group of elements and these are quoted in Table 2. There is only one significant correlation, that between Pb and Zn - a relationship which is not unexpected. Albeit very poor, there is some slight accord between Pb and Cu and Sn and Cu; the similar degree of Pb-Sn correlation probably reflects interference experienced between these metals during XRF determination. All other metals fail to correlate with any conviction, even Ag and Pb, though this is presumably due to the universally low levels of Ag recorded - only slightly above detection levels.

Uncertainties introduced by the employment of two differing methods of chemical analysis are emphasized by comparison of Tables 1 and 3. By AAS the values for all four metals are lower than those obtained by XRF and this difference is carried into all the other statistical parameters. The content ranges and intervals in these AAS results are such that the log-distribution plots (Fig. 7) are somewhat less than ideal. Although there are marked differences in the range of the anomalous sets, it is presumed that they do represent equivalent groupings of samples and, therefore, they are used in conjunction in the preparation of Figs. 8-10. Once again there is an insufficient range in the Ag values to permit the construction of a log-probability plot.

Table 3. Analytical summary for RQS 62-113 (in ppm)

Element	Range	Mean	St. Dev	Median	Anomalous
Ag	1-2	1.04	0.192	1	---
Cu	25-50	37.12	5.830	40	38 (43%)?
Pb	40-100	64.81	18.13	60	89 (13%)
Zn	80-140	111.73	15.53	110	130 (15.5%)

The plot for Cu is not satisfactory and it seems to yield an inflection point at 38ppm, this separating almost half of the total sample set as anomalously high. It seems almost certain that such an interpretation over-exaggerates the size of the anomalous group.

Again, the most significant correlation (Table 4) is between Pb and Zn but in this group there is greater accord between Cu and Pb. Ag again correlates very poorly with the other metals, but this is certainly due to the large number of samples with an Ag content below detection level. Thus the correlations of Ag with Cu and Pb are omitted.

Table 4. Element correlations for RQS 62-113

Cu	1.000		
Pb	0.486	1.000	
Zn	0.268	0.633	1.000
	Cu	Pb	Zn

GEOPHYSICAL INVESTIGATIONS

Because of the time-consuming nature of electrical geophysical methods, careful consideration was given to the ore parameters before selecting the best technique to employ at Lambriggan Mine. It was assumed that other reported lodes and any unsuspected lodes in the vicinity would have mineral compositions similar to that described for the Lambriggan Lode.

When pure the predominant ore mineral, sphalerite, is practically an electrical insulator but with impurities its resistivity may fall to a few ohm-metres. Galena, the second most abundant ore, is a good conductor, as are most other components of the mixed sulphide assemblage.

Table 5. Resistivity ranges for ore minerals and mixtures (in ohm-metres)

Mineral	Resistivity range
Sphalerite (ZnS)	1.5 - 1×10^7
Galena (PbS)	3×10^{-5} - 300
Arsenopyrite (FeAsS)	2×10^{-5} - 15
Pyrite (FeS ₂)	2.9×10^{-5} - 1.5
Quartz (SiO ₂)	$> 4 \times 10^{10}$
Mixtures	
30% ZnS, 5% PbS, 15% FeS ₂ , with 50% quartz gangue	0.75
70% ZnS, 17% PbS, 10% FeS ₂ , 3% CuFeS ₂ and no gangue	20.0
CuFeS ₂ = chalcopyrite	

Telford et al. (1976) suggest that zinc ores, when mixed with lead, copper or iron sulphides, have low resistivities (Table 5) and thus sphalerite mineralisation can produce electrical self-potential anomalies. From the ore description given by Dines (1956) it seemed that the SP method might be successful in this instance; clearly the ores would exercise little or no magnetic effect. In reality, the availability of additional time permitted the deployment of four methods of geophysical investigation, both electrical and magnetic, even though their potential seemed poor.

A geophysical base-line, designated Line 0, was aligned at 15 degrees west of north with three further parallel lines at 50 and 100m to the west and 72m to the east. All of these trend approximately normal to the vein strike. Farther east a long and sinuous line follows the field hedges and skirts close to No.2 and Elbof shafts. This and the very short line located near the drainage adit mouth

were used only for the SP measurements. These traverses are shown in Figure 11.

Induced Polarisation.

Observations were made with the Hunter Mark III time-domain equipment. The duty ratio was zero, the cycle time 8 seconds and the values of t_d and t_p respectively 15 and 80 milliseconds. Overvoltages were measured at 55, 175, 415 and 895 msecs, giving chargeabilities over the period 15-1215 msecs after switch-off.

Measurements were made with a Schlumberger gradient array along lines 0, 50W and 100W with C1-C2 at 500m and P1-P2 at 10m, and along line 50W with a dipole-dipole array of length 20m.

The gradient array results are shown in Figures 12 and 12A. For lines 0 and 50W there are broad resistivity minima and chargeability maxima at about 250m North of datum (see Fig. 11) and these have been attributed to the sub-outcrop of the Lambriggan Lode. Line 100W shows a bigger range of apparent resistivity and chargeability, with two distinct anomalous zones. The more southerly, at about 270m North, can be correlated with the Adit (42 ft) Level; the larger anomaly at 365m North is not above worked ground and was first thought to be an expression of the lode found midway along the drainage adit. Enquiry, however, has established that a 3-inch cast iron water main passes under this point and clearly this gives rise to the anomaly.

The dipole-dipole pseudosection for line 50W (Fig. 13) shows a conductive IP structure sub-cropping between 250 and 300m North, close to the assumed trace of the Lambriggan Lode. With a theoretical depth penetration of only 60m the dipole-dipole data is probably only sampling the worked ground.

Electro-Magnetic.

These surveys were made with VLF (EM16) equipment along lines 0, 50W and 100W and by APEX Max-Min (horizontal loop mode) on line 50W. The Rugby transmitter station (GBR 16 kHz) was used for the VLF measurements and observations were made every 5m with the equipment looking north-west. On lines 0 and 50W (Fig. 14) there are no significant VLF anomalies over the Lambriggan workings. On line 100W there is a 25% in-phase anomaly with a cross-over at 366m North which correlates with the IP chargeability maximum and apparent resistivity minimum over the cast iron water main.

The five frequency HLEM results for line 50W (Fig. 15) are inconclusive. The in-phase results are so similar between 325 North and 200 North as to suggest random noise (tilt-coil separation) errors. The 25% in-phase anomaly is also very similar across all frequencies, the only obvious change being in out-of-phase readings (increasingly positive as the frequency increases). Results were collected every 10m traversing south, with a coil separation of 50m. To produce a 24% in-phase anomaly would require a coil separation error of about 8%, ie. 4m. This might be less if the coils were not correctly aligned. Since the IP results for this line (Fig. 12) show only a slight apparent resistivity low, incorrect separation or tilt seems a likely cause of the anomaly.

Magnetic.

Observations of the total magnetic field were made along lines 0, 50W and 100W with a proton precession magnetometer. After diurnal change corrections the results (Fig. 16) show a very small (20nT) anomaly on line 0 at 325m North, and a similar anomaly on line 50W around 250 North. On line 100W the most significant natural anomaly occurs at 345m North.

Self Potential.

Despite literary references to SP anomalies over sphalerite mineralisation (Telford et al., 1976) no large anomalies were observed across the Lambriggan Lode (Fig. 17). The largest self potential was towards the northern end of line 100W where it reached more than 30mV; it is coincident with IP and EM 16 anomalies and relates to a buried cast iron pipe.

The porous pot electrodes consistently showed a potential difference of 20-25mV when placed adjacent to each other, despite recharging with saturated copper sulphate solution. This was most likely due to impure or unclean electrodes.

The other lines of self potential measurement, 72m East, SP 1 and SP 2 (Fig. 11) cross the lode structure or inferred lode strikes but show no SP anomalies except on line SP2, where there is a 30mV anomaly (Fig.18) over the lode at the adit mouth.

CONCLUSIONS

The anomalous metal values are plotted in Figs. 8-10 against the projections to surface of lodes worked or reported in the mine. There is, of course, some doubt about the precise position and attitude of some of these structures and even more uncertainty about their lateral extensions.

There are a large number of anomalous Cu values as determined by AAS, and when plotted (Fig. 8) these can be regarded as indicative of considerable lateral extension to all the east-west lodes. The XRF anomalies for Cu, however, do not support this contention but may suggest a structure some 100m north of Lambriggan Lode. The Pb anomalies in Fig. 9 seem only to reflect the southern lode and the lode seen near the mid point of the drainage adit. Anomalies along line A may be interpreted as showing that the caunter lode has a westerly dip, and not an easterly one as has been presumed from independent reports.

As sphalerite is the major constituent of the worked lodes, it may be assumed that Zn anomalies should be the best indicators of lode continuation. In fact Fig. 10 reveals a similar pattern to that in Fig. 9, with a marked cluster of anomalous values lying along a line trending east-north-east from Main Shaft: could it be that this is more correctly the outcrop trace of Lambriggan Lode? The isolated anomalies east, north-east and west of No. 2 Shaft can be tentatively correlated with presumed lodes north of Lambriggan Lode.

On the basis of the geochemistry, therefore, there is little

significant evidence for the existence of important lead-zinc veins in addition to the major one worked in the Lambriggan Mine. Indeed, even that lode cannot be traced with any certainty.

A similar degree of ambiguity attaches to interpretation of the geophysical results. The Lambriggan Lode can be recognised, but this has only been attempted in an area where it has previously been mined. Other than this the only claimable success is the identification of the adit mouth lode, but again only where it has been worked in a small way.

The geophysical results show that self potential and magnetic surveys are not suited to mapping extensions or finding new lodges of the Lambriggan type. Electro-magnetic methods ought to be capable of locating conducting sulphide ores but may lack the requisite depth penetration. Although one of the lodges may be extensively stoped down to 165 ft (50m), a water-filled lode cavity should also be a reasonable EM target.

The induced potential observations suggest that the ore has a lower resistivity than the country rocks (about a half) and an appreciable chargeability as well. This seems the most suitable method for any further exploration, preferably using a series of schlumberger or gradient arrays across the prospect and on both banks of the stream. Very low frequency measurements would provide a suitable and rapid supportive method.

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APPENDIX 1. XRF analyses for RQS 1-61 (in ppm)

Sample	Ce	Ba	Sb	Sn	Pb	Zn	Cu	Ca	Ni	Fe
RQS 1	57	418	8	37	62	124	33	1480	28	63590
2	67	455	1	26	53	120	33	1350	33	62480
3	73	479	0	36	127	218	45	1510	46	75950
4	58	425	6	57	94	273	42	1760	40	66110
5	61	432	0	71	129	321	51	2140	41	70600
6	62	417	0	55	130	295	53	1920	43	76070
7	52	395	2	44	61	164	47	1440	53	71410
8	49	417	0	109	84	177	55	1890	41	68250
9	49	431	0	128	89	171	56	2050	37	66400
10	55	428	2	130	94	180	57	2440	33	66370
11	68	446	3	123	93	184	57	2410	30	64730
12	69	420	7	41	79	153	54	1580	40	64350
13	82	473	3	24	58	122	40	1110	36	68380
14	No sample									
15	63	414	0	89	94	165	52	2410	31	63780
16	54	462	0	73	82	164	53	2190	29	63590
17	63	457	0	98	84	167	52	2360	30	64440
18	59	415	0	80	76	160	54	1840	37	66750
19	59	400	2	53	78	176	47	1590	55	70320
20	57	443	4	85	117	328	53	3350	40	71230
21	63	437	2	87	112	351	49	1870	37	71250
22	58	470	0	87	123	319	46	2420	38	71380
23	64	450	0	81	122	255	49	2910	38	68600
24	58	430	0	65	115	244	49	2210	37	68840
25	69	446	4	30	55	130	35	1820	33	61840
26	50	378	3	45	70	143	40	1810	28	63430
27	58	428	0	47	68	140	42	1960	25	65430
28	62	457	3	54	73	145	44	2520	25	65140
29	56	406	0	54	74	146	46	2730	25	64740
30	60	451	0	38	76	147	48	1900	31	66670
31	47	390	1	35	71	131	34	1850	26	65320
32	55	435	0	51	68	136	35	1870	27	62610
33	69	500	0	64	104	269	49	3020	43	69480
34	66	420	2	81	223	419	48	2550	40	70220
35	54	436	4	86	143	374	52	3030	37	68670
36	52	313	2	23	58	220	48	1940	77	89970
37	61	424	0	92	92	186	56	1950	42	69240
38	59	438	3	131	96	194	57	2440	38	68280
39	70	425	1	141	93	189	56	2320	36	67420
40	71	432	0	124	97	175	57	2250	31	65090
41	74	457	4	100	90	171	55	2170	30	63890
42	50	390	0	48	72	177	43	2170	27	56850
43	40	420	1	53	77	146	38	1880	25	56750
44	53	438	0	48	66	135	34	2030	24	57150
45	57	474	0	81	93	199	46	3180	33	66250
46	63	456	4	90	100	235	43	2990	33	66530
47	66	474	2	108	110	306	45	2990	35	67500
48	76	460	2	86	116	320	48	2750	36	69070
49	56	427	2	100	115	293	48	4050	33	66420
50	56	454	1	66	120	280	57	2940	35	69730
51	77	463	4	100	93	170	45	2460	31	63810
52	64	464	1	96	81	153	46	2570	30	64420

APPENDIX 1 (cont.)

Sample	Mn	Ti	Ag	U	Th	Sr	Zr	Mo
RQS 1	1310	7000	0	2	13	97	305	0
2	890	6850	1	4	15	98	343	1
3	1080	6730	1	3	14	105	217	0
4	1020	6380	0	3	13	97	289	2
5	1510	6870	0	2	13	105	285	1
6	1380	6830	1	5	13	85	261	1
7	1310	6640	0	2	12	79	309	0
8	1700	6940	0	3	14	85	288	1
9	1720	6880	0	2	14	84	307	1
10	2000	7000	0	3	14	84	309	1
11	1920	6940	3	3	11	81	307	1
12	1470	7010	0	3	13	72	349	1
13	910	6900	0	3	15	69	291	0
14	No sample							
15	1490	6940	1	4	13	77	307	1
16	1700	7160	0	2	13	84	312	2
17	1690	7110	1	2	12	90	299	0
18	1650	7190	0	5	11	90	315	0
19	1010	7100	1	3	13	72	296	0
20	1430	7080	1	4	13	115	272	1
21	1370	7200	0	2	12	98	277	2
22	1340	7050	1	4	11	113	271	3
23	1340	6980	0	4	14	122	258	0
24	1240	6990	1	3	14	106	248	2
25	1120	6780	0	3	10	104	312	2
26	1510	7020	1	3	14	109	346	1
27	1560	7070	0	1	12	106	274	1
28	1510	7320	1	2	12	109	269	1
29	1580	7220	0	2	12	97	262	0
30	1590	7170	0	3	11	95	287	1
31	1460	7050	0	2	13	101	302	1
32	1090	6900	1	5	11	103	312	2
33	1160	6840	0	3	15	125	318	2
34	1230	6800	1	1	14	102	278	1
35	1410	6870	0	4	12	107	270	0
36	1900	6390	0	4	10	70	250	1
37	1590	6990	0	4	13	82	288	1
38	1690	6930	1	4	12	82	289	2
39	1860	6970	0	3	12	80	294	0
40	2060	7160	0	1	11	85	307	1
41	2050	7020	1	3	14	83	315	1
42	1100	6570	2	2	12	88	297	0
43	1120	6720	0	3	12	82	315	2
44	1230	6840	0	2	12	86	319	0
45	1170	7010	0	5	14	121	266	2
46	1260	7120	0	3	13	115	273	0
47	1320	7000	1	4	13	117	266	0
48	1290	7120	1	3	13	106	270	0
49	1370	7070	0	3	15	120	274	0
50	1180	6990	0	4	13	115	272	1
51	1280	7070	1	5	13	93	289	1
52	1340	7100	0	3	15	93	287	0

APPENDIX 1 (cont.)

Sample	Ce	Ba	Sb	Sn	Pb	Zn	Cu	Ca	Ni	Fe
RQS 53	65	464	0	103	92	166	47	2600	28	61570
54	64	469	0	110	94	168	47	2910	30	64360
55	59	478	3	111	86	168	47	2570	30	63510
56	61	433	6	85	111	241	46	3200	31	61240
57	61	438	0	105	116	204	47	5240	30	63090
58	65	430	2	104	129	211	46	4840	30	64190
59	267	462	1	95	119	194	46	3530	35	68580
60	270	454	5	93	112	226	49	4390	38	67380
61	263	455	0	78	121	279	92	3600	38	67740

Sample	Mn	Ti	Ag	U	Th	Sr	Zr	Mo
RQS 53	1330	6950	0	3	14	88	297	1
54	1310	6910	1	2	12	86	292	1
55	1330	7030	0	2	11	86	300	1
56	1160	6880	1	3	13	108	271	0
57	1310	7100	0	3	14	126	278	0
58	1350	7000	0	3	13	124	266	4
59	1270	7110	0	3	14	121	257	2
60	1190	6880	0	4	13	124	255	1
61	1200	7080	0	3	14	118	255	2

APPENDIX 2. AAS analyses for RQS 62-113 (in ppm)

Sample	Cu	Pb	Zn	Ag	Sample	Cu	Pb	Zn	Ag
RQS 62	40	90	120	1	RQS 88	35	60	100	1
63	40	90	140	1	89	35	50	110	1
64	40	90	140	1	90	35	80	110	1
65	40	100	140	1	91	40	60	120	1
66	40	100	140	1	92	50	80	120	1
67	40	80	120	1	93	40	60	130	1
68	40	70	90	1	94	35	60	120	1
69	45	60	120	2	95	35	60	110	2
70	35	50	100	1	96	40	60	90	1
71	45	80	130	1	97	30	50	90	1
72	40	80	120	1	98	25	40	100	1
73	35	70	110	1	99	30	40	120	1
74	40	70	120	1	100	30	40	100	1
75	50	60	100	1	101	30	50	110	1
76	40	80	130	1	102	25	50	110	1
77	40	80	130	1	103	25	40	90	1
78	45	60	120	1	104	30	40	90	1
79	40	70	120	1	105	30	50	100	1
80	40	80	120	1	106	25	50	90	1
81	35	70	110	1	107	45	50	110	1
82	40	90	120	1	108	40	40	100	1
83	40	70	130	1	109	40	40	100	1
84	40	100	120	1	110	40	40	100	1
85	40	100	120	1	111	35	40	80	1
86	30	70	120	1	112	35	60	80	1
87	35	60	110	1	113	35	60	90	1

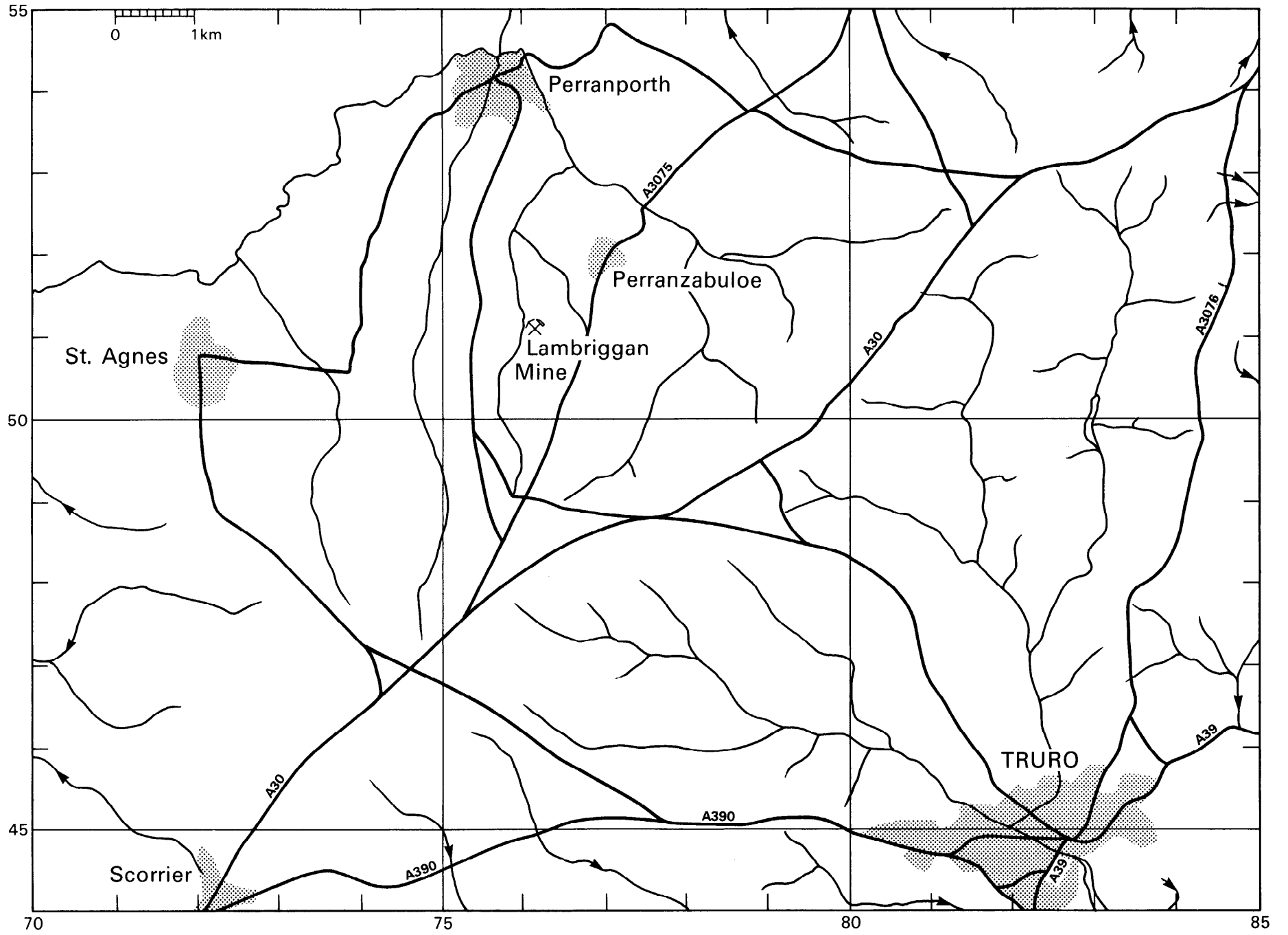


Figure 1 Location map

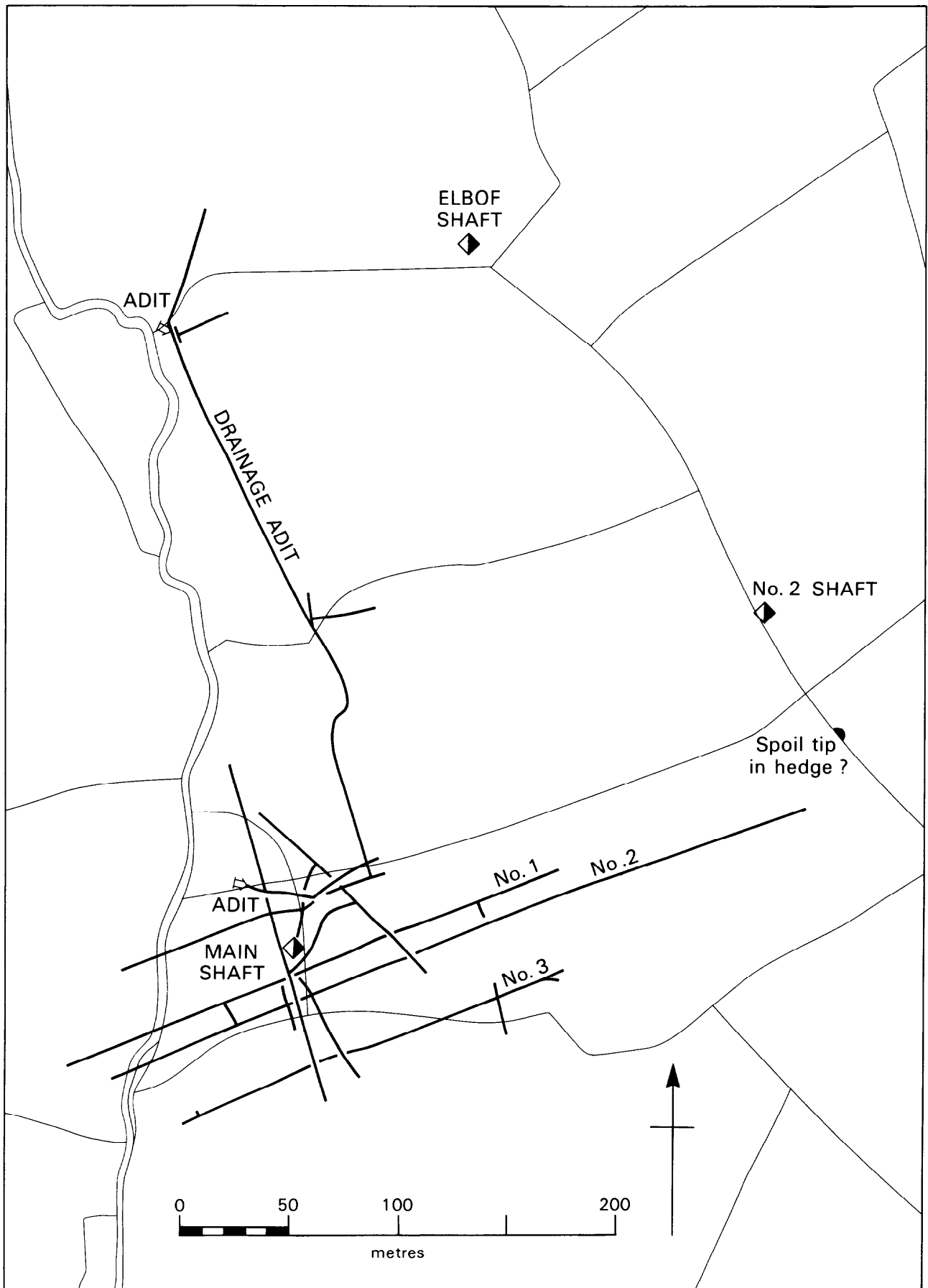


Figure 2 Lambriggan Mine plan (St Piran version)

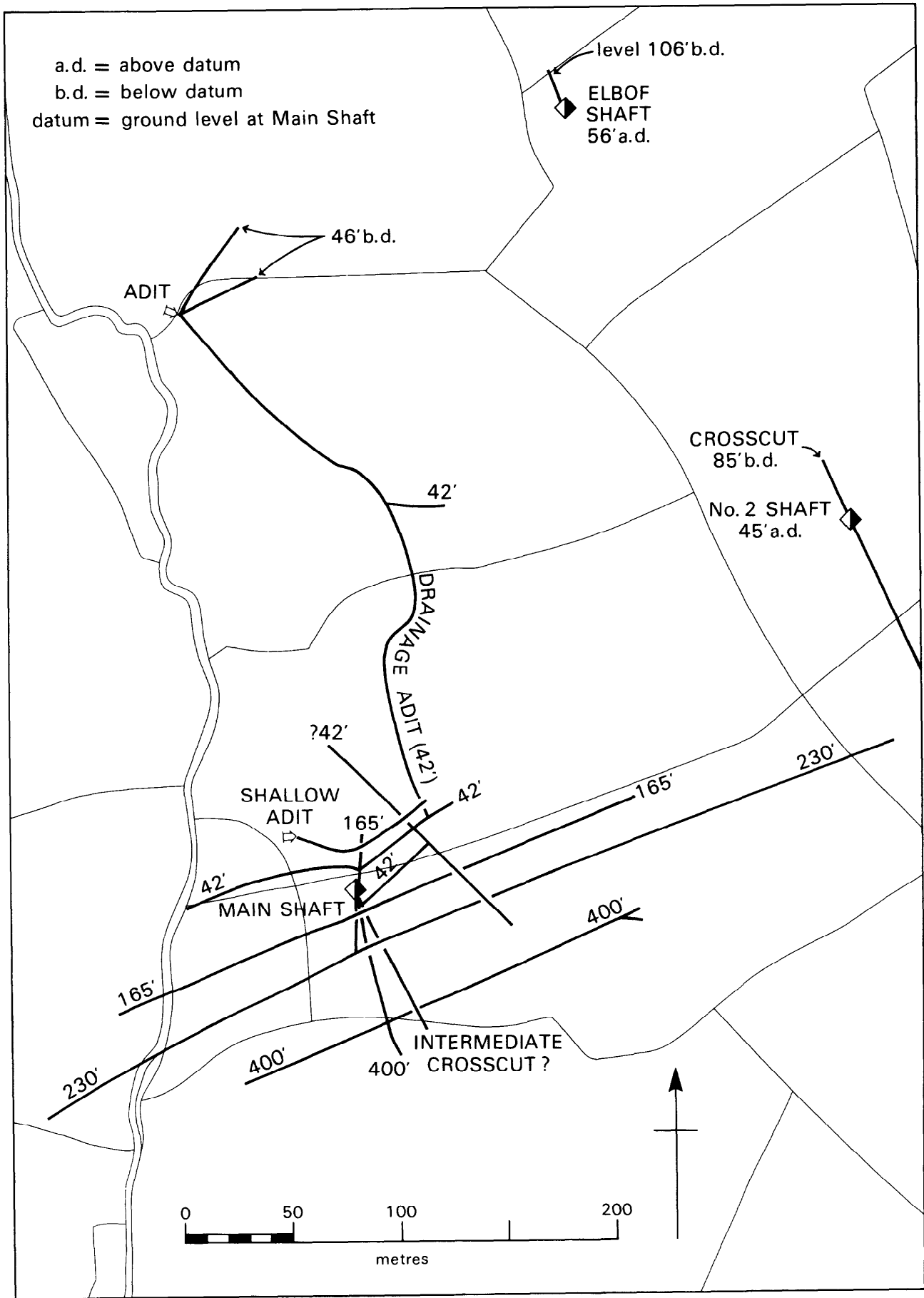


Figure 3 Lambriggan Mine plan (BGS version)

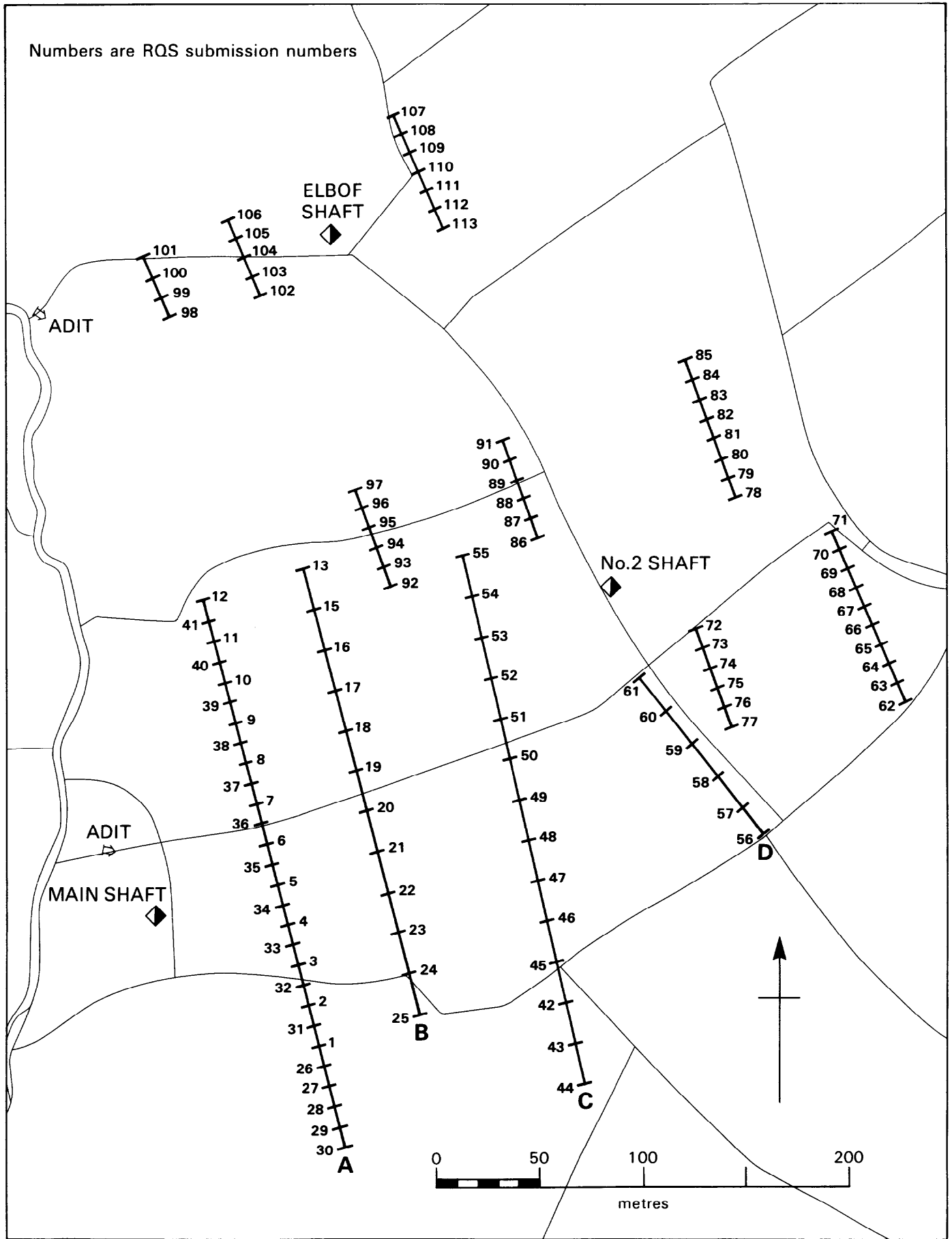


Figure 4 Geochemical traverses and sampling sites

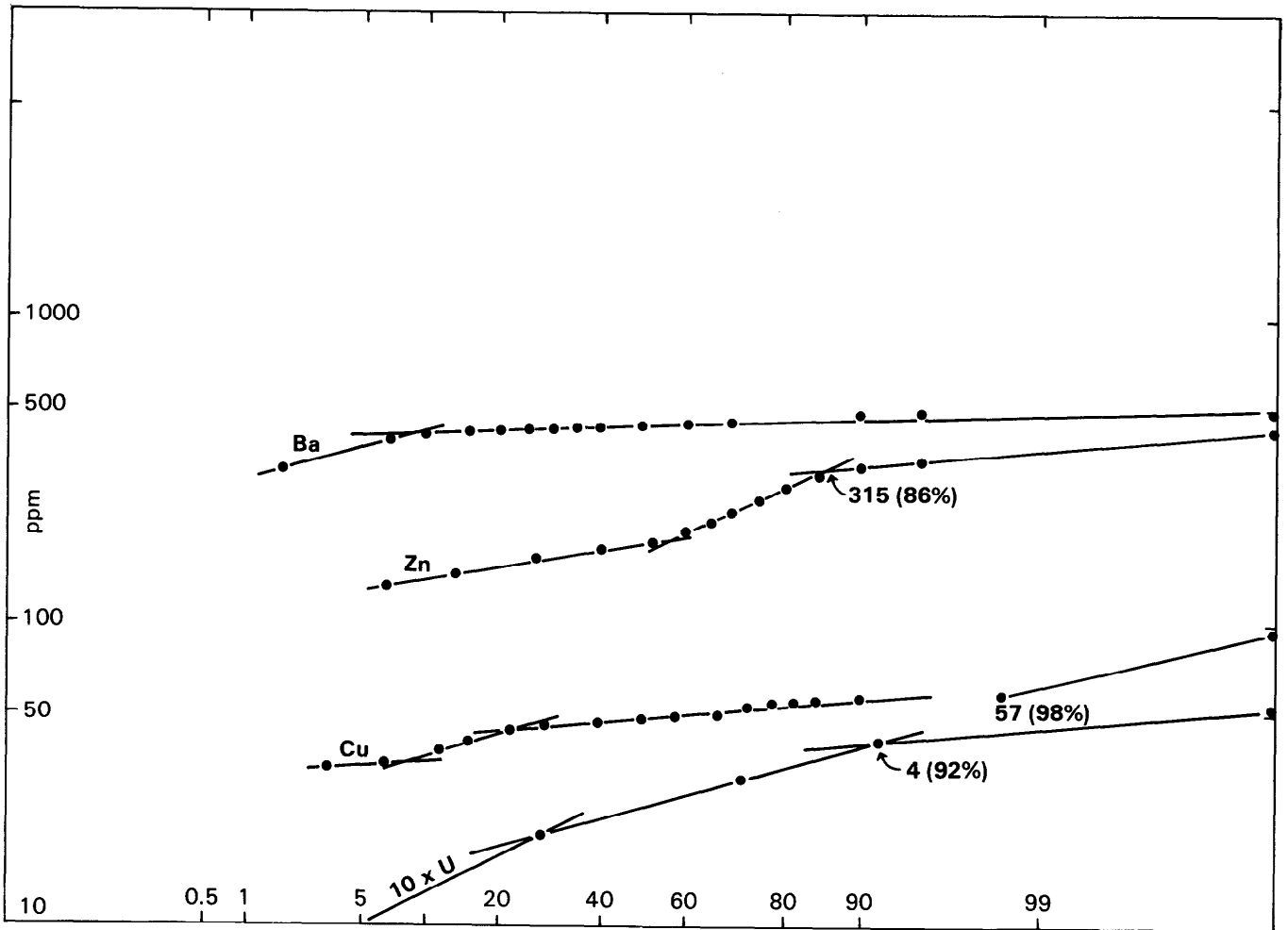


Figure 5 Log-probability plots for RQS 1-61

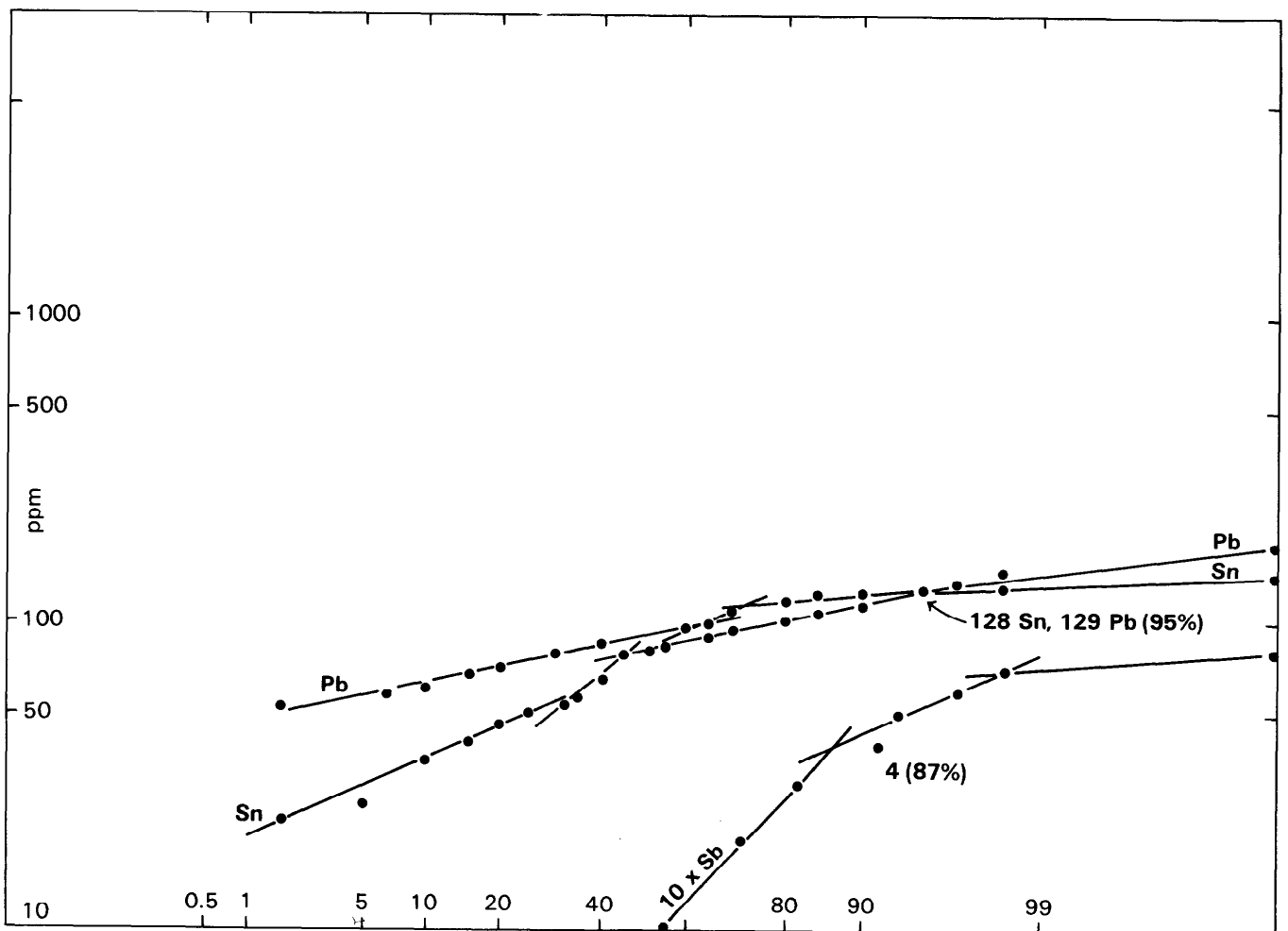


Figure 6 Log-probability plots for RQS 1-61

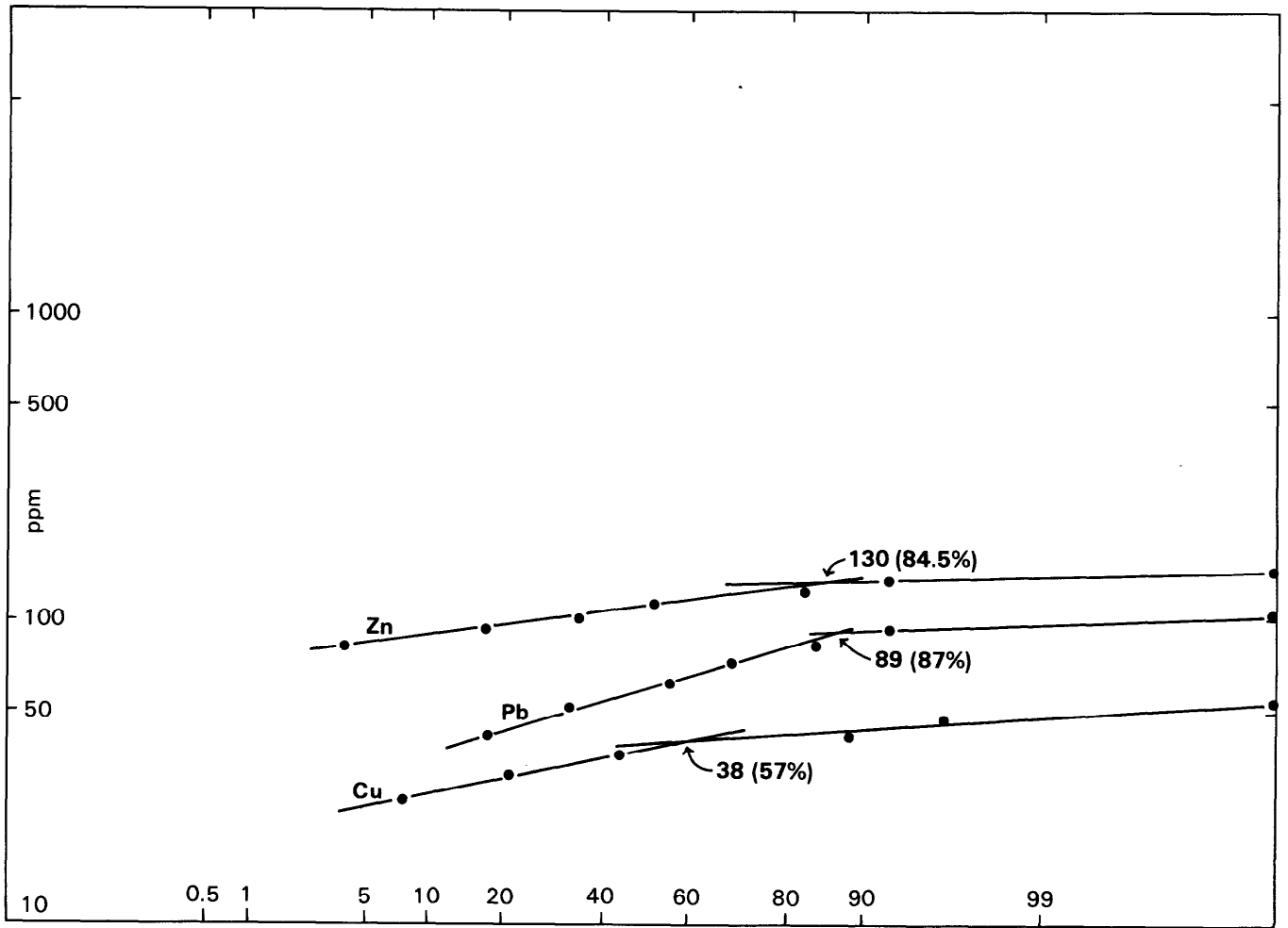


Figure 7 Log-probability plots for RQS 62-113

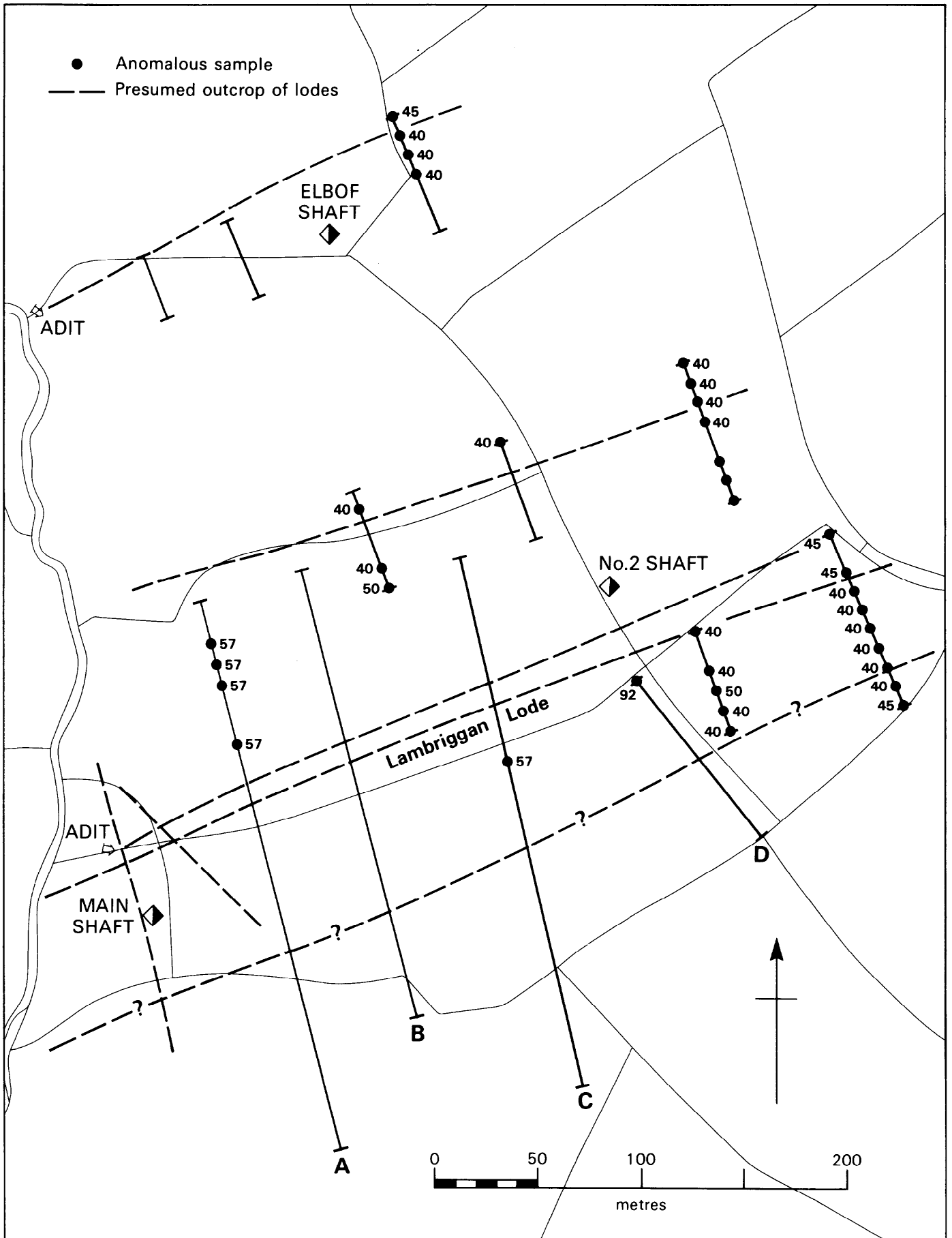


Figure 8 Distribution of Cu anomalies

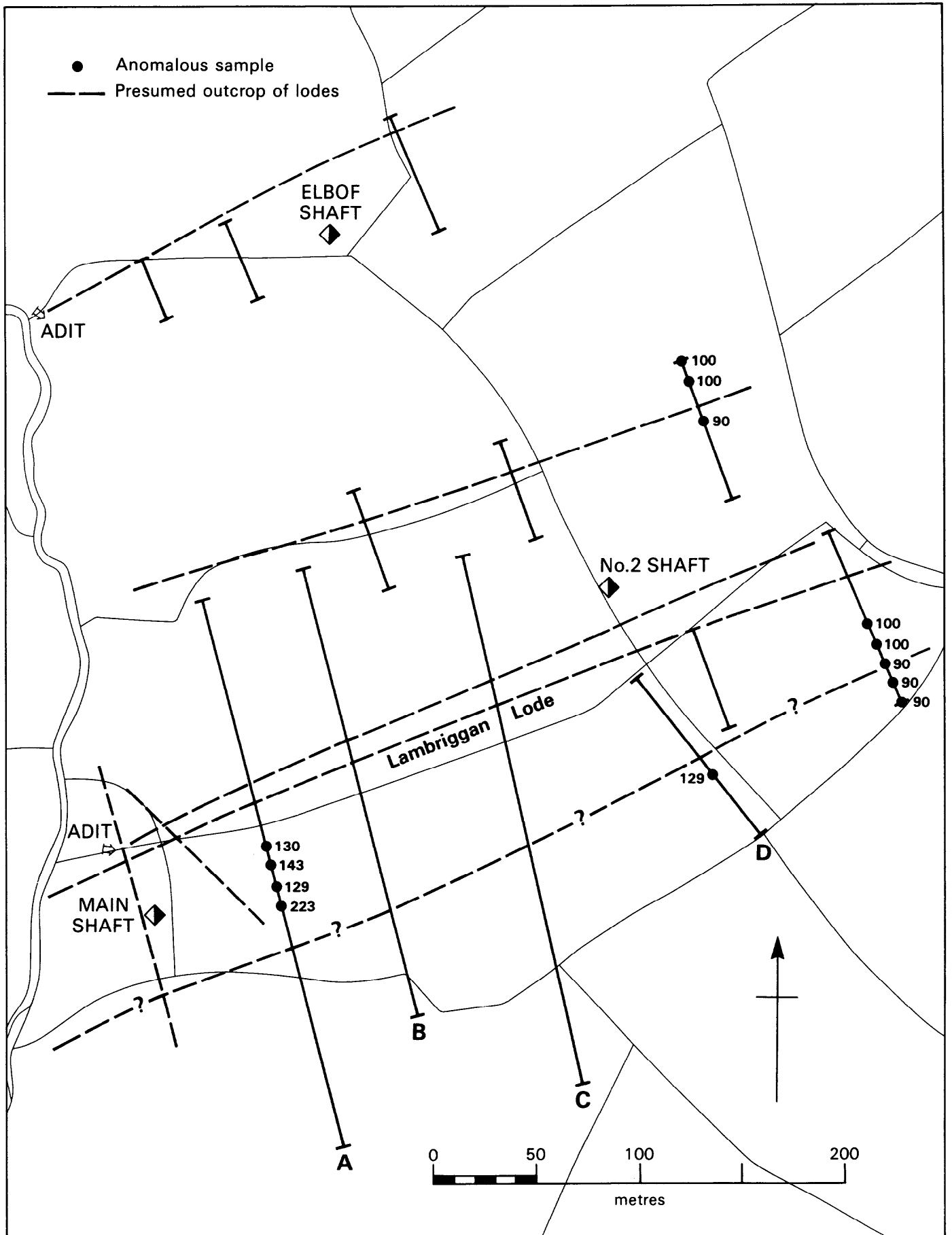


Figure 9 Distribution of Pb anomalies

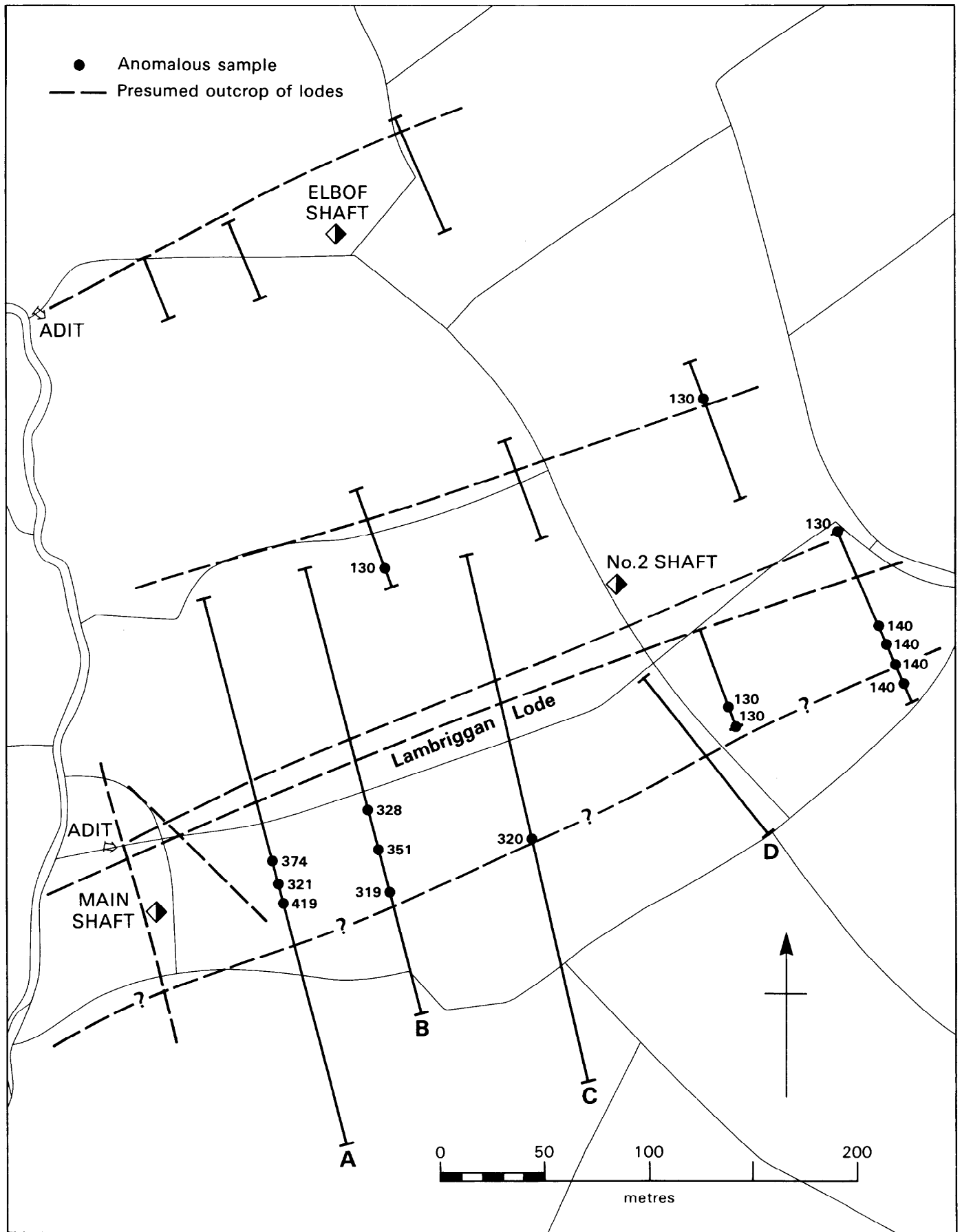


Figure 10 Distribution of Zn anomalies

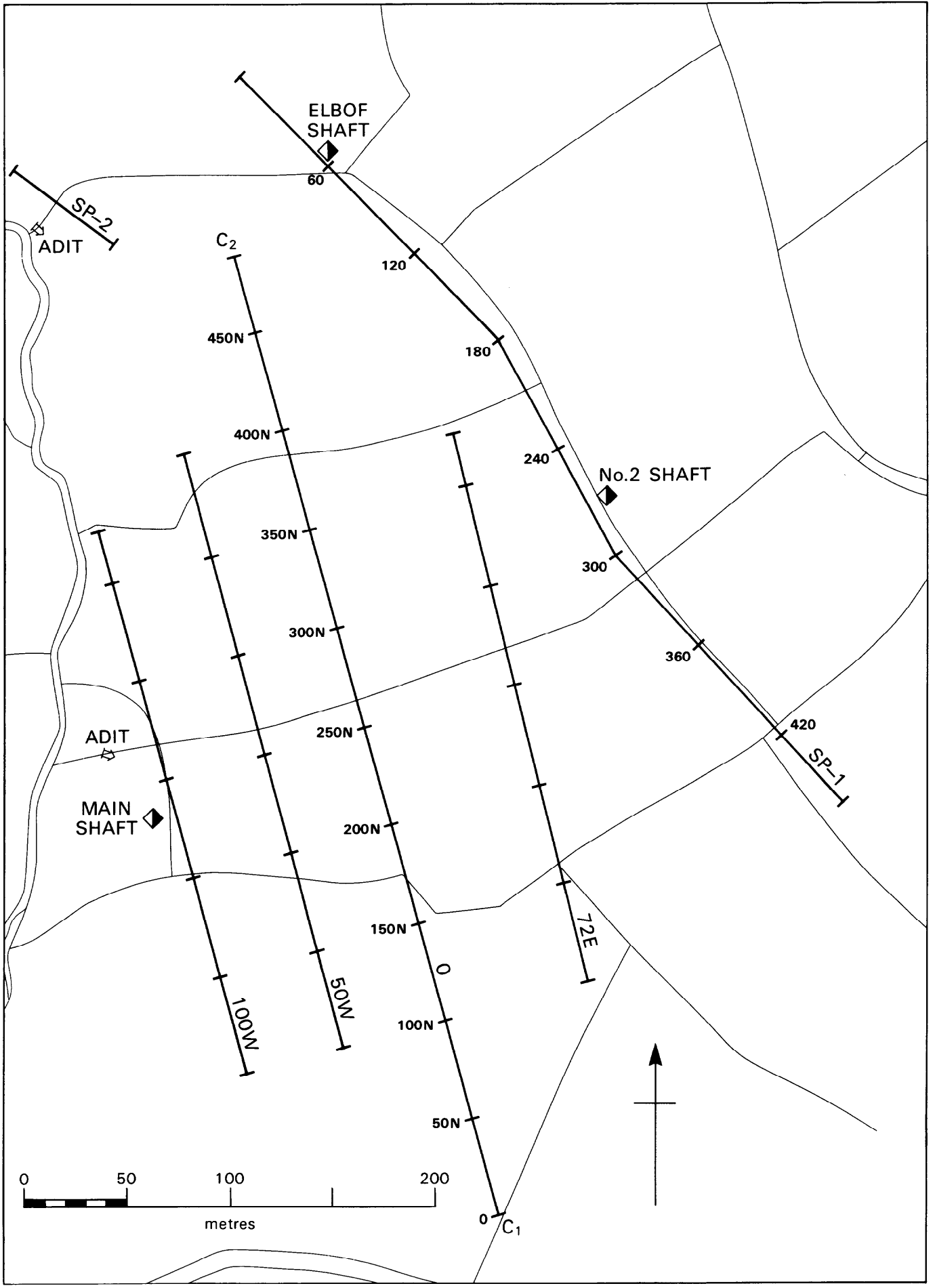


Figure 11 Geophysical traverses

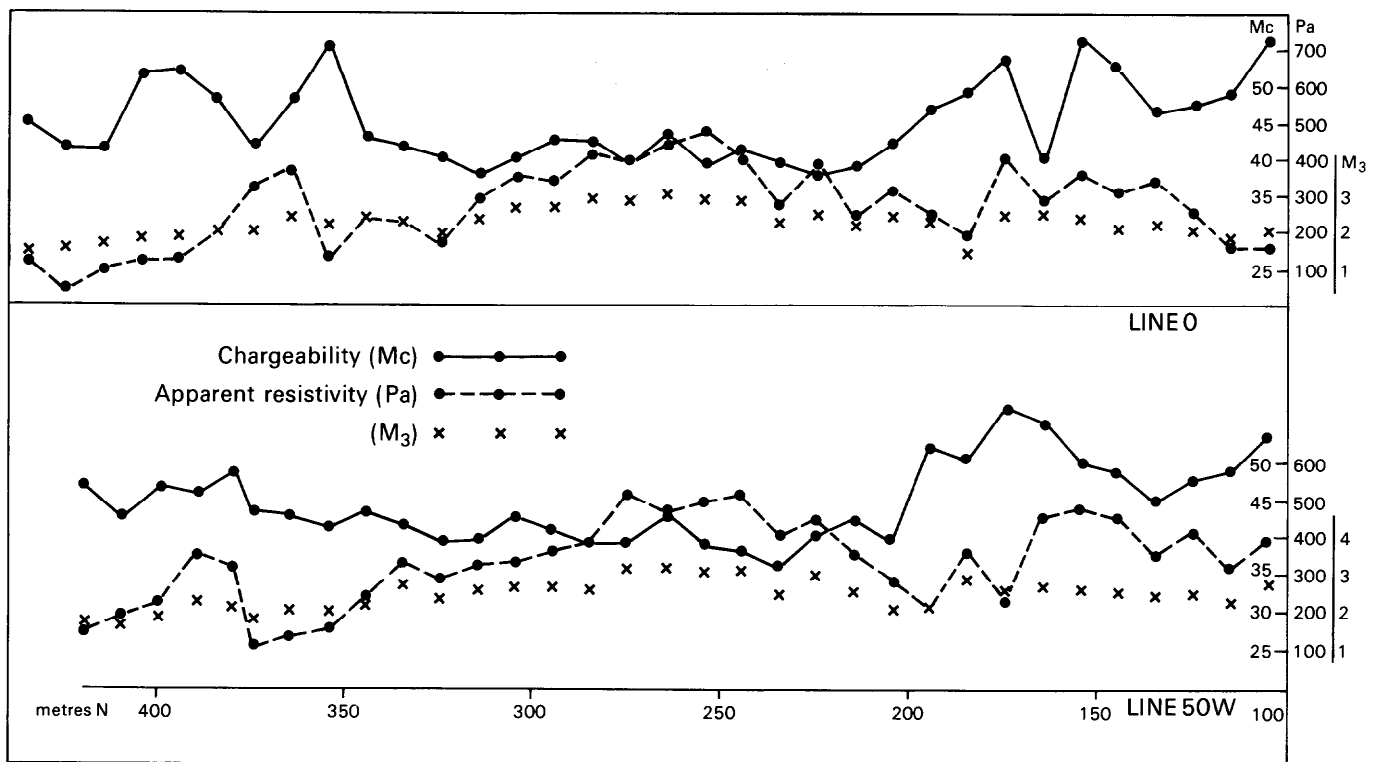


Figure 12 Gradient array IP results, lines 0, 50W

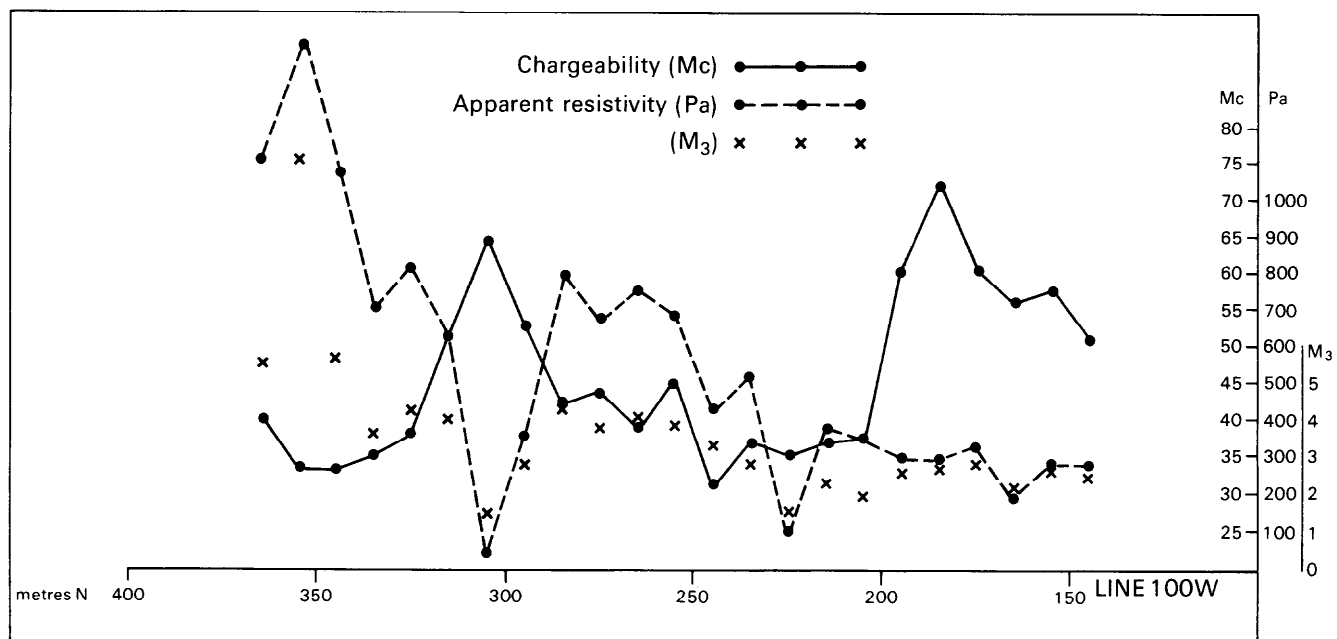


Figure 12A Gradient array IP results, line 100W

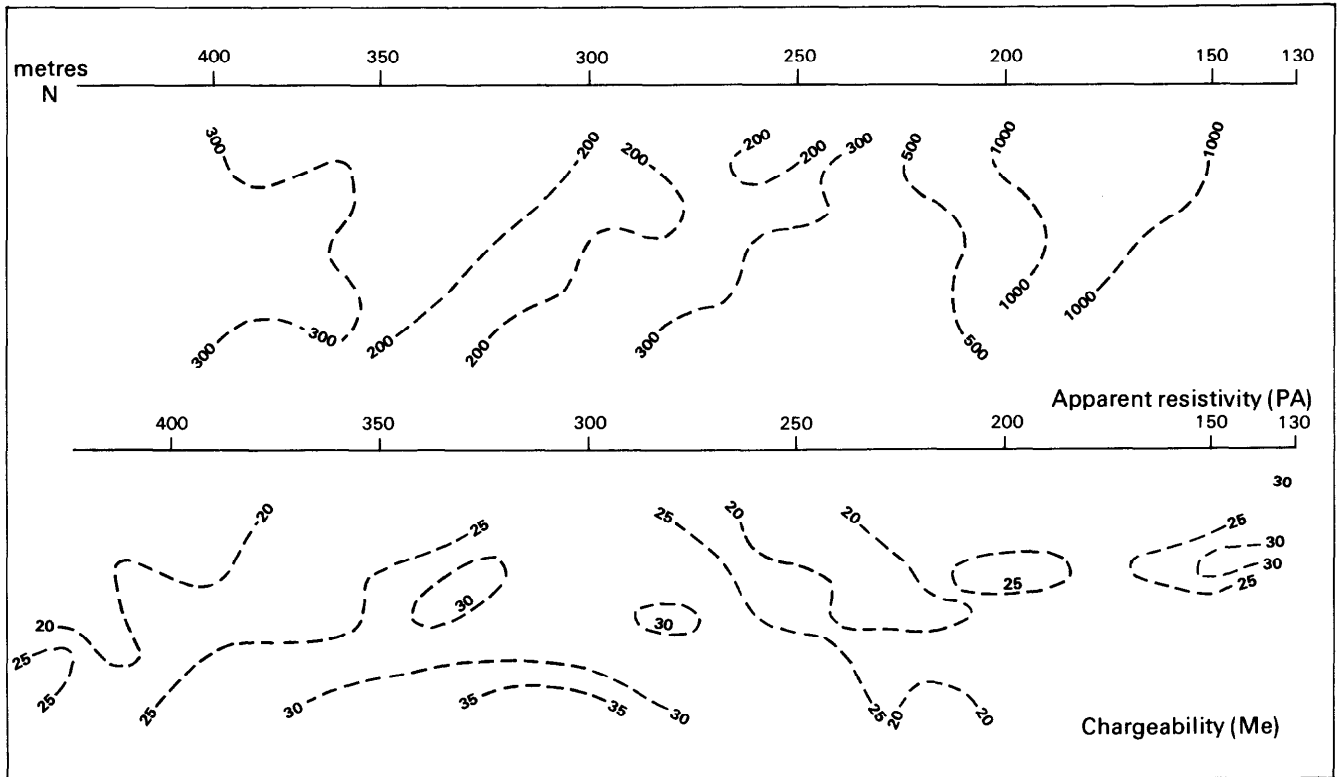


Figure 13 Dipole-dipole IP pseudosections, line 50W

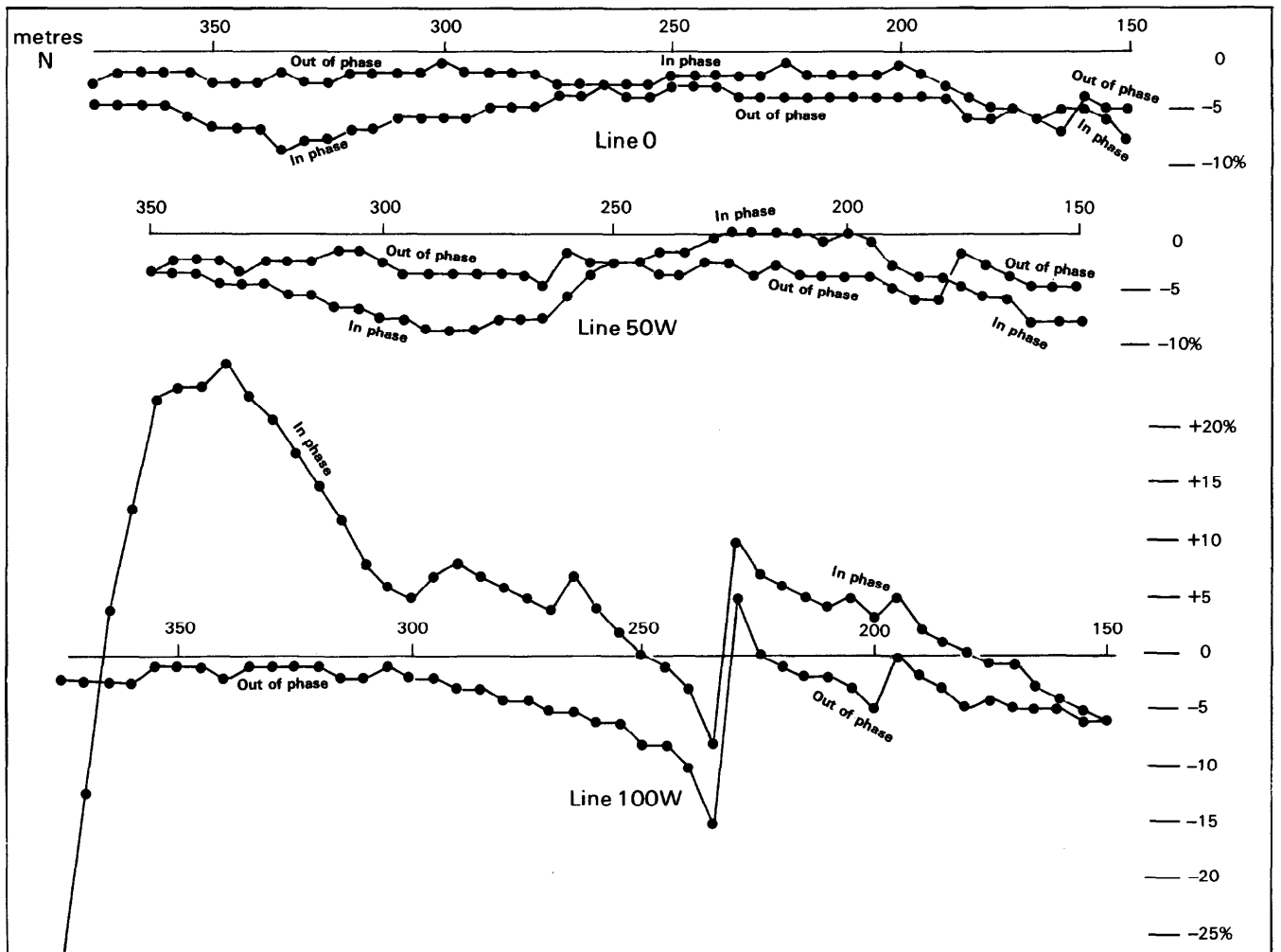


Figure 14 VLF EM16 electromagnetic profiles

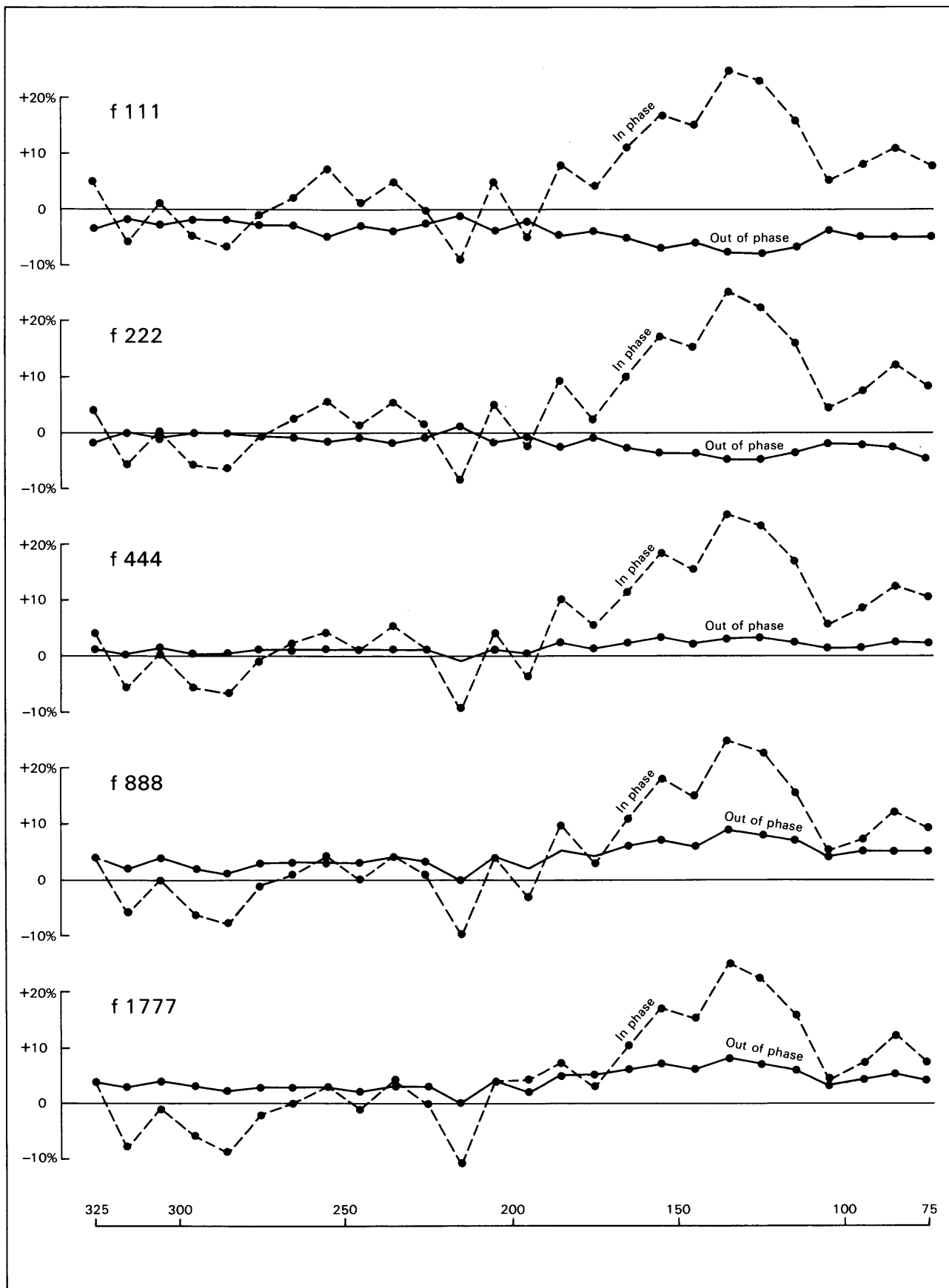


Figure 15 Horizontal loop (max. mode) EM results for 50W

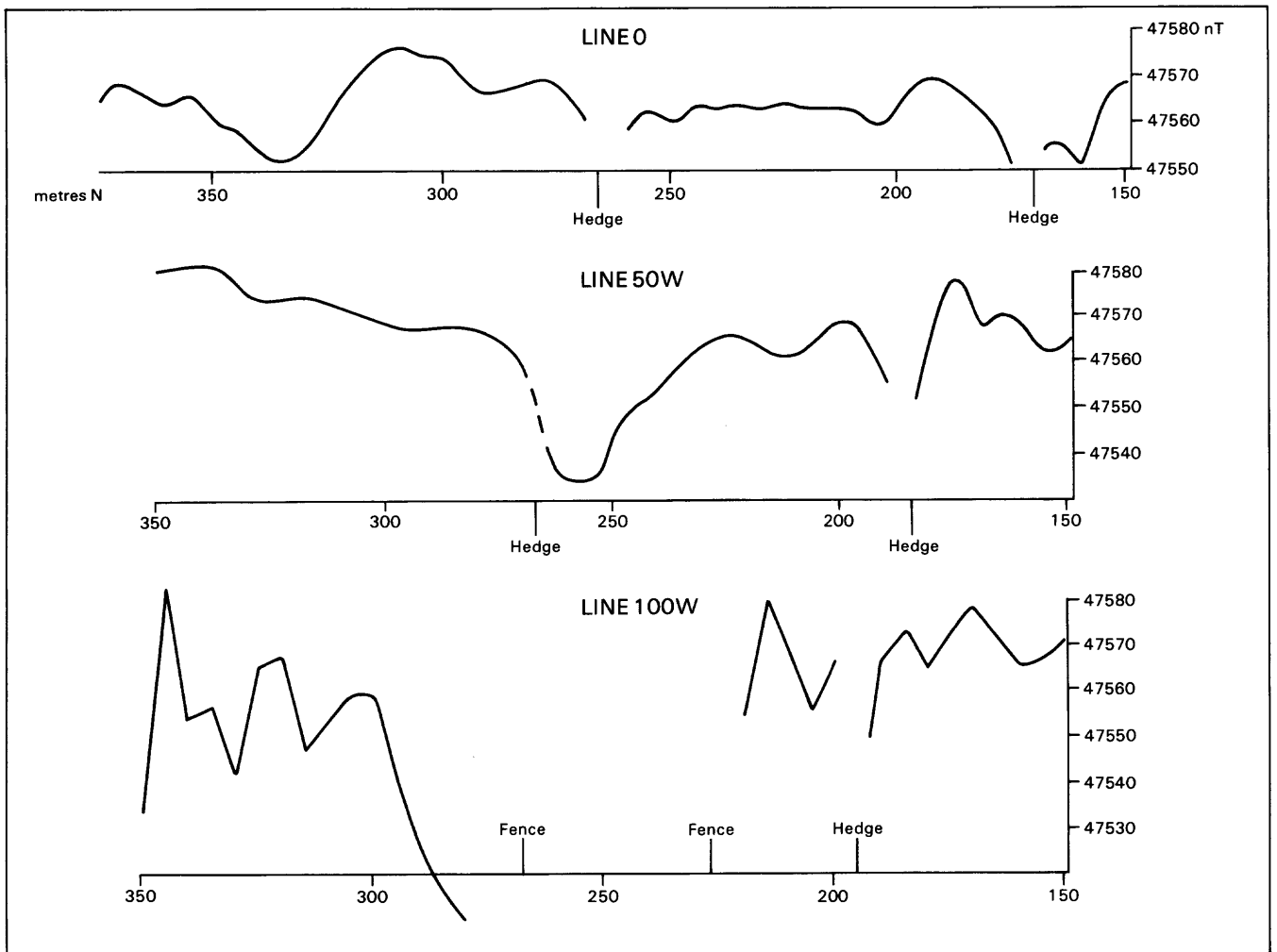


Figure 16 Magnetic profiles for lines 0, 50W and 100W

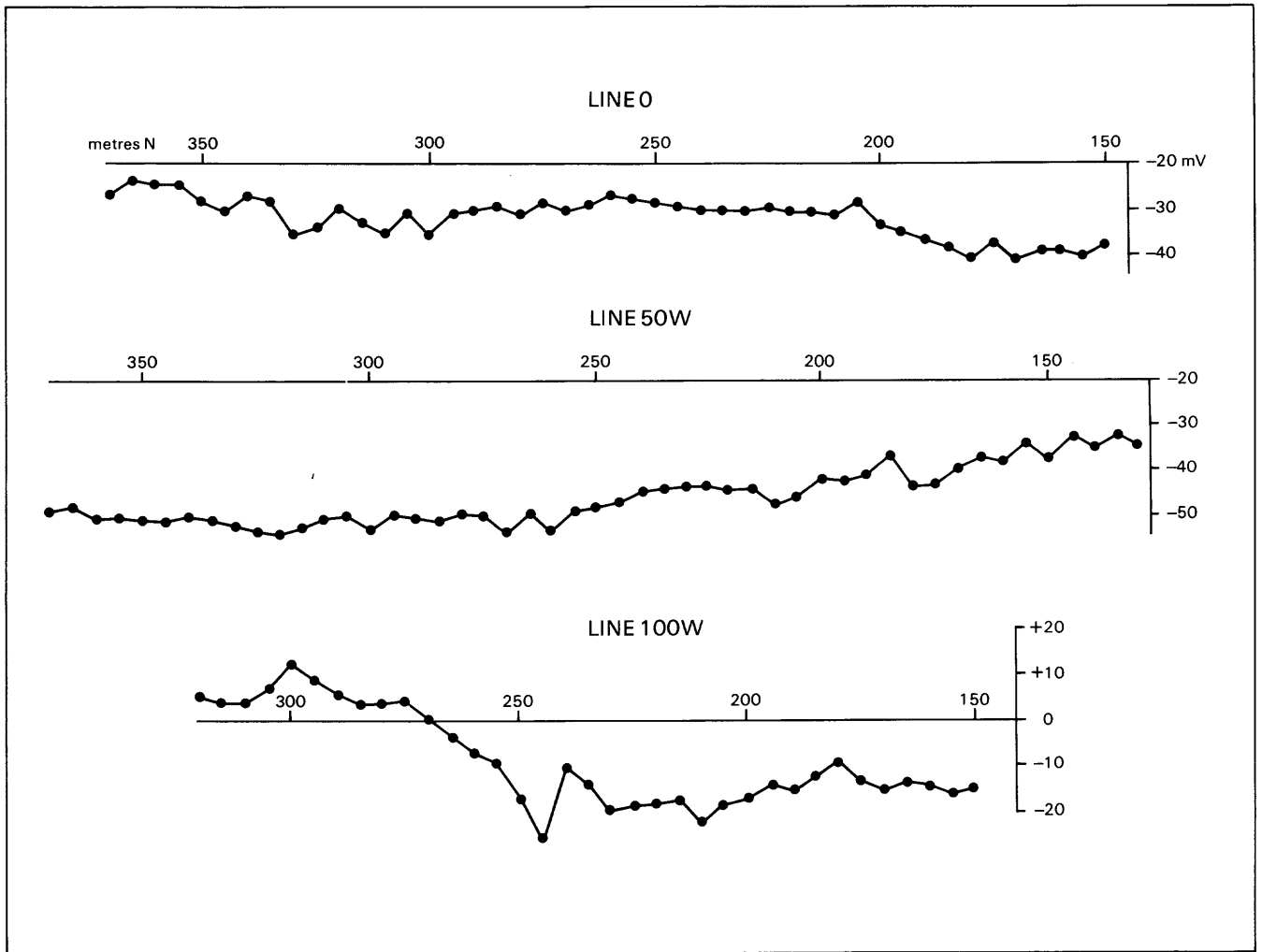


Figure 17 SP profiles for lines 0, 50W and 100W

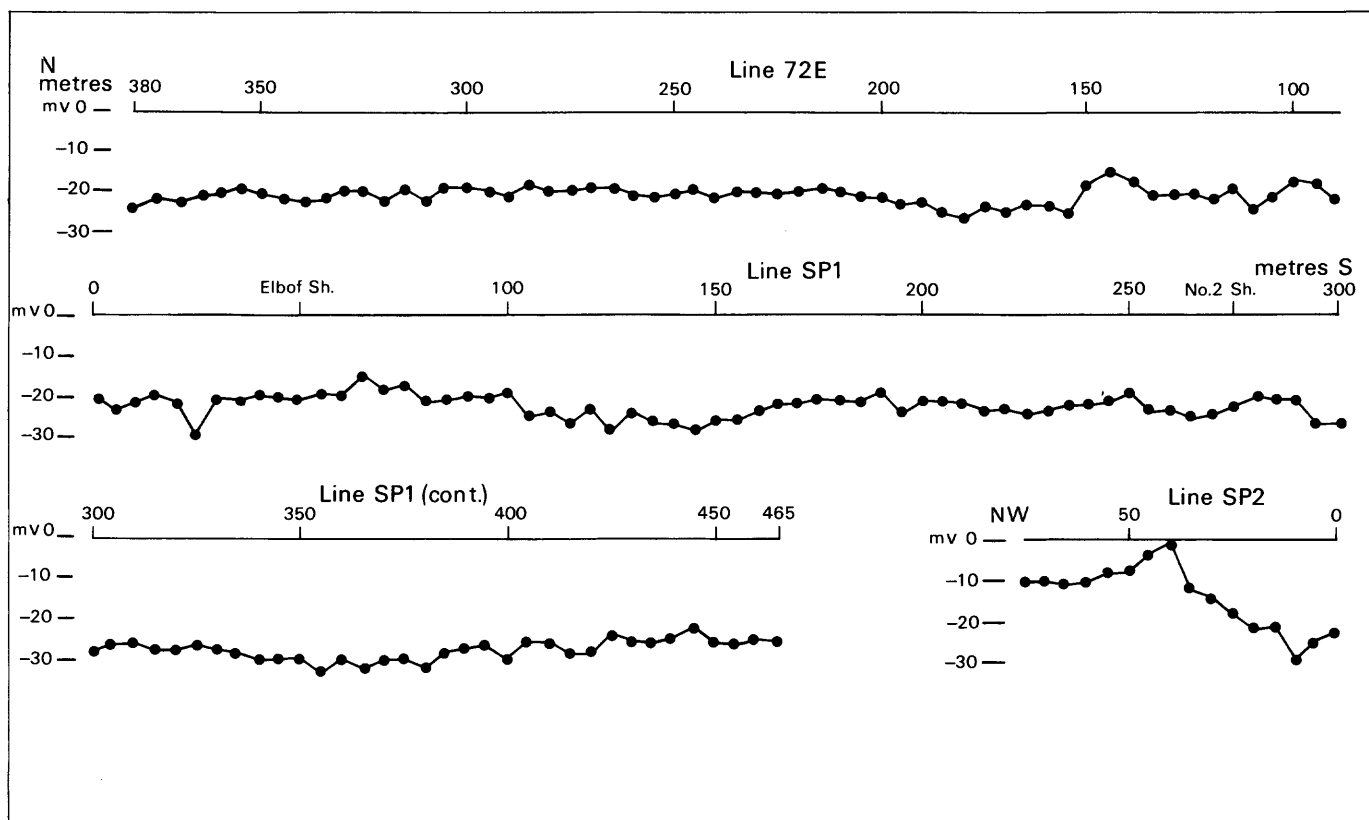


Figure 18 SP profiles for lines 72E, SP1 and SP2