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Geochemical investigations around Trewalder, near Camelford, Cornwall

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Geochemical investigations around Trewalder, near Camelford, Cornwall

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Cover illustration

A banded carbonate/sphalerite/marcasite/galena vein from the Gwynfynydd Gold Mine, near Dolgellau in North Wales

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SUMMARY

Stream sediment geochemistry to the north of St. Teath revealed two zinc anomalies suggestive of an apparently unexplored extension to the lead lode of Trewalder Mine. Although this mine was never more than a small affair, the prospect of zinc and argentiferous lead mineralisation in a location accustomed to extractive operations merited further limited geochemical investigation.

More detailed stream sampling and geochemistry confirmed these early findings, with a significant length of the River Allen reporting anomalous zinc levels in both sediments and panned concentrates. The absolute contents in these media indicate that most of the anomaly is due to hydromorphic transportation of zinc. There is no correlation with either lead or silver, rendering the prospect of a significant lead-silver-zinc lode somewhat less likely.

One hundred and fifty soil samples were collected from six lines sited to intersect at right angles the strike of the Trewalder Lode and its possible extensions to the north. A wide range of elements were determined on these samples. Log-probability plots failed to show any significant correlation between the distribution populations and the mapped lithology and mineralisation. Traverse profiles for Pb, Zn and Ba, on the other hand, can be interpreted as showing both particulate and hydromorphic anomalies which suggest that there may be more than one mesothermal lode in the Trewalder area, extending north of that hamlet for some distance, and that to the north of the River Allen, near Helland, the lode may change in character to become essentially barite.

Although there has been no work to evaluate the extended mineralisation, it appears from the relatively low tenor of the anomalies that the prospects of significant economic ore concentrations must be extremely small. Some previously unexplored Pb-Zn-Ba mineralisation seems to be indicated on the slopes to the west of the River Allen.

INTRODUCTION

The area examined comprises that part of the valley of the River Allen between St. Teath [SX 064 806]* and Old Delabole Quarry [075 838], together with the lower part of the tributary valley to the north-east of St. Teath. The land surface lies between 90m and 150m above O.D., and is of gentle relief. Much of the area is under pasture with only occasional arable fields; where the ground is poorly drained alongside the streams there are some strips and patches of scrubland. St. Teath and Helstone [089 813] are the only significant villages in the area (Figure 1). Transportation is now solely by road, the nearest railhead being at Bodmin Road Station [110 641].

The trace of a northerly trending lode, sub-parallel to the Allen and on the eastern side of the valley, is marked by a four shafts

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* All localities quoted in this report lie within the Ordnance Survey National Grid square designated SX, unless otherwise indicated.

(three now filled in) and an adit which are all that remains of the former Trewalder Mine. Surface subsidence at various places close by may indicate the presence of further shallow workings. A brief account of this lead mine is given by Hamilton Jenkin (1970). There is another drainage adit driven north-westwards from the west side of the Allen about 200m north-east of Helland farm [070 829]; presumably it was exploratory but found no mineralisation. Neither record nor local knowledge exists of any commercial interest in Trewalder Mine within living memory, though other mines in the district have been unsuccessfully re-opened earlier this century. Edwards (1916) stated that several antimony mines in the vicinity of Port Isaac [SW 997 807] were being investigated and from their ores he had detected gold up to levels of 8ppm. Unfortunately he gives no location for these mines.

Anomalous quantities of zinc were found in two samples of stream sediment collected from the River Allen south of the Delabole Quarry during an Uranium Reconnaissance Survey of Devon and Cornwall carried out in 1971. Panning concentrates taken from the same sites showed no anomalous zinc values, so it was deduced that this element in the sediment had been derived by hydromorphic transport from a mineralised structure running close to the stream but not crossing it. After an examination of the ground an alternative explanation of contamination was rejected. A sediment sample taken from a western tributary stream at Lanagan farm [068 817] showed only weak metal values. One of the anomalous samples was located on a northern prolongation of the Trewalder Lode and, in consequence, attention was focussed on that structure.

GEOLOGY AND MINERALISATION

The area was first surveyed geologically by De la Beche in 1838 but is most fully described by Reid et al. (1910). Later remapping (Bisson, verb. comm., 1965) redrew the Middle-Upper Devonian boundary. The lithology of the area is entirely slate, sub-division being made upon colour variations (Figure 2) and scattered fossiliferous locations. To the north of Newhall Green [071 822] are the light grey and green slates of Upper Devonian age, with Lower Devonian dark grey to black slates to the south. A small quarry [076 817] to the south-east of Trewalder hamlet [073 821] was apparently opened in a narrow "greenstone" body which trends east-north-east. Similar rocks occurring as brash in the nearby fields suggest that these horizons (presumably volcanic beds) may be developed more extensively than is depicted.

A curving north-easterly fault is believed to follow the Allen valley between Newhall Green and Old Delabole Quarry with two north-westerly directed feather faults forming minor drainage hollows to the west of Newhall and between there and Helland. It is not known whether these fractures affect the north-south lead lode, or whether they themselves may be mineralised.

The lode trends are very variable in the extended area around St. Teath. Edwards (1916), referring to nearby Treore Mine [020 800], stated that the country rock was cut by numerous quartz reefs with a general north-south direction and, from Dines (1956), it can be deduced that about one-third of lodes north and west of the River

Camel have this trend. All the mineralisation is epithermal in nature but its location may be related as much to abundant volcanic horizons in the succession as to the Bodmin Granite, a few kilometres to the east. The most common economic ore minerals are galena (usually argentiferous), sphalerite, jamesonite and siderite with which may be associated small amounts of chalcopyrite, stibnite, bournonite, antimonite, pyrite and gold. It seems that most of the antimony and gold mineralisation is found in the northerly and north-easterly veins; these metals are absent from veins trending north-west.

STREAM SEDIMENT GEOCHEMISTRY

Stream sediments were collected and panned concentrates prepared at fourteen sites in the study area. Seven of these are spaced at intervals of about 300m along the River Allen north of Knightsmill [072 806], one each from the west bank tributaries, and four from the eastern tributary above Bodulgate [076 814]; these localities are shown in Figure 3.

The sediment samples were dried and ground in an agate mortar to less than 100 mesh BSS size. Sub-samples were split for analytical determinations by BGS laboratories using four methods:- U by neutron activation analysis; As by colorimetry; Ba, Co, Cr, Fe, Mn, Mo, Ni, Sn, V, Y and Zr by optical emission spectrography; and Ag, Cu, Pb and Zn by atomic absorption spectrometry. Full analytical results are listed in Appendix 1 and a statistical summary is given in Table 1.

At each site the radiometric background was also checked using a 1413A portable scintillation counter. Nowhere was this found to be even slightly anomalous.

Table 1. Summary statistics, stream sediments (in ppm)

Element	Range	Mean	S.D.	Median
Ag	0-2	0.643	0.718	1
As	30-100	66.07	18.82	70
Ba	320-560	407.1	91.22	420
Co	24-100	53.57	25.91	75
Cr	130-240	185.7	33.10	180
Cu	20-40	26.43	8.113	20
Fe	56000-75000	70929	7796	75000
Mn	2400-4200	3129	661.6	3200
Mo	0-1	0.571	0.495	1
Ni	56-130	89.86	26.14	100
Pb	40-130	59.29	24.34	50
Sn	10-750	126.1	201.8	42
U	2-3	2.643	0.479	3
V	75-130	106.8	15.99	100
Y	10-75	25.21	16.66	18
Zn	140-1040	546.4	347.3	820
Zr	130-560	262.1	109.3	240

The panned concentrates were oven dried at high temperature prior to sub-sampling. About 8g was then powdered in an agate Tema mill for preparation for analysis by X-ray fluorescence spectrometry. A wide range of elements were determined - Ag, Ba, Cu, Fe, Mn, Ni, Pb, Sn, Zn and Zr. A colorimetric method was used to determine As. These results are comprehensively listed in Appendix 2; the summary statistics comprise Table 2.

Table 2. Summary statistics, panned concentrates (in ppm)

Element	Range	Mean	S.D.	Median
Ag	1-11	5.154	3.109	6
As	70-310	149.3	64.42	140
Ba	300-470	388.6	45.80	390
Cu	0-470	46.43	118.6	10
Fe	46700-80800	55914	9194	53700
Mn	630-5000	2089	1298	1900
Ni	55-150	93.93	31.01	110
Pb	90-450	177.1	105.2	130
Sn	20-2200	594.6	717.4	390
Zn	140-770	358.6	196.0	440
Zr	103-182	124.0	18.74	124

Log-distribution plots have not been prepared for the sediments and panned concentrates; their validity would have been highly suspect because of the small numbers of samples. Values for some of the more significant metals have been plotted on schematic representations of the drainage pattern in Figures 4-6. From these plots are derived the following comments.

Arsenic background in sediments derived from underlying Upper Devonian slates is around 30ppm, and from the Middle Devonian is about 70ppm. The panned concentrate results, as might be expected, confirm this distribution though in sample 161 (Figure 3) the panned concentrate does not reflect the high As level seen in the sediment (Figure 4). None of the variations in concentration is attributable to mineralisation.

The levels of barium in sediment appear to bear an antipathetic to those in the equivalent panned concentrate (Figure 4). As it most improbable that a mineral as heavy as barite was lost during careful panning, the only acceptable explanation would appear to be that all the barium in the sediments is located within the clay minerals. This lack of detrital barite confirms that the Trewalder Lode does not contain this species as a gangue mineral.

High copper concentrations are seen in the sediments immediately downstream from the Delabole Quarry tips, these levels decreasing to a background of about 20ppm at St. Teath (Figure 4). Panned concentrates do not mirror this distribution, however, and it is necessary to invoke one of two explanations. Either the background level in Upper Devonian slates is about twice that in the Middle Devonian, or there has been vigorous leaching of the quarry tips. Highly anomalous copper in a panned concentrate from the River Allen at Newhall Green presumably reflects contamination, as do the lesser anomalies downstream.

Manganese shows no distinct distribution pattern in the sediments but in panned concentrates the highest levels are clearly confined to the tributary around Treforda, and the low values located in the western tributaries (Figure 5). Bands of calc-flinta interbedded in the slates around Treforda may explain the former feature.

Although there are no mineralisation sources of tin in this area three significantly anomalous sediment samples report in the eastern tributary and are matched by high panned concentrate values (Figure 5). Broadly comparable correlations are found in samples from the western tributaries around Newhall Green and Lanegan. All these anomalies must be presumed to reflect modern contamination.

Nickel values are consistently high in the River Allen samples, both in the sediments and the panned concentrates, with all the tributary streams showing lower levels of this metal (Figure 5). There is no obvious explanation for this distribution.

As might be anticipated in a lead mineralised area, the lead-in-sediment background is moderately high, at about 45ppm (Figure 6). In the River Allen to the south of Newhall Green two samples are markedly richer and probably include finely comminuted debris from the mine waste, a conclusion supported by high levels of lead in their panned concentrates. Anomalous levels were also reported from other panned samples taken just below the quarry tips and from near Treforda. Whilst the former may be due to mineralisation from the quarry observed by Bisson, the latter does not accord with any known veining.

The silver contents of the sediments, unlike those of the panned concentrates, are so close to the detection level as to be relatively meaningless (Figure 6). The distribution of concentrate values defies rational geological explanation; clearly they are not directly ascribable to argentiferous galena mineralisation.

Anomalous zinc values, both in stream sediments and in panned concentrates, are confined strictly to the River Allen and extend over the whole length sampled (Figure 6). The absolute values, though, show that all the zinc is not concentrated upon panning, indicating clearly that a sizeable proportion must be held in non-mineral form. The low zinc levels reported from nearby tributaries confirm that this distribution is not related to lithology and, in consequence, it must be assumed to reflect mineralisation. Extension over the full sampled length of the River Allen raises the possibility of a northerly continuation to the Trewalder Lode.

Comparison of the distribution plots for lead, silver and zinc values (Figure 6) shows clearly that these three metals do not bear a positive sympathetic relationship to one another. It would appear that the Trewalder Lode might be a stronger sphalerite structure than it is an argentiferous galena one.

SOIL GEOCHEMISTRY

In an attempt to confirm the source of this highly restricted distribution of anomalous zinc a series of soil samples were collected along traverses which cross the River Allen valley at right angles. Line I (Figure 7) lies 50m south of the southern end of the Trewalder Mine workings, Line II crosses the middle of the workings and acted as a control on the validity of this geochemical approach. Lines III to V were spaced northwards at 200m intervals and Line VI is sited a short distance downstream from the Delabole Quarry tips. Although Line VI might be too far north to meet the Trewalder Lode, the results would provide an assessment of the veining believed to have been sought in the adit near Helland.

Sampling stations along the traverses are spaced at differing intervals; their positions are shown in Figure 7. The soil samples were taken by hand augering to a depth of about 80cm. After oven drying the samples were disaggregated and the -10 mesh BSS screened fractions were ground in an agate mortar to a -100 mesh size. A sub-sample was ignited to determine the weight loss on ignition (listed in Appendix 4) prior to final splitting to provide sub-samples for determination of Ag, Cu, Pb, Sb and Zn by AAS, of U by NAA and of Ba, Be, Co, Cr, Fe oxide, Mn, Mo, Nb, Ni, Pd, Sn, V, Y and Zr by OES. All analyses were carried out by the Analytical Chemistry Unit of BGS.

At each of the soil sampling stations radiometric readings were also taken using a 1413A scintillation counter. Variations of count rate found throughout the area all fell within normal statistical limits.

The full analytical data for the 150 soil samples are listed in Appendix 3 and summary statistics for the total set are given in Table 4. Comparison of the elemental contents for individual traverse lines, using only the content ranges and the median values, is made in Table 3. Log-probability plots have been prepared for most of the metals analysed and these are included as Figures 8-13. The values of inflexion points defining population sets within these plots are included in Table 4.

In Table 3 the values for Ag, Mo and Sb are all too close to their respective detection levels to permit any meaningful comparisons of ranges and medians. Co, Cu, Ni and V are at their highest in the south and it seems reasonable to ascribe this distribution to the occurrence of volcanic horizons in the Middle Devonian slates. Cr, an indicator of basic igneous rocks and of weathered lead mineralisation, displays a low median in Line I despite its wide range of values. Of the lode metals, Pb is at its highest in Line III, the traverse immediately to the north of the workings. Zn, on the other hand, is reasonably high in the southermost three traverses, though an individual high value is found in Line IV. Ba appears low in most lines, and especially so in Line V. Its higher levels in Line VI may reflect the occurrence of small barite veins which locally traverse the slates in Delabole Quarry. Sn in soils exhibits a range of values, all of which are low; the rare anomalous higher values are assumed to be due to contamination.

Table 3. Comparison of elemental contents of soils, by traverses (in ppm, except for Fe oxide in per cent; ranges in upper line, medians in parentheses)

	Line I	Line II	Line III	Line IV	Line V	Line VI
Ag	0-1	1-2	0-3	0-2	0-2	0-1
	(1)	(2)	(1)	(1)	(0)	(1)
Ba	0-2400	0-2400	0-1800	100-2400	0-1300	180-3200
	(750)	(560)	(320)	(420)	(240)	(750)
Be	0-8	0-8	2-6*	0-13	NR	2-8
	(4)	(4)	(4)	(4)	--	(4)
Co	2-180	0-180	18-56	0-320	0-56	13-32
	(56)	(24)	(24)	(24)	(24)	(24)
Cr	0-420	0-320	0-420	32-320	0-320	75-240
	(32)	(130)	(180)	(240)	(180)	(180)
Cu	25-70	15-65	10-65	15-110	15-40	15-45
	(45)	(35)	(30)	(25)	(25)	(20)
FeOx	0.0-32.0	0.0-32.0	0.0-18.0	1.0-18.0	0.0-13.0	5.6-18.0
	(18.0)	(13.0)	(13.0)	(13.0)	(10.0)	(13.0)
Mn	320-7500	180-2400	240-2400	180-2400	0-3200	750-2400
	(1800)	(1300)	(1300)	(1300)	(1300)	(1300)
Mo	0-4	0-2	0-6	0-3	0-8	0-3
	(0)	(0)	(1)	(0)	(2)	(0)
Nb	0-130	0-56	0-100	0-56	0-100	0-56
	(56)	(0)	(0)	(0)	(56)	(0)
Ni	13-320	4-240	3-180	0-420	0-100	42-100
	(130)	(100)	(100)	(100)	(42)	(42)
Pb	30-210	40-190	40-690	40-260	40-80	30-80
	(50)	(60)	(70)	(60)	(50)	(50)
Sb	0-20	0-30	0-20	0	0-20	0
	(0)	(0)	(0)	(0)	(0)	(0)
Sn	0-13	0-75	0-24	0-13	0-18	1-18
	(1)	(2)	(4)	(4)	(6)	(6)
U	2.3-4.5	2.4-4.0	2.2-3.8	1.7-3.4	2.4-4.1	2.2-3.2
	(3.2)	(3.1)	(2.8)	(2.8)	(2.8)	(2.8)
V	56-750	32-560	42-320	56-420	32-240	130-240
	(320)	(180)	(240)	(180)	(180)	(180)
Y	0-56	0-56	2-130	0-56	0-56	2-42
	(24)	(24)	(42)	(32)	(32)	(13)
Zn	80-270	130-790	110-540	70-1640	70-380	60-340
	(160)	(240)	(180)	(110)	(90)	(90)
Zr	0-1300	0-1000	130-1000	0-1000	0-1300	100-1000
	(420)	(180)	(320)	(420)	(560)	(180)

* incomplete set, n = 25
NR = not reported

From the log-probability plot (Figure 8) it can be deduced that all Pb values above 66 ppm are more or less anomalous, these representing some 16% of the total set. It is obvious, however, that the higher inflexion point at 130 ppm marks the lower end of a more significant anomalous subset which might be of potential exploration interest. The equivalent anomalous subset for Zn appears to be somewhat larger and encompasses all values above 275ppm, this representing about 8.5% of the total.

Table 4. Summary statistics, soil samples (in ppm, except for Fe oxides which are in per cent)
n = 150

Element	Range	Mean	S.D.	Median	Inflexion points
Ag	0-3	0.900	0.651	1	Not plottable
Ba	0-3200	595.6	503.7	560	750(85%)
Be*	0-13	3.770	1.834	4	Near gaussian
Co	0-320	34.72	35.02	24	25(67%); ?180(99.3%)
Cr	0-420	192.6	93.78	180	93(10%)
Cu	10-110	31.47	14.57	30	Near gaussian
FeOx	0.0-32.0	11.97	5.537	13.0	8.0(19%)
Mn	0-7500	1606	1185	1300	660(10%); 2700(94.5%)
Mo	0-8	0.880	1.205	1	Near gaussian?
Nb	0-130	19.60	30.85	0	Not plottable
Ni	0-420	86.13	63.29	56	44(33%); ?320(99.3%)
Pb	30-690	70.87	72.34	60	66(84%); 130(97%)
Sb	0-30	2.467	6.727	0	Not plottable
Sn	0-75	5.633	7.252	4	13(96.5%)
U	1.7-4.5	2.910	0.439	2.8	Not plotted
V	32-750	212.9	115.4	180	100(12%)
Y	0-130	28.79	17.95	32	8(16.5%); 25(40%)
Zn	60-1640	169.9	154.8	130	98(31%); 275(91.5%); 385(95.5%)
Zr	0-1300	423.6	306.5	320	100(11%); 550(68%)

* incomplete set, n = 113

Samples containing more than 750ppm Ba are considered to be anomalous; these constituting some 15% of the total (Figure 9). Cu, on the other hand produces a plot which is almost a straight line, this indicating a near-gaussian distribution. From this it may be deduced that the copper determined is all contained within the sediments and that this metal does not accompany (at significant levels, at least) any lead-zinc mineralisation.

In Figure 10 the Be plot has been drawn as a straight line, points being too widely spaced to be otherwise joined with any certainty. This indicates a near-gaussian distribution, a presumption which would accord with the expected behaviour for this element. The Sn plot is less easy to interpret. An inflexion point at 2.6 ppm seems too low to accept as defining the upper limit of background values in a set which comprises only 37% of the total. It should be noted, however, that a regional background of 3.3 ppm was determined for S.W. England pelites was determined by Beer and Ball (1986). In the belief that there should be virtually no anomalous tin in the Devonian rocks of this area the inflexion point at 9.6 ppm was dismissed in favour of the one at 13 ppm; this gives an anomalous set of only 3.5%, a handful of samples which could well be contaminated.

The Cr plot seems to show a clear subset with values below 93 ppm. This includes seven samples in which Cr is not detectable and five in which the levels are low. Their disposition does not allow of any simple geological explanation.

There is some similarity in the plots for Co, Ni and V (Figure 11) in that they all seem to exhibit two populations, but the sizes of the subsets differ widely. For V the low value subset includes only 12% of the total, all bar one of these correlating with the low Cr samples. About one-third of the analysed samples fall into the low value Ni subset, the upper limit of which is at 44 ppm, and include most of the Cr- and V-low samples together with many of the samples in the northernmost two traverses. In the case of Co two-thirds of the samples are in the low value population. All the samples in Line VI plot within this subset, the remainder being scattered irregularly through the other traverses. There appears to be no correlation with the geology.

The distributions of FeOx and Mn (Figure 12) do not show the accord which might be expected, except that both have relatively small low value populations. Mn, however, also exhibits a very small anomalous subset at values above 2700 ppm. There are only a few points for Mo and these seem to indicate a near-gaussian distribution.

Again, in the last of the log-probability plots (Figure 13), Y and Zr exhibit some similarity of shape with a large upper population and at least one lower subset. The lowest subsets are somewhat similar in size but the uppermost ones are notably different. Neither of the elements appear to correlate in any way with the geology.

This overall lack of correlation between metal values and both lithology and mineralisation is rather disturbing and, in order to examine the distribution of mineralisation more closely, profiles for Pb, Zn and Ba were constructed for each traverse (Figures 14-16). Suchplots demonstrate that, in traverses I, II and III, there is commonly a correlation between two of these elements and rarely between all three. In the other three traverses, Zn and Ba peaks may often be slightly offset; there is only one significant Pb peak, this being in Line IV and itself offset to Zn.

From these profiles it has been possible to arrive at the conclusions presented in the next section.

CONCLUSIONS

The few stream sediment and accompanying panned concentrate samples collected from the River Allen and its tributaries have confirmed the recognition, made during earlier and wider spaced geochemical studies, of an anomalous of zinc area downslope from the former Trewalder Mine. Metal contents of these drainage samples suggested possible extensions to the known Pb-Zn veining, especially to the north, and a probable compositional change with an increased importance of barite also to the north. Among the minor metals (for example Co, Cr and Ni) variations in content were considered to reflect local differences in lithology, in particular the presence of volcanic horizons within the Middle Devonian slates.

Viewed on a traverse by traverse basis the metal contents of the 150 soil samples collected tend to confirm the general conclusions about the Trewalder Lode derived from the drainage samples. They also support the view that tin is present mainly as a contaminant. Contents of the other minor metals, however, do not seem to correlate in any sensible way with the lithologies as mapped.

The anomalous populations of Pb, Zn and Ba derived from log-probability diagrams fail to provide a readily interpretable model of metal distribution and its relationship to the known mesothermal mineralisation. In an attempt to define the location of the metal veins and examine their persistence outside the mined area, profiles for Pb, Zn and Ba were prepared for the individual traverses. From these it was evident that there is a varying association between the three elements and not uncommonly one may be near absent. It is also obvious that Ba becomes increasingly abundant towards the north, but not directly accompanied by Zn, and with Pb being locally anomalous.

The transference of this information to a ground plan (Figure 17) creates a somewhat confused picture of an erratically distributed mesothermal mineralisation. However, by applying considerations of elemental mobility in order to enable presumptions about particulate and hydromorphic transportation, it is possible to resolve this confusion into a more probable pattern of primary lead, zinc and barium distribution.

Such an interpretation (Figure 18) envisages two, probably three, north-south Pb-Zn-Ba lodes at Trewalder, one extending the full length of the mine workings and presumably the lode exploited therein. To the east of this, and within about 120m, parallel or branch veins of generally similar composition can be inferred. To the south only one lode is indicated and it may be presumed that the easterly structures either die out or merge with the Trewalder Lode. Traced northwards they all seem to merge as they approach the fault which follows the River Allen. Even farther east there are signs of a Ba vein on Line V and a Ba-Zn vein on Line VI; these may be short and localised structures only.

Significant Zn anomalies, without associated Pb and Ba and likely therefore to be of hydromorphic type, are located in the valley bottom close to the River Allen and are believed to mark the position of the fault which Bisson maps here. At the extreme western end of Line V another Zn anomaly is similarly located with respect to a fault and may be assumed also as of hydromorphic origin.

West of the valley lineament anomalous Pb values occur in samples north of Newhall (on Line III) and close to the mill leat on Line IV; below both areas are Zn anomalies which may well be hydromorphic. The Newhalls lead is considered to be a reflection of local mineralisation even though none is known to have ever been reported at this locality. Farther south, a Pb anomaly on Line II from a site very close to the river is thought to reflect particulate contamination derived from mine waste dumps upstream, unlike the isolated Ba anomaly on Line I and the elevated Zn values at the western end of Line I. HighBa almost certainly reflects the presence of particulate barite, and as this does not move far in soils the Ba anomaly is considered to denote mineralisation. The Zn is probably largely hydromorphic but clearly suggests unknown zinc concentrations higher up-slope.

Also to the west of the fault a Ba anomaly towards the western end of Line VI presumably reflects a barite structure which may be the vein sought in the adit north-east of Helland.

From this model it can be seen that there is a little undeveloped strike length on the Trewalder Lode to the north of the old workings, but none to the south. In addition there may be some unexplored metal values in parallel or branch lodes to the east of the main one. Earlier exploration of these areas is believed to have been thwarted by the resistance of a major landowner. Zinc predominates over lead and there is also the possibility of previously unworked barite as a by-product. Perhaps the most interesting outcome of this geochemical study is the suggestion of mineralisation on the western slopes of the Allen valley, a part of the area which appears to have been little explored in the past.

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APPENDIX 1. STREAM SEDIMENT ANALYSES (in ppm)
n = 14

Sample No.	Location GR.	OES Ba	Co	Cr	Fe	Mn	Mo	Ni	Sn
BTC 154	0760.8125	250	32	240	75000	2400	1	75	750
155	0700.8155	560	75	180	75000	4200	0	100	42
156	0720.8115	560	75	180	75000	3200	1	130	32
157	0695.1850	560	32	180	75000	2400	0	75	42
158	0700.1850	420	75	180	75000	3200	1	130	56
159	0805.8150	320	32	180	75000	2400	0	56	180
160	0675.2300	320	24	100	75000	3200	1	75	100
161	0875.2400	320	32	180	75000	3200	1	75	32
162	0705.2300	420	75	180	75000	4200	0	100	42
163	0700.2500	320	24	180	75000	2400	1	56	18
164	0715.2550	420	75	180	56000	3200	1	100	10
165	0845.1800	420	24	130	56000	3200	0	56	420
166	0720.2800	420	75	130	75000	2400	0	100	24
167	0740.3050	320	100	240	56000	4200	1	130	18

Sample No.	OES V	Y	Zr	AAS Ag	Cu	Pb	Zn	COL As	NAA U
BTC 154	100	24	240	0	20	50	250	80	3
155	100	75	240	0	30	100	830	70	3
156	100	13	180	0	20	60	1040	70	2
157	100	18	240	2	20	50	250	60	3
158	130	32	180	1	40	130	900	80	3
159	130	13	420	2	20	50	210	70	3
160	100	18	560	0	20	40	160	80	2
161	130	13	240	1	20	50	210	100	2
162	100	13	180	1	30	60	950	65	3
163	100	32	320	0	20	50	140	70	2
164	100	18	320	0	30	50	830	30	3
165	75	10	130	1	20	60	210	75	3
166	130	32	180	0	40	40	820	45	2
167	100	42	240	1	40	40	850	30	3

APPENDIX 2. PANNED CONCENTRATE ANALYSES (in ppm)
n = 14

Sample No.	Location GR.	XRF Ag	Ba	Cu	Fe	Mn	Ni	Pb
BTP 154	0760.8125	1	340	10	59500	3500	70	130
155	0700.8155	1	390	55	62400	1800	120	450
156	0720.8115	4	390	10	50100	1100	110	120
157	0695.8185	6	340	5	50900	700	70	110
158	0700.8185	3	470	50	80800	2500	150	390
159	0805.8150	6	300	5	60800	5000	60	150
160	0675.8230	7	350	5	53700	810	65	90
161	0875.2400	7	370	0	47100	2000	65	180
162	0705.2300		440	5	48400	1400	120	110
163	0700.2500	11	390	5	46800	630	55	100
164	0715.8255	6	440	470	46700	1500	110	130
165	0845.8180	4	370	15	66600	4400	70	220
166	0720.8280	10	420	5	53700	1900	110	170
167	0740.8305	1	430	10	55300	2000	140	130

Sample No.	XRF Sn	Zn	Zr	COL As
BTP 154	2200	190	107	210
155	390	560	129	210
156	20	560	126	140
157	1300	200	182	110
158	150	770	106	310
159	2100	180	103	190
160	630	170	135	180
161	85	160	126	130
162	35	500	116	110
163	80	140	113	100
164	45	470	124	70
165	590	200	133	170
166	480	440	120	80
167	220	480	116	80

APPENDIX 3. SOIL ANALYSES
Quoted in ppm except for Fe203, which is in per cent; n = 150

Sample No.	AAS					OES				
	Ag	Cu	Pb	Sb	Zn	Ba	Be	Co	Cr	Fe203
Line I										
BTS 1	1	45	50	0	200	560	6	56	320	24.0
2	1	45	60	20	200	0	1	8	0	0.0
3	1	40	60	0	200	320	4	42	320	18.0
4	1	45	50	0	160	750	3	32	320	13.0
5	1	45	50	20	160	560	4	56	420	24.0
6	1	40	40	0	160	750	4	56	320	32.0
7	1	35	60	0	190	320	4	56	180	24.0
8	0	45	50	0	160	240	4	32	320	18.0
9	0	50	80	0	250	560	4	42	320	18.0
10	0	40	210	20	190	2400	8	32	320	32.0
11	0	40	60	20	120	750	3	18	420	18.0
12	0	55	50	20	80	750	4	24	420	18.0
13	0	60	70	0	120	750	4	56	320	24.0
14	1	70	70	20	120	750	4	100	420	13.0
15	1	50	70	0	160	560	4	56	240	18.0
16	1	40	60	0	150	750	4	56	320	18.0
17	0	30	60	0	150	240	0	2	0	1.8
18	1	40	50	20	140	750	4	56	320	18.0
19	0	25	50	0	120	560	6	32	240	13.0
20	1	25	50	0	160	560	3	42	320	13.0
21	0	40	50	0	150	750	4	130	420	18.0
22	1	35	40	0	240	750	4	100	420	13.0
23	0	45	30	0	200	1800	6	130	240	18.0
24	0	50	40	20	270	750	6	180	240	13.0
Line II										
BTS 50	1	40	70	0	270	320	4	32	130	18.0
51	2	40	50	0	200	100	0	0	32	1.3
52	2	45	60	0	270	750	4	56	180	18.0
53	2	45	60	0	310	0	0	0	0	0.0
54	2	55	50	0	320	1300	4	24	75	13.0
55	2	35	60	0	300	100	2	24	130	10.0
56	2	25	50	0	220	240	0	0	0	1.8
57	1	20	40	0	130	750	4	56	130	32.0
58	2	65	190	20	280	100	0	0	0	1.3
59	2	55	50	30	420	750	6	180	180	18.0
60	2	45	50	20	240	1800	8	75	180	18.0
61	2	30	70	0	190	560	6	32	320	13.0
62	2	20	50	0	150	420	4	24	320	13.0
63	2	25	60	0	170	750	4	24	130	10.0
64	2	15	60	0	150	560	4	32	240	13.0
65	1	25	60	0	790	2400	8	56	180	13.0
66	1	15	120	0	130	1000	4	18	240	10.0
67	2	30	60	0	200	180	0	0	32	1.3

APPENDIX 3 (cont.)

Sample No.		OES Mn	Mo*	Nb	Ni	Sn*	V	Y	Zr	NAA U	GRAV LOI
Line I											
BTS	1	7500	0	75	180	3	420	32	750	2.6	7.6
	2	750	0	0	18	0	56	0	0	3.6	8.6
	3	7500	1	56	130	0	240	24	130	2.6	8.2
	4	5600	2	56	100	0	180	13	130	2.7	8.8
	5	7500	0	56	320	0	320	32	180	2.4	7.3
	6	5600	0	56	240	0	420	18	100	2.3	6.0
	7	3200	0	130	180	0	420	18	420	2.5	7.8
	8	4200	4	56	100	1	240	18	560	3.5	5.1
	9	1300	1	0	130	2	240	24	320	3.3	5.4
	10	1000	0	0	75	0	320	10	100	3.2	3.8
	11	1800	0	0	75	2	750	24	560	3.2	3.8
	12	1800	0	56	100	1	420	32	420	3.1	4.9
	13	1300	0	0	130	3	560	32	560	3.5	6.9
	14	3200	3	0	130	0	240	18	560	4.1	5.1
	15	1300	2	75	130	2	560	24	1000	3.0	5.3
	16	1300	0	0	130	4	240	24	130	2.8	6.2
	17	320	0	0	13	1	75	4	420	2.7	6.9
	18	1800	1	0	180	2	420	42	420	2.6	2.7
	19	1000	2	0	10	13	320	56	750	2.5	21.1
	20	1800	2	0	130	4	420	42	1300	3.5	7.1
	21	3200	0	0	240	1	320	42	320	3.8	2.8
	22	2400	2	0	240	6	420	42	320	3.6	2.6
	23	1000	0	0	240	0	320	24	240	3.9	2.8
	24	2400	2	0	240	3	420	42	240	4.5	5.7
Line II											
BTS	50	1300	0	0	100	2	180	32	130	2.8	7.9
	51	420	0	0	8	0	56	2	0	3.5	10.8
	52	1300	0	0	180	0	320	42	750	3.8	12.6
	53	320	0	0	6	0	32	0	56	3.1	11.2
	54	1000	0	0	100	1	130	24	750	3.5	10.8
	55	2400	2	56	130	3	130	32	180	3.5	11.0
	56	180	0	0	13	0	56	0	0	3.1	13.2
	57	1000	0	0	180	0	320	42	180	2.4	7.4
	58	320	0	0	13	0	56	0	0	3.0	10.6
	59	2400	0	0	240	1	420	24	180	4.0	7.8
	60	1300	0	0	180	4	560	42	240	3.8	8.2
	61	1800	0	0	130	4	320	32	240	2.8	9.2
	62	1000	1	56	130	8	320	32	1000	3.1	5.4
	63	1800	0	0	56	10	130	8	180	2.8	6.4
	64	1300	1	0	100	10	320	56	130	2.8	8.0
	65	1800	0	0	130	10	100	3	130	3.2	6.0
	66	1000	0	0	75	75	180	10	750	2.9	10.4
	67	1000	0	0	4	0	42	0	0	2.8	11.0

APPENDIX 3 (cont.)

Sample No.		AAS					OES			
	Ag	Cu	Pb	Sb	Zn	Ba	Be	Co	Cr	Fe2O3
Line III										
BTS 25	1	40	50	0	270	1800	4	56	420	13.0
26	1	30	50	0	180	1300	4	24	180	10.0
27	1	35	50	20	210	1300	4	42	320	13.0
28	0	35	50	0	230	1800	4	42	180	18.0
29	1	35	60	20	220	2400	4	42	320	18.0
30	1	35	120	0	400	1800	2	24	180	7.5
31	2	30	70	0	150	1800	4	24	240	10.0
32	3	35	70	0	170	1300	3	32	240	10.0
33	2	50	50	0	230	240	3	56	130	18.0
34	1	50	70	0	190	560	4	42	180	13.0
35	1	30	50	0	140	750	3	24	130	13.0
36	0	30	60	0	150	750	3	32	130	13.0
37	1	25	40	0	140	240	2	32	130	13.0
38	1	35	110	0	250	1800	6	24	75	7.5
39	2	20	60	0	170	320	3	24	130	13.0
40	1	25	80	0	130	320	3	24	130	13.0
41	2	25	100	0	230	420	3	32	180	13.0
42	2	25	110	0	220	560	4	24	180	13.0
43	1	35	100	0	420	1800	4	18	130	10.0
44	1	30	90	0	170	320	3	24	130	13.0
45	1	15	70	0	180	560	4	24	180	13.0
46	1	10	70	0	190	240	3	24	180	10.0
47	0	15	60	0	150	420	3	18	180	13.0
48	0	25	130	0	180	240	6	24	180	5.6
49	1	25	110	0	180	240	4	24	130	5.6
101	1	35	60	0	110	180		24	130	4.2
102	1	15	50	0	140	240		24	130	7.5
103	1	65	690	0	540	240		32	180	5.6
104	0	40	590	0	180	240		24	130	10.0
105	1	25	80	20	130	0		24	0	0.0
106	1	25	80	20	120	180		42	130	10.0
Line IV										
BTS 68	1	20	60	0	120	750	2	18	180	13.0
69	1	20	50	0	110	750	2	24	240	13.0
70	1	15	40	0	100	750	3	32	180	13.0
71	1	20	60	0	110	420	3	32	240	13.0
72	1	30	60	0	160	130	0	0	32	1.3
73	1	20	40	0	110	750	4	32	320	18.0
74	1	20	60	0	120	1800	4	24	240	13.0
75	1	55	80	0	90	2400	4	32	130	13.0
76	1	25	50	0	110	560	4	42	240	13.0
77	1	20	60	0	100	1000	4	24	130	10.0
78	1	50	90	0	450	320	6	56	240	13.0
79	2	110	60	0	140	240	0	2	32	1.0
80	2	80	60	0	170	240	4	24	240	10.0
81	1	50	70	0	150	420	4	24	240	13.0

APPENDIX 3 (cont.)

Sample No.	Mn	Mo*	Nb	Ni	Sn*	V	Y	Zr	NAA U	GRAV LOI
	OES									
Line III										
BTS 25	1800	6	0	180	6	320	56	750	2.9	3.9
26	1300	1	0	75	0	130	24	320	2.8	5.9
27	1300	1	0	100	6	180	18	320	2.6	5.4
28	1800	0	0	130	2	240	24	320	2.7	5.0
29	2400	0	0	130	8	240	32	240	3.1	8.1
30	1800	1	0	56	1	130	32	420	3.0	6.9
31	1800	1	56	100	3	320	130	560	2.4	15.1
32	1300	0	56	100	4	180	56	1000	2.5	7.7
33	1800	0	0	180	2	320	42	420	3.1	4.7
34	1300	1	0	130	8	130	42	130	2.9	6.9
35	1300	0	0	56	4	100	13	130	3.0	4.7
36	1300	0	56	100	3	240	56	750	3.8	2.4
37	1000	2	56	130	2	320	42	1000	3.1	3.9
38	750	0	0	42	1	130	13	750	2.8	5.4
39	1300	1	0	130	4	240	32	180	2.5	4.4
40	1300	0	0	100	6	180	32	180	2.3	2.7
41	1300	1	0	130	4	240	32	320	2.3	3.6
42	1300	0	0	100	6	130	32	130	2.2	3.9
43	560	0	0	56	1	42	2	130	2.8	4.8
44	1800	1	0	75	6	240	42	1000	3.4	5.6
45	2400	0	0	75	4	180	42	130	2.5	5.6
46	1300	1	0	100	4	240	42	560	2.2	3.1
47	1300	1	56	100	2	180	42	750	2.5	2.8
48	1800	1	0	56	13	240	56	320	2.7	14.6
49	1800	0	0	42	10	180	42	320	3.2	16.7
101	1000	0	56	42	6	240	56	560	2.8	14.2
102	750	1	56	56	4	320	56	1000	2.9	21.8
103	750	1	0	130	24	240	42	1000	3.3	4.0
104	420	2	0	42	8	240	32	320	2.9	4.6
105	240	0	0	3	0	56	4	320	2.6	9.8
106	2400	1	100	42	18	240	32	1000	2.7	8.6
Line IV										
BTS 68	1300	1	0	56	3	100	10	130	2.5	8.0
69	1800	1	0	56	2	180	18	180	2.5	5.2
70	1000	0	0	56	1	320	32	560	3.1	3.6
71	1300	0	0	100	4	320	42	560	2.6	9.0
72	320	0	0	0	0	56	0	0	3.1	4.2
73	1800	0	0	130	4	320	32	750	2.7	7.8
74	1800	0	0	100	0	130	13	240	2.5	8.6
75	1000	0	0	56	1	130	3	180	3.4	2.8
76	1300	0	0	130	4	420	32	1000	2.7	4.4
77	1300	0	0	56	3	130	10	100	2.4	7.0
78	1800	1	0	130	13	240	56	560	2.5	15.4
79	180	0	0	13	8	56	6	56	3.2	12.0
80	1000	1	0	100	13	240	56	750	2.9	17.2
81	1300	2	56	100	13	320	56	750	3.2	11.4

APPENDIX 3 (cont.)

Sample No.	AAS Ag	Cu	Pb	Sb	Zn	OES Ba	Be	Co	Cr	Fe2O3
Line IV (cont.)										
BTS 82	1	85	90	0	1640	750	13	320	180	13.0
83	0	25	260	0	70	420	3	18	240	13.0
84	1	40	60	0	100	240	4	24	180	10.0
85	1	20	50	0	110	320	4	32	240	13.0
86	1	35	50	0	100	100	6	56	320	13.0
87	1	20	40	0	90	420	3	56	240	13.0
Line V										
BTS 144	1	20	60	0	100	320		24	130	10.0
145	0	15	50	0	90	130		24	130	7.5
146	0	20	60	0	100	320		24	180	13.0
147	0	15	50	0	90	1300		24	130	10.0
148	0	20	50	0	100	240		24	130	10.0
150	1	20	60	0	90	320		24	240	13.0
151	1	15	50	0	90	320		24	240	13.0
152	0	20	50	0	90	320		24	240	13.0
153	0	20	40	0	80	320		24	130	13.0
154	0	30	50	0	130	240		24	240	10.0
155	1	30	80	0	120	240		32	240	10.0
156	0	30	60	0	130	320		56	320	13.0
157	1	25	60	0	110	420		42	320	13.0
158	0	30	60	20	100	1000		24	240	10.0
159	0	25	60	0	90	24		24	180	5.6
160	0	35	60	0	90	750		24	180	7.5
161	0	25	50	0	100	240		24	180	10.0
162	0	30	50	0	100	100		24	180	4.2
163	1	15	40	0	80	320		24	130	7.5
164	1	40	70	0	380	180		32	130	7.5
165	1	15	80	0	90	750		10	130	10.0
166	0	25	80	0	100	180		24	180	10.0
167	0	25	80	0	70	240		24	180	13.0
168	1	25	50	0	90	180		24	240	10.0
169	0	30	50	20	90	0		0	0	0.0
170	0	25	50	0	90	130		24	240	10.0
171	0	30	50	0	100	240		24	180	10.0
172	0	20	60	0	80	130		24	180	10.0
173	0	20	50	20	80	180		24	180	13.0
174	0	35	60	0	140	180		42	130	4.2
175	0	25	50	0	180	240		24	180	5.6
Line VI										
BTS 176	1	25	60	0	110	1000	3	24	240	13.0
177	1	20	70	0	90	320	4	24	240	13.0
178	1	40	80	0	120	180	4	24	180	10.0

APPENDIX 3 (cont.)

Sample No.	Mn	Mo*	Nb	Ni	Sn*	V	Y	Zr	NAA U	GRAV LOI
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Line IV (cont.)										
BTS 82	2400	0	0	420	13	180	42	420	3.4	12.2
83	1300	1	0	56	10	180	56	320	2.7	10.0
84	1000	1	0	100	8	180	42	560	2.8	6.6
85	1300	1	0	130	10	240	42	180	2.8	6.8
86	2400	3	0	100	8	320	42	750	3.2	5.0
87	1000	1	0	100	10	320	42	1000	1.7	5.0
Line V										
BTS 144	1000	1	56	42	6	180	32	560	2.5	8.4
145	1300	1	56	42	4	130	24	560	2.5	6.2
146	1800	2	56	42	10	180	42	1300	2.6	8.6
147	1300	0	0	42	3	100	18	240	2.6	10.4
148	1800	1	0	42	6	180	24	420	2.4	12.0
150	2400	2	75	42	18	180	32	750	2.6	9.8
151	1800	2	0	42	13	240	32	750	2.6	10.6
152	1300	2	56	32	10	180	42	750	3.2	11.2
153	1300	1	56	42	6	130	42	420	2.7	10.2
154	3200	2	56	56	6	180	32	560	3.2	5.4
155	3200	3	56	56	8	240	42	560	2.9	9.2
156	3200	2	56	75	6	240	32	1000	3.0	7.4
157	1300	4	75	100	4	240	42	750	3.1	7.6
158	1300	0	0	42	3	130	32	130	3.4	2.2
159	1000	2	56	42	8	130	56	130	4.1	4.4
160	1000	1	56	42	2	100	32	180	3.7	11.2
161	1800	0	56	56	6	180	42	560	3.9	7.0
162	1000	0	100	42	4	100	18	750	3.3	4.4
163	1000	1	100	42	6	130	42	560	2.7	17.2
164	1300	1	0	75	10	130	32	320	3.2	15.0
165	750	1	56	42	3	130	24	560	2.6	12.6
166	1000	1	0	42	13	130	32	320	2.7	17.4
167	1300	1	0	42	13	130	42	320	2.6	11.4
168	2400	2	75	42	6	180	32	750	2.8	9.0
169	0	8	100	0	0	32	0	0	2.9	9.8
170	2400	2	56	42	8	180	42	750	2.7	12.8
171	1800	2	56	42	10	130	32	560	2.6	9.0
172	2400	3	56	42	6	180	32	750	2.6	11.4
173	2400	4	75	32	8	180	32	560	2.6	7.0
174	750	2	0	42	6	180	32	320	3.0	10.2
175	750	1	56	42	8	180	32	420	2.8	10.2
Line VI										
BTS 176	1800	2	0	42	13	180	32	560	2.2	1.4
177	2400	3	0	42	18	240	32	750	2.4	17.4
178	1300	2	0	42	13	130	32	1000	3.0	11.6

APPENDIX 3 (cont.)

Sample No.	AAS Ag	Cu	Pb	Sb	Zn	OES Ba	Be	Co	Cr	Fe2O3
Line VI (cont.)										
BTS 179	1	30	60	0	120	240	2	24	75	5.6
180	1	30	60	0	200	1000	4	24	180	13.0
181	1	25	60	0	130	560	4	24	180	13.0
182	1	25	60	0	110	750	6	24	240	18.0
183	1	25	50	0	120	320	3	24	180	13.0
184	1	25	50	0	130	560	4	24	180	13.0
185	1	15	40	0	90	750	4	18	130	13.0
186	1	35	60	0	120	750	6	24	240	13.0
187	1	45	50	0	340	750	8	24	180	13.0
188	1	70	60	0	100	560	4	32	130	13.0
189	1	20	50	0	100	560	4	24	180	13.0
190	1	15	40	0	80	1300	2	13	180	10.0
191	1	20	50	0	80	3200	2	18	130	10.0
192	1	20	40	0	90	1000	3	24	130	10.0
193	1	15	50	0	80	560	4	18	180	10.0
194	1	15	50	0	70	1000	4	18	100	10.0
195	1	20	50	0	70	1000	3	18	130	10.0
196	1	25	80	0	70	750	4	32	130	13.0
197	1	20	40	0	70	1000	3	24	130	10.0
198	0	20	40	0	60	750	4	24	100	13.0
199	1	20	30	0	70	750	3	24	130	13.0
200	1	15	40	0	70	750	3	18	100	10.0
201	1	25	50	0	70	750	4	24	130	10.0

APPENDIX 3 (cont.)

Sample No.	OES Mn	Mo*	Nb	Ni	Sn*	V	Y	Zr	NAA U	GRAV LOI
Line IV (cont.)										
BTS 179	750	2	0	42	6	180	42	1000	2.9	7.2
180	1000	1	0	56	3	130	32	420	3.0	4.4
181	750	1	0	42	6	180	13	420	2.5	4.6
182	1000	2	0	56	6	180	13	420	2.8	4.6
183	1000	0	0	42	13	180	32	420	3.0	8.2
184	1300	0	0	100	3	130	24	130	2.8	4.8
185	1800	1	0	56	8	180	24	130	2.9	10.0
186	1300	0	56	100	3	180	42	180	3.2	6.8
187	1800	0	0	100	10	180	32	130	2.7	18.6
188	1300	0	0	56	8	240	18	130	2.8	15.4
189	1800	0	0	75	6	180	24	240	2.8	8.4
190	1300	0	0	42	1	130	2	180	2.5	9.6
191	1000	0	0	42	1	130	3	420	2.7	10.4
192	1000	0	56	56	4	180	4	180	2.5	6.4
193	1300	0	56	42	6	130	10	130	2.5	8.8
194	1300	0	0	42	6	130	4	100	2.8	8.6
195	1000	0	0	42	4	180	4	100	2.7	8.6
196	1300	0	0	56	3	130	3	130	3.0	2.6
197	1000	0	0	56	1	130	4	100	2.8	4.6
198	1000	0	0	42	3	180	4	130	2.6	6.0
199	750	0	0	56	1	130	10	100	2.8	3.8
200	750	0	0	42	1	130	4	180	2.8	5.2
201	1000	0	0	42	4	130	4	100	2.9	6.8

* Mo and Sn are values corrected for interference
Pd was also sought by OES but results are not meaningful

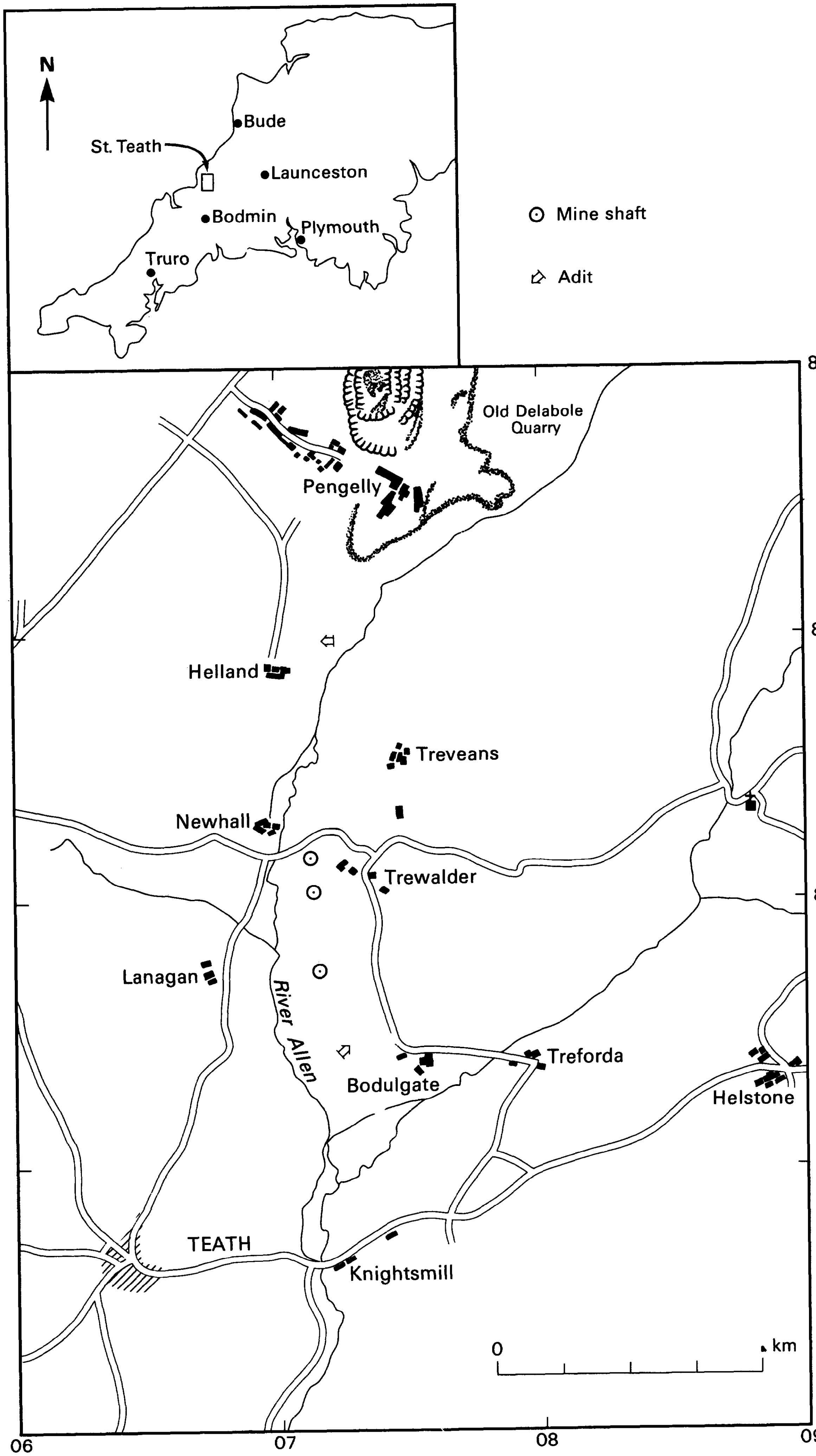

Fig. 1 Location map

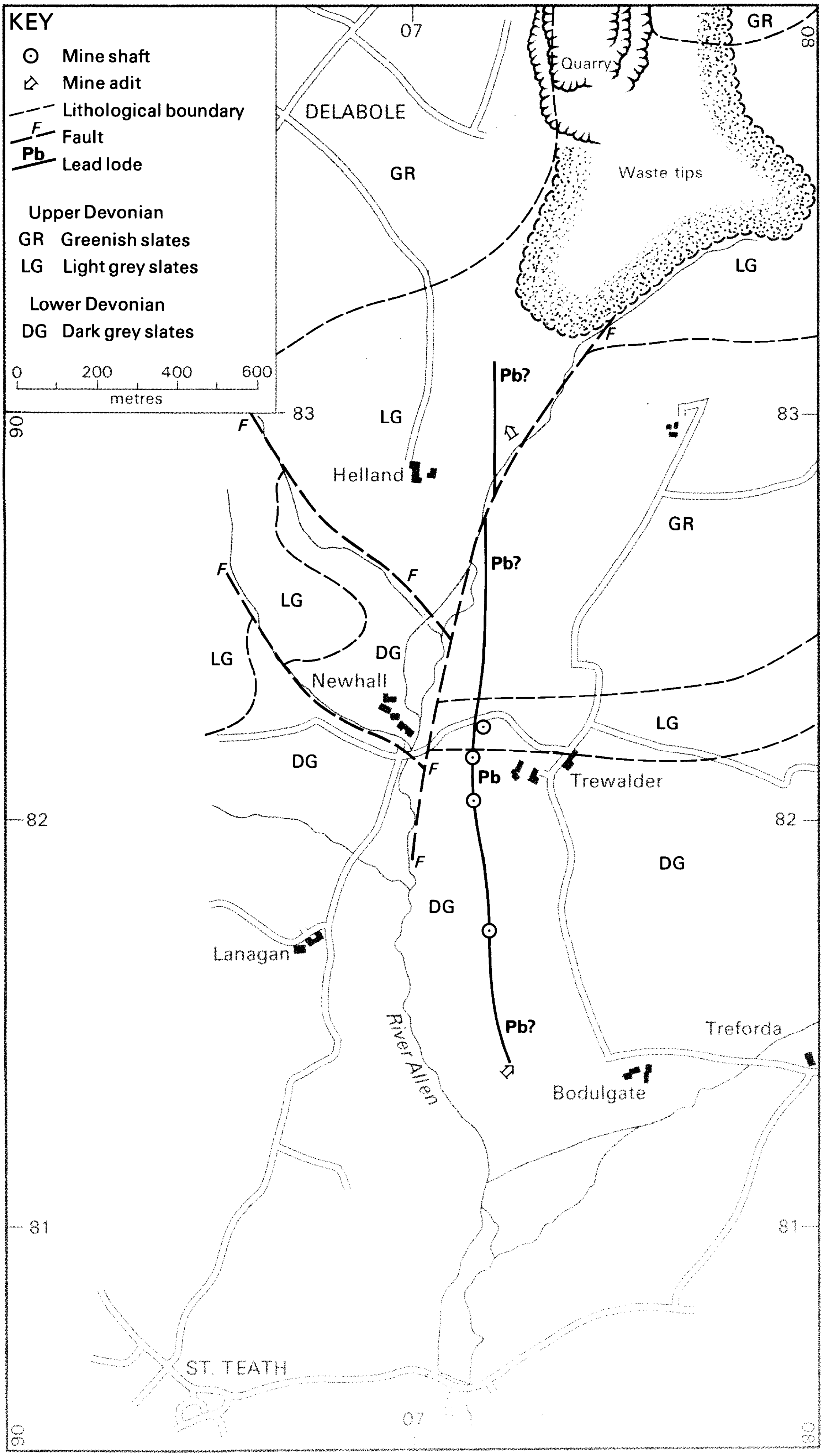

Fig. 2 Lithology of the Allen Valley

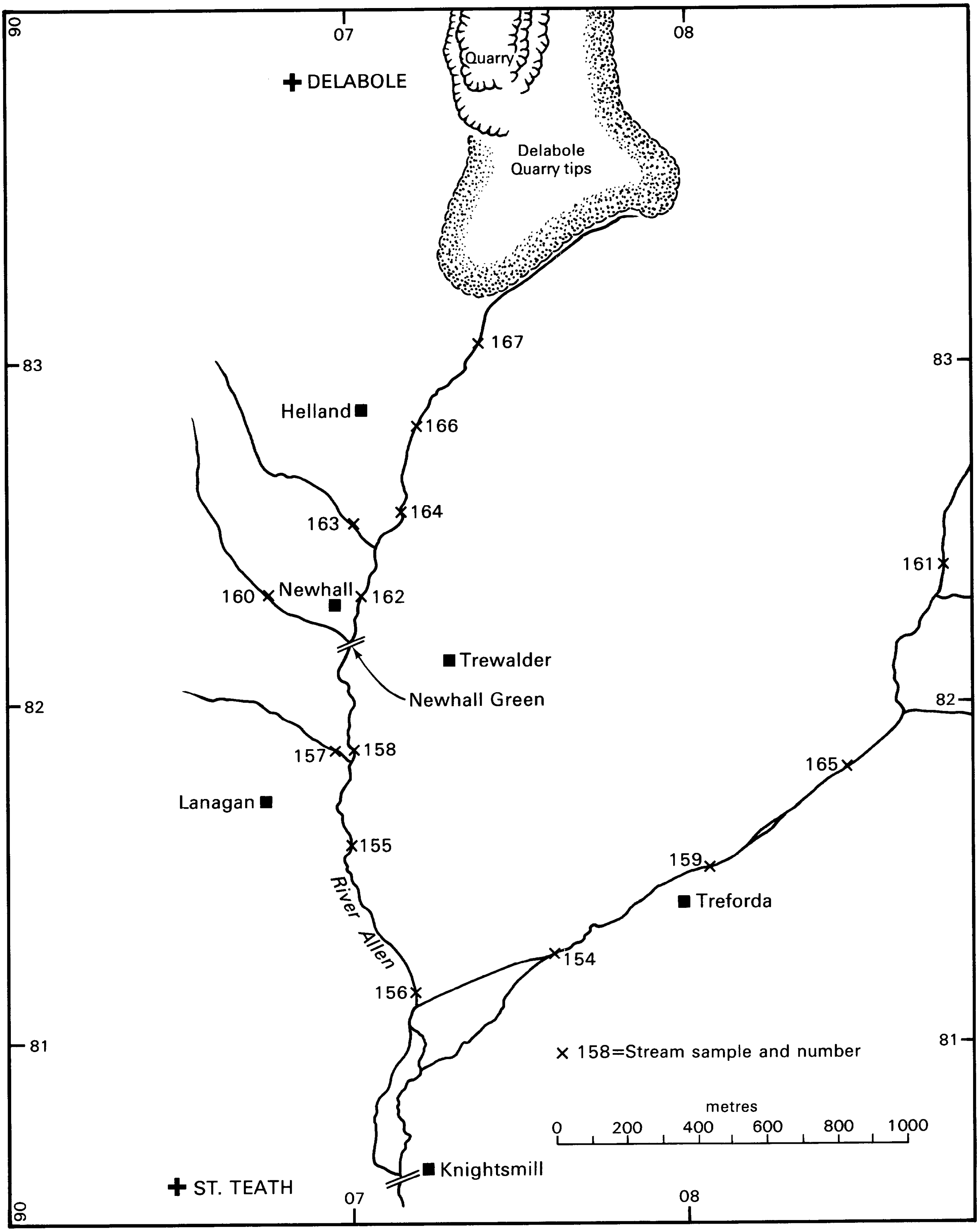

Fig. 3 Stream sample locations

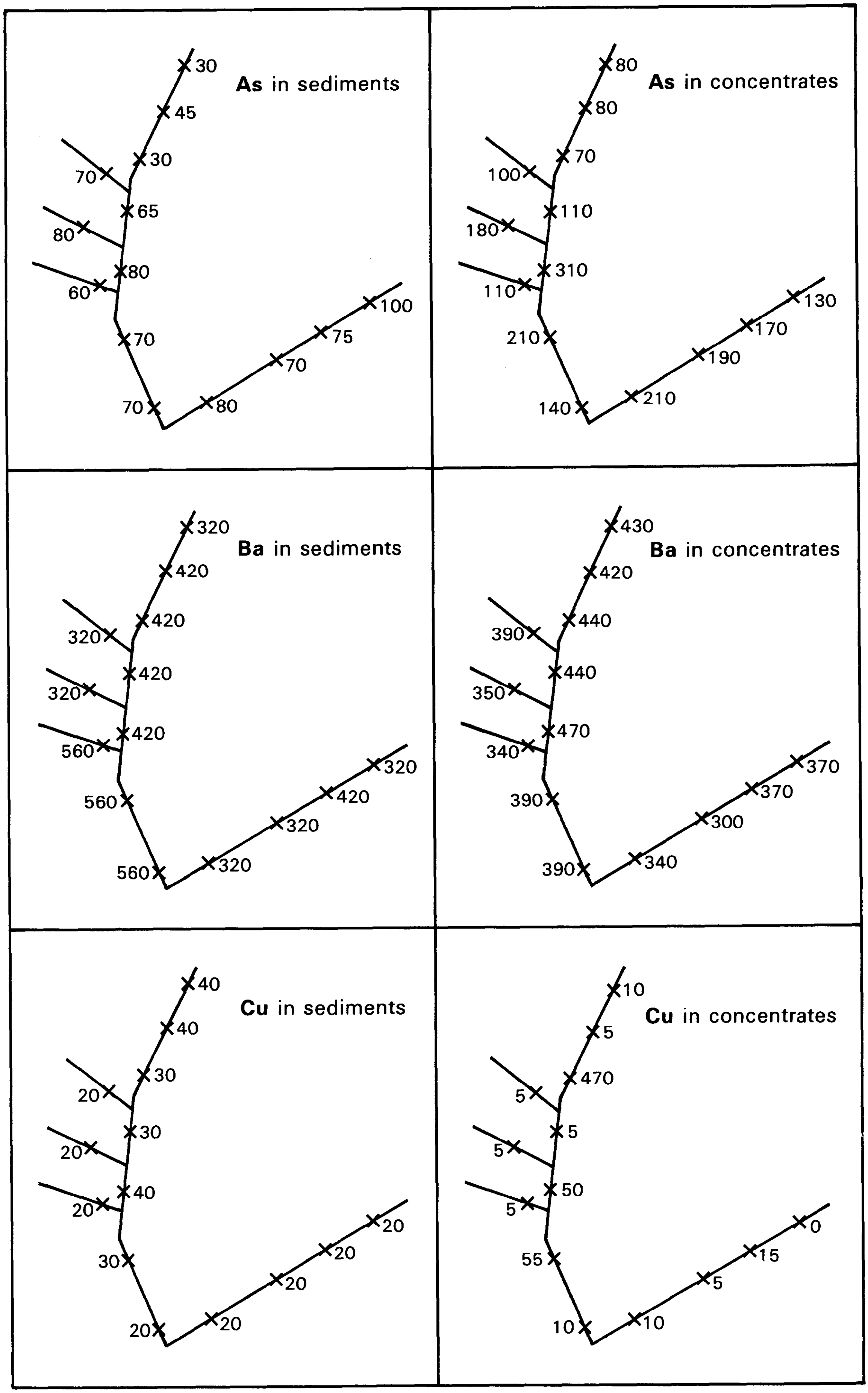

Fig. 4 Schematic distribution of metals in drainage
(values in ppm)

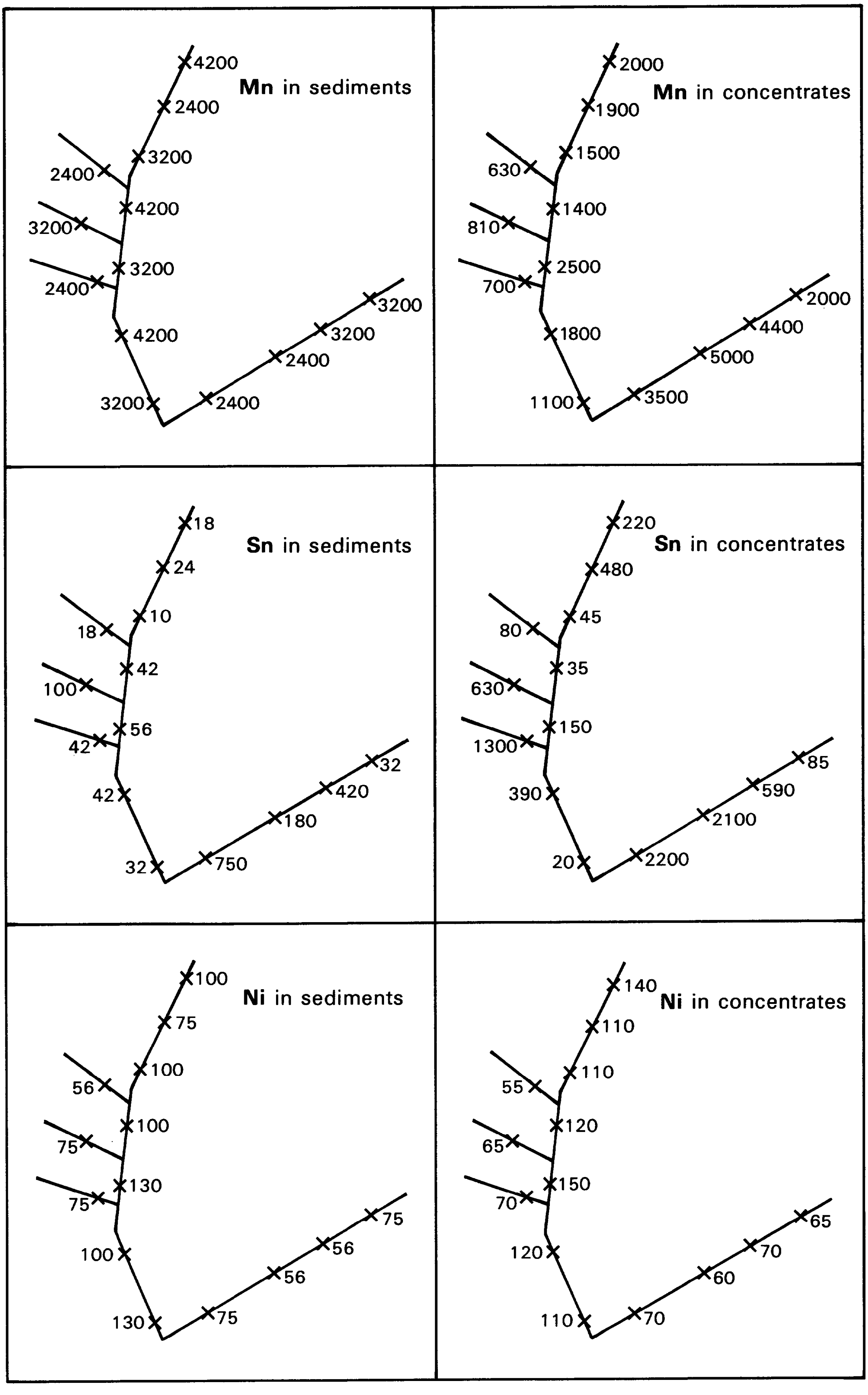

Fig. 5 Schematic distribution of metals in drainage
(values in ppm)

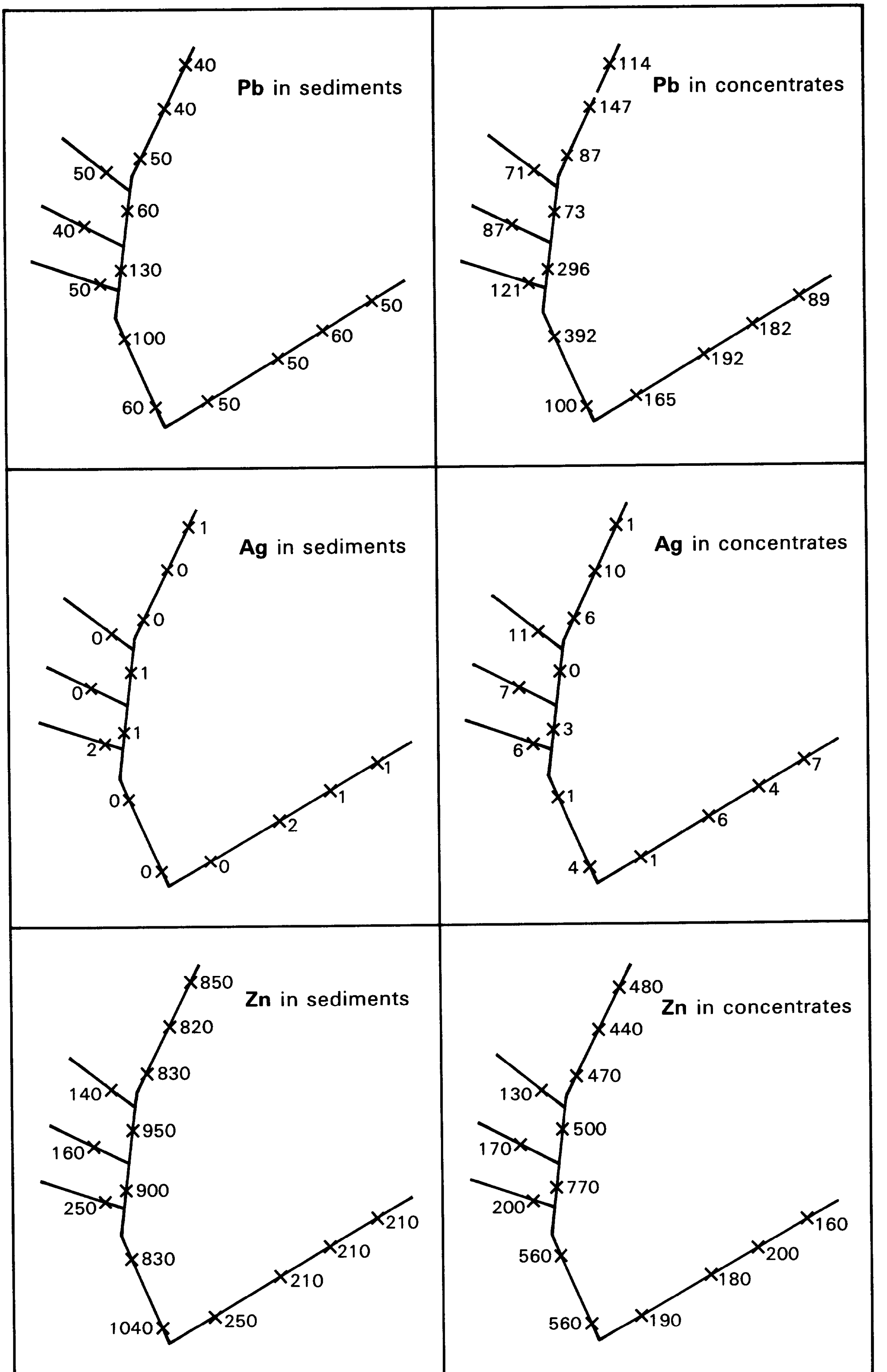

Fig. 6 Schematic distribution of metals in drainage

(values in ppm)

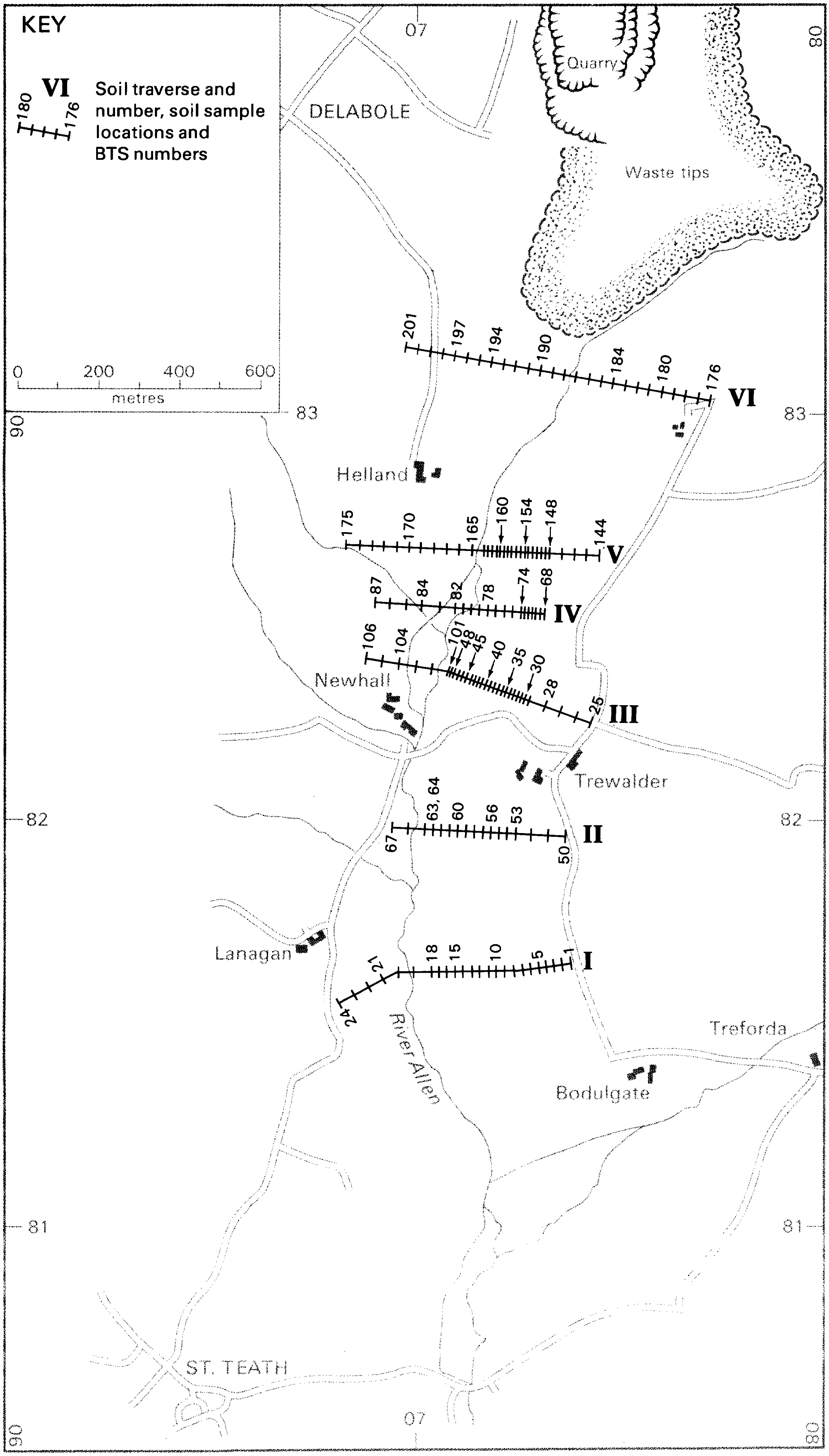

Fig. 7 Location of soil sampling traverses

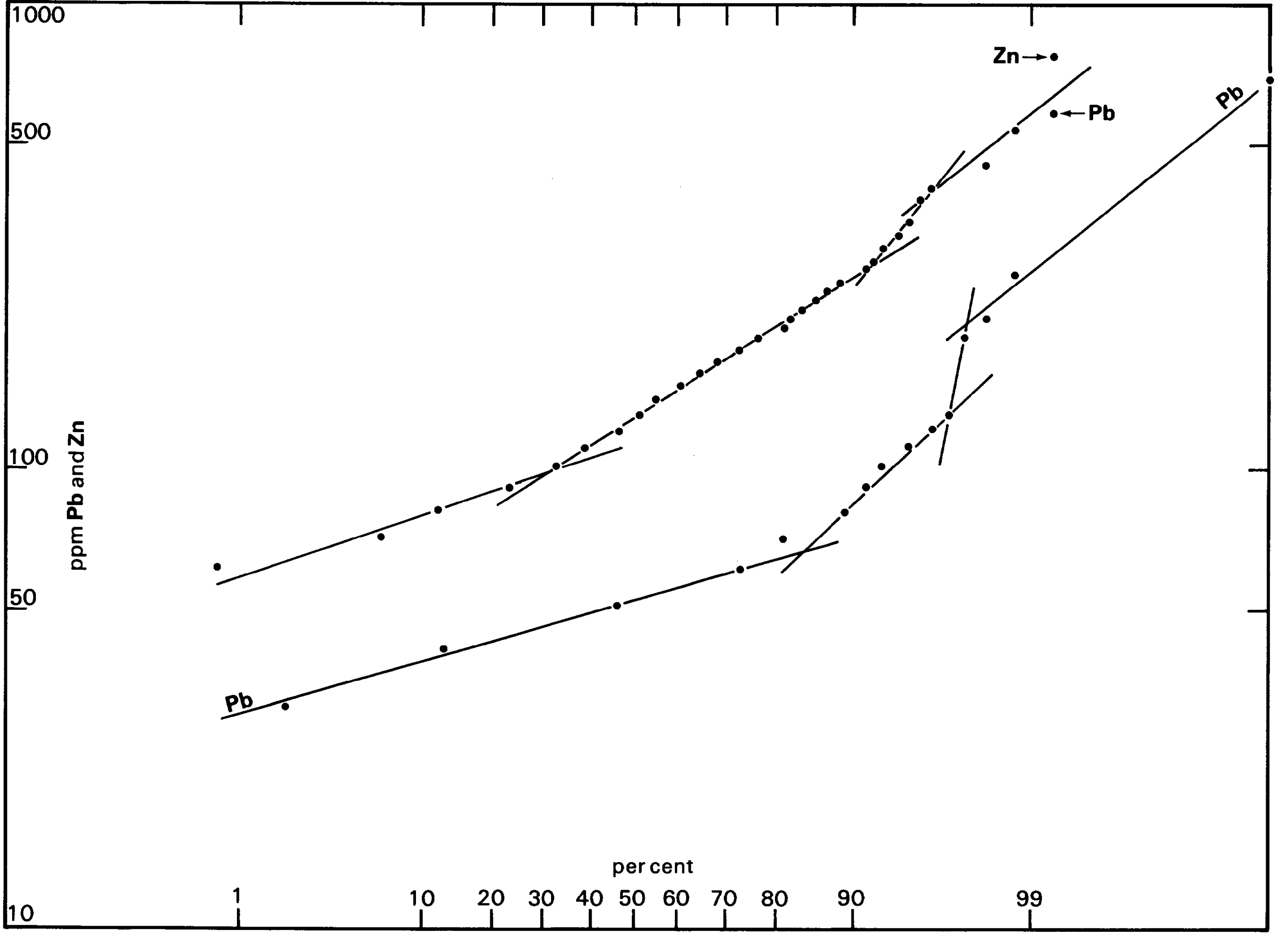

Fig. 8 Log-probability plot, **Pb** and **Zn** in soils

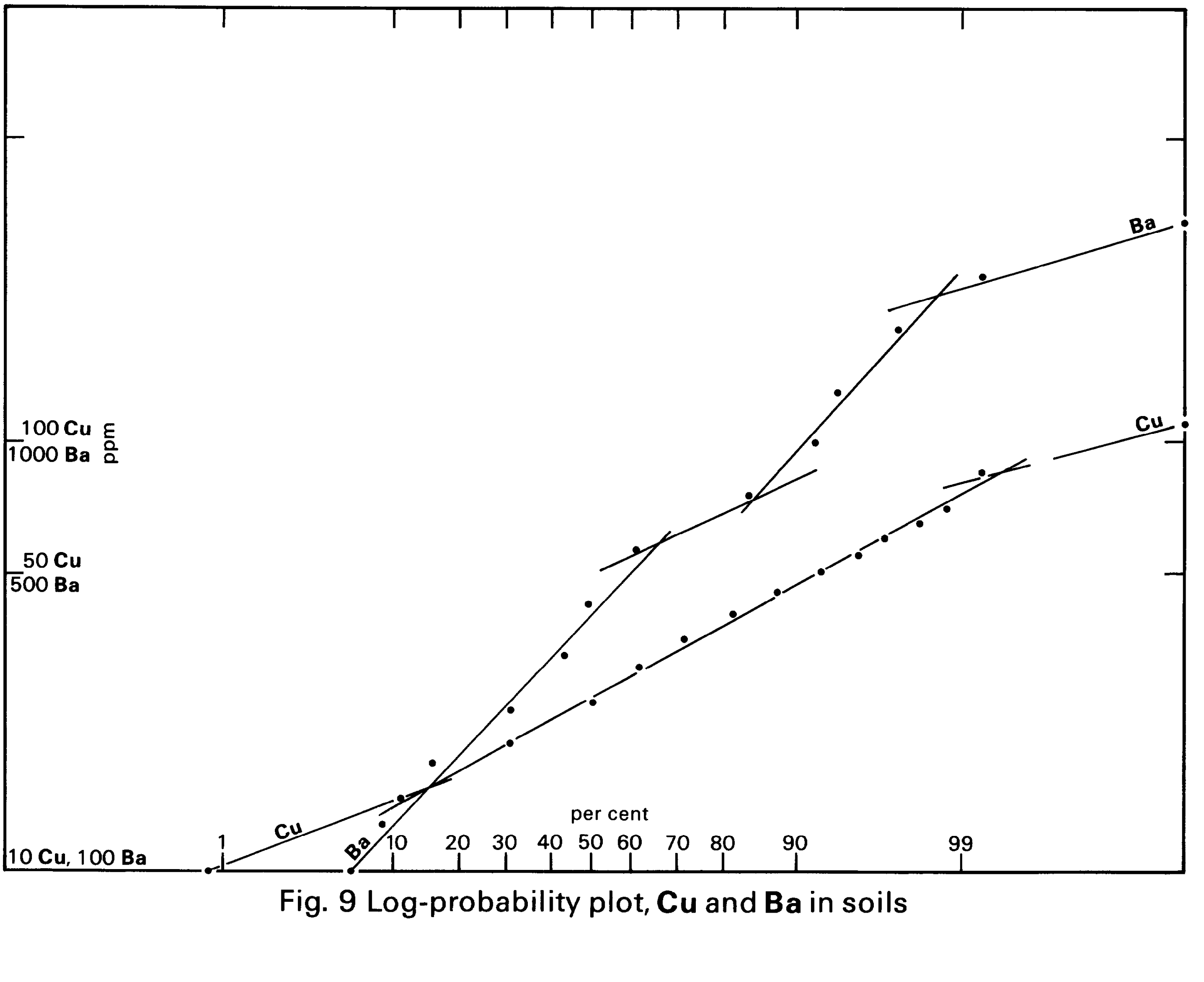

Fig. 9 Log-probability plot, **Cu** and **Ba** in soils

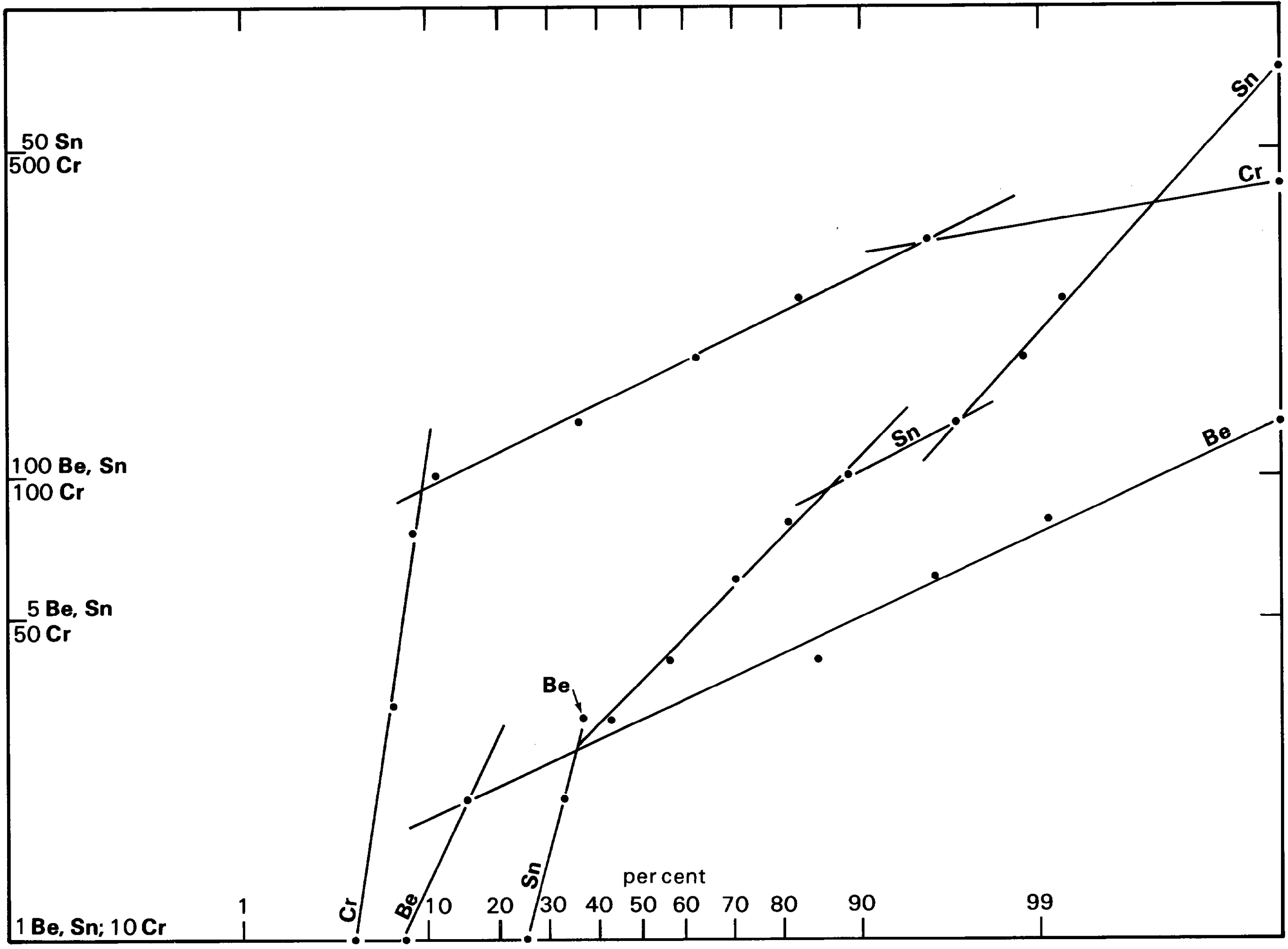

Fig. 10 Log-probability plot, **Cr**, **Sn** and **Be** in soils

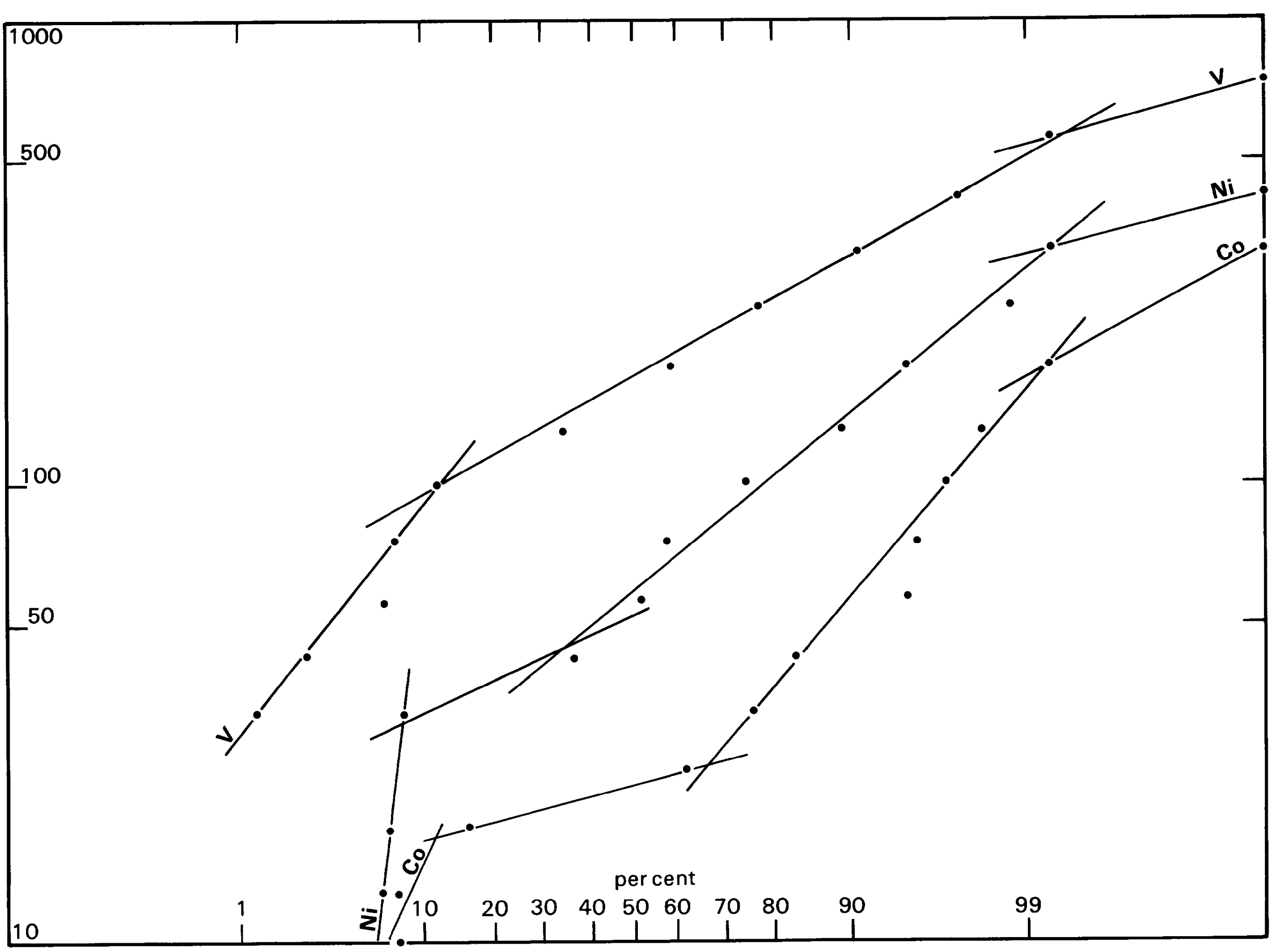

Fig. 11 Log-probability plot, **Co**, **Ni** and **V** in soils

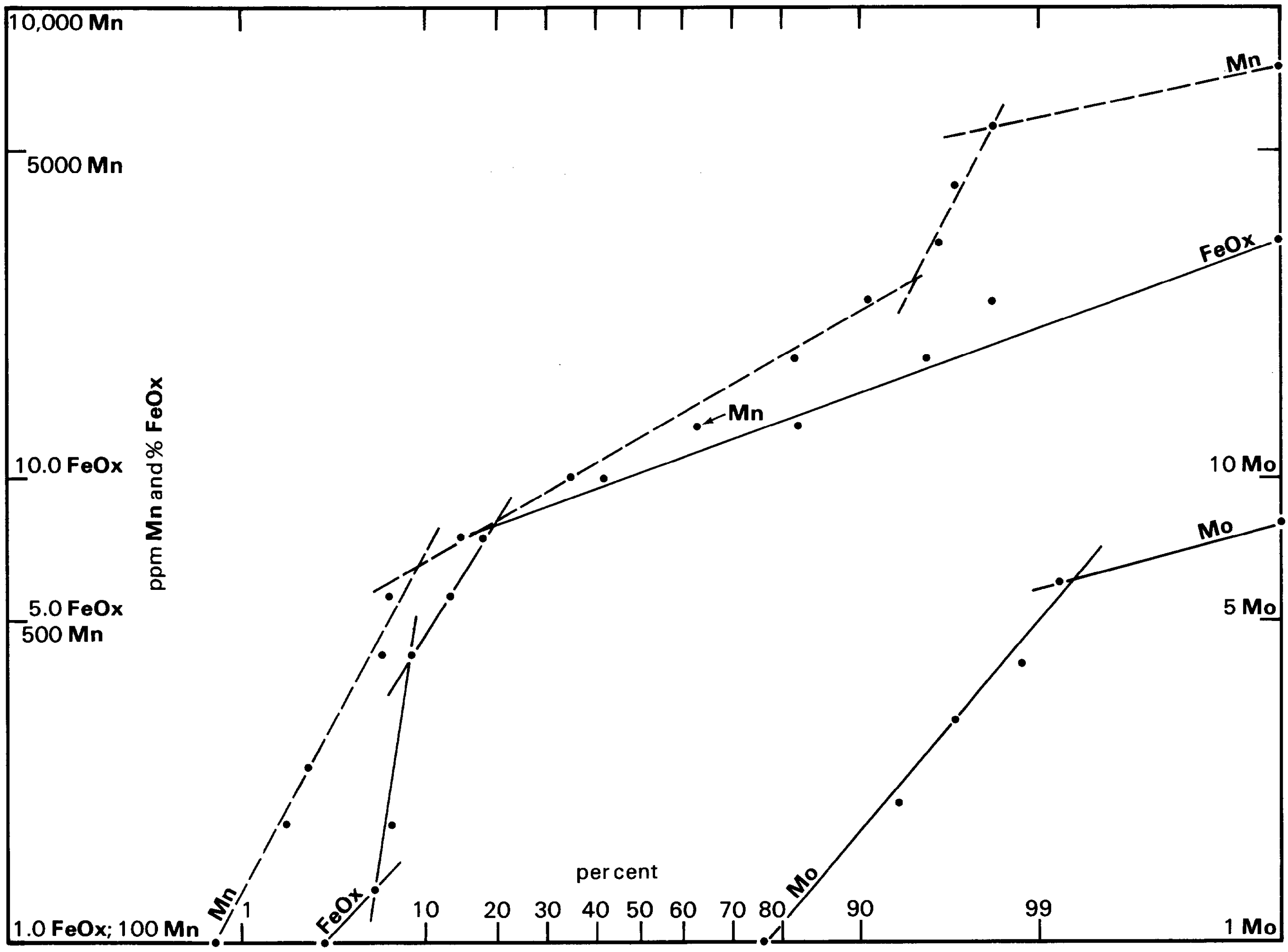

Fig. 12 Log-probability plot, **FeOx**, **Mn** and **Mo** in soils

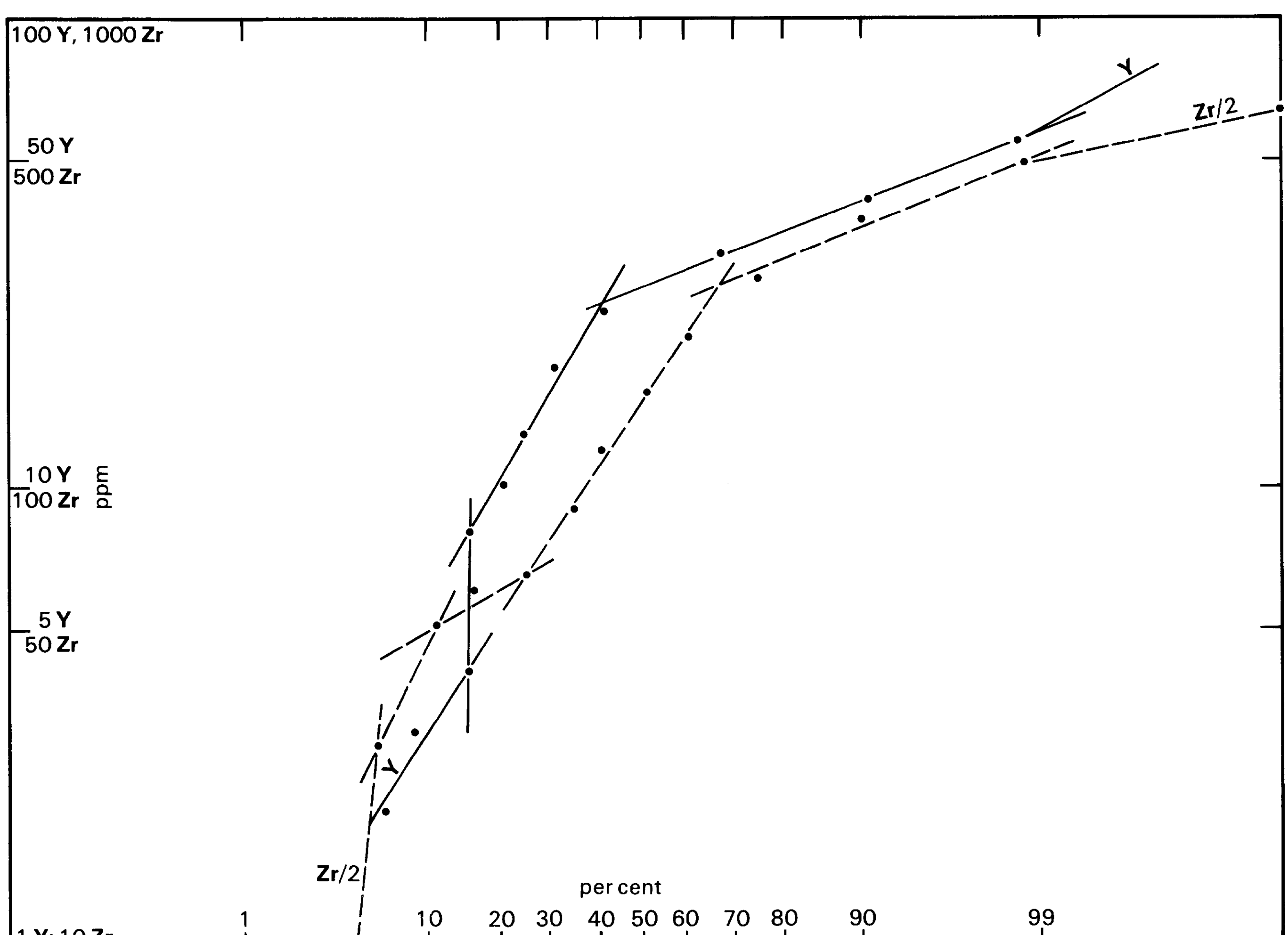

Fig. 13 Log-probability plot, **Y** and **Zr** in soils

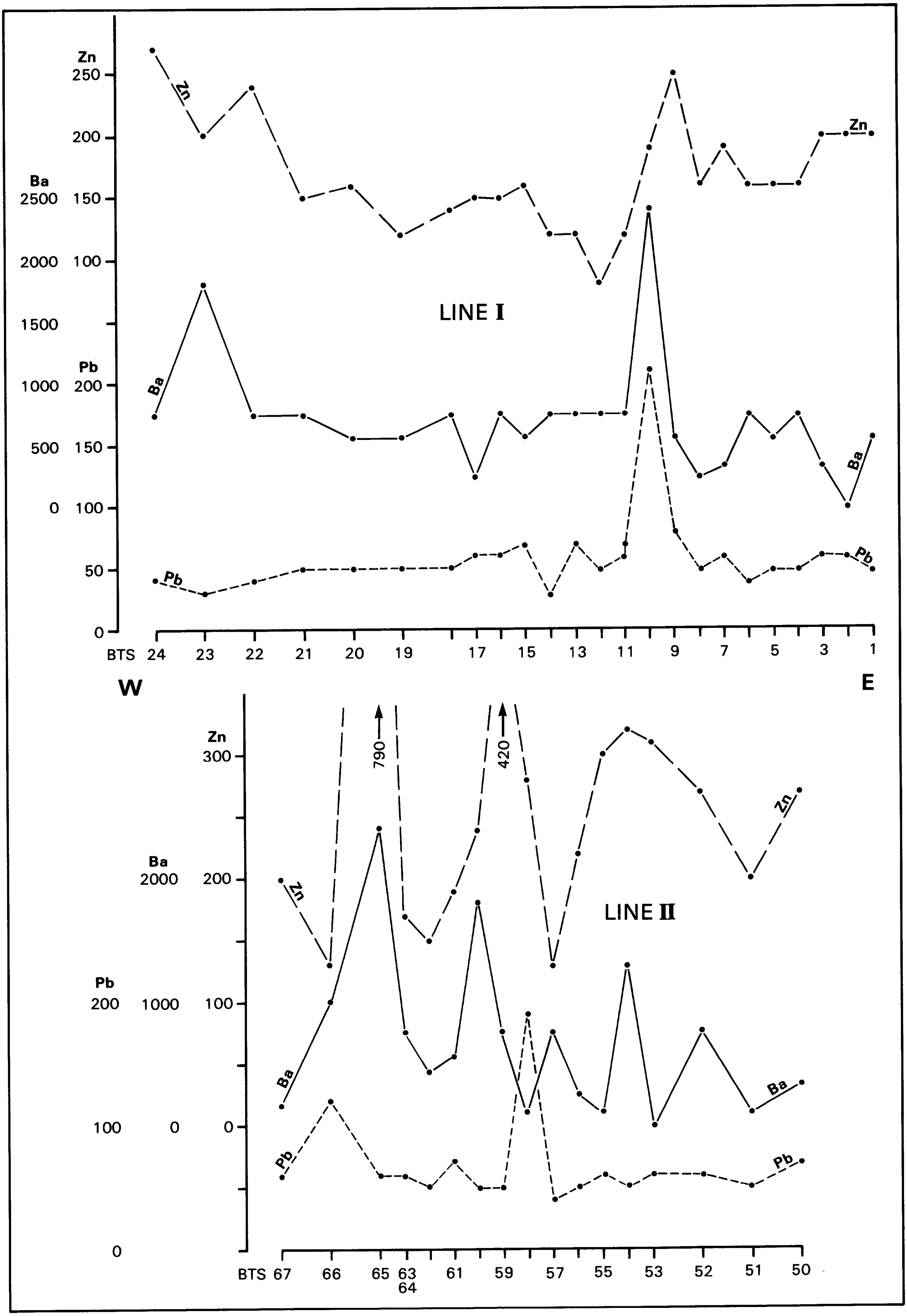

Fig. 14 **Pb, Zn** and **Ba** soil profiles

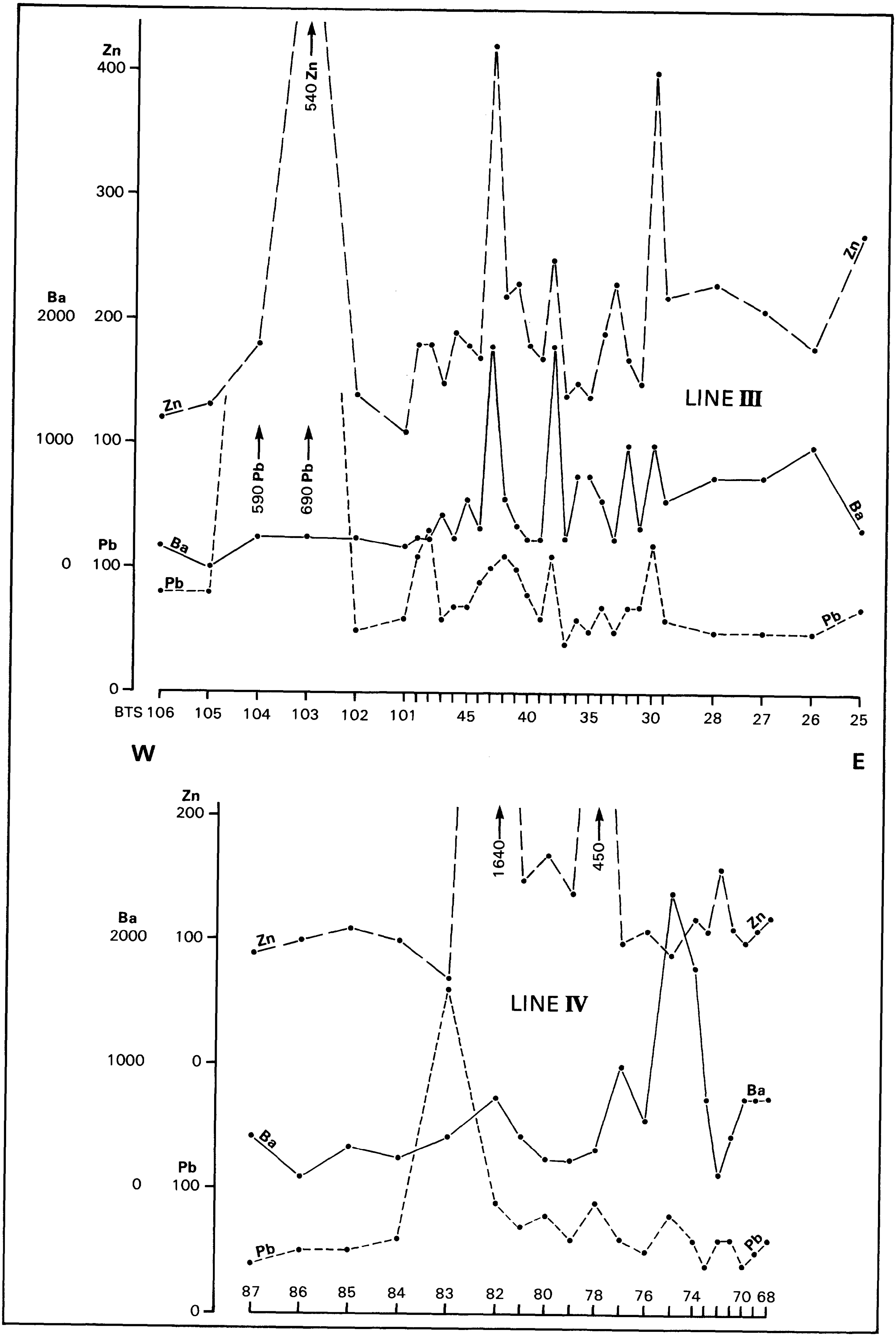

Fig. 15 **Pb, Zn** and **Ba** soil profiles

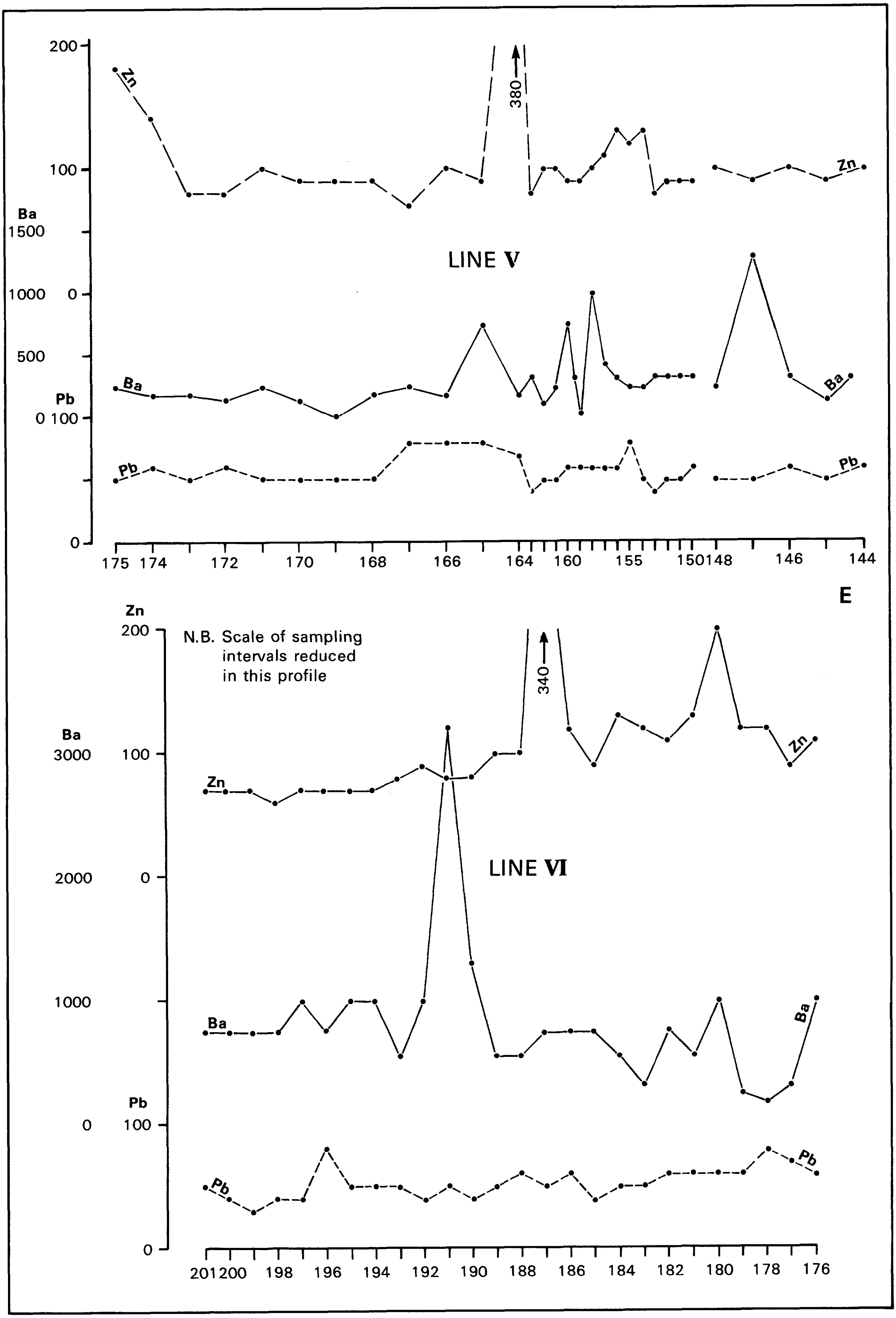

Fig. 16 **Pb, Zn** and **Ba** soil profiles

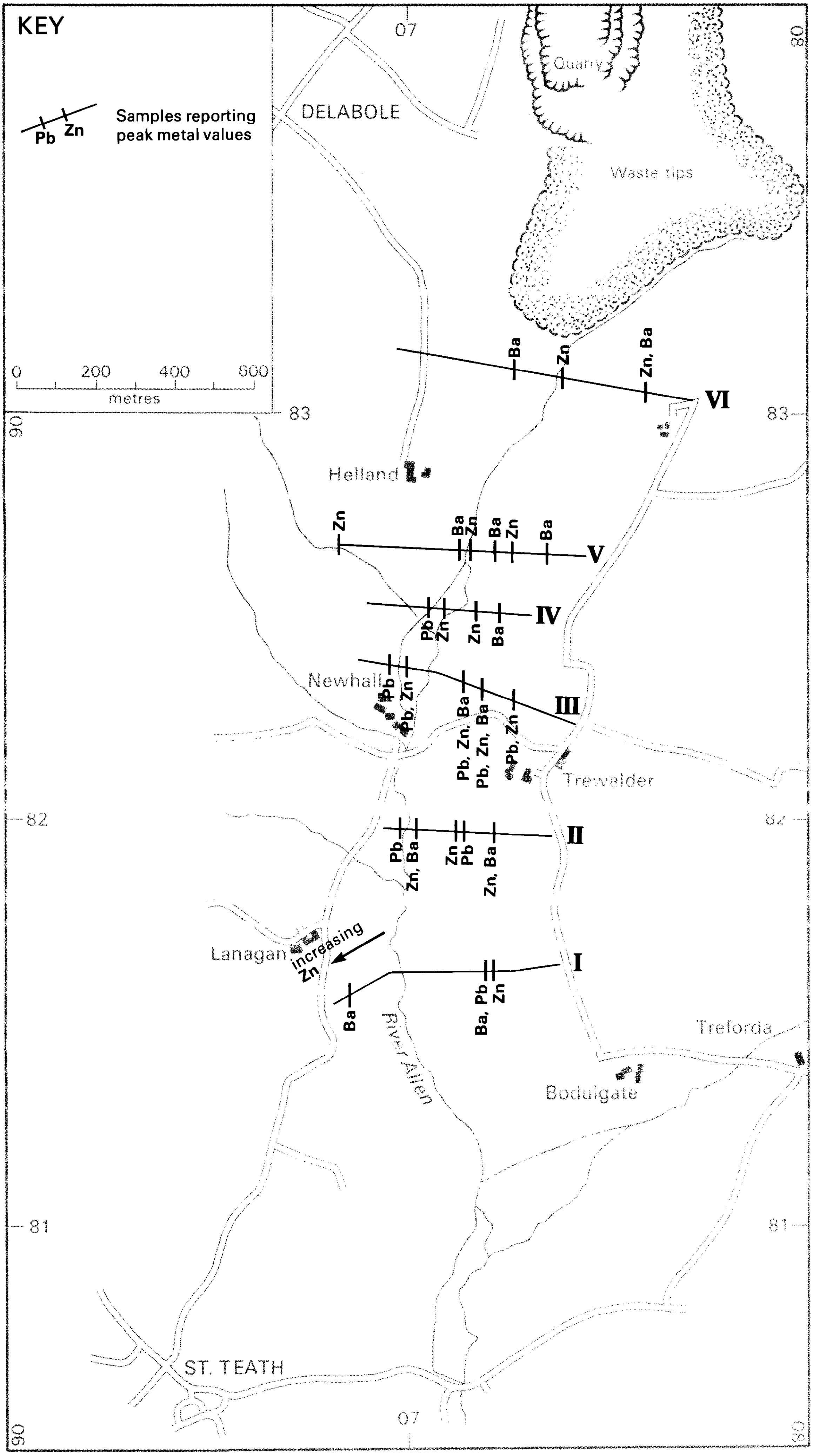

Fig. 17 Distribution of metal anomalies

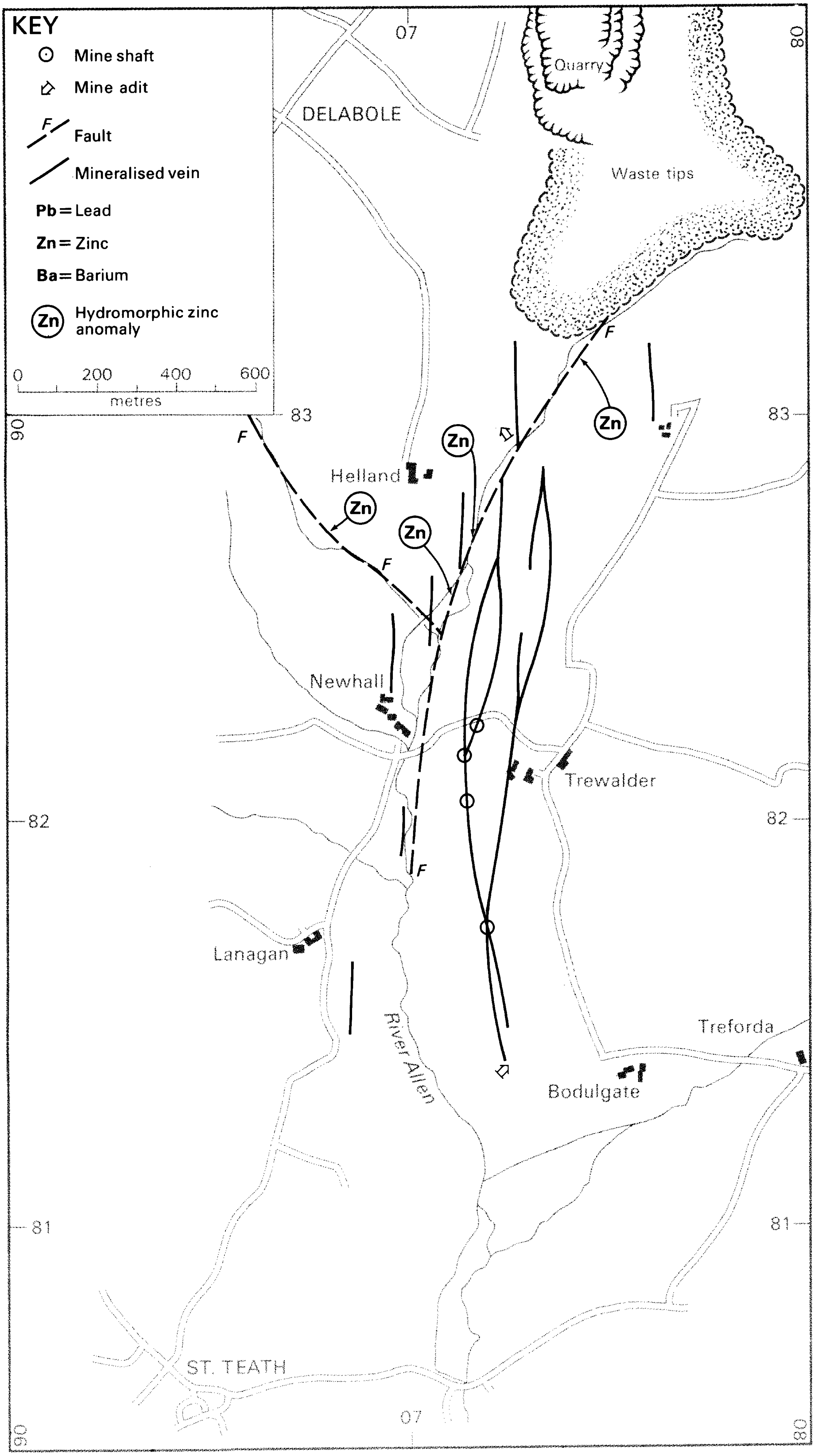

Fig. 18 Interpretation of anomalies