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MINERAL RESOURCES		
FILE REF:	DOC. REF:	
28M/93(6)		
10 JAN 2005		
OFFICER	FOR ACTION	FOR INFO
See folio 40		

SUBMITTED TO PASMENCO EXPLORATION, BURNIE, TASMANIA

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## SUMMARY

The response of  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr)$ ,  $(Mn \times Ba)/(Ca \times Na \times Sr)$ ,  $Mn \times Ba$  (hot  $HNO_3$  insoluble concentrations by PIXE and PIGME) and EPR index demonstrate that there are two types of geochemical alteration in the Chester mine area. The first one is the alteration related to massive sulphide mineralisation associated with the I.P. anomaly and with NS faults at Mount Kershaw, and the other is the alteration related to other type of mineralisation or metamorphism and deformation associated with both alteration zones (Chester alteration zone and North Bastyan hydrothermal alteration zone). The geochemical response of Mn, Ba Zn and Pb, and EPR index in both alteration zones of the Chester mine area demonstrate that the mineralisation and alteration in the Chester mine are not similar to the Rosebery-Hercules type massive sulphide mineralisation and alteration. However the alteration in the I.P. anomaly, and NS fault zones at the Mount Kershaw are considered to be related to massive sulphide mineralisation and consequently those areas are interesting for massive sulphide mineralisation.

The distribution patterns of Zn, Pb, Ba, As, Sb,  $Pb \times Ba \times As$ ,  $Ba \times As$ ,  $(Zn \times Pb)/Cu$  and  $(Ba \times As)/Cu$  (by AAS and NAA) in the 80900N and 80550N sections indicate that there is a possibility of hidden mineralisation (probably different to massive sulphide type) or source of these elements at depth below the Drill Site shear (below the Chester deposit) and Chester shear zones.

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# EXPLORATION LITHOGEOCHEMISTRY AND ELECTRON PARAMAGNETIC RESONANCE (EPR) OF ROCKS IN THE CHESTER MINE AREA, WESTERN TASMANIA

## INTRODUCTION

Lithogeochemical and EPR studies were performed in the Chester mine area to determine the type of alteration and mineralisation potential. The exploration methods and approach used in this study are similar to those developed in the Rosebery mine area (van Moort and Aung Pwa, 1993; Aung Pwa, 1996). The Chester mine, disused old pyrite mine approximately 8 km north of Rosebery is located within the Mount Read Volcanics (Fig. 1). Production was 0.11 Mt pyritic ore at 27.9 % S. Reserves are 2.8 Mt at more than 20 % S (Green, 1990).

The following studies are involved in this investigation:

- (1) Determination of alteration and identification of alteration related to massive sulphide mineralisation
- (2) Evaluation of mineralisation potential on the surface of the Chester mine area, and at the depths of Drill site shear zone below the Chester deposit and of the Chester shear zones.

## 2. GEOLOGY AND MINERALISATION

The geology and mineralisation are based on Stevens (1974), Collins et al. (1981) and Corbett and McNeill (1986) and on surface geology and section maps of Pasminco Exploration (1993). The study area mainly consists of rhyolitic volcanoclastics and breccia together with minor amount of dacitic lava. Corbett and McNeill (1986) interpreted these rocks to be the Mount Black Volcanics sitting on the hanging wall pyroclastics of Rosebery area. The rocks between the Chester and Drill Site Shear zones are pumiceous Volcanoclastics (Fig. 2). There are two significant shear zones, the Drill site and Chester shear zones trending NS and two NS faults at Mount Cheshaw. The Chester deposit occurs at the northern end of the Drill Site shear zone. There are two alteration zones; the

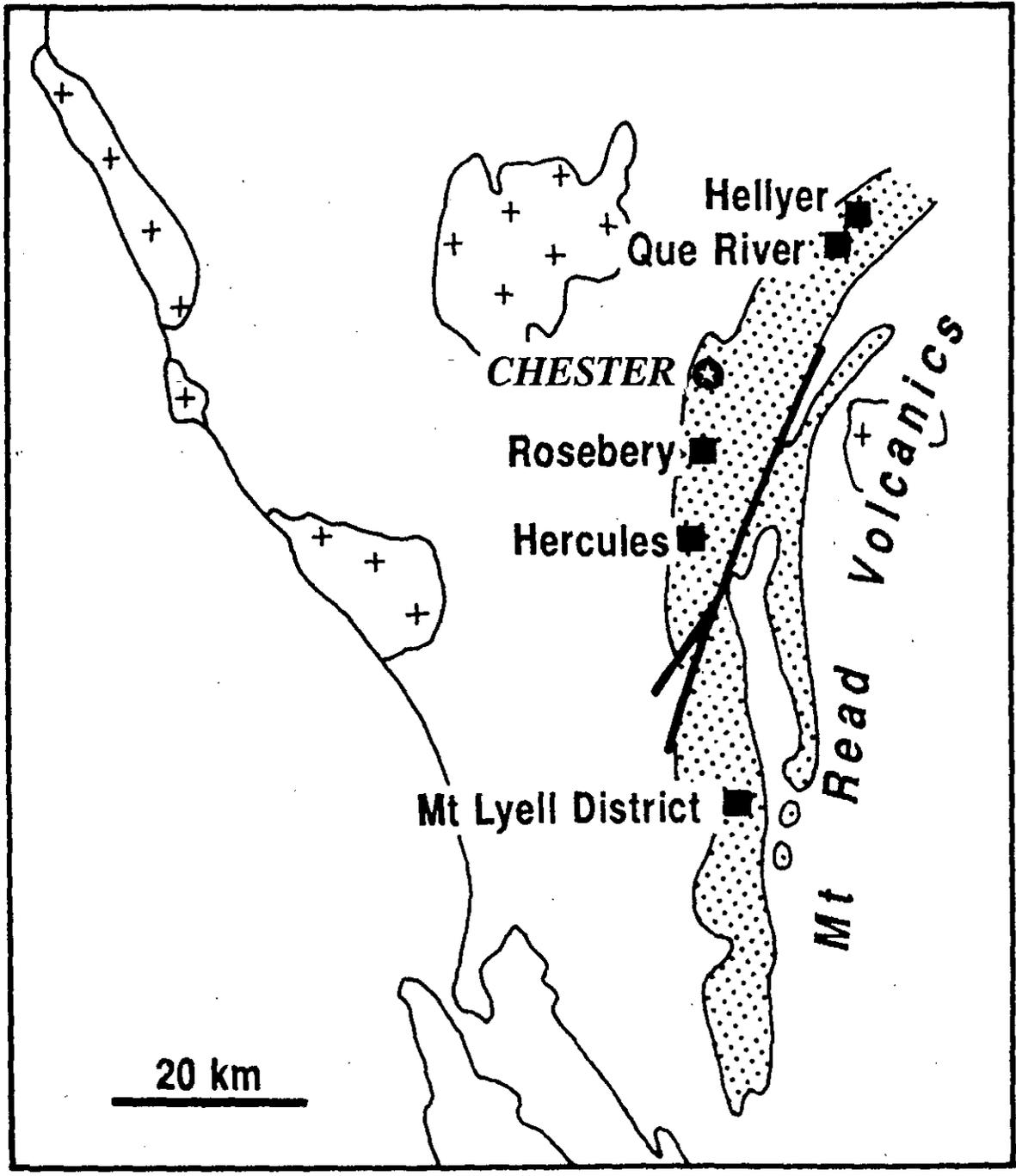


Fig. 1. Mount Read volcanics and location of the Chester mine.

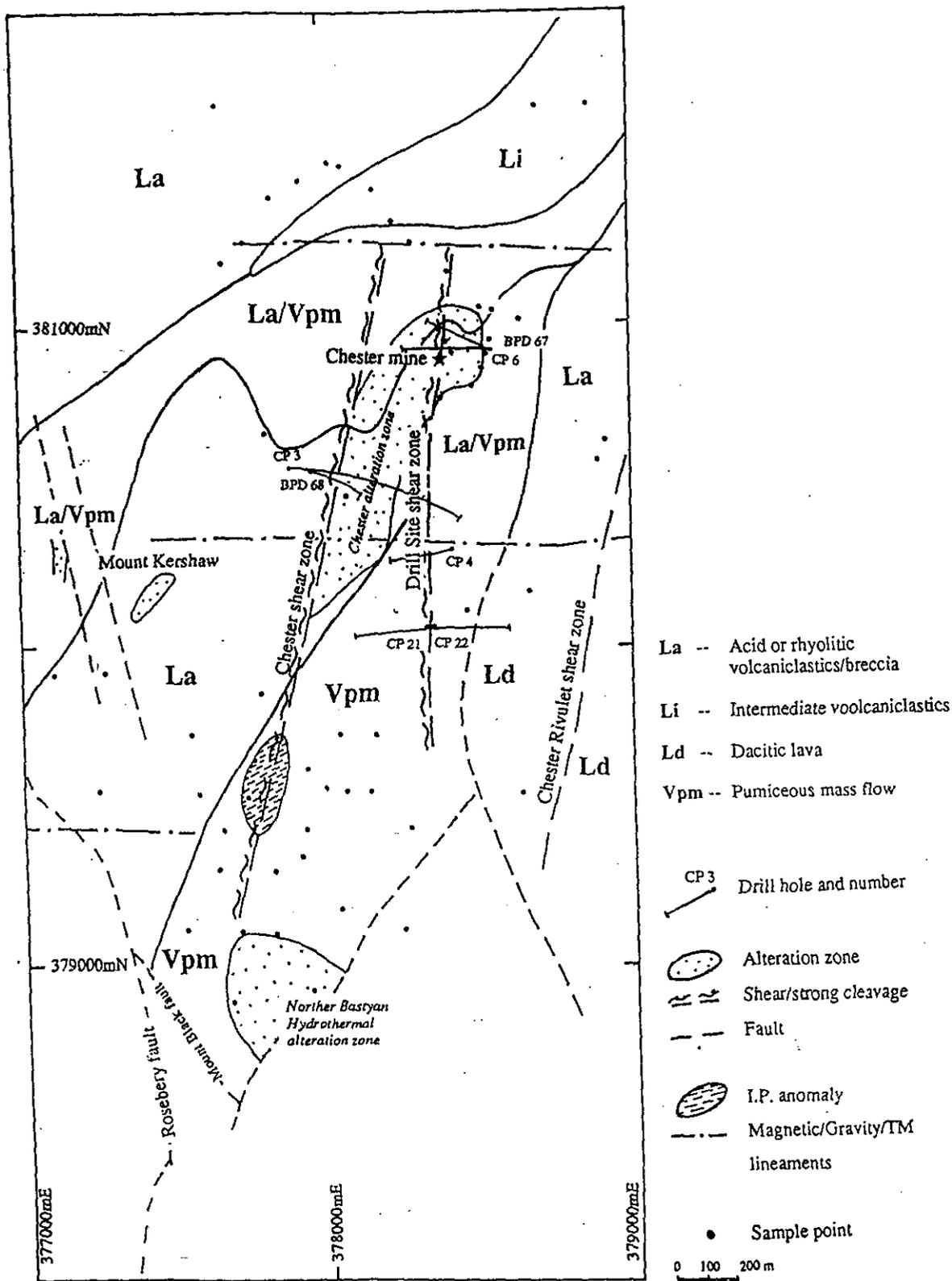


Fig. 2. Geology of the Chester mine area. The area is covered by rhyolitic volcanoclastics and breccia together with minor amount of dacitic lava in the east.

northern one (Chester alteration zone) about 1 km in NS length between the above two shear zones is associated with the Chester deposit, and a southern smaller zone (North Bastyan hydrothermal alteration zone) is located south of the Chester shear zone. The alteration zone in the Chester mine area is characterised by three concentric zones (Stevens, 1974): (1) inner zone of quartz-sericite-pyrite±carbonate, (2) a narrow zone of quartz-sericite-chlorite±carbonate and (3) outer weakly altered zone. The mineralisation in the Chester mine working occurs as massive pyrite, interbedded pyrite and chert, disseminated pyrite, and remobilised pyrite and quartz (Collins et al., 1981). Pyrite veins intersect chert beds and euhedral pyrite, quartz and barite occur along faults and joints. In the northwestern part of the mine working there is a chert breccia containing fragments of chert, banded chert/rhyolite, pyritic chert, and pyritic pyroclastic rock which are cemented in a siliceous pyrite matrix.

Reid (1918) interpreted that mineralisation resulted from hydrothermal solution circulating through premineralisation fractures and metasomatically replacing the schistosed rocks containing original calcite. However Collins et al. (1981) reinterpreted the mineralisation to be of volcanogenic massive sulphide type.

### 3. SAMPLING AND ANALYSES

Five surface rock and thirty-six drill core samples were collected by Aung Pwa and Alind Nand in July 1995. Additional fifty-seven surface rock powder samples (Fig. 3) from the previous collection were obtained from Mr. Mike Saxon (geologist, Pasminco Exploration Burnie). All the samples were analysed for K, Al, Fe, Ca, Na, Ti, Mn, Ba, F, Rb, Sr, Cl, Zn, Pb, Ga, V and Zr by PIXE/PIGME, and for EPR intensities (EPR intensities measured over the sweeps  $326.5 \pm 5$  and  $\pm 100$  mT) by EPR powder spectroscopy after hot  $\text{HNO}_3$  treatment. Thirty-four drill core and fifteen surface samples were analysed for Cu, Pb, Zn, Ag and Cd by AAS (after aqua regia/perchloric digestion), and for Sb, As, Ba, Au and Hg by NAA by Becquerel Laboratories (BQ).

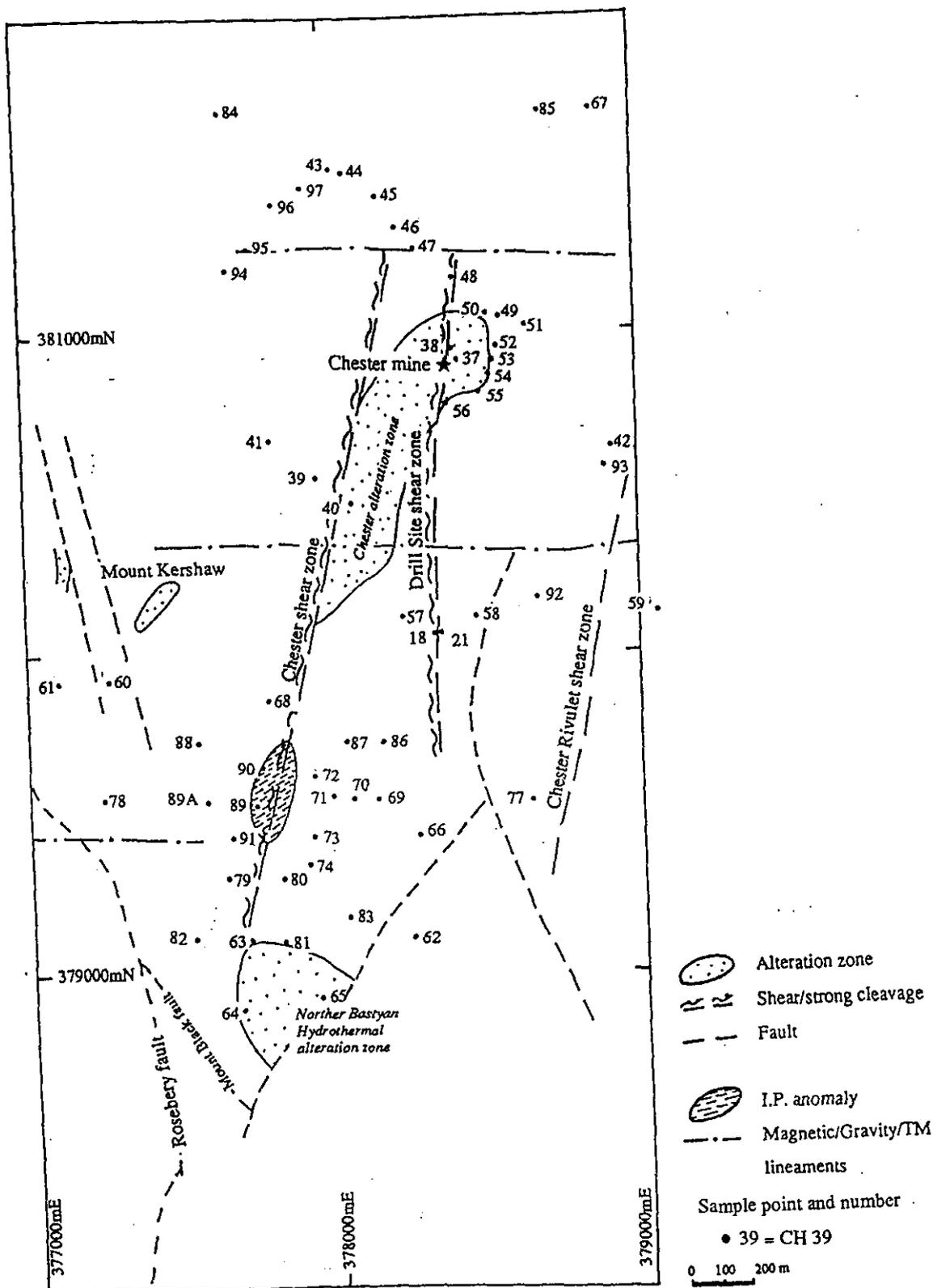


Fig. 3. Locations of sample points on the surface near and around the Chester mine area.

## 4. SURFACE GEOCHEMICAL (BY PIXE AND PIGME) AND EPR SIGNATURES

### 4.1. Determination of Wall-rock Alteration

The multiplicative index of  $\text{Ca} \times \text{Na} \times \text{Sr}$ ,  $(\text{K} \times \text{Rb})/(\text{Ca} \times \text{Na} \times \text{Sr})$  ratio and EPR intensity measured at magnetic density sweep over  $326.5 \pm 5$  mT were used to determine general alteration.

#### 4.1.1. Multiplicative Index of $\text{Ca} \times \text{Na} \times \text{Sr}$

The distribution of multiplicative indices of  $\text{Ca} \times \text{Na} \times \text{Sr} \times 10^{-6}$  in the rocks on the surface near and around the Chester mine is shown in Fig. 4. There is a large zone of  $\text{Ca} \times \text{Na} \times \text{Sr} \times 10^{-6}$  index less than 100 in the central part of the area. The Chester alteration zones (including the Chester mine), and NS Chester and drill site shear zones fall within above zone of low  $\text{Ca} \times \text{Na} \times \text{Sr} \times 10^{-6}$  index ( $< 100$ ). Northern, eastern and southwestern parts of the area have a high index.

#### 4.1.2. Multiplicative Ratio of $(\text{K} \times \text{Rb})/(\text{Ca} \times \text{Na} \times \text{Sr})$

Fig. 5 shows the areal distribution of the multiplicative ratio of  $(\text{K} \times \text{Rb})/(\text{Ca} \times \text{Na} \times \text{Sr}) \times 10^2$  in the rocks. A large zone of the ratio greater than 1 with a possible NS trend occupies most parts of the area especially in the central part. Both altered zones (northern Chester alteration and southern the North Bastyan alteration zones), shear zones and I.P. anomaly occur within the zones of  $(\text{K} \times \text{Rb})/(\text{Ca} \times \text{Na} \times \text{Sr}) \times 10^2$  ratio greater than 1. The ratios decrease toward north and southeast.

#### 4.1.3. EPR Intensity Measured at Magnetic Flux Density Sweep over $326.5 \pm 5$ mT

Areal distribution of EPR intensity measured at magnetic density sweep over  $326.5 \pm 5$  mT shown in Fig. 6 reveals a zone of EPR intensity greater than 9 cm trending NS and outlining the Chester alteration zone, Chester shear zone and I.P. anomaly. Drill site shear and the North Bastyan alteration zone partly fall within the zone. Northern, eastern and western parts of the study area are recognised in the area of low EPR intensity ( $< 9$  cm).

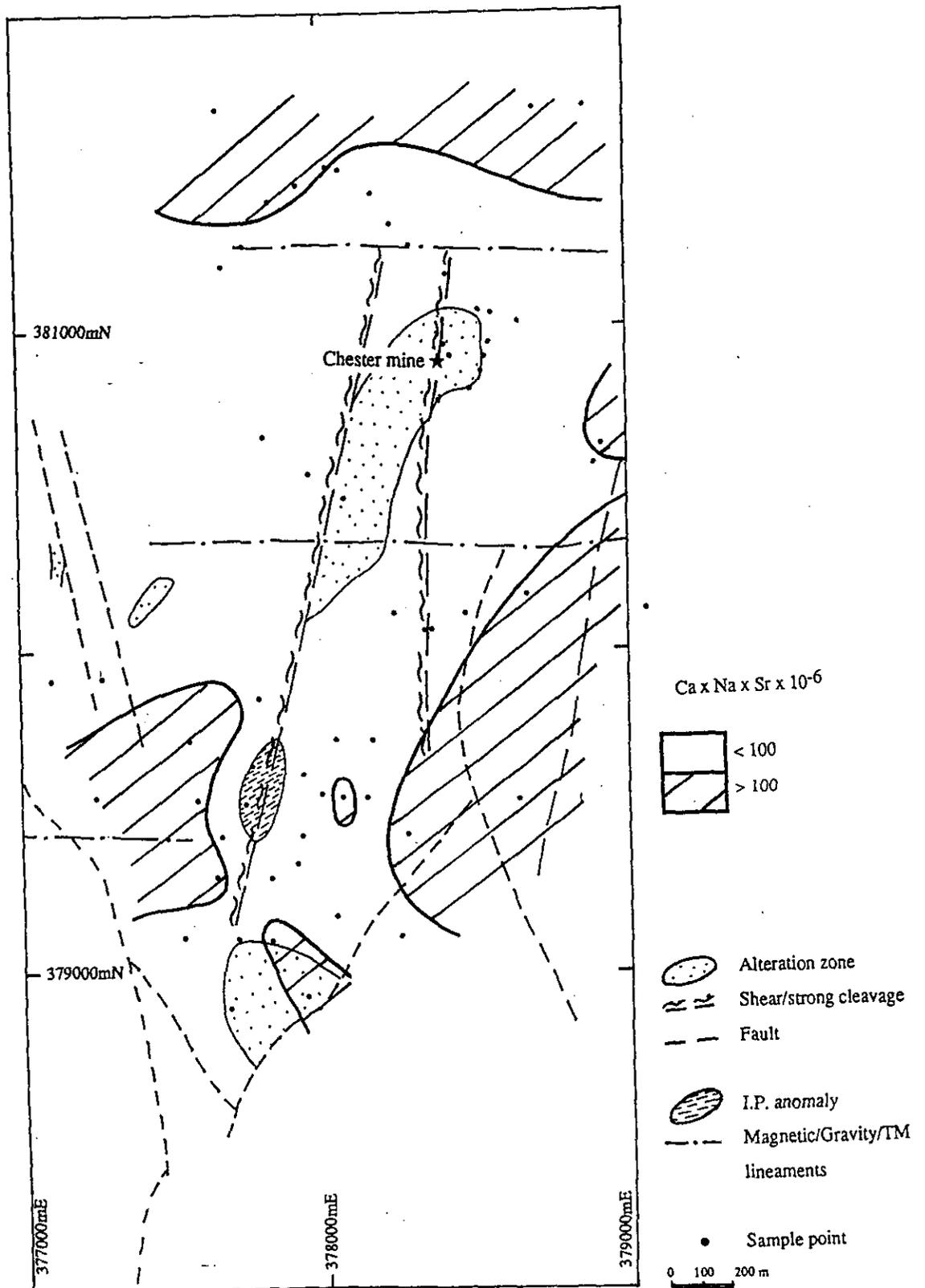


Fig. 4. Distribution of multiplicative indices of  $\text{Ca} \times \text{Na} \times \text{Sr} \times 10^{-6}$  in the rocks on the surface near and around the Chester mine.

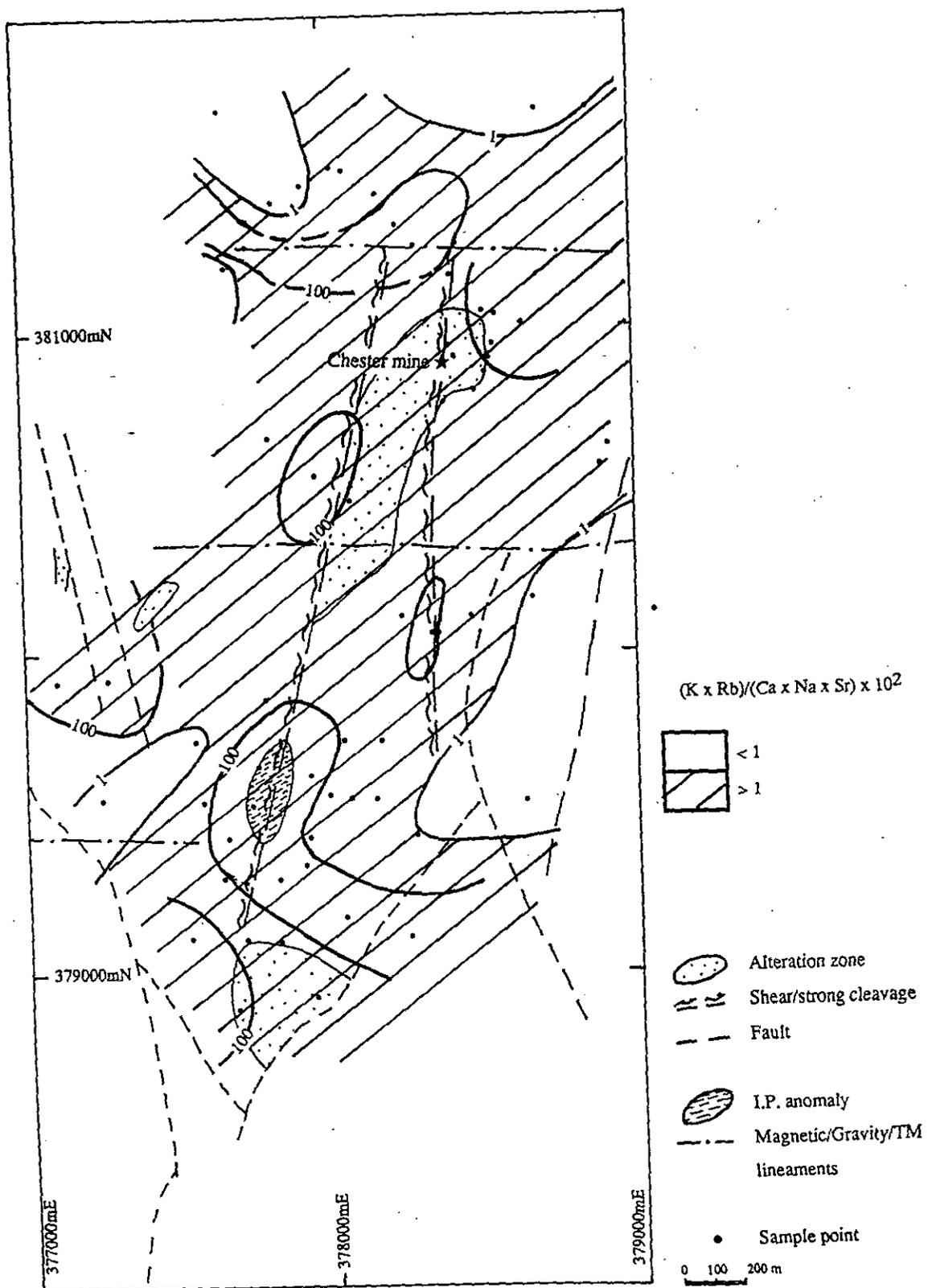


Fig. 5. Distribution of multiplicative ratios of  $(K \times Rb) / (Ca \times Na \times Sr) \times 10^2$  in the rocks near and around the Chester mine.

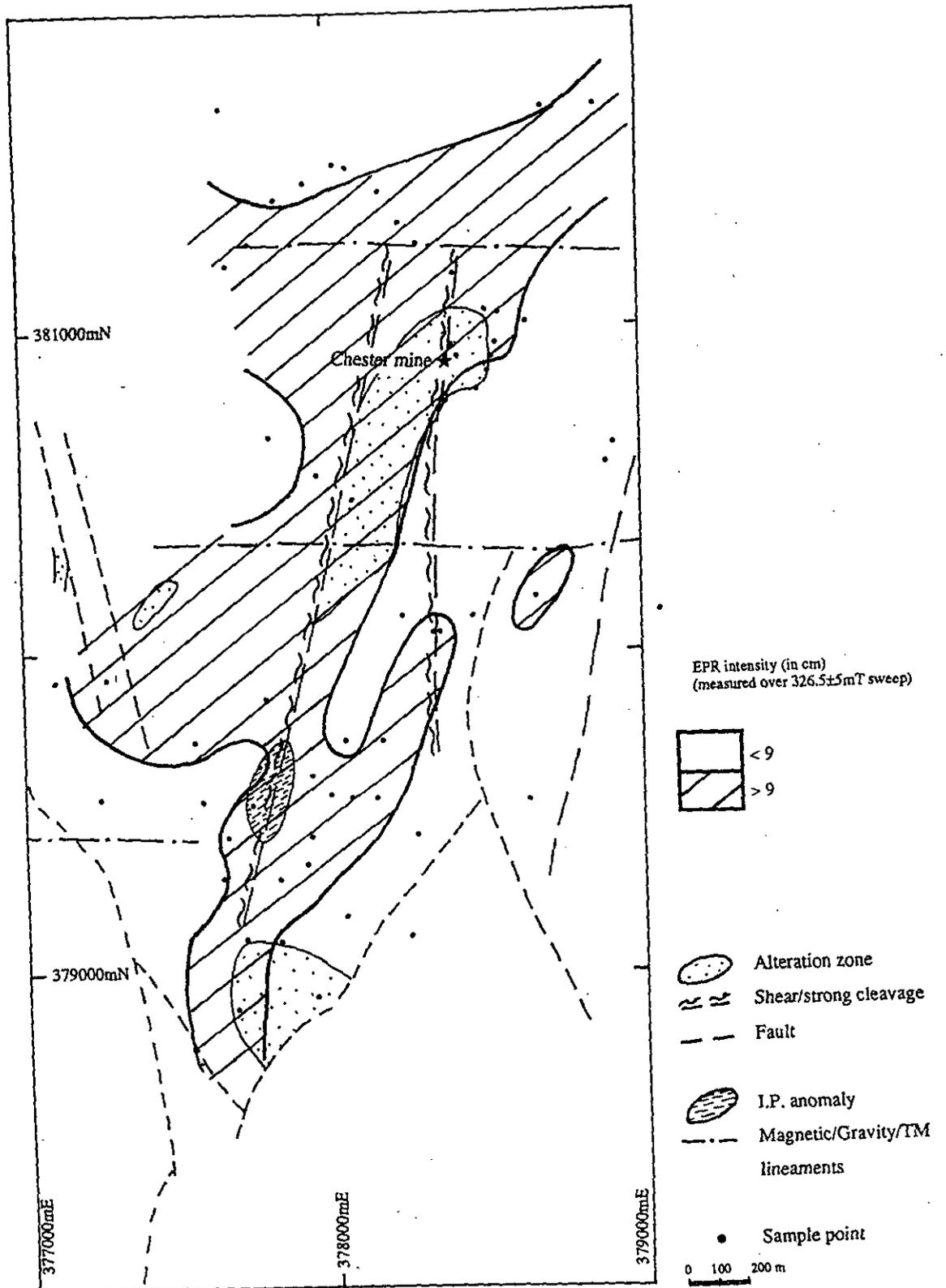


Fig. 6. Distribution of EPR intensities measured at magnetic flux density sweep over  $326.5 \pm 5$  mT in the rock near and around the Chester mine.

This EPR intensity determined over  $326.5 \pm 5$  mT sweeps is indicative of wall rock alteration in general.

#### **4.2. Identification of Alteration related to Massive Sulphide Mineralisation**

The alteration related to massive sulphide mineralisation in the Rosebery and Hercules mine areas is in addition to depletion in Ca, Na and Sr characterised by enrichment in K, Mn, Ba, Rb and F (Aung Pwa, 1996; Aung Pwa and van Moort, 1994). Multi-element indices of  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr)$  and  $(Mn \times Ba)/(Ca \times Na \times Sr)$  formulated in the Rosebery area are used in this study to identify the alteration specifically related to massive sulphide mineralisation. EPR intensity (strong EPR intensities measured at magnetic density sweep over  $326.5 \pm 5$  mT and over  $326.5 \pm 100$  mT) is also used as a supporting criteria.

##### **4.2.1. Multiplicative Ratio of $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr)$**

Fig. 7 shows the areal distribution of multiplicative ratio of  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr)$  in the surface rocks of the Chester mine area. There are five zones of the ratio greater than 1 indicating the alteration related to massive sulphide mineralisation. These include the one in the north located in the northern edge of Chester alteration zone, one outlining I.P. anomaly, one in the west (Mount Kershaw) associated with faults, one at the western edge of southern alteration zone (the North Bastyan alteration zone), and a last one on the Drill site shear zone. Most parts of alteration and shear zones are located in the area of  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr) \times 10^{-4}$  ratio less than 1. A noticeable feature is that the Chester alteration zone associated with the Chester deposit and the North Bastyan alteration zone do not have the geochemical characteristics similar to the footwall alteration zone of the Rosebery and Hercules deposits.

The Chester alteration is different to the alteration related to massive sulphide mineralisation. Alteration similar to the one associated with the Rosebery deposit exist in the areas of the I.P. anomaly and Mount Kershaw.

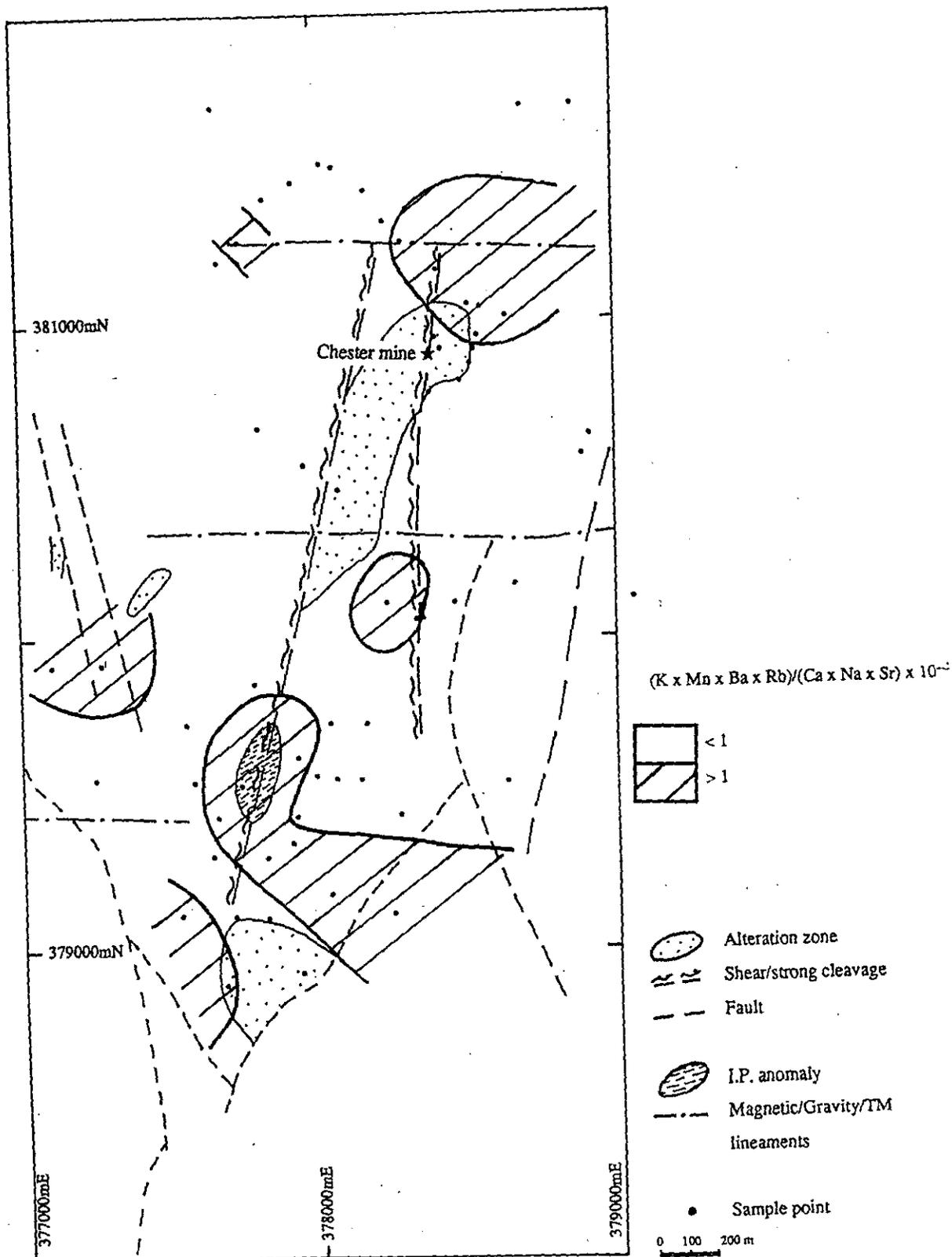


Fig. 7. Distribution of multiplicative ratios of  $(K \times Mn \times Ba \times Rb) / (Ca \times Na \times Sr) \times 10^{-4}$  (by PIXE and PIGME ) in the rocks near and around the Chester mine.

#### **4.2.2. Multiplicative Ratio of $(Mn \times Ba)/(Ca \times Na \times Sr)$**

The distribution of multiplicative ratio of  $(Mn \times Ba)/(Ca \times Na \times Sr)$  shown in Fig. 8 reveals four small zones of the ratio greater than 1; two in the north of the Chester mine, one in the west associated with faults, and one in the south outlining I.P. anomaly. Most parts of the alteration and shear zones occur in the area of low  $(Mn \times Ba)/(Ca \times Na \times Sr) \times 10^2$  ratio ( $< 1$ ). The Chester deposit and Chester alteration zone do not have geochemical alteration signature related to massive sulphide mineralisation. There are geochemical alteration zones (greater than 1 of the ratio) indicating the relation with massive sulphide mineralisation in the study area.

#### **4.3. EPR Index**

EPR index is a multiplicative value of EPR intensities measured at magnetic density sweeps over  $326.5 \pm 5$  mT and over  $326.5 \pm 100$  mT. EPR index in the Rosebery area is an indicator of alteration related to massive sulphide mineralisation. EPR intensities measured at magnetic density sweeps over  $326.5 \pm 100$  mT (not shown in the text) in the Chester alteration zone are significantly low but high values occur in the other parts of the study area. The distribution of EPR indices in the rocks is shown in Fig. 9. There are five zones with an index greater than 60; the norther one at the northern edge of the Chester alteration zone, southern one at the southern edge of the North Bastyan alteration zone, one associated with I.P. anomaly, one associated with NS faults at Mount Kershaw, and last one in the south of the Chester alteration zone. Both alteration zones do not show significant high EPR indices. The distribution pattern of the EPR index in the Chester mine area is comparable to that of multiplicative index of  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr)$  presented in Fig. 7.

#### **4.4. Determination of Mineralisation Potential**

Hot  $HNO_3$  insoluble Mn, Ba, Zn and Pb in the rocks are the best indicator elements for massive sulphide mineralisation in the Rosebery and Hercules mine areas (Aung Pwa and van Moort, 1994 and 1996). In this study multiplicative indices of  $Mn \times Ba$ ,  $Mn \times Ba \times Zn \times Pb$  and  $Zn \times Pb$  are used to determine the mineralisation potential of the Chester mine area. These indices indicate the enrichment in Mn and Ba together with Zn and Pb which all display high values in the rocks near and around the mineralisation.

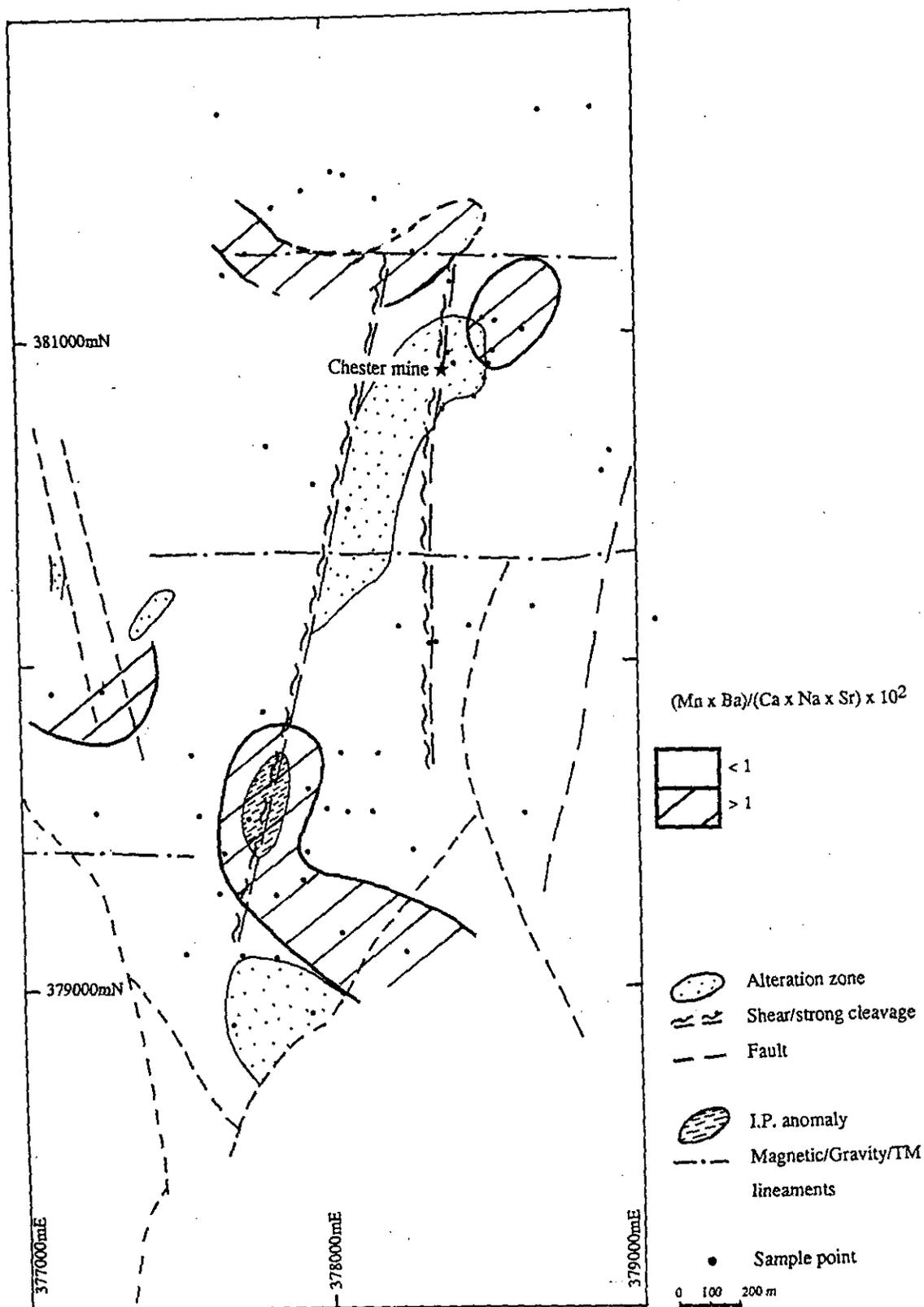


Fig. 8. Distribution of multiplicative ratios of  $(Mn \times Ba)/(Ca \times Na \times Sr) \times 10^2$  (by PIXE and FIGME) in the rocks near and around the Chester mine.

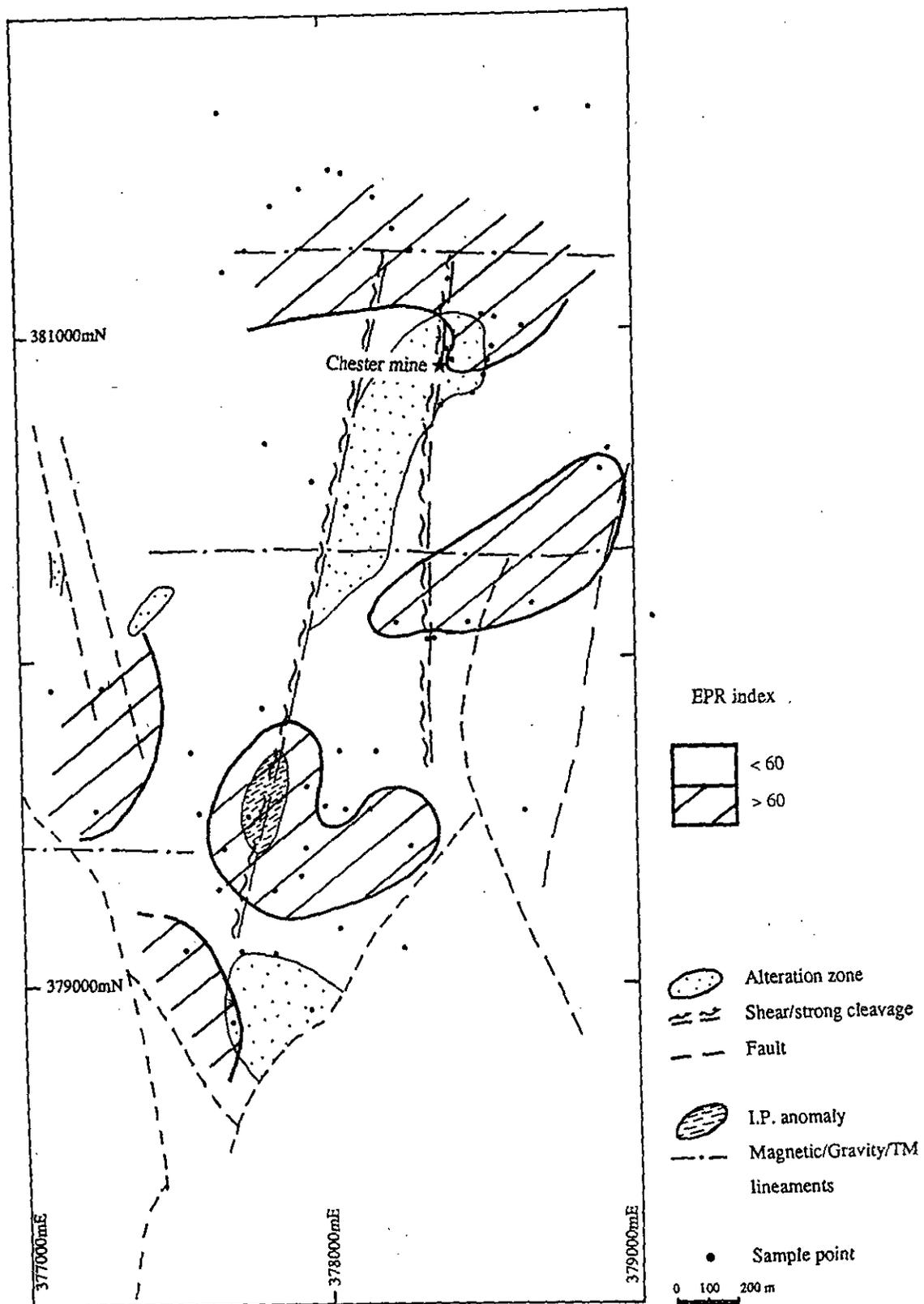


Fig. 9. Distribution of EPR indices in the rocks near and around the Chester mine.

Figs. 10, 11 and 12 shows the areal distribution of multiplicative indices of  $Mn \times Ba$ ,  $Mn \times Ba \times Zn \times Pb$  and  $Zn \times Pb$  in the rocks on the surface near and around the Chester mine area. The I.P. anomaly is located within the zones of high  $Mn \times Ba \times 10^{-4}$  ( $> 5$ ),  $Mn \times Ba \times Zn \times Pb \times 10^{-6}$  ( $> 1$ ) and  $Zn \times Pb$  ( $> 50$ ). High values of the indices also occur in the west of the study area (Mount Kershaw) associated with faults. Some high zones are also present in the north and east of the area. A noticeable feature is that no significant high  $Mn \times Ba$ ,  $Mn \times Ba \times Zn \times Pb$  and  $Zn \times Pb$  indices in the rocks occur in the Chester mine area and within both alteration zones (Chester alteration and North Bastyan alteration zones).

The surface geochemical signatures (PIXE and PIGME data) indicate that the mineralisation and alteration in the Chester mine are not similar to the massive sulphide mineralisation such as the Rosebery and Hercules deposits (Aung Pwa and van Moort, 1994 and 1995). Both alteration zones are considered not to be related to massive sulphide mineralisation and may be related to other type of mineralisation or metamorphism and deformation. The surface PIXE/PIGME data also demonstrate that the possibility of Rosebery-Hercules type mineralisation in the Chester mine area particularly within the alteration zones is weak. The geochemical and EPR response of both alteration zones, the Chester and Drill site shear zones (near the Chester alteration zone) and Chester deposit are not encouraging for further exploration. However there is also geochemical alteration related to massive sulphide mineralisation in the area. The geochemical alteration zones, (the one with  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr) \times 10^{-4}$  ratio ( $< 1$ ) associated with I.P. anomaly, and other associated with NS faults at the Mount Kershaw) are considered to be related to massive sulphide mineralisation and consequently those are potentially interesting.

##### **5. GEOCHEMICAL SIGNATURES IN THE DRILL CORE SAMPLES - EXAMINATION OF ALTERATION AND MINERALISATION POTENTIAL AT THE DEPTH**

This study was conducted to confirm the type of alteration, and to determine the mineralisation potential below the surface of the Chester mine, and at the depth of the Chester shear zone. The alteration study is based on the PIXE and PIGME analyses, and mineralisation potential is based on a combination of PIXE, AAS and NAA data.

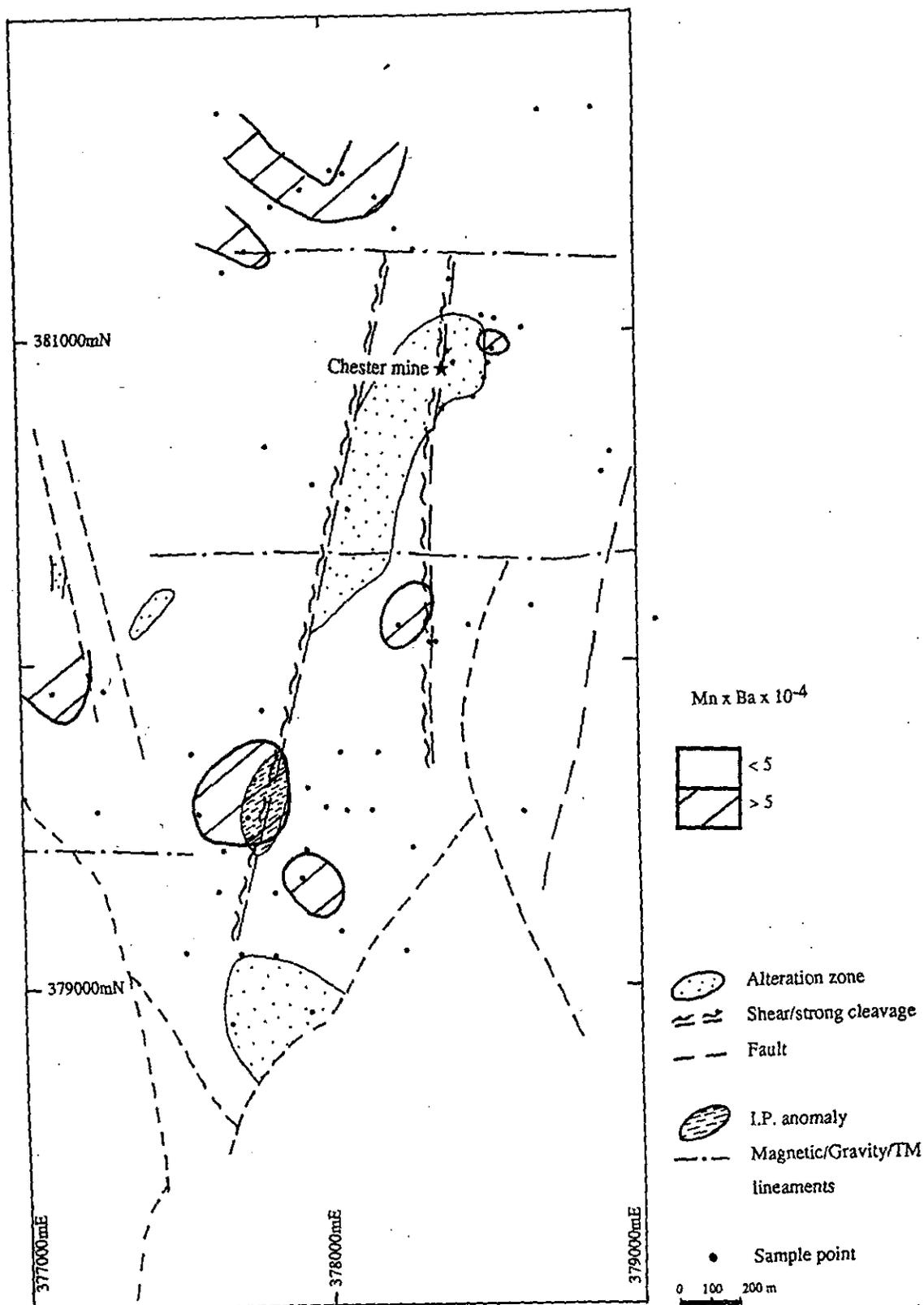


Fig. 10. Distribution of multiplicative indices of  $Mn \times Ba \times 10^{-4}$  (by PIXE and PIGME) in the rocks near and around the Chester mine.

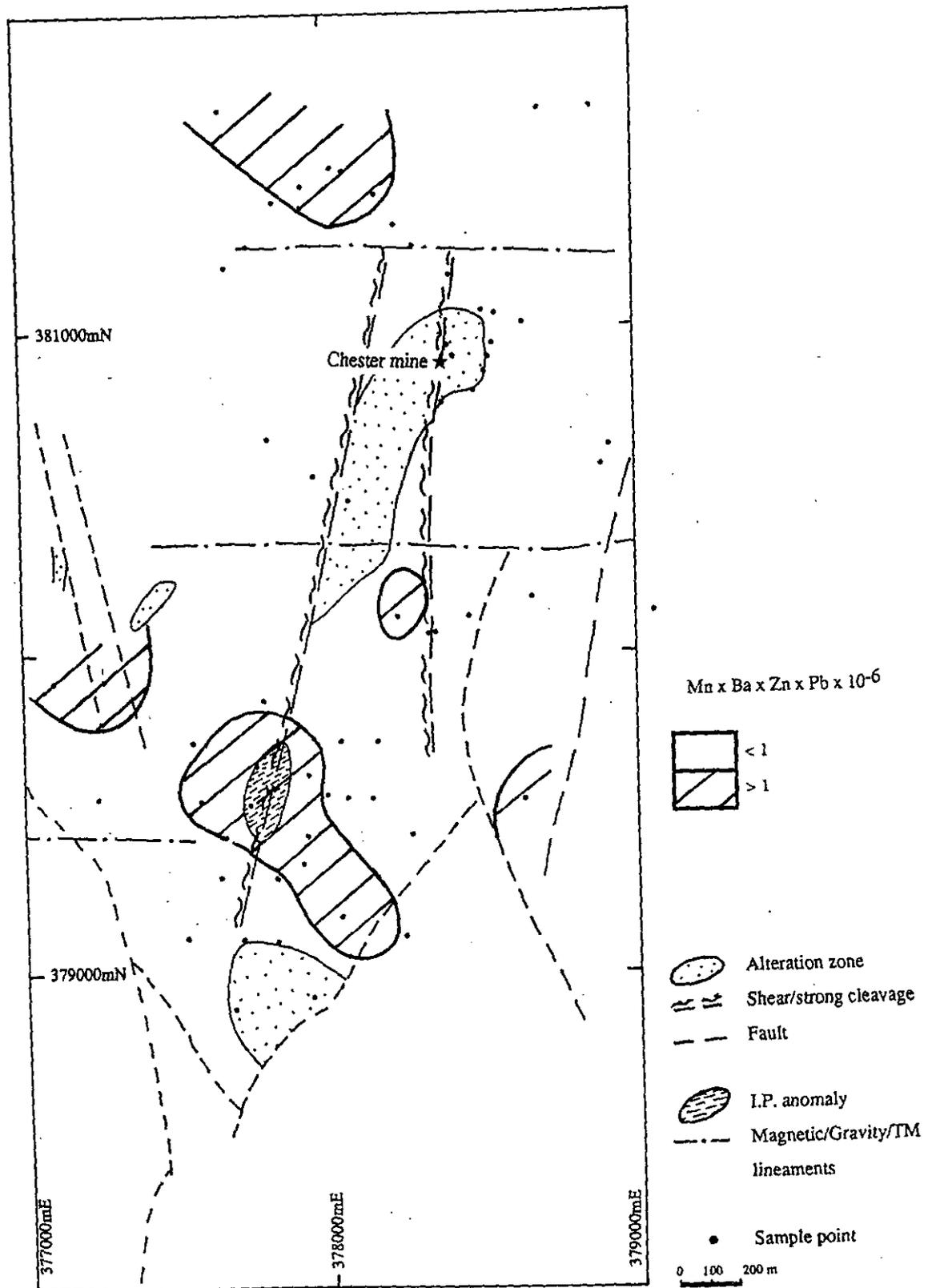


Fig. 11. Distribution of multiplicative indices of  $Mn \times Ba \times Zn \times Pb \times 10^{-6}$  (by PIXE and FIGME) in the rocks near and around the Chester mine.

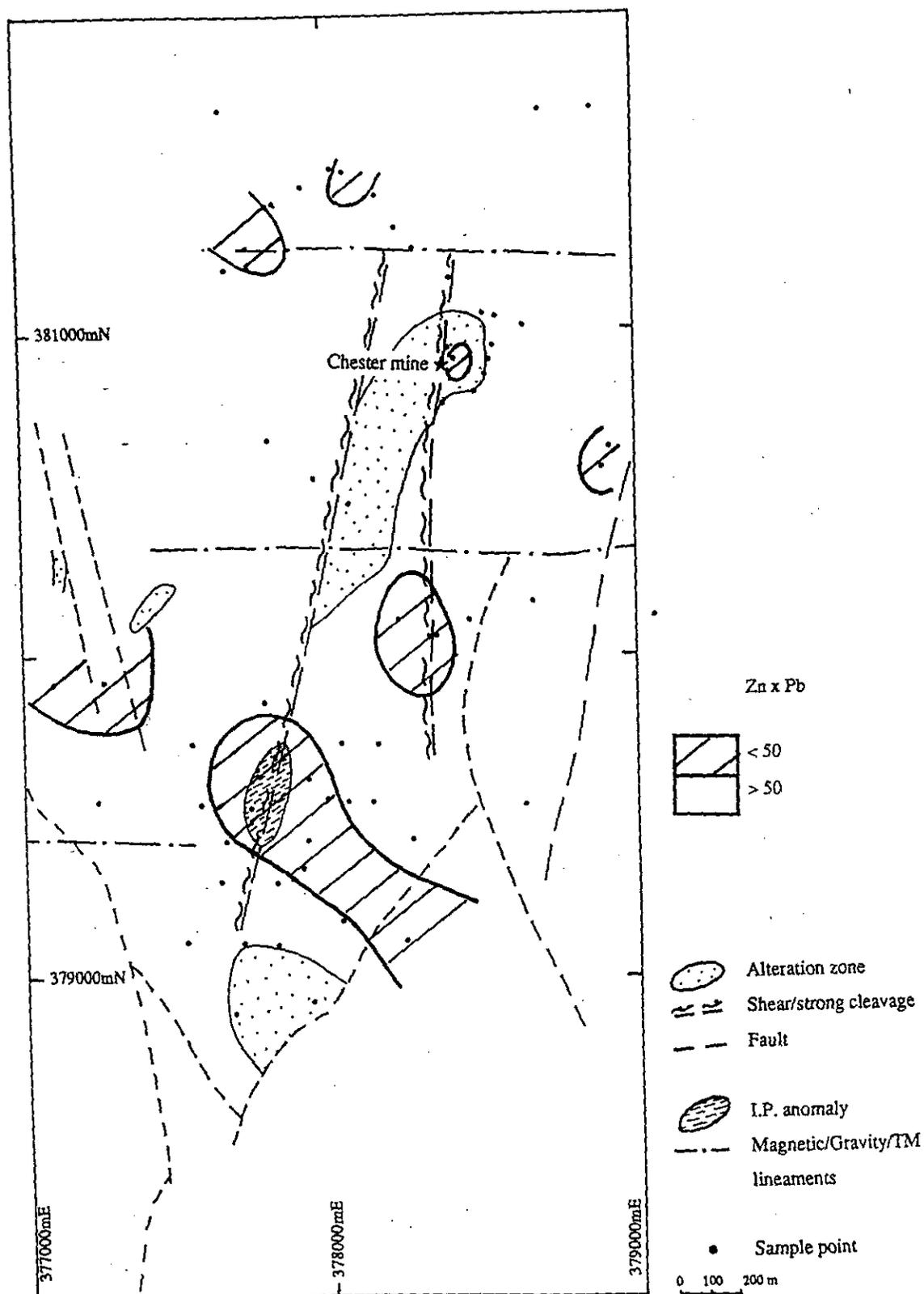


Fig. 12. Distribution of multiplicative indices of Zn x Pb (by PIXE and PIGME ) in the rocks near and around the Chester mine.

### 5.1. PIXE and PIGME Data

Table 1 presents the important geochemical parameters to determine the alteration, to identify the alteration related to massive sulphide mineralisation, and to determine the mineralisation potential in the Chester mine area. Except for drill core samples from drill holes CP 3 and BPD 68 other samples from the drill holes (CP 6, BPD 67, CP 4, CP 21 and CP 22) intersecting the Drill Site shear zone exhibit high  $(K \times Rb)/(Ca \times Na \times Sr) \times 10^2$  ratios ( $> 1$ ) and low multiplicative index  $Ca \times Na \times Sr \times 10^{-6}$  ( $< 100$ ) indicating strong wall-rock alteration. The drill holes (CP 3 and BPD 68) with low  $(K \times Rb)/(Ca \times Na \times Sr)$  and high  $Ca \times Na \times Sr$  index intersecting the Chester shear zone have weak or no geochemical alteration. The majority of the drill core sample shows a low  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr) \times 10^{-4}$  ratio ( $< 1$ ), and  $(Mn \times Ba)/(Ca \times Na \times Sr) \times 10^2$  ratio ( $< 1$ ) indicating the weak alteration related to massive sulphide mineralisation. However a few samples from drill holes CP 4, CP 6, CP 21 and BPD 67 have high ratios; six samples have a  $(K \times Mn \times Ba \times Rb)/(Ca \times Na \times Sr) \times 10^{-4}$  ratio greater than 1, and two samples have a  $(Mn \times Ba)/(Ca \times Na \times Sr) \times 10^2$  ratio greater than 1 in the rocks. Similarly the multiplicative indices of  $Mn \times Ba$  are remarkably low and most of the values are less than 5 which is in the Rosebery area a standard value for identification of alteration related to massive sulphide mineralisation and mineralisation potential (Aung Pwa, 1996). More than 80 % of the drill core samples (29 samples out of 36) have Mn value less than 50 ppm (which is a standard value used in Rosebery to identify the alteration related to massive sulphide mineralisation). These geochemical signatures are different to those of the altered footwall associated with the Rosebery and Hercules deposits (Aung Pwa and van Moort, 1994 and 1995). Moderately high  $Mn \times Ba \times Zn \times Pb$  and  $Zn \times Pb$  values are recognised in few samples from drill holes CP 3, CP 6 and BPD 67.

### 5.2. AAS and NAA Data

These two types of analysis particularly AAS are commonly used in exploration geochemistry for various types of mineralisation. In this study we use AAS (for Zn, Pb, Cu, Ag and Cd) and NAA (for Ba, As, Sb, Au and Hg) analyses to determine the subsurface mineralisation potential. In practice we try to predict the level of mineralisation system in the Chester mine area and to determine the mineralisation potential along the Drill site shear and Chester shear zone. Geochemical zonality has been used to predict the level of the mineralisation system and to determine the subsurface mineralisation potential (Beus and Grigorian, 1977; Gundobin, 1984; Lahtinen, 1989). A total of 34 samples from 7 drill holes, CP 6, BPD 67, CP 4, CP 21, CP 22, CP 3 and BPD 68 are involved in this

Table 1. Geochemical (PIXE/PIGME data) and EPR data for the drill core samples, Chester mine area.

Sample No.	Location Drill hole	Location metre	Mn	(Ca/NaxSr) x 10 <sup>-6</sup>	(KxRb)/(Ca/NaxSr) x 10 <sup>2</sup>	(MaxBaxKxRb)/(Ca/NaxSr) x 10 <sup>-4</sup>	(MnxBa)/(CaNaSr) x 10 <sup>2</sup>	MaxBa x 10 <sup>-4</sup>	MaxBaxZnxB x 10 <sup>-6</sup>	ZnxB	EPR±5mT (cm)	EPR±100mT (cm)	EPR index
CH1	CP3	143	9	42.41	0.10	0.00	0.00	0	0.00	5	35	0	0
CH2		154	5	453.98	0.02	0.00	0.00	0	0.01	6	35	0	0
CH3		166.5	0	283.12	0.01	0.00	0.00	0	0.00	44	15	0	0
CH4		185.5	4	110.03	0.02	0.00	0.01	1	0.00	0	10	0	0
CH5		206	0	549.46	0.01	0.00	0.00	0	0.00	58	25	0	0
CH6		229	4	206.91	0.02	0.00	0.00	0	0.07	50	17	0	0
CH7		252	9	5.57	17.26	0.18	0.19	1	1.72	161	12	2	24
CH8		271	8	555.45	0.13	0.00	0.00	0	0.01	8	9	2	18
CH9	CP4	130.4	22	2.22	141.04	2.06	0.66	1	2.98	204	11	4	44
CH10		154.3	5	126.42	0.46	0.00	0.00	0	0.00	1	35	0	0
CH11		172.5	3	1.97	0.04	0.00	0.00	0	0.00	2	23	1	23
CH12		200	7	11.34	0.00	0.00	0.00	0	0.00	0	21	2	42
CH13	CP6	100	1	6.08	14.82	0.02	0.02	0	0.01	9	30	0	0
CH14		116	36	36.97	4.11	0.21	0.14	5	3.22	64	11	4	44
CH15		143.5	25	292.06	0.06	0.00	0.00	1	0.03	4	9	2	18
CH16		167	51	9.15	46.06	1.27	0.30	3	0.00	0	5	5	25
CH17		180	47	2.18	126.71	2.35	0.85	2	1.48	80	23	5	115
CH18	CP21	0.2	21	0.59	309.09	1.54	0.85	0	0.45	91	9	3	27
CH19		20.5	51	25.91	5.43	0.05	0.03	1	0.30	34	9	8	72
CH20		40	38	67.56	2.61	0.01	0.00	0	0.13	40	8	15	120
CH21	CP22	4	23	8.77	15.01	0.02	0.02	0	0.08	48	9	3	27
CH22		21	33	107.86	0.67	0.00	0.01	1	0.35	50	8	7	56
CH23		39	22	217.50	0.34	0.00	0.00	0	0.02	10	8	1	8
CH24	BPD67	151	87	11.73	25.58	0.98	0.33	4	1.07	28	9	9	81
CH25		181	142	0.28	1210.51	80.45	23.87	7	15.28	230	13	11	143
CH26		206	43	296.43	0.45	0.00	0.00	1	0.28	36	5	5	25
CH27		235.5	102	103.28	1.86	0.08	0.04	4	3.19	72	4	7	28
CH28		267.5	37	0.21	1034.36	20.09	9.39	2	0.27	14	10	4	40
CH29		292	70	396.22	0.15	0.00	0.01	2	1.03	48	5	5	25
CH30	BPD68	194.5	14	186.90	0.29	0.01	0.01	2	3.07	160	11	1	11
CH31		227.5	11	1574.09	0.01	0.00	0.00	0	0.01	22	19	0	0
CH32		251.5	3	2993.93	0.00	0.00	0.00	0	0.01	38	37	0	0
CH33		281.5	3	149.57	0.32	0.00	0.00	0	0.00	12	32	0	0
CH34		314.5	15	7.75	19.86	0.03	0.02	0	0.01	6	16	0	0
CH35		344.5	24	239.54	0.29	0.00	0.00	1	0.19	20	7	3	21
CH36		378.5	52	57.18	3.37	0.08	0.04	2	0.00	0	5	5	25

study. Moreover 15 surface samples near the Chester mine and the I.P. anomaly were also analysed by AAS and NAA for above elements. The Rosebery deposit is associated with a significant lateral (along dip direction of the host rock) geochemical zonation (Aung Pwa, 1996). There are two sections available to study the zonation in the Chester mine area, 80550N (380550mN) section (for the Chester shear zone) and 80900N (380900mN) section (for the Chester mineralisation system and Drill site shear zone). Table 2 shows the geochemical signatures (AAS and NAA data) for the drill core samples.

### 5.2.1. 80900N Section

The 809000N section of the Chester mine area (Fig. 13) passes through the Chester deposit and Drill Site shear zone, and is mainly composed of dacitic lava and pumiceous volcanoclastics. Some mafic dykes also occur near the shear zone. There are two drill holes, CP 6 and BPD 67 below the Chester mine working. Three surface samples, and 5 and 6 drill core samples from the drill holes CP 6 and BPD 67 respectively were involved in this study. The locations of these samples are shown in Fig. 13. Although Zn, Pb, Cu, Ba, As, Sb, Ag, Cd, Au and Hg were analysed, only the first six of the elements are discussed as the concentrations of other elements are mostly below the detection limits.

*Distribution of Zn, Pb, Cu, Ba, As and Sb:* Figs. 14, 15, 16, 17, 18 and 19 show the distribution of Zn, Pb, Cu, Ba, As and Sb respectively in the drill cores samples of drill holes CP 6 and BPD 67 in 809000N section of the Chester mine area. All elements enrich near and along the Drill Site shear zone above which the Chester mine working occurs. Zn, Pb and As show general similarity in distribution pattern; low values in the rocks on the surface and increasing toward depth. The geochemical halos of Zn (> 50 ppm), Pb (> 20 ppm) and As (> 10 ppm) open to the depth and narrow upward. Cu concentrates at the middle part of the section and does not show any increase to the surface and depth. The Ba halo (> 750 ppm) occur through out the section with an increase at the surface. Sb also displays high values (> 1.5 ppm) along the Drill site shear zone.

The geochemical halos of multiplicative indices of  $Pb \times Ba \times As \times 10^{-4}$  (> 20) and  $Ba \times As \times 10^{-2}$  (> 100) and ratios  $(Zn \times Pb)/Cu$  (> 50) and  $(Ba \times As)/Cu$  (> 500) display significant opening toward depth and narrowing upward, and remarkably low values at the surface (Figs. 20, 21, 22 and 23). In other words these index and ratios significantly increase toward depth.

Table 2. AAS and NAA data (in ppm) for the drill core samples from the Chester mine area.

Sample No	Drill hole	Cu	Pb	Zn	Ag	Cd	Sb	As	Ba	Au	Hg	As x Ba x Pb x 10 <sup>-4</sup>	Ba x As x 10 <sup>-2</sup>	Zn x Pb/Cu	Ba x As/Cu
CH1	CP 3	13	80	18	<1	<1	1.88	23.20	322	<5	<2	59.8	74.7	111	574.8
CH3		23	82	22	<1	<1	1.55	29.10	1820	<5	<2	434.3	529.8	78	2302.7
CH4		28	278	43	1	<1	2.01	25.30	1660	<5	<2	1159.1	420.0	424	1499.9
CH5		184	208	15	1	<1	3.12	16.20	645	41.4	<2	217.3	104.5	19	63.7
CH6		34	57	32	<1	<1	2.95	64.30	518	<5	<2	189.9	333.1	54	979.8
CH8		15	37	91	<1	<1	1.63	71.80	648	<5	<2	172.1	465.3	224	3101.8
CH9	CP 4	19	158	46	2	<1	1.87	10.30	942	<5	<2	153.3	97.0	389	510.7
CH10		8	18	4	<1	<1	1.06	3.24	142	<5	<2	0.8	4.6	12	78.7
CH11		11	11	7	<1	<1	1.35	4.87	73	<5	<2	0.4	3.6	7	32.5
CH12		8	17	11	<1	<1	2.04	8.02	91	<5	<2	1.2	7.3	31	121.8
CH13	CP 6	7	14	9	<1	<1	1.28	7.05	2010	<5	<2	19.8	141.7	18	2024.4
CH14		45	65	110	<1	<1	1.73	9.33	2030	<5	<2	123.1	189.4	159	420.9
CH15		38	12	138	<1	<1	1.21	47.70	713	<5	<2	40.8	340.1	46	944.7
CH16		8	3	408	<1	3	2.72	4.49	1360	<5	<2	1.8	61.1	203	1017.7
CH17		14	186	555	<1	<1	1.42	9.28	816	<5	<2	140.8	75.7	7374	540.9
CH18	CP 21	13	78	38	<1	<1	1.45	7.25	929	<5	<2	51.2	67.4	222	518.1
CH19		4	17	246	<1	<1	1.48	3.78	639	<5	<2	4.1	24.2	1048	603.9
CH20		6	12	306	<1	<1	1.59	4.27	983	<5	<2	5.0	42.0	612	699.6
CH21	CP 22	11	77	64	<1	<1	2.20	8.59	716	<5	<2	47.4	61.5	448	559.1
CH22		7	12	246	<1	<1	1.25	5.27	780	<5	<2	4.8	40.1	422	572.2
CH23		11	19	202	<1	<1	1.18	12.30	701	<5	<2	16.4	86.2	348	783.8
CH24	BPD 67	8	9	59	<1	<1	1.33	8.83	965	<5	<2	7.7	85.2	68	1065.1
CH25		34	176	715	<1	2	2.16	13.20	925	<5	<2	214.9	122.1	3701	359.1
CH26		11	21	90	1	<1	1.73	13.40	860	8.0	<2	24.2	115.2	172	1047.6
CH27		14	114	93	<1	<1	1.17	24.70	766	<5	<2	221.3	194.1	757	1386.7
CH28		8	8	19	<1	<1	1.13	13.30	984	<5	<2	10.5	130.9	19	1635.9
CH29		15	447	492	<1	<1	1.00	7.46	709	<5	<2	236.4	52.9	14662	352.8
CH30	BPD 68	15	129	277	1	<1	0.89	37.40	1390	<5	<2	670.6	519.9	2382	3485.7
CH31		17	54	15	<1	<1	1.71	10.70	524	9.1	<2	30.3	58.1	48	329.8
CH32		7	25	10	<1	<1	1.51	24.40	482	<5	<2	29.4	117.6	36	1680.1
CH33		3	9	7	<1	<1	1.70	4.56	271	<5	<2	1.1	12.4	21	411.9
CH34		4	5	18	<1	<1	1.35	4.70	704	<5	<2	1.7	33.1	23	827.2
CH35		73	177	141	1	<1	2.91	70.30	1090	13.3	<2	1356.3	768.3	342	1049.7
CH36		23	31	1560	<1	4	2.99	31.40	1480	<5	<2	144.1	464.7	2103	2020.5

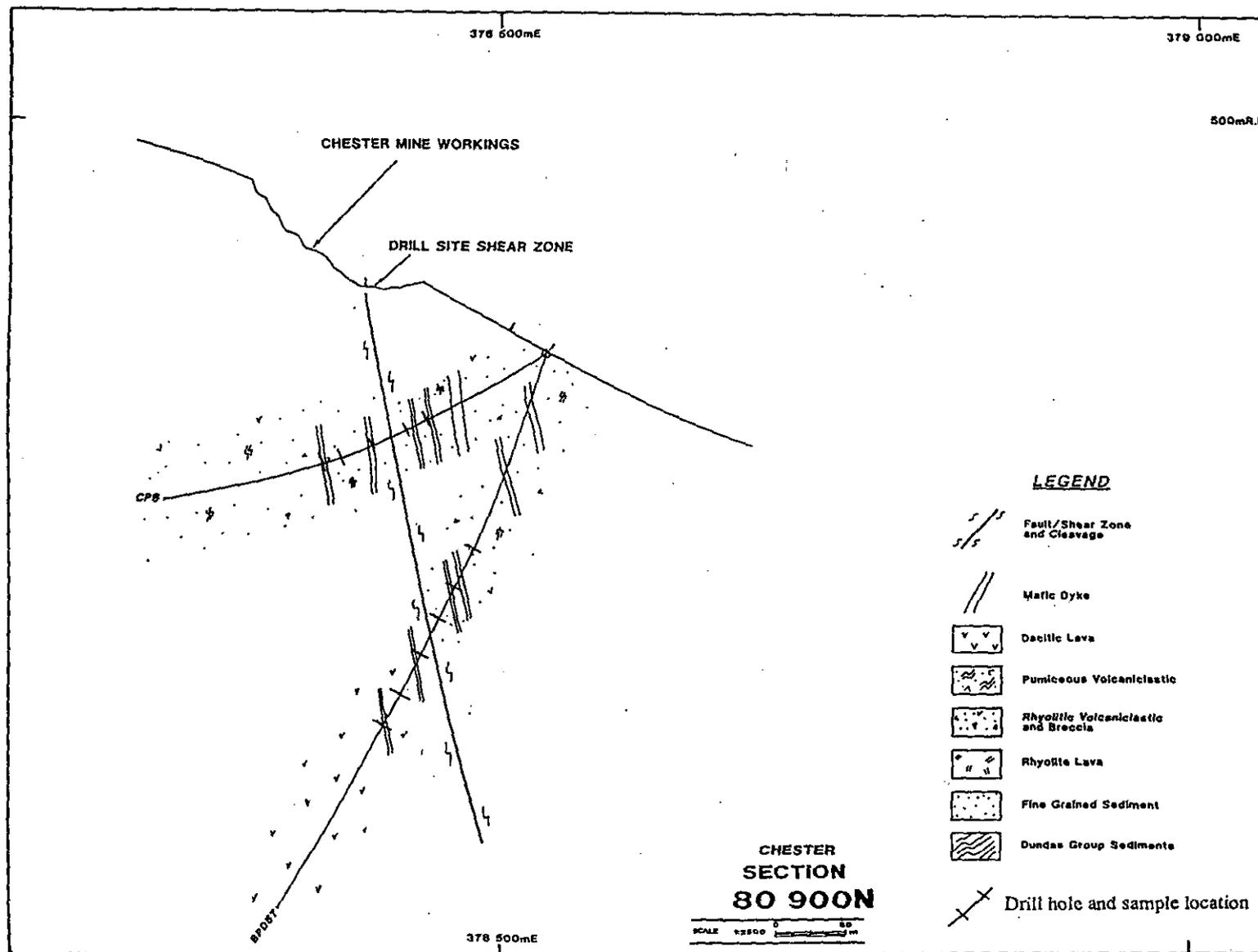


Fig. 13. Geology and drill holes in 80900N section, Chester mine.

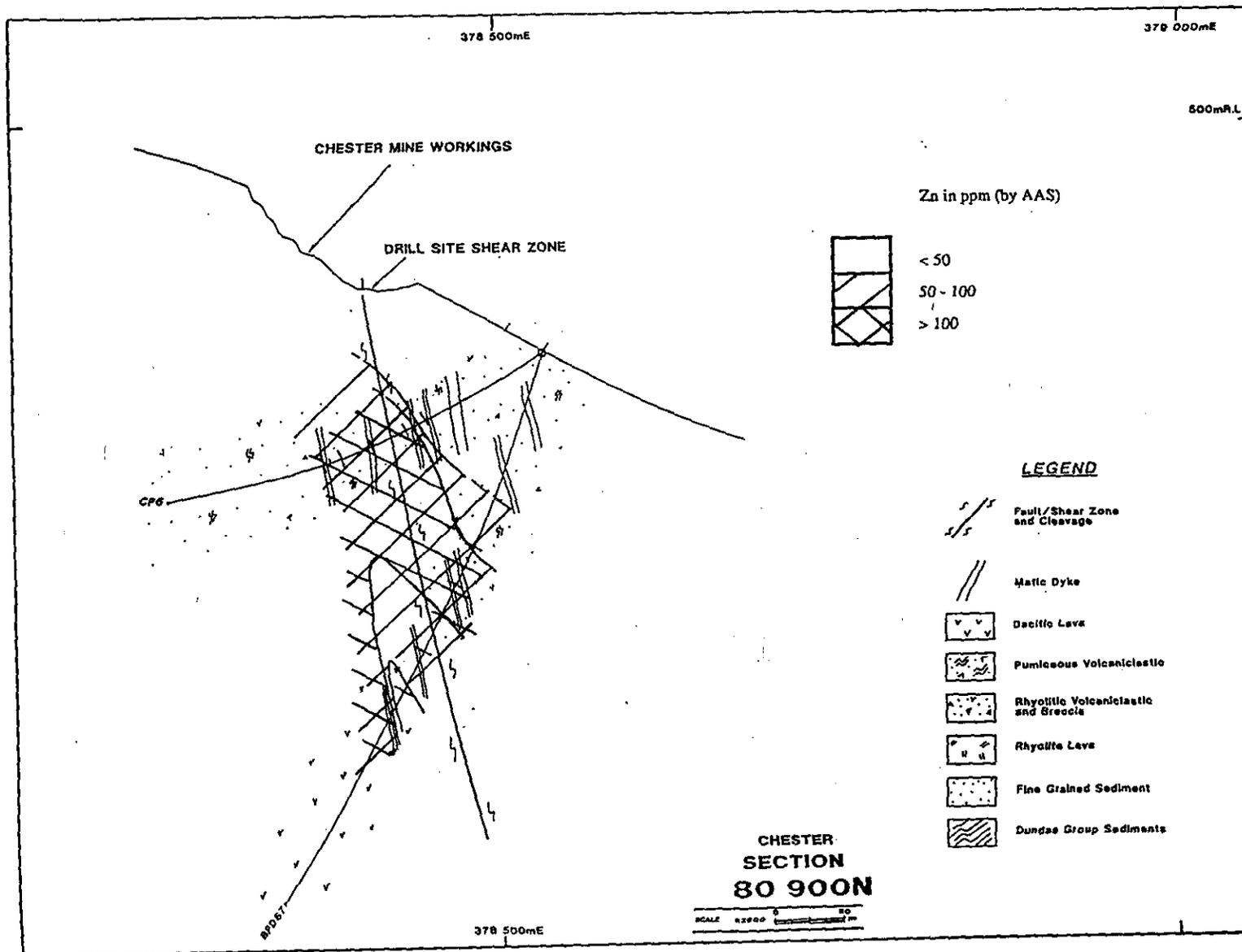


Fig. 14. Distribution of Zn in the rocks of the drill holes from 80900N section, Chester mine.

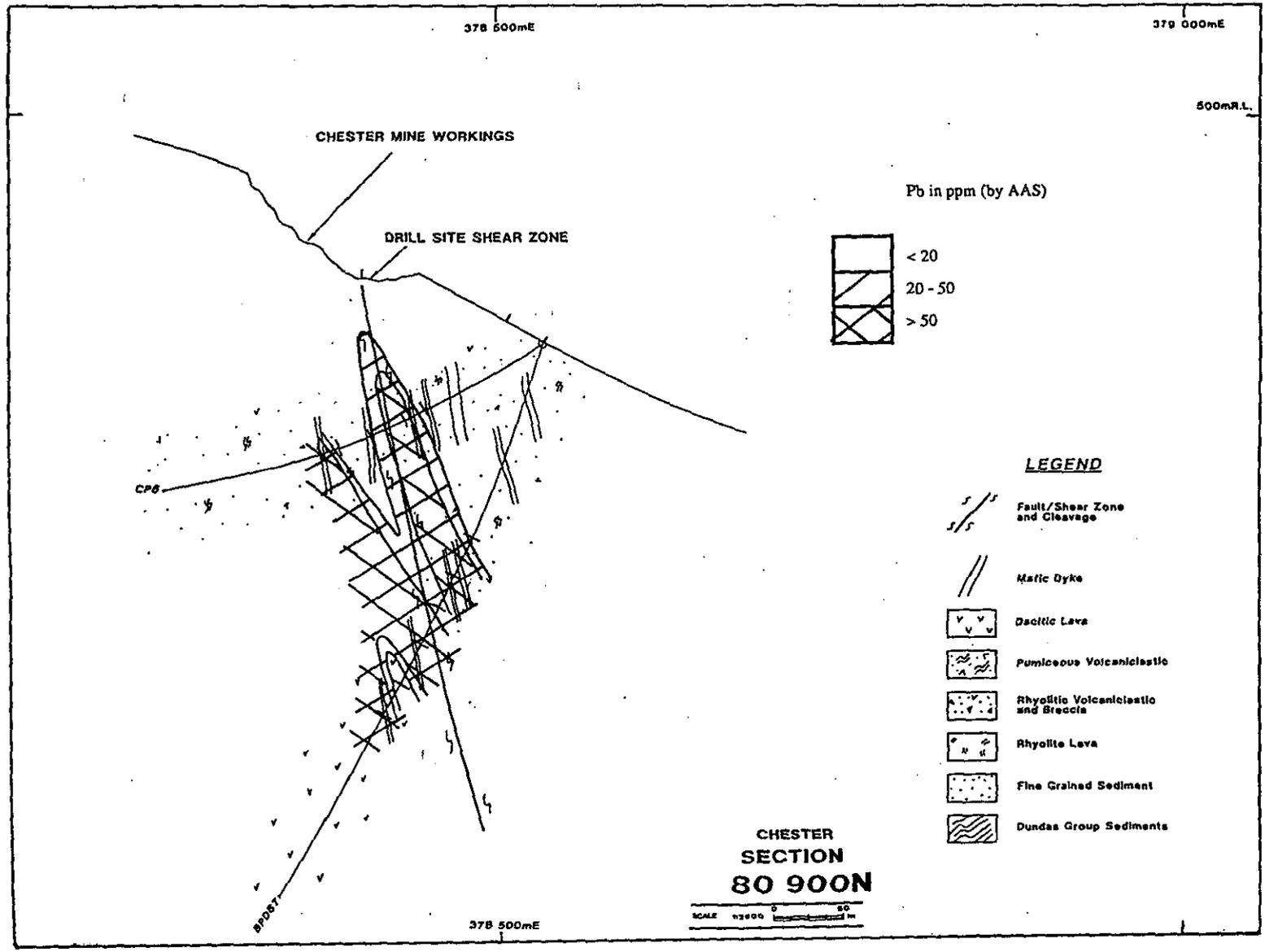


Fig. 15. Distribution of Pb in the rocks of the drill holes from 80900N section, Chester mine.

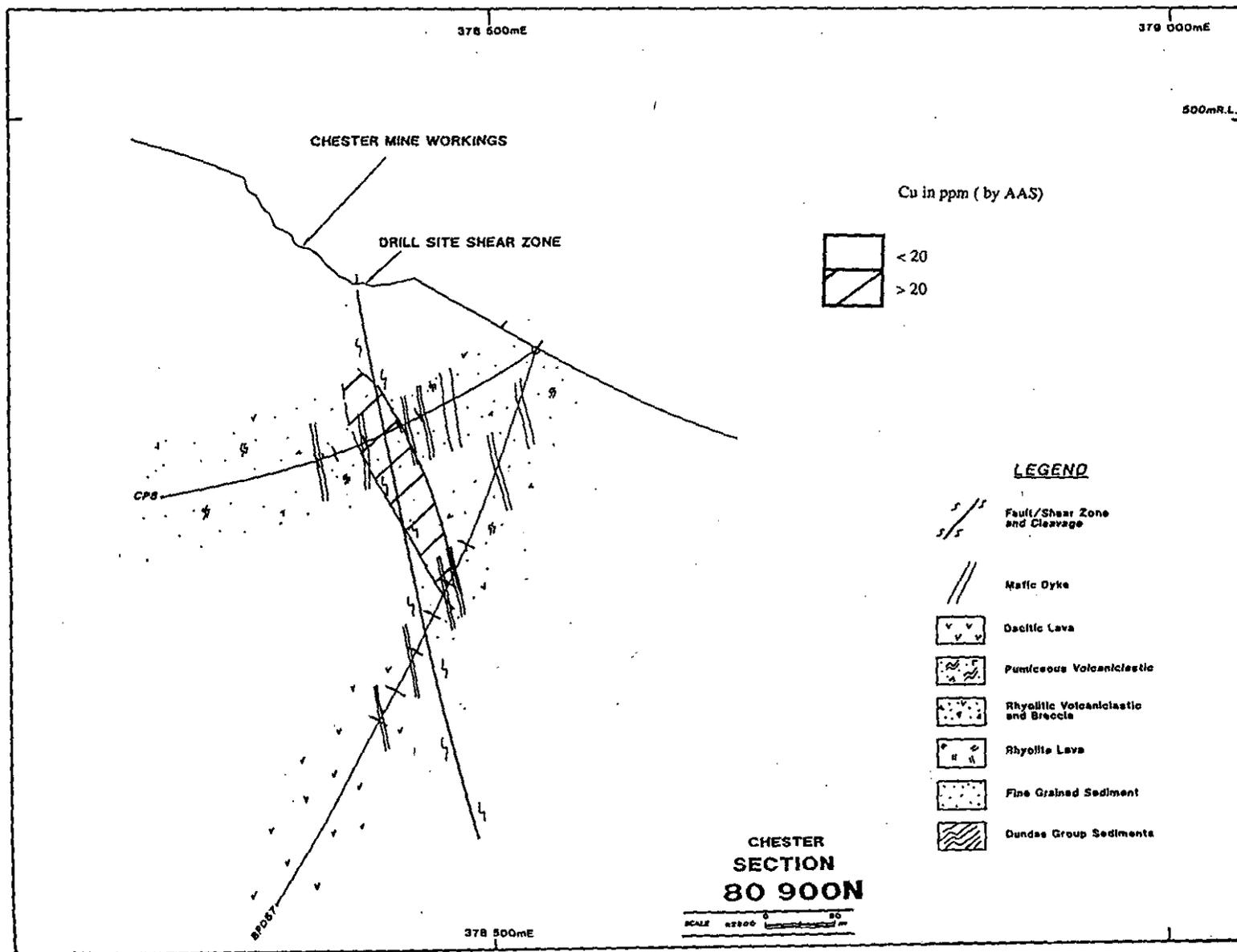


Fig. 16. Distribution of Cu in the rocks of the drill holes from 80900N section, Chester mine.

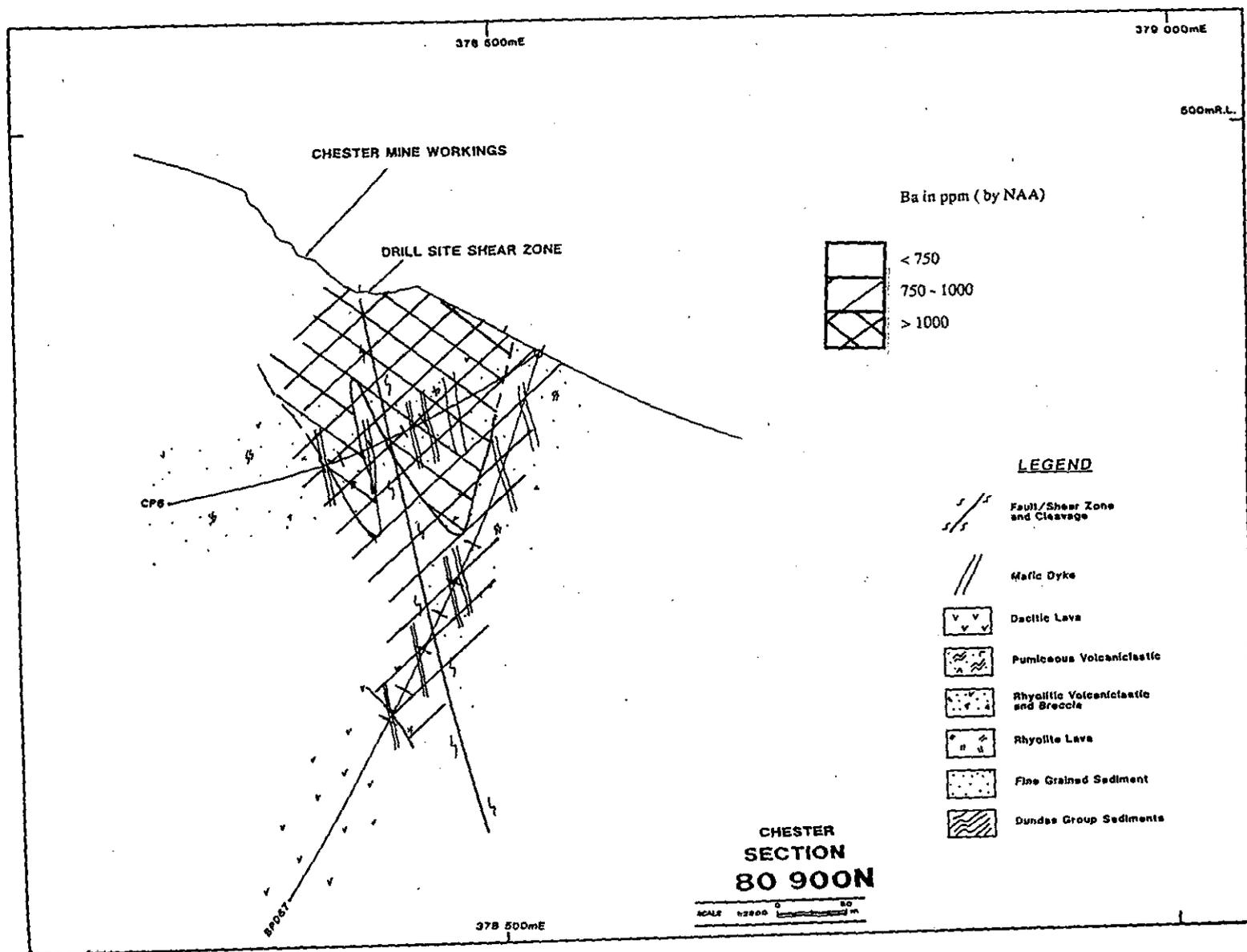


Fig. 17. Distribution of Ba in the rocks of the drill holes from 80900N section, Chester mine.

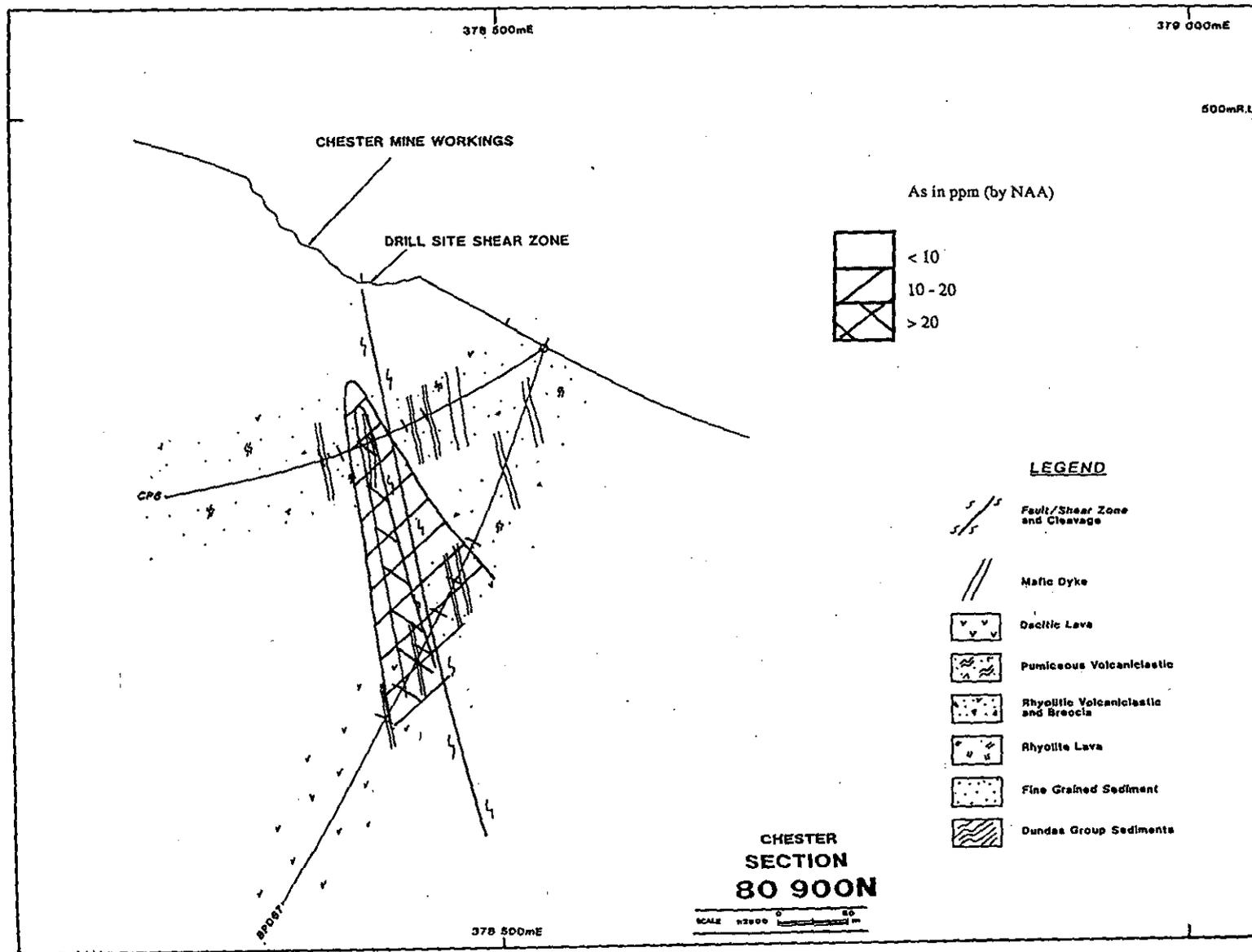


Fig. 18. Distribution of As in the rocks of the drill holes from 80900N section, Chester mine.

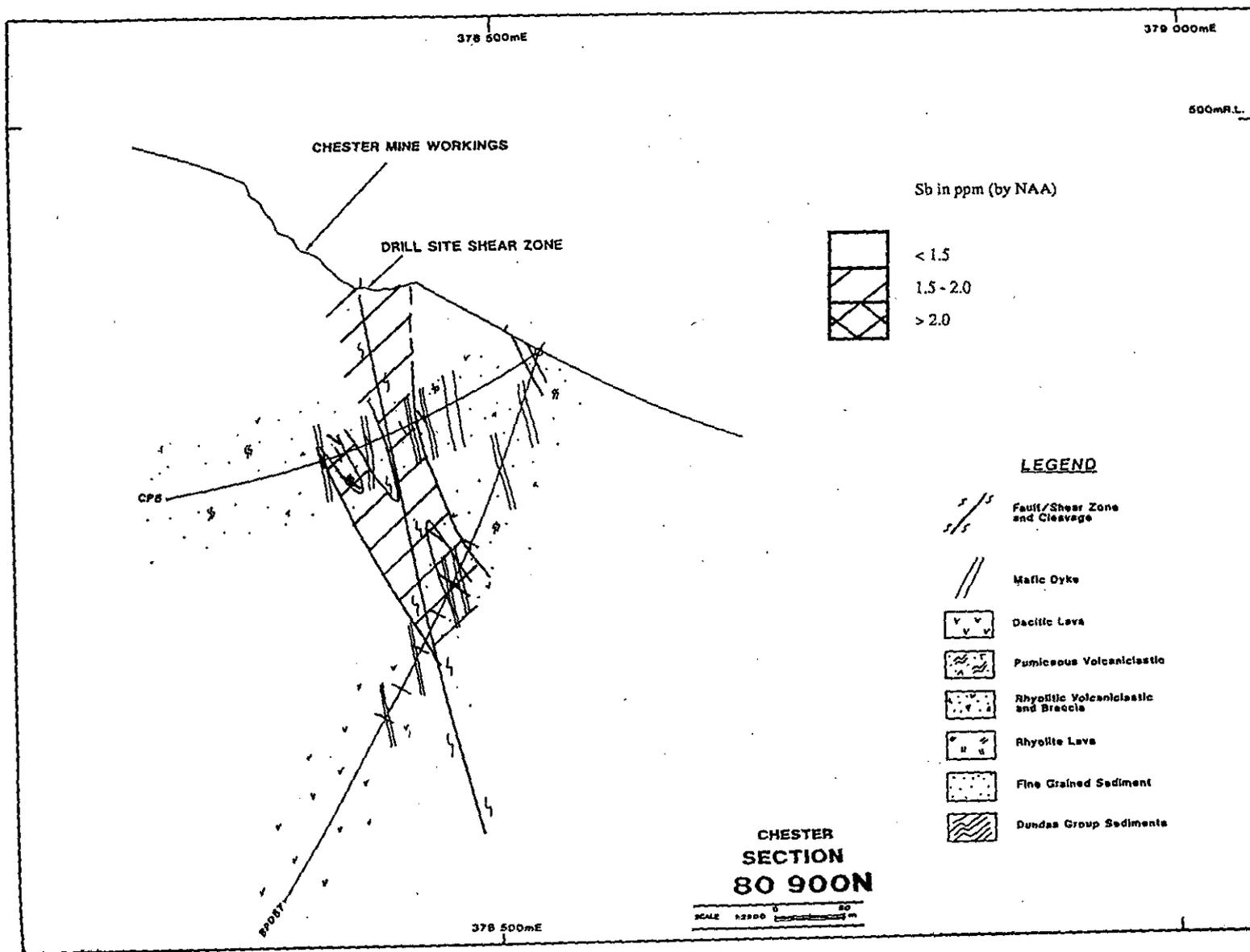


Fig. 19. Distribution of Sb in the rocks of the drill holes from 80900N section, Chester mine.

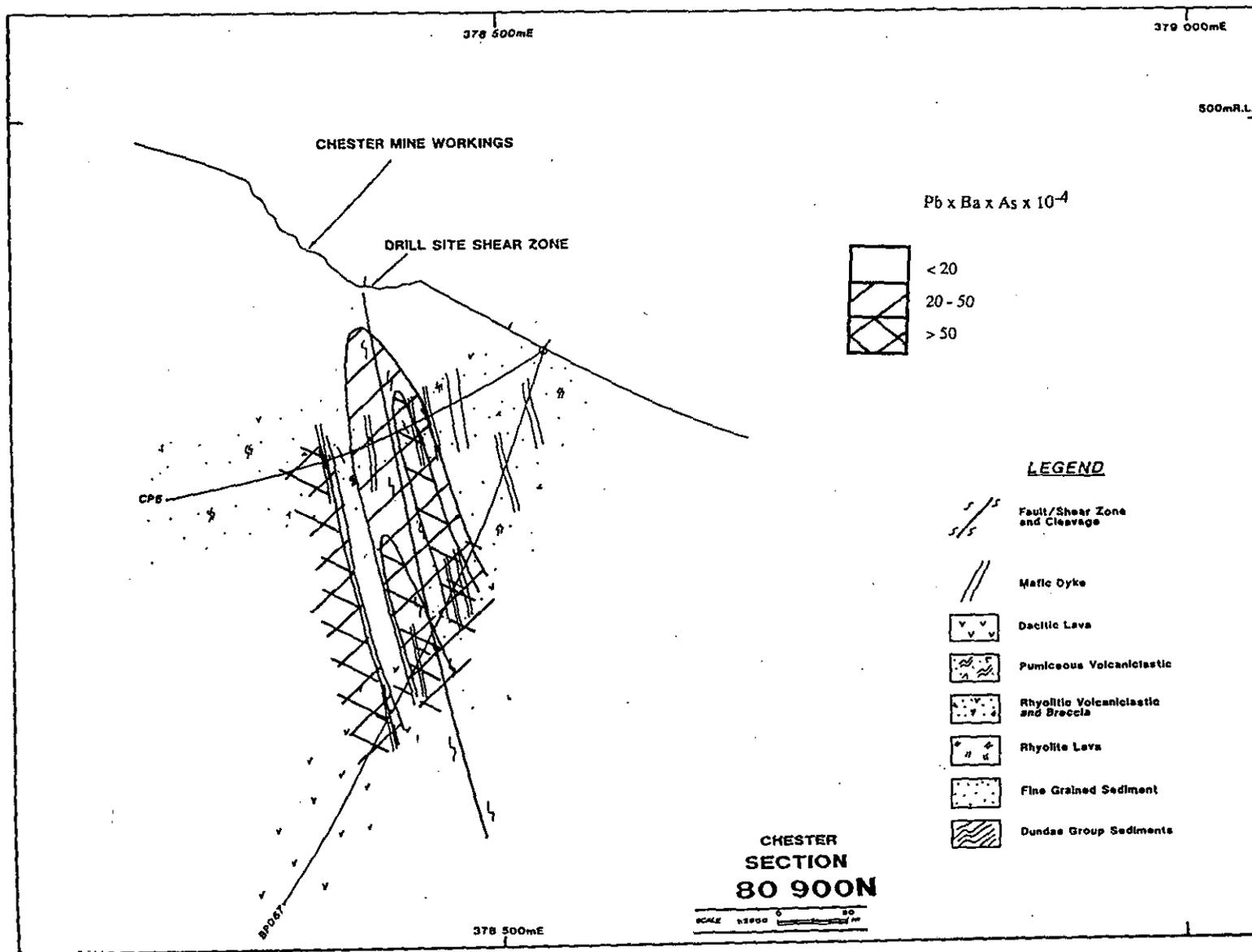


Fig. 20. Distribution of Pb x Ba x As x 10<sup>-4</sup> in the rocks of the drill holes from 80900N section, Chester mine.

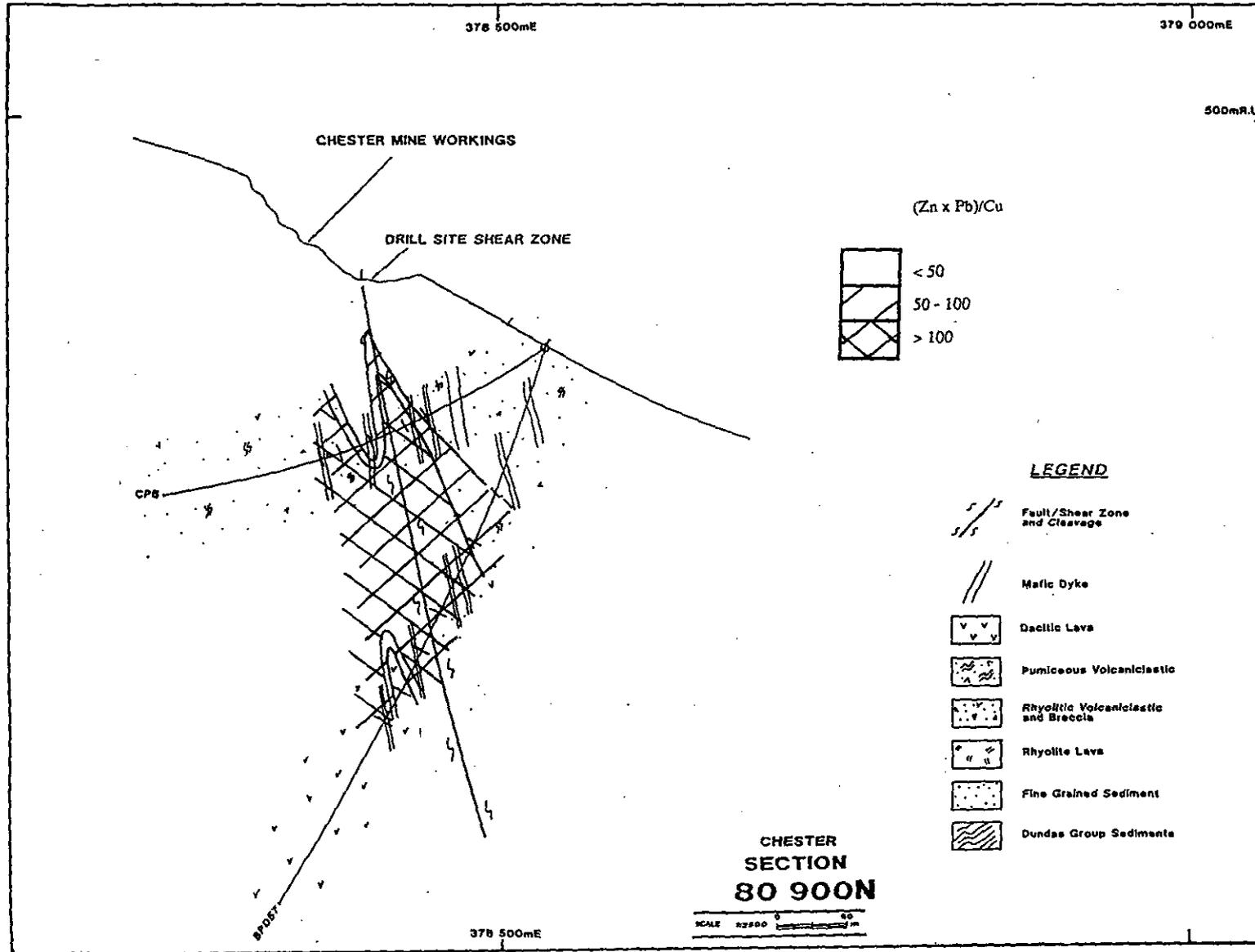


Fig. 21. Distribution of  $Ba \times As \times 10^{-2}$  in the rocks of the drill holes from 80900N section, Chester mine.

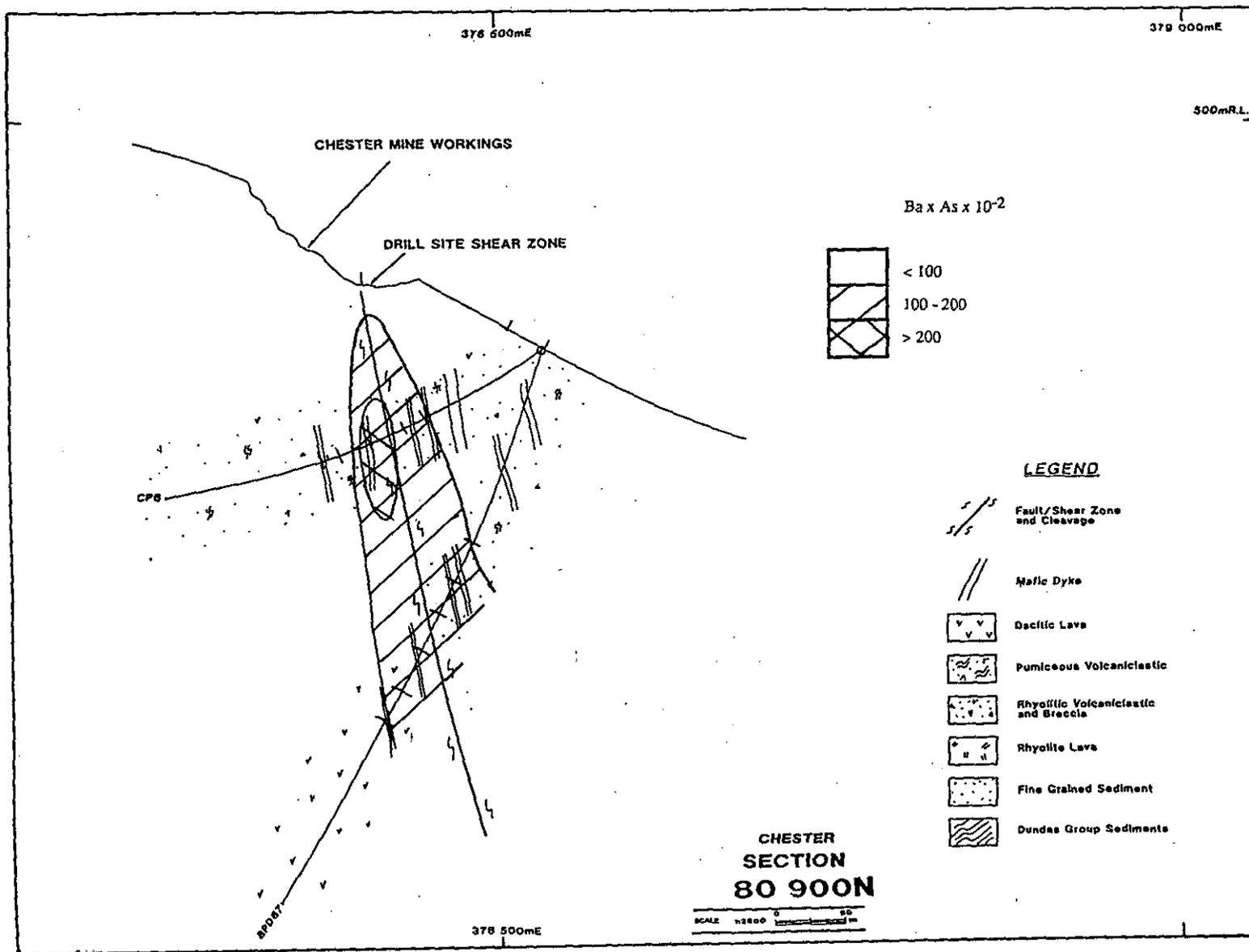


Fig. 22. Distribution of  $(Zn \times Pb)/Cu$  in the rocks of the drill holes from 80900N section, Chester mine.

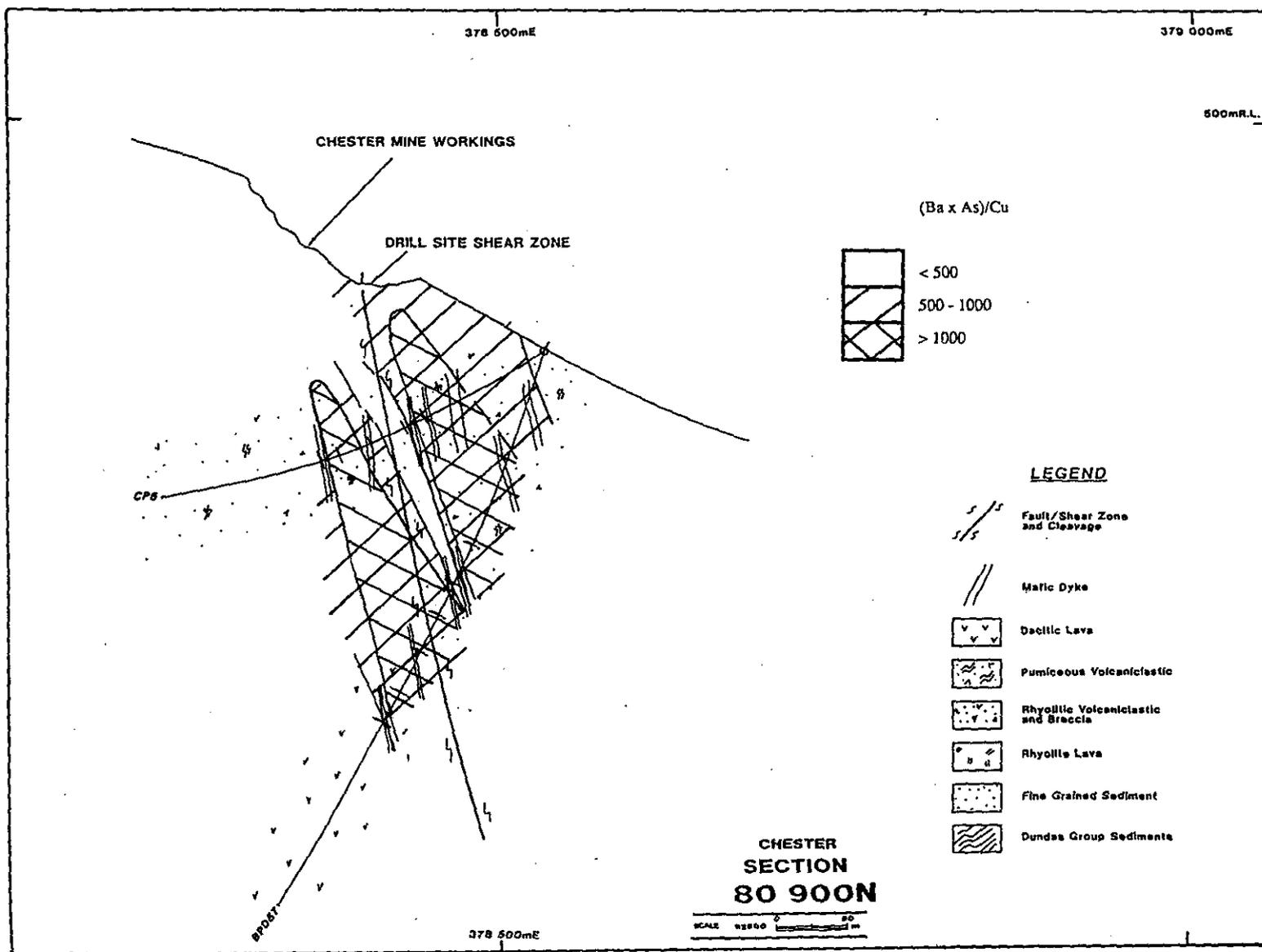


Fig. 23. Distribution of (Ba x As)/Cu in the rocks of the drill holes from 80900N section, Chester mine.

The Drill Site shear zone is clearly characterised by elevated values of Zn, Pb, Ba, As and Sb and these elements form significant geochemical halos opening to the depth. In contrast Cu does not show significant high value at the depth. Increase of multiplicative indices of  $Pb \times Ba \times As$  and  $Ba \times As$ , and ratios  $(Zn \times Pb)/Cu$  and  $(Ba \times As)/Cu$  toward depth indicate the possible mineralisation or source of these elements at the depth along the Drill Site shear zone.

### 5.2.2. 80550N Section

The 80550N section of the Chester mine area (Fig. 24) shows Chester shear zone which has an approximate width of 50 m. The section is mainly composed of rhyolitic volcanoclastics and breccia, and some mafic dykes also occur within and near the shear zone. There are two drill holes, CP 3 and BPD 68 below the Chester mine working. Three surface samples, and 6 and 7 respective drill core samples from the drill holes CP 3 and BPD 68 were involved in this study. The distribution of Zn, Pb, Cu, Ba, As and Sb in the drill core samples of the section are discussed.

*Distribution of Zn, Pb, Cu, Ba, As and Sb:* Figs. 25, 26, 27, 28, 29 and 30 show the distribution of Zn, Pb, Cu, Ba, As and Sb respectively in the drill cores samples of drill holes CP 3 and BPD 68 in 809550N section of the Chester mine area. The Chester shear zone is characterised by high values of Zn, Pb, Cu, Ba, As and Sb in different pattern. The geochemical halos of Zn ( $> 50$  ppm), Pb, ( $> 20$  ppm) Ba ( $> 750$  ppm), As ( $> 10$  ppm) and Sb ( $> 1.5$  ppm) show downward extension along the margins (particularly eastern margin) of the shear zones. Pb, Cu, Ba, As and Sb form the halos with upward opening along the western margin of the shear zone.

The geochemical halos defined by high multiplicative indices of  $Pb \times Ba \times As \times 10^{-4}$  ( $> 20$ ) and  $Ba \times As \times 10^{-2}$  ( $> 100$ ) and high ratios of  $(Zn \times Pb)/Cu$  ( $> 50$ ) and  $(Ba \times As)/Cu$  ( $> 500$ ) show high values along the Chester shear zone and extend to the depth along the shear zone (Figs. 31, 32, 33 and 34).

Similar to the Drill Site shear zone the Chester shear zone also exhibits the geochemical halos of high values of Zn, Pb, Ba, As and Sb extending to the depth. High multiplicative indices of  $Pb \times Ba \times As$  and  $Ba \times As$ , and ratios of  $(Zn \times Pb)/Cu$  and  $(Ba \times As)/Cu$  toward depth indicate the possible mineralisation or source of these elements at the depth along the Chester shear zone.

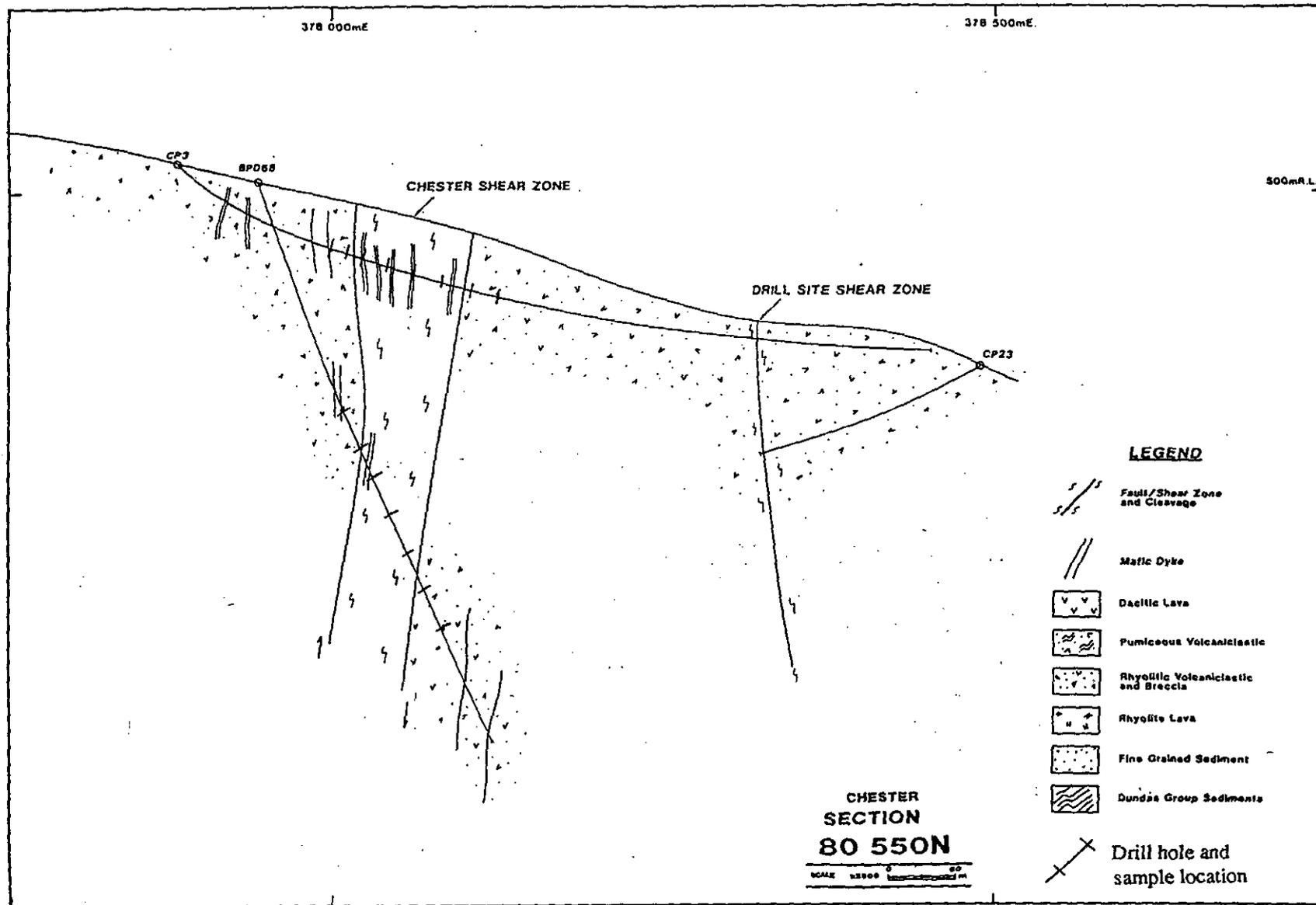


Fig. 24. Geology and drill holes in 80550N section, Chester mine.











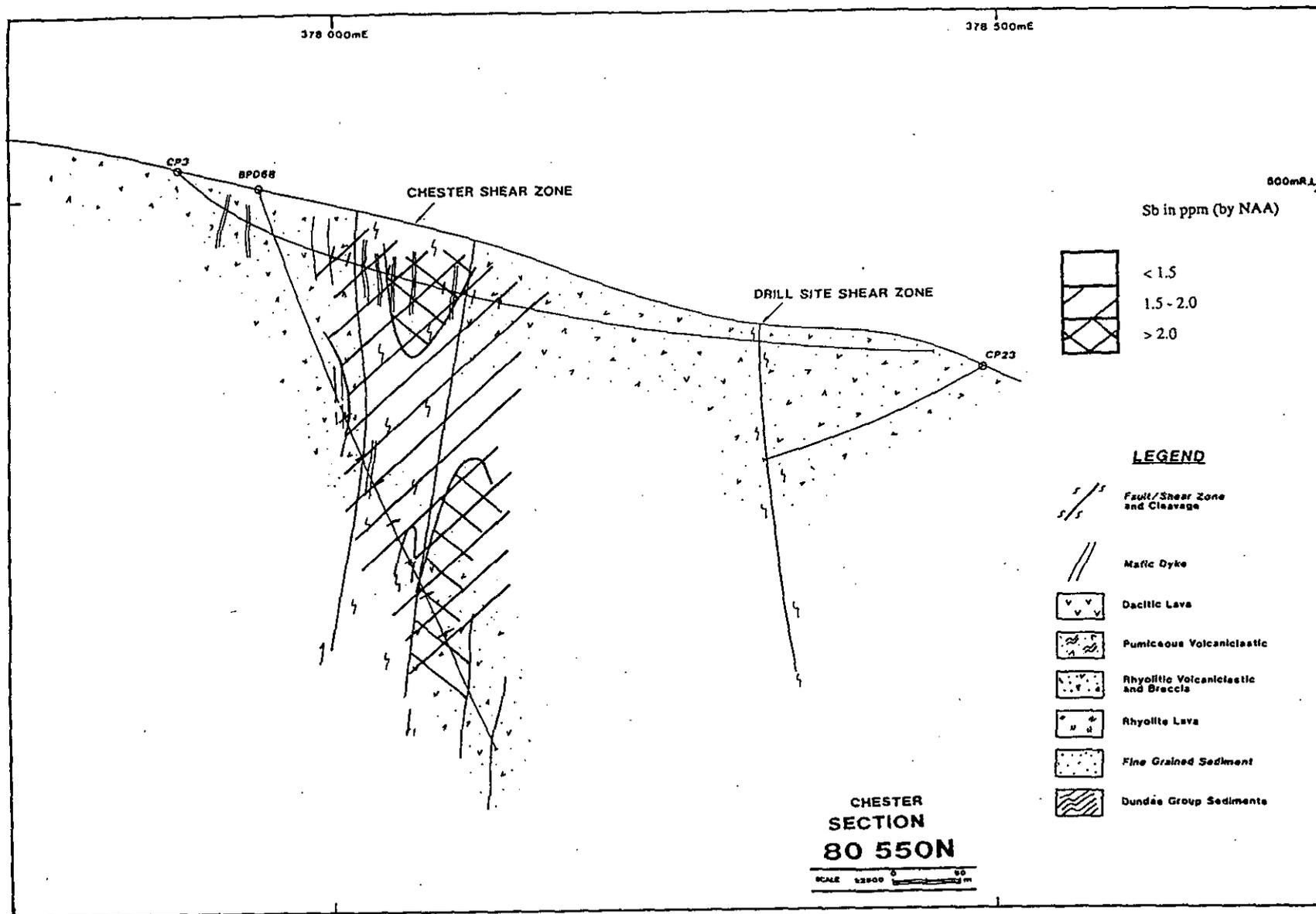


Fig. 30. Distribution of Sb in the rocks of the drill holes from 80550N section, Chester mine.









### 5.2.3. Other Drill Holes

The other drill holes CP 4, CP 21 and CP 22 intersecting the Drill site shear zone have some interesting geochemical response particularly in CP 21 and CP 22. Moderate to high values of Zn and Pb, moderate values of Ba and As occur in the drill core samples of these two drill holes. Although these drill holes are located outside the Chester alteration zone, above geochemical signatures in the drill hole CP 21 and CP 22 may indicate that the southern extension of the Drill Site shear zone is interesting in terms of mineralisation potential. As mentioned before these drill holes have no geochemical alteration signatures (based on PIXE and PIGME data) of massive sulphide mineralisation. Consequently the mineralisation is considered to be a different type.

## 6. AAS AND NAA RESULTS FOR SOME SURFACE SAMPLES

Zn, Pb and Cu (Table 3) do not show significant high values in the samples near the Chester deposit but some Ba, As and Sb contents are moderately high (> 750 ppm Ba, > 20 ppm As and > 1.5 ppm Sb). High multiplicative indices of Ba x As and Ba x As/Cu ratio occur in some samples near the mine but the multiplicative indices of Pb x Ba x As and (Zn x Pb)/Cu ratio are significantly low for all samples. Based on the AAS and NAA data (for seven samples) it is difficult to predict the mineralisation potential near and around the Chester deposit. The samples near the I.P. anomaly (which occur in the geochemical alteration zone related to massive sulphide mineralisation as mentioned above) have significantly high values of Zn and (Zn x Pb)/Cu ratio and moderate values of Ba and Pb but low values of other elements, multiplicative indices of Pb x Ba x As, Ba x As, and (Ba x As)/Cu ratio. Based on these geochemical signature it may be difficult to predict that the possibility of hidden ineralisation or source of these elements below the surface in and around the I.P. anomaly. (As mentioned above it should be noted that the geochemical alteration zones based on PIXE and PIGME results associated with I.P. anomaly and NS faults in Mount Kershaw are interpreted to be massive sulphide related alteration).

Table 3. AAS and NAA data (in ppm) for the surface rock samples from the Chester mine area.

Sample No	Drill hole	Cu	Pb	Zn	Ag	Cd	Sb	As	Ba	Au	Hg	As x 10 <sup>-4</sup>	Ba x 10 <sup>-4</sup>	Pb	Ba x 10 <sup>-2</sup>	As	Zn x Pb/Cu	Ba x As/Cu
CH47		4	3	11	<1	<1	0.92	1.67	1010	-5.0	-2.0	0.5	16.9				8	421.7
CH48		6	3	36	<1	<1	1.60	4.61	1130	-5.0	-2.0	1.6	52.1				18	868.2
CH49		5	3	12	<1	<1	0.87	2.59	697	-5.0	-2.0	0.5	18.1				7	361.0
CH50		4	3	8	<1	<1	1.23	3.00	1090	-5.0	-2.0	1.0	32.7				6	817.5
CH53		8	3	27	<1	<1	2.42	1.71	861	-5.0	-2.0	0.4	14.7				10	184.0
CH55		39	7	14	<1	<1	3.43	21.10	796	-5.0	-2.0	11.8	168.0				3	430.7
CH56		18	7	66	<1	<1	1.99	16.70	767	-5.0	-2.0	9.0	128.1				29	800.6
CH63		2	3	41	<1	<1	1.04	1.00	610	-5.0	-2.0	0.2	6.1				62	305.0
CH68		4	58	402	<1	<1	1.03	1.49	971	-5.0	-2.0	8.4	14.5			5829		361.7
CH69		2	3	38	<1	<1	0.64	1.00	854	-5.0	-2.0	0.3	8.5				57	427.0
CH70		6	14	51	<1	<1	0.85	1.41	676	-5.0	-2.0	1.3	9.5				119	158.9
CH71		8	48	261	<1	<1	1.63	1.11	371	-5.0	-2.0	2.0	4.1			1566		51.5
CH72		14	15	21	<1	<1	1.45	3.20	1280	-5.0	-2.0	6.1	41.0				23	292.6
CH73		3	31	82	<1	<1	0.92	1.57	682	-5.0	-2.0	3.3	10.7				647	356.9
CH74		9	16	424	<1	<1	0.93	1.00	873	-5.0	-2.0	1.4	8.7				754	97.0

## 7. CONCLUSIONS

### 7.1. Surface Geochemical and EPR response

The multiplicative index of  $\text{Ca} \times \text{Na} \times \text{Sr}$ ,  $(\text{K} \times \text{Rb})/(\text{Ca} \times \text{Na} \times \text{Sr})$  ratio and EPR intensity measured at magnetic density sweeps over  $326.5 \pm 5$  mT demonstrate that most parts of the Chester mine area including both alteration zones, NS shear zones and faults and I.P. anomaly are geochemically altered. The surface geochemical response based on PIXE and FIGME data, and EPR response ( $(\text{K} \times \text{Mn} \times \text{Ba} \times \text{Rb})/(\text{Ca} \times \text{Na} \times \text{Sr})$ ,  $(\text{Mn} \times \text{Ba})/(\text{Ca} \times \text{Na} \times \text{Sr})$ ,  $\text{Mn} \times \text{Ba}$  and EPR index) there are two types of geochemical alteration: (1) alteration related to massive sulphide mineralisation associated with the I.P. anomaly and with NS faults at Mount Kershaw, and (2) alteration related to other type of mineralisation or metamorphism and deformation associated with northern (Chester alteration zone) and southern (North Bastyan hydrothermal alteration zone) mineralogical alteration zones. Significant low values of hot  $\text{HNO}_3$  insoluble Mn, Ba Zn and Pb in both alteration zones demonstrate that the mineralisation and alteration in the Chester mine are not similar to the massive sulphide mineralisation such as Rosebery deposit. The EPR index also shows low values in both alteration zones indicating the alteration unrelated to massive sulphide mineralisation. Consequently the Chester mineralisation is not considered to be massive sulphide type mineralisation. The possibility of Rosebery-Hercules type mineralisation in the Chester mine area particularly within the alteration zones is poor. The geochemical alteration zones (eg. zones of  $(\text{Mn} \times \text{Ba})/(\text{Ca} \times \text{Na} \times \text{Sr})$ ) associated with I.P. anomaly, and with NS faults at the Mount Kershaw are considered to be interesting for massive sulphide mineralisation.

Surface AAS and NAA data particularly Zn, Pb and Ba in the rock samples near the I.P. anomaly demonstrate that there is a possibility of hidden mineralisation or source of these elements in and around the I.P. anomaly. However it is not possible to evaluate the the I.P. anomaly more detail by AAS and NAA data because there are no data for those samples within the anomaly.

### 7.2. Drill Core Geochemical and EPR Response

The PIXE, FIGME and EPR data of the drill core samples near and around the Chester deposit demonstrate that the geochemical signatures are different to those of the footwall alteration zone associated with Rosebery and Hercule deposits. Consequently the alteration

(Chester alteration zone) is considered to be unrelated to massive sulphide mineralisation and probably related to other type of mineralisation, metamorphism and/or deformation. Remarkable distribution patterns of Zn, Pb, Ba, As, Sb, Pb x Ba x As, Ba x As, (Zn x Pb)/Cu and (Ba x As)/Cu in the 80900N and 80550N sections showing high values at the depths of the Drill site and Chester shear zones demonstrate that there is a strong possibility of hidden mineralisation or source of these elements at the depths of the Drill site shear (below the Chester deposit) and Chester shear zones. As mentioned before the mineralisation (if present) below these shear zones is considered to be different from massive sulphide type.

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APPENDICES

# APPENDIX I

## CHESTER MINE - SURFACE PIXE, PIGME AND EPR DATA

Sample No.	Pasminco No	K	Al	Fe	Ca in %	Na	Ti	Mn	Ba	F	Rb	Sr	Cl	Zn ppm	Pb	Ga	V	Y	Zr	Nb	EPR±5mT (cm)	EPR±100mT (cm)
CH37		2.13	4.32	0.35	0.02	0.08	0.28	19	439	315	78	23	142	10	11	10	74	8	107	9	11	12
CH38		1.64	3.98	0.03	0.02	0.15	0.29	6	73	309	71	33	135	2	7	9	75	12	114	7	35	0
CH39		1.40	2.94	0.05	0.02	0.04	0.23	12	73	410	54	9	176	3	5	18	46	8	109	14	21	0
CH40		1.18	3.06	0.01	0.01	0.11	0.10	6	2600	366	39	45	100	1	10	8	0	6	112	8	11	0
CH41		1.95	3.72	0.53	0.02	0.20	0.23	29	106	719	84	13	193	9	3	9	71	16	126	13	7	2
CH42	79706	2.58	6.08	0.61	0.03	1.50	0.29	41	132	754	119	41	149	13	5	15	115	25	149	11	8	6
CH43	79725	1.88	4.67	0.56	0.03	1.02	0.29	36	195	545	84	34	185	10	4	10	65	18	150	3	9	9
CH44	79727	2.39	5.20	0.72	0.03	0.73	0.29	169	390	500	97	21	225	29	6	12	105	11	146	9	7	19
CH45	79729	3.41	3.35	0.09	0.03	0.43	0.10	72	755	132	85	55	201	5	5	6	13	8	87	4	11	13
CH46	79732	1.29	2.14	0.40	0.02	0.02	0.15	64	0	498	63	3	109	6	0	6	43	11	115	12	16	20
CH47	79734	3.11	5.31	1.22	0.02	0.03	0.34	28	418	827	150	9	288	14	3	16	120	11	151	12	12	14
CH48	79738	2.73	3.65	0.54	0.02	0.14	0.09	41	722	553	100	18	169	10	1	7	3	2	83	13	10	7
CH49	79740	1.49	2.79	0.19	0.02	0.02	0.07	40	330	362	63	6	142	5	2	6	13	11	55	5	11	14
CH50	79741	1.78	3.32	0.22	0.02	0.05	0.12	29	776	562	73	7	200	6	1	9	9	11	112	7	10	9
CH51	79743	2.45	4.45	0.45	0.02	0.11	0.22	37	477	875	114	7	180	10	4	12	75	14	145	7	8	8
CH52	79749	3.12	5.41	0.62	0.02	0.03	0.16	71	643	765	129	4	349	12	0	12	29	13	146	13	10	8
CH53	79750	2.59	5.06	0.55	0.02	0.02	0.27	53	324	705	139	3	162	18	1	13	111	16	141	9	16	5
CH54	79751	2.72	6.11	0.63	0.02	0.46	0.34	34	372	820	143	11	223	11	4	15	141	10	180	11	8	4
CH55	79752	3.22	7.06	0.65	0.03	0.32	0.31	21	479	679	172	14	230	16	3	18	138	10	160	14	8	4
CH56	79754	2.27	5.30	0.47	0.03	0.88	0.29	28	349	577	98	31	174	10	4	11	101	14	186	10	6	2
CH57	34801	2.80	5.34	0.82	0.03	0.32	0.31	141	435	719	128	13	241	27	5	12	91	12	147	13	7	11
CH58	34805	2.28	4.32	0.85	0.02	0.29	0.22	30	439	592	108	11	236	7	0	11	76	10	128	10	6	9
CH59	34810	2.11	5.70	0.90	0.05	1.82	0.27	64	300	598	104	68	195	6	4	12	102	22	148	5	6	9
CH60	34818	2.36	4.43	0.64	0.02	0.04	0.11	83	217	433	118	7	156	17	9	8	26	8	81	5	9	8
CH61	34820	2.59	5.04	0.75	0.02	0.04	0.28	197	355	559	120	4	175	21	8	9	121	15	131	8	8	10
CH62	34838	2.71	4.92	0.63	0.02	0.04	0.32	61	172	755	126	3	168	14	5	11	111	10	159	6	8	4
CH63	34842	2.11	4.88	0.75	0.03	0.97	0.17	43	186	510	101	24	201	24	2	13	41	18	303	8	9	6
CH64	34847	2.44	4.44	0.66	0.02	0.03	0.13	81	393	608	108	5	136	16	0	8	33	19	172	10	14	7
CH65	34848	1.90	5.53	0.54	0.03	1.75	0.16	36	273	582	95	33	120	10	3	12	42	9	324	7	5	4
CH66	34854	1.93	5.78	0.81	0.03	2.09	0.18	34	480	563	96	47	149	18	0	13	40	7	201	12	7	11
CH67	34866	3.24	4.72	0.52	0.09	1.02	0.10	38	507	470	104	51	123	6	4	11	15	7	182	7	16	12
CH68	34877	2.09	4.92	0.66	0.02	0.76	0.14	34	542	364	102	16	180	19	0	11	38	15	154	7	9	4
CH69	34878	2.13	5.38	0.78	0.02	1.06	0.16	18	541	493	97	26	192	8	1	13	23	13	156	7	10	7
CH70	34879	1.97	5.54	0.67	0.03	1.71	0.17	17	272	432	90	35	119	16	1	12	57	11	170	9	12	
CH71	34880	1.73	4.30	0.47	0.02	0.97	0.13	46	66	508	76	28	131	17	9	10	21	8	143	13	9	3
CH72	34888	2.84	5.60	0.64	0.02	0.06	0.17	52	722	616	136	9	200	16	4	18	30	12	141	9	12	5
CH73	34889	2.22	5.07	0.82	0.03	0.81	0.14	66	418	486	111	21	154	25	2	11	17	10	134	6	10	6
CH74	34894	3.12	5.64	0.94	0.02	0.04	0.13	2928	586	631	140	7	221	54	10	12	7	8	113	9	13	10
CH75	38429	2.35	5.24	0.86	0.03	0.10	0.05	112	103	2413	129	5	211	9	1	11	0	11	51	17	16	2
CH76	32775	3.32	6.19	0.76	0.03	0.04	0.17	53	473	790	163	5	167	11	4	14	36	12	203	15	8	5
CH77	34829	2.33	5.54	0.95	0.07	1.81	0.30	68	251	432	108	91	237	13	6	11	107	12	136	9	4	13

CHESTER MINE - SURFACE PIXE, PIGME AND EPR DATA (Cont.)

Sample No.	Pasminco No	K	Al	Fe	Ca	Na	Ti	Mn	Ba	F	Rb	Sr	Cl	Zn	Pb	Ga	V	Y	Zr	Nb	EPR±5mT (cm)	EPR±100mT (cm)
CH78	34832	2.53	5.00	0.30	0.04	2.25	0.13	39	509	354	64	49	136	2	1	8	27	20	180	14	7	9
CH79	34835	1.85	5.41	0.60	0.03	1.62	0.15	56	315	505	85	34	141	21	2	14	24	21	240	10	8	7
CH80	34836	3.04	5.77	0.85	0.02	0.03	0.17	68	384	757	152	5	254	20	0	11	34	14	153	11	10	6
CH81	34841	1.98	5.37	0.66	0.03	1.51	0.18	51	108	456	91	30	217	15	2	12	34	12	190	9	6	6
CH82	34844	2.58	4.71	0.81	0.03	0.03	0.24	101	177	748	124	4	267	19	3	11	67	12	316	11	9	12
CH83	34852	2.40	4.25	0.67	0.02	0.03	0.11	85	288	631	112	3	160	23	2	9	12	13	146	12	7	7
CH84	34859	2.10	6.24	0.96	0.77	2.47	0.46	109	834	325	56	458	105	7	7	11	95	19	159	8	2	
CH85	34864	2.92	4.98	0.55	0.08	1.63	0.15	67	523	498	89	72	181	5	3	11	30	17	202	9	8	
CH86	34872	2.32	5.09	1.01	0.03	0.65	0.17	23	371	503	103	13	201	10	2	10	42	15	145	11	11	3
CH87	34874	2.54	5.26	0.77	0.02	0.34	0.18	29	417	563	128	9	133	24	0	12	30	13	183	7	6	8
CH88	34876	1.80	5.59	1.03	1.95	2.35	0.25	191	55	263	56	240	46	3	4	9	104	17	159	7	9	5
CH89	34882	2.64	5.04	0.74	0.02	0.05	0.12	88	631	645	127	4	202	16	7	11	21	11	106	9	16	12
CH89A	34884	2.58	5.23	0.82	0.03	1.26	0.12	60	766	703	108	37	191	13	3	11	8	19	337	9	6	4
CH90	34886	2.91	5.62	0.81	0.02	0.06	0.12	106	529	741	133	4	235	27	3	12	13	8	129	6	8	11
CH91	34893	2.89	5.42	0.53	0.03	0.03	0.15	66	253	616	124	2	248	11	3	4	17	11	154	7	12	5
CH92	79701	1.79	5.16	0.81	0.05	2.10	0.23	88	230	465	90	60	127	17	0	8	99	6	127	12	9	14
CH93	79707	2.42	5.36	0.59	0.04	0.78	0.22	65	304	697	109	19	135	13	4	13	63	11	78	10	7	13
CH94	79714	0.18	1.40	0.09	0.02	0.74	0.25	16	0	73	10	33	179	3	2	5	46	30	364	17	17	13
CH95	79716	2.59	4.40	0.47	0.02	0.21	0.13	170	279	799	122	4	190	11	5	10	30	13	118	16	19	10
CH96	79719	1.47	5.07	0.54	0.04	1.89	0.11	48	68	537	77	65	147	12	4	10	19	14	124	11	7	10
CH97	79723	1.99	5.75	0.88	0.10	1.92	0.21	79	894	676	137	126	118	8	2	17	19	9	237	10	5	18

## APPENDIX II

### CHESTER MINE - DRILL CORE PIXE, PIGME AND EPR DATA

Sample No.	Pasmenco No	Location Drill hole	Location metre	← in % →							← ppm →											EPR±5mT (cm)	EPR±100mT (cm)	
				K	Al	Fe	Ca	Na	Ti	Mn	Ba	F	Rb	Sr	Cl	Zn	Pb	Ga	V	Y	Zr			Nb
CH1		CP3	143.0	0.33	5.19	0.03	0.01	0.29	0.38	9	38	347	13	150	78	1	5	4	102	7	146	8	35	0
CH2			154.0	0.45	5.82	0.02	0.02	0.59	0.29	5	362	385	18	397	154	1	6	5	88	4	141	7	35	0
CH3			166.5	0.25	2.32	0.04	0.02	0.40	0.30	0	1617	239	11	362	94	2	22	1	54	8	125	9	15	0
CH4			185.5	0.20	1.83	0.03	0.01	0.29	0.38	4	1632	213	12	275	28	0	31	0	73	8	162	10	10	0
CH5			206.0	0.34	3.30	0.04	0.02	0.62	0.32	0	414	377	15	375	80	2	29	2	64	4	91	9	25	0
CH6			229.0	0.30	2.41	0.06	0.02	0.37	0.40	4	368	303	13	290	30	5	10	1	66	10	149	8	17	0
CH7			252.0	1.48	3.22	0.05	0.02	0.08	0.32	9	1190	415	65	38	84	7	23	9	69	17	149	6	12	2
CH8			271.0	1.26	4.71	0.20	0.03	2.00	0.26	8	124	435	56	86	104	4	2	7	71	8	129	6	9	2
CH9		CP4	130.4	2.73	5.15	0.33	0.02	0.07	0.27	22	664	777	115	15	213	17	12	34	98	10	172	5	11	4
CH10			154.3	1.45	4.37	0.01	0.02	0.12	0.29	5	0	217	40	508	114	1	1	0	64	10	150	7	35	0
CH11			172.5	0.04	5.91	0.01	0.00	0.04	0.28	3	0	248	2	111	153	2	1	3	68	5	154	6	23	1
CH12			200.0	0.02	4.83	0.04	0.02	0.01	0.28	7	0	312	2	614	99	0	24	7	80	14	134	2	21	2
CH13		CP6	100.0	1.53	3.72	0.03	0.02	0.08	0.30	1	1123	577	59	49	102	3	3	10	79	44	136	10	30	0
CH14			116.0	1.88	4.23	0.18	0.02	0.38	0.30	36	1399	648	81	43	153	8	8	11	74	12	124	12	11	4
CH15			143.5	0.63	2.90	0.10	0.03	1.36	0.29	25	346	224	29	79	51	4	1	4	68	12	126	8	9	2
CH16			167.0	2.81	5.64	1.34	0.03	0.10	0.68	51	542	586	150	35	312	9	0	16	188	15	71	8	5	5
CH17			180.0	2.41	4.86	0.11	0.02	0.06	0.29	47	394	762	115	15	218	8	10	12	110	16	139	9	23	5
CH18		CP21	0.2	2.02	3.65	0.35	0.02	0.04	0.24	21	237	568	90	7	153	13	7	9	64	13	110	8	9	3
CH19			20.5	1.74	3.94	0.60	0.02	0.81	0.24	51	175	461	81	13	207	17	2	10	76	13	124	6	9	8
CH20			40.0	1.88	4.60	0.69	0.03	1.08	0.30	38	87	531	94	25	156	20	2	10	66	15	152	11	8	15
CH21		CP22	4.0	1.67	3.42	0.21	0.02	0.41	0.36	23	69	454	79	12	155	12	4	10	79	18	166	8	9	3
CH22			21.0	1.16	3.71	0.36	0.02	1.21	0.27	33	213	337	62	38	115	10	5	7	78	13	144	9	8	7
CH23			39.0	1.23	4.30	0.34	0.03	1.78	0.29	22	91	389	60	49	169	10	1	9	70	12	150	9	8	1
CH24		BPD67	151.0	2.50	5.01	0.74	0.02	0.42	0.30	87	440	533	120	12	188	14	2	10	116	6	123	11	9	9
CH25			181.0	2.81	4.93	0.48	0.03	0.03	0.32	142	468	930	120	4	217	23	10	11	108	11	140	8	13	11
CH26			206.0	1.82	5.44	0.24	0.03	1.90	0.29	43	183	501	74	48	201	9	4	10	106	9	106	13	5	5
CH27			235.5	2.02	5.12	0.33	0.03	1.31	0.32	102	435	700	95	31	128	12	6	10	70	12	162	8	4	7
CH28			267.5	2.35	4.60	0.19	0.02	0.03	0.30	37	525	633	91	3	118	7	2	15	111	10	121	11	10	4
CH29			292.0	1.24	4.50	0.21	0.03	2.06	0.27	70	306	488	49	56	177	6	8	7	77	22	148	13	5	5
CH30		BPD68	194.5	1.06	3.40	0.07	0.03	0.27	0.33	14	1371	400	51	256	81	8	20	7	77	23	155	9	11	1
CH31			227.5	0.50	4.43	0.05	0.03	0.79	0.33	11	42	393	23	592	138	2	11	2	98	9	151	9	19	0
CH32			251.5	0.62	6.55	0.05	0.03	1.07	0.38	3	57	511	23	814	69	2	19	3	78	11	224	10	37	0
CH33			281.5	1.07	8.06	0.04	0.02	0.36	0.36	3	21	436	45	221	202	2	6	5	120	13	194	14	32	0
CH34			314.5	1.92	4.29	0.07	0.02	0.11	0.32	15	96	376	80	41	185	3	2	4	87	12	144	9	16	0
CH35			344.5	1.23	4.29	0.21	0.02	1.66	0.30	24	393	412	56	64	65	5	4	7	85	8	95	10	7	3
CH36			378.5	2.07	5.04	0.52	0.02	0.81	0.40	52	455	613	93	30	193	16	0	12	124	20	136	16	5	5

## APPENDIX III

AAS and NAA data (in ppm except for Au) for the drill core samples from the Chester mine area.

Sample No	Drill hole	Cu	Pb	Zn	Ag	Cd	Sb	As	Ba	Au (ppb)	Hg
CH1	CP 3	13	80	18	<1	<1	1.88	23.20	322	<5	<2
CH3		23	82	22	<1	<1	1.55	29.10	1820	<5	<2
CH4		28	276	43	1	<1	2.01	25.30	1660	<5	<2
CH5		164	208	15	1	<1	3.12	16.20	645	41.4	<2
CH6		34	57	32	<1	<1	2.95	64.30	518	<5	<2
CH8		15	37	91	<1	<1	1.63	71.80	648	<5	<2
CH9	CP 4	19	158	46	2	<1	1.67	10.30	942	<5	<2
CH10		6	18	4	<1	<1	1.06	3.24	142	<5	<2
CH11		11	11	7	<1	<1	1.35	4.87	73	<5	<2
CH12		6	17	11	<1	<1	2.04	8.02	91	<5	<2
CH13	CP 6	7	14	9	<1	<1	1.26	7.05	2010	<5	<2
CH14		45	65	110	<1	<1	1.73	9.33	2030	<5	<2
CH15		36	12	138	<1	<1	1.21	47.70	713	<5	<2
CH16		6	3	406	<1	3	2.72	4.49	1360	<5	<2
CH17		14	186	555	<1	<1	1.42	9.28	816	<5	<2
CH18	CP 21	13	76	38	<1	<1	1.45	7.25	929	<5	<2
CH19		4	17	246	<1	<1	1.46	3.78	639	<5	<2
CH20		6	12	306	<1	<1	1.59	4.27	983	<5	<2
CH21	CP 22	11	77	64	<1	<1	2.20	8.59	716	<5	<2
CH22		7	12	246	<1	<1	1.25	5.27	760	<5	<2
CH23		11	19	202	<1	<1	1.18	12.30	701	<5	<2
CH24	BPD 67	8	9	59	<1	<1	1.33	8.83	965	<5	<2
CH25		34	176	715	<1	2	2.16	13.20	925	<5	<2
CH26		11	21	90	1	<1	1.73	13.40	860	8.0	<2
CH27		14	114	93	<1	<1	1.17	24.70	786	<5	<2
CH28		8	8	19	<1	<1	1.13	13.30	984	<5	<2
CH29		15	447	492	<1	<1	1.00	7.46	709	<5	<2
CH30	BPD 68	15	129	277	1	<1	0.89	37.40	1390	<5	<2
CH31		17	54	15	<1	<1	1.71	10.70	524	9.1	<2
CH32		7	25	10	<1	<1	1.51	24.40	482	<5	<2
CH33		3	9	7	<1	<1	1.70	4.56	271	<5	<2
CH34		4	5	18	<1	<1	1.35	4.70	704	<5	<2
CH35		73	177	141	1	<1	2.91	70.30	1090	13.3	<2
CH36		23	31	1560	<1	4	2.99	31.40	1480	<5	<2

## APPENDIX IV.

AAS and NAA data (in ppm except for Au) for the surface rock samples from the Chester mine area.

Sample No	Cu	Pb	Zn	Ag	Cd	Sb	As	Ba	Au (ppb)	Hg
CH47	4	3	11	<1	<1	0.92	1.67	1010	<5	<2
CH48	6	3	36	<1	<1	1.60	4.61	1130	<5	<2
CH49	5	3	12	<1	<1	0.87	2.59	697	<5	<2
CH50	4	3	8	<1	<1	1.23	3.00	1090	<5	<2
CH53	8	3	27	<1	<1	2.42	1.71	861	<5	<2
CH55	39	7	14	<1	<1	3.43	21.10	796	<5	<2
CH56	16	7	66	<1	<1	1.99	16.70	767	<5	<2
CH63	2	3	41	<1	<1	1.04	1.00	610	<5	<2
CH68	4	58	402	<1	<1	1.03	1.49	971	<5	<2
CH69	2	3	38	<1	<1	0.64	1.00	854	<5	<2
CH70	6	14	51	<1	<1	0.85	1.41	676	<5	<2
CH71	8	48	261	<1	<1	1.63	1.11	371	<5	<2
CH72	14	15	21	<1	<1	1.45	3.20	1280	<5	<2
CH73	3	31	82	<1	<1	0.92	1.57	682	<5	<2
CH74	9	16	424	<1	<1	0.93	1.00	873	<5	<2