Chapter 3 Drilling

3-1 Drilling Method

Drilling was carried out by using one set of Banka Drill, which is commonly used for investigation of Quaternary deposits.

The drill used is a motor-driven machine reconstructed by GSM, which is called "Semimechanized Banka Drill". Drilling works were carried out by 6 operators of GSM and 6 local labours.

The three (3) boreholes were vertically drilled down to the bedrock.

The drilling sludge was carefully checked and compiled into a 1/200 columnar map. As a rule, heavy mineral concentrates were collected by panning from sludge obtained every 1.5m in drilling length, and analyzed for 8 elements, Au, Ag, Pb, Zn, Cu, As, W and Sn.

Clay samples were examined by chemical analysis, X-ray diffraction analysis and firing test to consider their possible uses.

3-2 Process of Drilling

As the Banka Drill is a large-sized machine of 2.6m x 2.0m x 2.5m in size and 4 ton in weight, all the 3 drill-sites were selected in the gardens of private houses for agricultural roads where cars and tractors were passing through.

The drilling method used is of a percussion type as described below:

A casing cutting shoe (external diametre = 5.5") was firstly attached to a casing pipe (external diametre = 5"), secondly a sand pump (external diametre = 3") with a cutting shoe was inserted into the casing pipe and then drilled by falling a 120kg weight of sinker bar on the sand pump. In parallel to this, the casing pipe was always advanced up to the top of sand pump by 6 persons through rotation.

The Banka Drill is, as mentioned above, reconstructed and reassembled by GSM, therefore, type and speficiation for every machine are not too clear. Consumables were chiefly made up of diesel and oil. Sandpump, jack and sliding jar were also considered as a part of consumables.

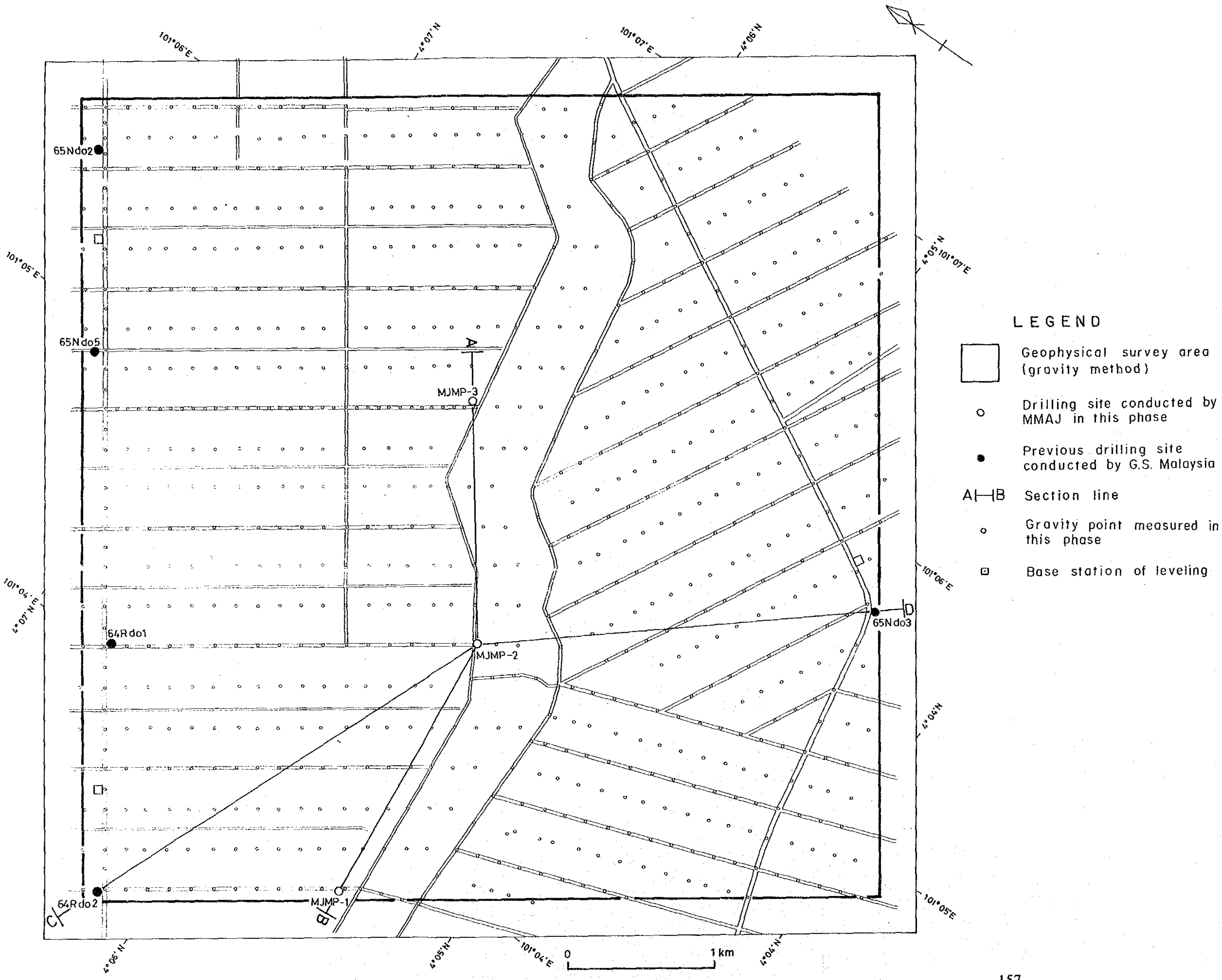


Fig. III - 3 - 1 Location map of drilling holes

Specifications of drilling machine and details of consumed materials are shown in Table III-3-1 and III-3-2, respectively.

Drilling works were carried out by one shift a day with 6.5 effective working hours. Drilling speeds were, on the average, 10m/shift for shallow section from the surface and 3 - 5m/shift for section deeper than 50m.

Drilling records of each borehole are shown in table III-3-3, III-3-4, and III-3-5. Progress records of each borehole are illustrated in Fig. III-3-2.

3-3 Results of Survey

A columnar section of each hole and geological section are shown in fig. III-3-3. Results of chemical analysis and X-ray diffraction analysis on drilling sludge are given in Table A-4 and A-5, respectively.

The Quaternary sediments encountered in each hole belong to the Simpang Formation of Pleistocene of an estuarine deposit type.

Details of geology and occurence of placer are as follows:

(1) Drill hole MJMP-1 (-90°, 98.0m)

[1] Geology

0 - 9.1m Humic soil

Dark grey clay (with many wood fragments in the section 4.6 - 8.2m)

9.1-17.4 Granule with clay intercalation

Pale bluish grey - grey granule (with pale bluish grey clay in the section 11.6 - 13.7m)

17.4-27.4 Clay

Pale yellowish orange - pale grey, slightly sandy clay

27.4-47.9 Sand and gravel

Grey medium to coarse sand, with poorly sorted quartz gravels (3 - 4mm in size) in a biotite matrix in the section of 41.4 - 47.9m. Remarkably graded

Table III - 3 - 1 Specification of drilling machine

Semi-Mechanized Banka	1 set
1. Capacity	150 m
2. Dimensions L×W×H	2.6 × 2.0 × 2.5 m
3. Engine	S.T.3. Lister Air cooled diesel engine
4. Casing	Length : 5 feet External diameter 5″ Internal diameter 4.4″
5. Casing Cutting shoe	External diameter 5½″ Internal diameter 5″
6. Sand pump	External diameter 3″ Internal diameter 2.5″
7. Sand pump cutting shoe	
8. Sand pump cutting shoe value	
9. Sinker bar	120 kg
10. Sliding jar	
11. Wire rope	3/4″

Table III - 3 - 2 Details of consumed materials

Item	Unit	MJMP-1	MJMP-2	MJMP-3	Total
Sand pump	set	—	—	1	1
Sinker bar	set	—	—	1	1
Diesel	ℓ	1700 ℓ	1000 ℓ	800 ℓ	3,500 ℓ

Table III - 3 - 3 Timetable of drilling work (1)

(MJMP-1)

	Length		No. of Shift		Man-day	
	Drilling	Core	Drilling	Total	Engineer	Worker
August	m	m				
23	Mobilization	-				
24	12.2	5.1				
25	Off day	-				
26	12.2	9.4	2	2.5	15	15
27	10.7	9.6				
28	12.2	11.4				
29	7.6	6.9				
30	4.6	4.7				
31	4.6	4.2				
September						
1	Off day	-				
2	3.0	2.9	6	6	36	36
3	4.6	4.8				
4	3.0	2.5				
5	6.1	5.9				
6	3.0	3.2				
7	4.6	4.0				
8	Off day	-				
9	3.0	3.1	6	6	36	36
10	Replacement of casings	-				
11	1.5	1.9				
12	1.5	3.1				
13	3.6	1.9				
14	Extraction of casing	-				
15	Off day	-				
16	Extraction of casing	-	3	6	36	36
17	do.	-				
18	do.	-				
19	do.	-				
20	Return of accessories	-				
21	Load & un-load Banka	-	0	5	30	30
Total	98.0	84.6	17	25.5	153	153

Table III-3-3 Timetable of drilling work (2)

(MJMP-2)

	Length		No. of Shift		Man-day	
	Drilling	Core	Drilling	Total	Engineer	Worker
July 29	m Mobilization	m -	-	1.0	6	6
30	Set-up					
31	Off day					
August 1	do.					
2	do.					
3	do.					
4	do.					
5	do.		-	0.5	3	3
6	13.6	6.9				
7	10.7	10.8				
8	10.7	7.1				
9	7.6	6.4				
10	7.6	3.9				
11	Panning	-				
12	10.7	9.5	6	7	42	42
13	6.1	6.7				
14	Extraction of casings	-				
15	4.6	3.6				
16	3.0	1.0				
17	Recovering	-				
18	Off day	-				
19	1.8	2.7	5	7	36	36
20	Extraction of casing	-				
21	do.	-				
22	do.	-				
23	do.	-	3.5	3.5	21	21
Total	76.5	58.6	14.5	19	114	114

Table III-3-3 Timetable of drilling work (3)

(MJMP-3)

	Length		No. of Shift		Man-day	
	Drilling	Core	Drilling	Total	Engineer	Worker
Jury	m	m				
16	Set-up					
17	9.1	6.5				
18	10.7	8.6				
19	6.1	7.0				
20	13.7	9.5				
21	Off day	-				
22	9.1	6.5	5	5.5	33	33
23	1.5	1.3				
24	6.1	4.2				
25	6.4	4.8				
26	Extraction of casing pipe	-				
27	do.	-				
28	do.	-	3	6	42	42
Total	62.8	48.4	8	11.5	75	75

Table III - 3 - 4 Details of drilling work

Hole No.	Drilling			Shift		Man-day		Working time						
								Drilling				Removing	Others	Grand total
	Bit size	Drilling length	Core length	Drilling	Total	Engineer	Worker	Net drilling	Accessory working	Recovering	Total			
MJMP-1	3″	m 98.0	m 84.6	22	25.5	153	153	h 115	h 31	h 6	h 152	h 3	h 4	h 159
MJMP-2	3″	76.5	58.6	14.5	19	115	114	68	27	7	111	6	6	123
MJMP-3	3″	62.8	48.4	9.5	11.5	81	81	54	18	7	79	3	3	85

Table III - 3 - 5 Summary record of drilling work (1)

(MJMP-1)

		Drilling period				Total man-day	
			Day	Work day	Off day	Engineer	Worker
Operation	Preparation	23.8.1989	0.5	0.5	0	3	3
	Drilling	24.8.1989 ~ 19.9.1989	27	drilling 22	4	135	135
				recovering 1	0	6	6
	Removing	20.9.1989 ~ 21.9.1989	2	2	0	12	12
	Total	23.8.1989 ~ 21.9.1989	29.5	25.5	4	156	156

Drilling Length	Plan	70.0 m	Unconsolidated surface sediment	0 m
	Increase or Decrease	+28.0	Core length	84.6
	Drilled length	98.0	Core recovery	86.3

Core recovery by sediment		
	Thickness	Core recovery
Mud & silt	19.8 m	53.1 %
Sand	41.2	97.2
Gravel	35.0	93.5

Working hour	Drilling	114.75 h	75 %	72 %
	Accessory work	31.50	21	20
	Recovering	6.00	4	4
	Total	152.25	100	96
	Setting up	3.75	-	2
	Removing	3.00	-	2
	Others	0	-	0
	Grand total	159.00	-	100

Efficiency of Drilling	
Total m/work day	98.0m / 22days (4.45 m/day)
Total m/ total shifts	98.0m / 22shifts (4.45 m/shifts)

Drilling length by bit size			
Bit size	3″		
Drilled length	98.0 m		
Core length	84.6		

Casing	Size	Meterage	Recovery
	5・½ inch	98.0 m	100 %

Table III-3-5 Summary record of drilling work (2)

(MJMP-2)

		Drilling period	Day	Work day	Off day	Total man-day: Engineer	Total man-day: Worker
Operation	Set-up	30.7.1989	0.5	0.5	0	3	3
	Drilling	31.7.1989 ~ 23.8.1989	24.5	drilling 14.5	7	87	87
				recovering 2	0	12	12
	Removing	29.7.1989	1	1	0	6	6
	Total	29.7.1989 ~ 23.8.1989	26	19	7	108	108

Drilling Length		m		m
	Plan	70.0	Unconsolidated surface sediment	9.1
	Increase or Decrease	+ 6.5	Core length	56.5
	Drilled length	76.5	Core recovery	81.8 %

Working hour		h	%	%
	Drilling	68.00	65	56
	Accessory work	30.38	29	25
	Recovering	6.75	6	5
	Total	105.13	100	86
	Setting up	3.75	-	3
	Removing	6.75	-	6
	Others	6.00	-	5
	Grand total	121.63	100	100

Casing	Size	Meterage	Recovery
	5 • ½ inch	76.5 m	100 %

Core recovery by sediment

	Thickness	Core recovery
Mud & silt	38.1 m	70.8 %
Sand	24.4	72.6
Gravel	14.00	99.5

Efficiency of Drilling

Total m/work day	76.5m / 14.5days (5.28 m/day)
Total m/ total shifts	76.5m / 14.5shifts (5.28 m/shifts)

Drilling length by bit size

Bit size	3″		
Drilled length	76.5 m		
Core length	58.6		

Table III–3–5   Summary record of drilling work (3)

(MJMP-3)

		Drilling period	Day	Work day	Off day	Total man-day: Engineer	Total man-day: Worker
Operation	Set-up	16.7.1989	0.5	0.5	0	3	3
	Drilling	17.7.1989 ～ 28.7.1989	12	drilling 9.5	1	63	63
				recovering 1.5	0	9	9
	Removing	(From Ipoh on 16.7.1989)					
	Total	16.7.1989 ～ 28.7.1989	12.5	11.5	1	75	75

Drilling Length	Plan	70.0 m	Unconsolidated surface sediment	3.0 m
	Increase or Decrease	- 7.2	Core length	47.6
	Drilled length	62.8	Core recovery	80.0

Core recovery by sediment

	Thickness	Core recovery
Mud & silt	18.3 m	66.7 %
Sand	24.4	91.8
Gravel	19.8	69.7

Working hour	Drilling	54.00 h	68 %	64 %
	Accessory work	18.00	23	21
	Recovering	7.00	9	8
	Total	79.00	100	94
	Setting up	2.00	-	2
	Removing	-	-	-
	Others	3.00	-	4
	Grand total	84.00	100	100

Efficiency of Drilling

Total m/ work day	62.8m / 9.5days (6.61 m/day)
Total m/ total shifts	62.8m / 9.5days (6.61 m/day)

Drilling length by bit size

Bit size	3″		
Drilled length	62.8 m		
Core length	48.4		

	Size	Meterage	Recovery
Casing	5・½ inch	62.8 m	100 %

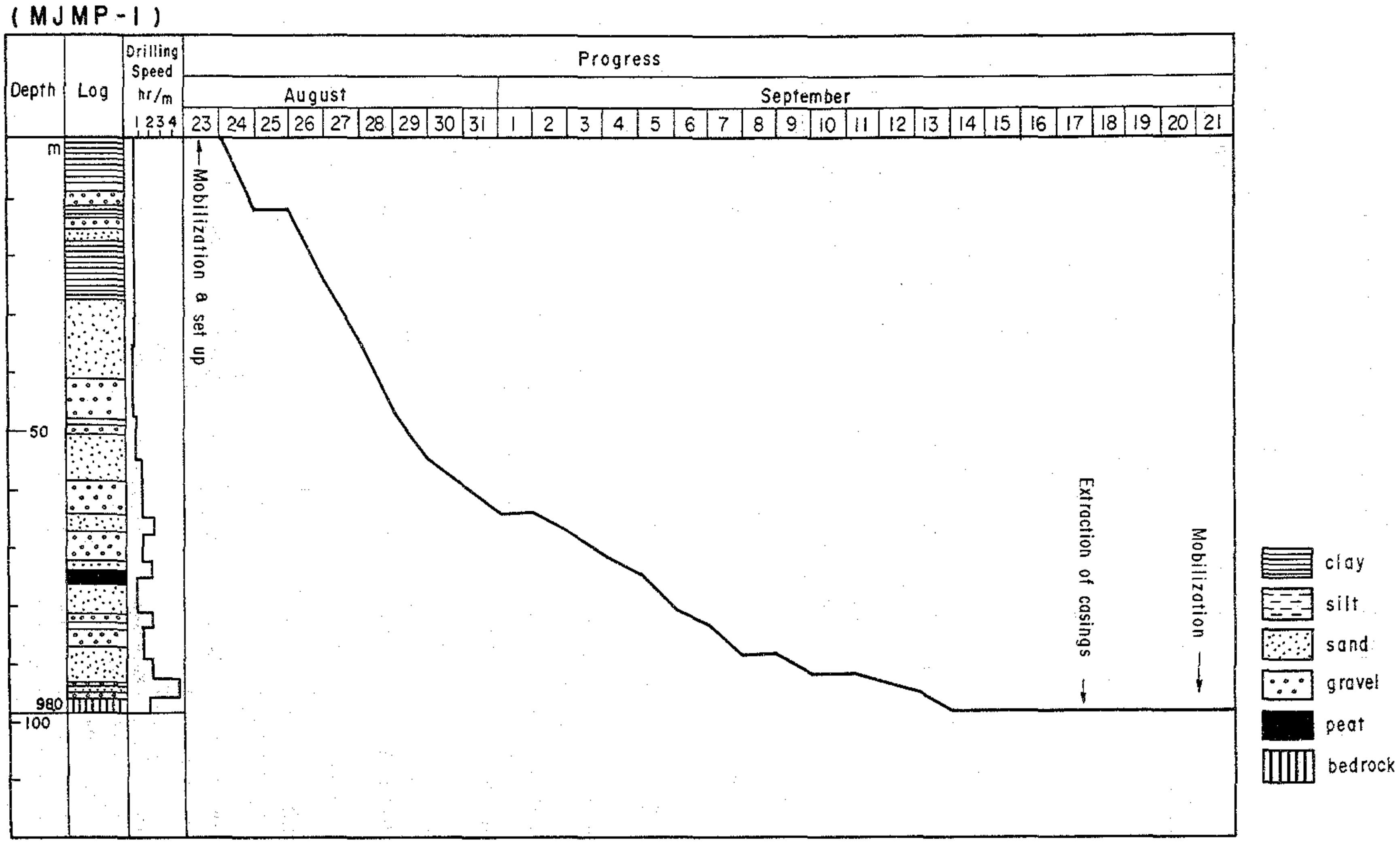


Fig. III - 3 - 2 Progress record of drilling (1)

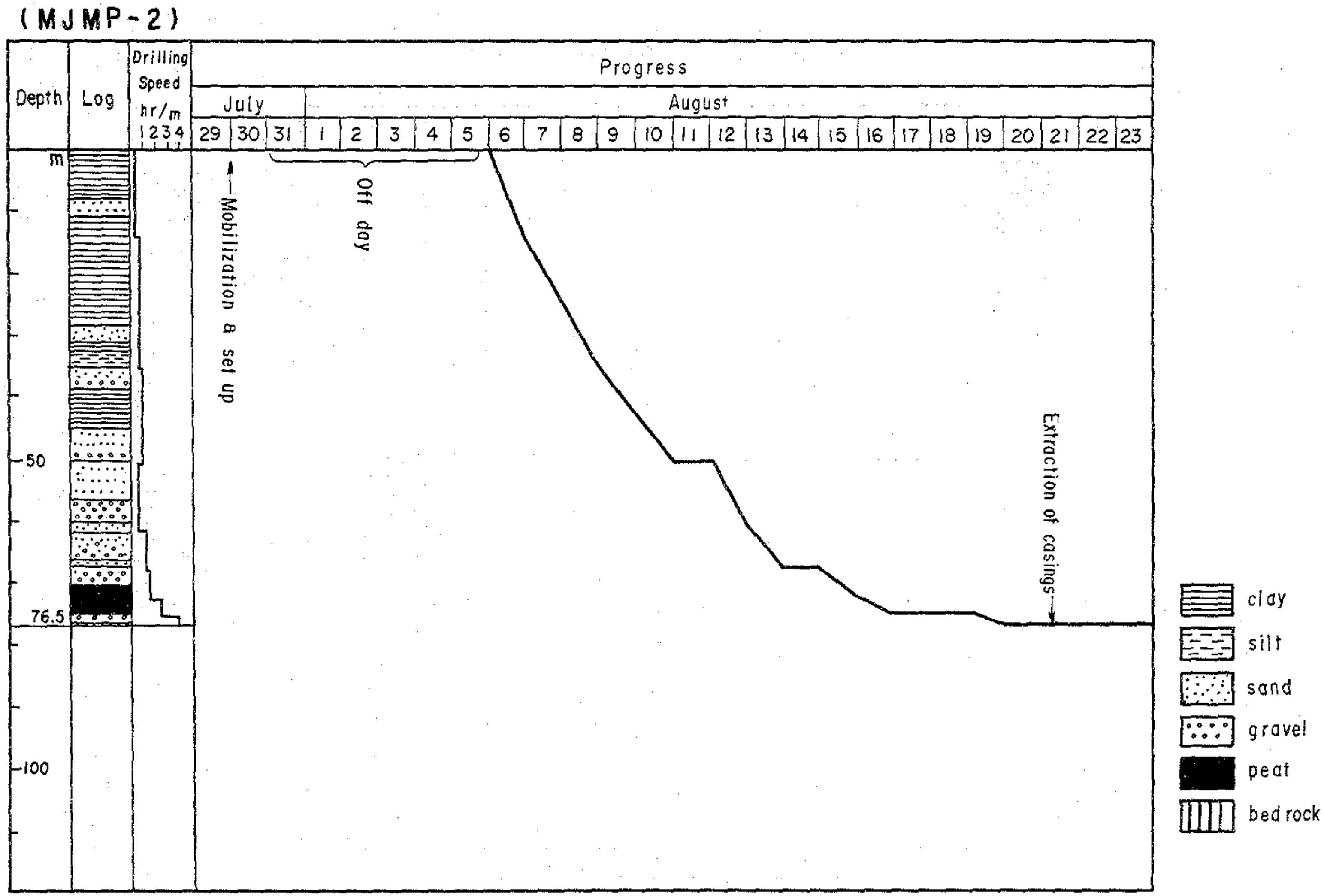


Fig. III–3–2 Progress record of drilling (2)

(MJMP-3)

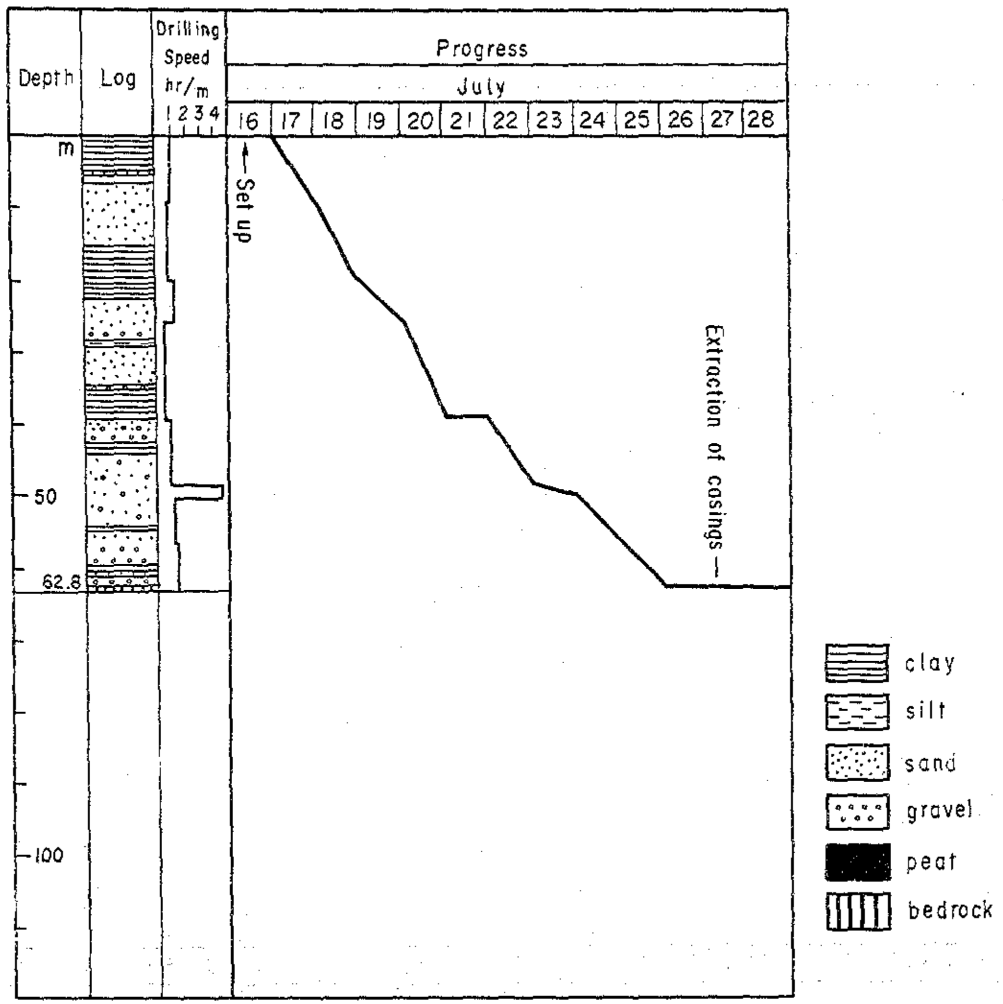


Fig. III–3–2 Progress record of drilling (3)

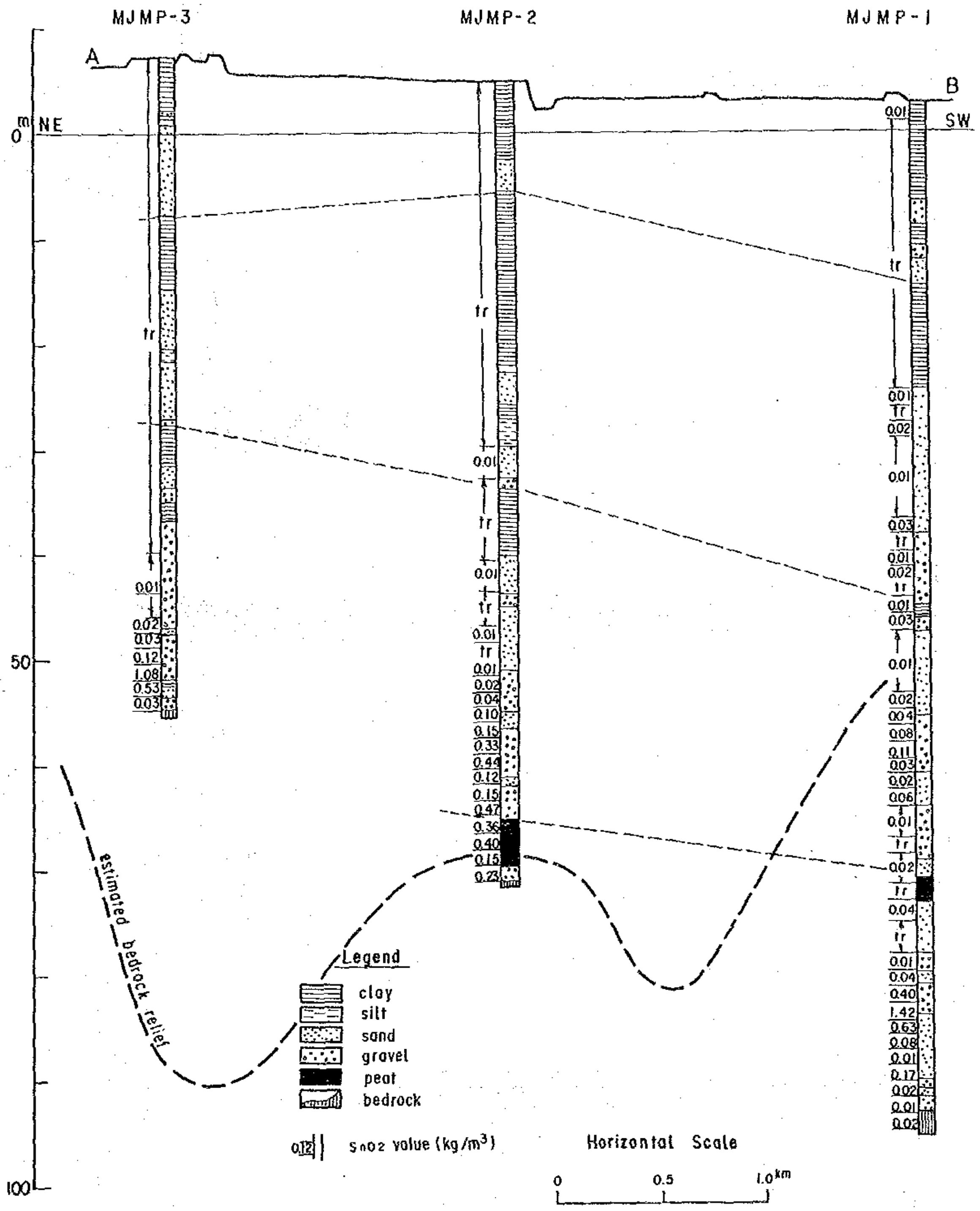


Fig. III–3–3 Geological section of drilling holes (1)

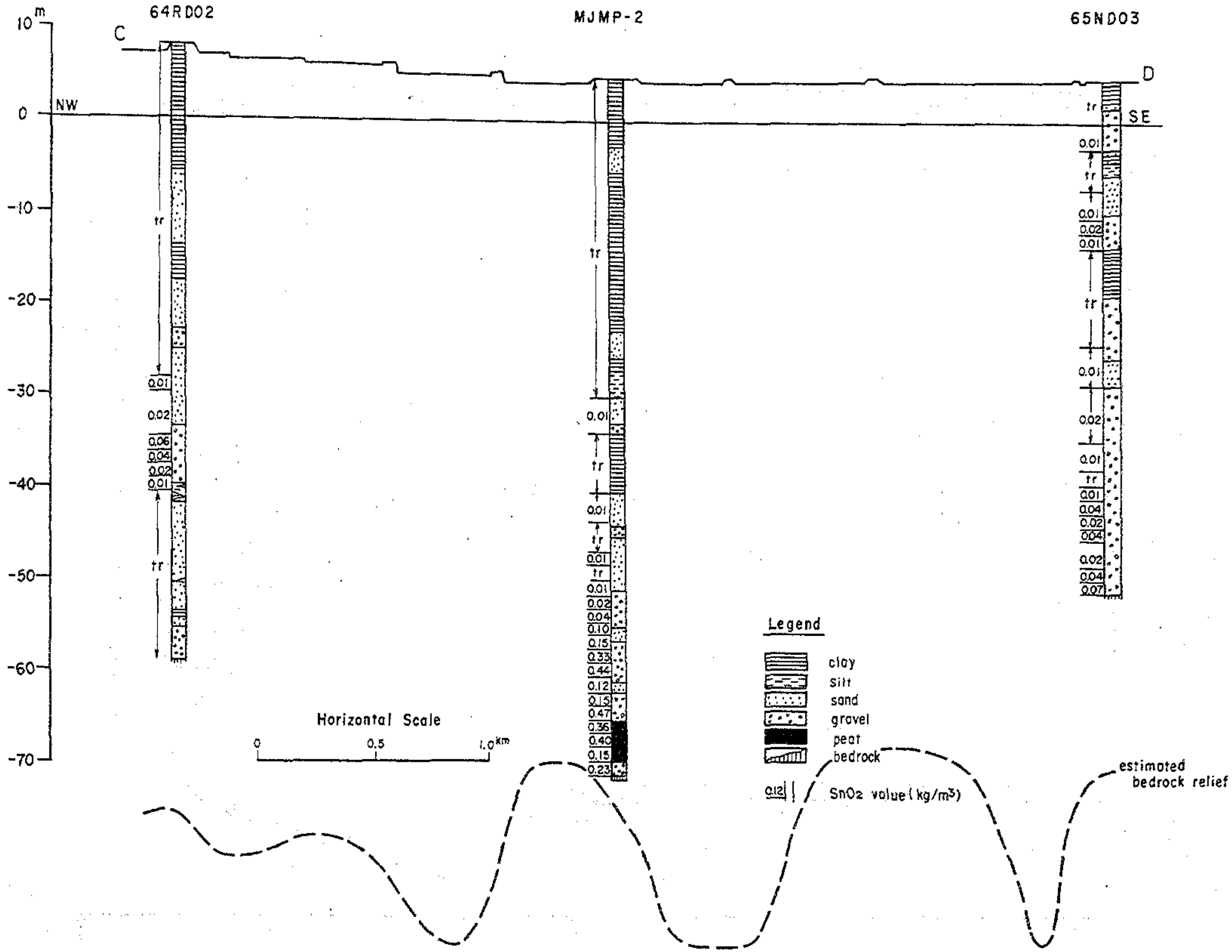


Fig. III–3–3 Geological section of drilling holes (2)

47.9-73.8 Sand and gravel

Repeat of graded bed consisting of pale grey sandy clay, pale grey medium - coarse sand and pale grey to brownish grey gravel (thickness of unite bed: 5-8m), gravel: rounded quartz gravel (4-8mm in size)

73.8-76.2 Peat

Dark brown - black, sandy. Usually peat occurs near the bedrock. It is very rare that peat appears 20m apart from the bedrock.

76.2-96.0 Sand and gravel

Repeat of graded bed of sand and gravel (thickness of unite bed: 3 - 6m), dark brown peats in the granule sections of 76.2 - 81.1m and 82.9 - 83.8m)

96.0-98.0 Bedrock

Pale grey silt - sandstone, which seems to be a part of the Belata Formation.

(2) Distribution of Heavy Minerals

Weights of heavy minerals obtained by panning are 20g in clay and silt, 52g in sand and 100g in gravel per 1,5m drilling length. Analytical results are shown in Table A-4 in ppm. Contents of all elements but Sn are very low.

The contents range are as follows:

Au:tr-0.023ppm	Ag:tr-0.001ppm	Cr:tr-0.04 ppm	Pb:tr-12.47ppm
Zn:tr-0.97ppm	W:tr-0.44ppm	As: tr-0.17ppm	

Sn, ranging from 0.10 to 553.66 ppm, shows 154.74ppm, 553.66ppm and 248.64ppm for 1.5m long sections between 83.8m and 88.4m depth near the bedrock.

The grade of placer tin is usually shown in SnO_2 kg/m^3.

If converted values over $0.200 kg/m^3$ SnO_2 are picked up, the following sections are footlighted (Fig. III-3-3).

Section	SnO_2 Content	
83.8 - 85.3m (1.5m gravel)	0.40	kg/m^3
85.3 - 86.9m (1.6m gravel)	1.42	kg/m^3
86.9 - 88.4m (1.5m sand)	0.63	kg/m3
Total thickness:4.6m Average:	0.81	kg/m^3

(3) Clay

Clay samples were collected form 4 shallow sections (depths: 0.3 - 1.5m, 4.6 - 6.1m, 12.2 - 12.8m and 18.3 - 19.8m) and examined by chemical analysis, X-ray diffraction analysis and firing test. The resutls are shown in Tables III-3-6, A-3 and A-5.

Clays are mainly composed of kaolinite and quartz with accessory montmorillonite, sericite, anhydrite (?) and plagioclase (?).

Chemical components are as follows:

SiO_2: 49 - 67%	Fe_2O_3: 0.8 - 4.7%
Tio_2: 0.60 - 1.06%	Cao + MgO: 0.19 - 1.41%
Al_2O_3: 17 - 26%	$Na_2O + K_2O$: 0.74 - 2.03%

Fired colours present light buff, chocolate brown and off white at 1200°C, water absorption at 1200°C ranges from 8.8 to 16.7%. Firing shrinkage at 1200°C varies from 5.4 - 12.9% and tempring water ranges from 33,3 t0 47,3%.

TableIII − 3 − 6 Firing Test Results of Clay Samples from MJMP-1

Sample No.	Depth (m)	Fired Colour (1200℃)	Water Absorption (%)	Firing Shrinkage (%)	Tewpering Water (%)	Possible Uses
MJMP-1/S_1	0.3− 1.5	Light buff	8.8	12.9	47.3	Wall tilss, sanitary ware
MJMP-1/S_2	4.6− 6.1	chocolate brown	11.4	5.8	37.3	Bricks, pipes, roofing tiles
MJMP-1/S_2	12.2−12.8	off white	16.7	5.4	33.3	Wall tiles

Summing up these properties the clays are unfit for chinaware or paper filler but may be considered as having some applications such as wall tiles, roofing tiles, bricks, sanitary ware, etc.

2. Drill hole MJMP - 2 (-90°, 76,5m)

(1) Geology

0-10.7m	Humic soil	
		Brownish grey clay with very coarse sand at the bottom (7.6 - 10.7m)
10.7-31.0m	Clay	
		Pale grey clay with a few medium sand, a few wood at the bottom. Bruwnish grey coarse sand with quartz granules at the bottom (28.3 - 31.0m)
31.0-38.7m	Clay silt, sand and gravel	
		Pale grey clay (31.0 - 32.3m), pale grey silt (32.3 - 35.0m), graded sand 35.0 - 37.8m) and quartz pebble gravel (37.7 - 38.7m)
38.7-49.9m	Clay sand and gravel	
		Pale bluish grey clay (38.7 - 45.1m), pale grey graded sand (45.1 - 48.8m, wood fragments at the lower part) and pale grey quartz granule.
49.9-70.1m	Sand and gravel	
		Pale grey sand (49.9 - 56.1m), brownish grey quartz granule (56.1 - 60.0m), pale grey, medium to coarse sand (60.0 - 61m, some wood), brown quartz pebble gravel (61.1 - 66.1m), pale grey coarse sand (66.1 - 67.0m) and brown guartz pebble gravel (67.0 - 70.1m, some woods at the bottom)
70.1-74.7m	Peat	
		Dark brown peat
74.7-76.2m	Gravel	
		Dark brown quartz granule
76.2-76.5m	Bedrock	
		white weathered silt

(2) Distribution of Heavy Minerals

Average weights of heavy minerals obtained by panning per 1.5m drilling length are 11g in clay and silt, 38g in sand, 59g in peat, 164g in gravel, showing an increase of weight of heavy minerals in accordance with an increase of their size, just same as in the drill hole MJMP-1.

Analytical results are shown in Fig. A-7. All elements but Sn are very low in content.

Significant Sn contents represented by SnO_2 kg/m^3 are as follows (Fig. III - 3 - 3);

Section		SnO_2 Content	
62.5 - 64.0m (1.5m gravel)		0.33	kg/m^3
64.0 - 65.6m (1.6m gravel)		0.44	kg/m3
Total thickness:3.1m	Average:	0.39	kg/m^3
68.6 - 70.1m (1.5m gravel)		0.47	kg/m^3
70.1 - 71.7m (1.6m gravel)		0.36	kg/m^3
71.7 - 73.2m (1.5m sand)		0.40	kg/m3
Total thickness:4.6m	Average:	0.41	kg/m^3

(3) Clay

Clay samples were collected from 4 shallow sections and examined by firing test. The results are given in Table III - 3 - 7.

Table III - 3 - 7 Firing Test Results of Clay Samples from MJMP-2

Sample No.	Depth (m)	Fired Colour (1,200℃)	Water Absorption (%)	Firing Shrinkage (%)	Tempering Water (%)	Possible Uses
MJMP-2/S_1	0 − 1.2	Light brown	18.0	3.5	28.3	Bricks
MJMP-2/S_2	1.8− 3.0	Light brown	19.7	8.6	38.7	Bricks, Pipes, roofing tiles
MJMP-2/S_3	4.9− 5.5	Light reddish brown	−	nil	32.7	Bricks
MJMP-2/S_4	6.4− 7.3	brown	12.1	7.2	33.3	Bricks, Pipes, roofing tiles
MJMP-2/S_5	10.7−11.6	off white	16.7	4.3	30.0	Wall tiles

As is evident from this table, the clay tested are not of high quality, indicating some applications such as structural clay ware (bricks, pipe) or wall tile.

(3) Drill hole MJMP - 3 (-90°C, 62.8m)

[1] Geology

0- 3.0m	Humic soil	
		Pale grey clay
3.0- 5.5m	Clay and sand	
		Consisting of pale grey clay (3.0 - 4.9m) and pale bluish grey medium sand (4.9 - 5.5m)
5.5-15.2m	Clay and sand	
		Consisting of pale grey silty clay (5.5 - 6.4m) and pale grey graded sand (sizes of sand are 0.95mm at the bottom and 0.35mm at the top)
15.2-42.2m	Clay, sand and gravel	
		Three sedimental cycles of clay sand gravel from the upper to the lower parts as (1) pale grey clay (15.2 - 22.3m) pale grey medium sand (22.3 - 28.0m) (2) greyish yellow brown silt (28.0 - 29.0m) pale grey graded sand (29.0 - 34.7m) quartz pebbel gravel (34.7 - 35.0m) and (3) pale grey, quartz sandstone granules bearing clay (35.0 - 39.0m) pale grey medium sand (39.0 - 41.1m) pale grey granule (41.1 - 42.4m).
42.4-62.2m	Clay, sand and gravel	
		Greyish yellow brown clay (42.4 - 44.4m) and pale blue, 1 - 2cm sized quartz bearing gravel (44.2 - 62.2m).
62.2-62.8m	Bedrock	
		Dark grey sanstone

[2] Distribution of Heavy Minerals

Average weights of heavy minerals collected by panning per 1.5m drilling length are 8g in clay, 19g in sand and 34g in gravel, especially 181.0g in a gravel bed on the bedrok.

Analytical results are shown in Table A-4 in ppm, contents of all elements but Sn are very low.

Significant Sn contents represented with SnO_2 kg/m^3 are as follows (Fig. III - 3 - 3);

Section		SnO_2 Content	
57.9 - 59.4m (1.5m gravel)		1.08	kg/m^3
59.4 - 61.0m (1.6m gravel)		0.53	kg/m3
Total thickness:3.1m	Average:	0.81	kg/m^3

[3] Clay

Clay samples collected from 3 shallow sections were examined by firing tests. The results are shown in Table III - 3 - 8.

Table III - 3 - 8 Firing Test Results of Clay Samples from MJMP-3

Sample No.	Depth (m)	Fired Colour (1,200℃)	Water Absorption (%)	Firing Shrinkage (%)	Tempering Water (%)	Possible Uses
MJMP-3/FT-1	0.6 – 0.9	pale brown	12.0	7.2	33.0	Wall tiles, sanitary ware, table ware
MJMP-3/FT-1	1.8 – 2.1	buff	16.9	4.2	33.3	
MJMP-3/FT-1	6.4 – 6.7	white	17.3	7.3	41.7	

The clays tested are not of high quality. However, some applications such as wall tile and table can be considered just like clays from MJMP-1 and MJMP-2 holes.

3-4 Discussion

Geological sections of 3 holes are shown in Fig. III - 3 - 3. As is evident from this figure, the Quaternary sediments consist of repeated sedimentary units as gravel, sand, silt or clay, showing a double grading structure. The geological columnar sections of 3 holes have stratigraphical resemblance, in spite of being 1.5 - 2.0km apart from each other.

Geology of each hole changes from clay to sand or gravel near a depth of 45m. In the drillholes of MJMP-1 and MJMP-2 peat beds were encountered. Based on the GSM existing data, peat beds generally occur near the bedrock like in the MJMP-2 hole and are not seated apart from bedrock as 20m in the MJMP-1 hole. In the MJMP-1 hole, sand and gravel under the peat bed are homogeneous in character and have not a graded structure, therefore, they might have fallen down and filled locally the hollow surface.

Placer tin occurs mainly in gravel beds on or near the bedrock.

No gold flakes can be found in any section of drill holes.

As each hole encountered some clay beds, physical tests were carried out on the clays of shallow beds which hve more economical value.

As the contents of chemical components such as SiO_2, TiO_2, AlO_3, Fe_2O_3, CaO + MgO, Na_2O + K_2O and H_2O are beyond the provisions and fired colour is not white, these clays can not be used for chinaware or paper filler. However, some uses for structural clay ware (bricks, pipes, roofing tiles etc.) or furniture (wall tiles, sanitary ware,table ware etc.) may be considered.

At present, GSM survey team is conducting a ball clay investigation in the Changkat jong sheet 20km south of the survey area. The ball clay resembles the clays of MJMP-1, MJMP-2 and MJMP-3 holes in chemical component. As the clays in both areas contain 1 - 4% Fe_2O_3, exploration would need to discover clay beds with 0.5 - 1.0% less Fe_2O_3 content (Wilson I. R. 1989).

Chapter 4 General Discussion on the Survey Results

4-1 Placer Tin Deposit

Considering the integrated results of gravimetric survey and drilling, it can be stated that the bedrock structure is becoming clear and that the potential for areal distribution of tin seems higher.

Gravity survey in this phase disclosed the bedrock topography as shown in Fig. I-3-4. In the bedrock topography there are large scaled hollows some of which seem to be traces of ancient meander, though small scale rectilinear hollows were presumed before the gravimetric survey.

The crests of the bedrock in the northern area extend towards southeast and turns towards south in the central part. The hollows are arranged on the west of the above crests with a U shape, showing 50m of maximum difference between crest and hollow of both curvatures.

According to the gravity interpretation map (Fig. III-2-21, Fig. I-3-4), all sites of 3 holes in this phase and 6 existing holes of GSM are located above crests or transitional slopes between crest and hollow. Therefore, no holes have yet investigated the hollows. As placer tin is apt to accumulate in the hollows, drilling is necessary to reach these parts.

In the northern part of the sruvey area, the bedrock was interpreted to saddenly sink with a steep angle, suggesting a fault scarp. From its location, this scarp might be traces of ancient S. Kinta. As this geological structure is considered to have relations with placer in deposits it is desirable to clarify the structure at an early opportunity.

4-2 Clay Deposits

Each of the drilling holes encountered some superficial clay beds, which can be classified into 3 sections from a viewpoint of depth, namely. Om -10m, -15 -25m and -35m -45m.

Physical tests to investigate their possible uses were conducted on the clay samples collected only from sections shallower than 15m due to the facts that (1) clay particle increases its size towards depth, indicating decrease of utility value, and (2) clays deeper than 15m depth would be of no commercial profit at all.

Summing up the results of chemical analysis, X-ray diffraction analysis and firing test, it can be stated that all clays are rich in Fe and of not so high quality. However, they may be suitable for structural clay wares (bricks, pipe, roofing tiles etc.) or wall tiles, sanitary ware and table ware. Blending with other types of clay might open a new market, therefore, it is desirable to carried out blending tests etc. to improve the quality of the clay.

PART IV AREA C

Chapter 1 Outline of the Area c Survey

1-1 Outline of the Survey

The phase I survey disclosed geochemical anomalies of Au, Sn and REE in the drainage basin of S, Jopal, a branch of S. Ringat. In Phase II detailed geological and geochemical survey were carried out to clarify the details of these anomalies.

As the area was released from forest reservation last year, logging is under operation and many roads were set up, which enabled a survey team to mobilize by 4 wheel driven jeep (last year mobilization was made by human power).

Rock samples (123pcs) were collected from all the drainage systems in the area, and subjected to chemical analyses.

1-2 Objectives and Method of the Survey

The objectives of the survey are to clarify the distribution of mineralization and to choose the most promising areas in the anomalous zones of Au, Sn, REE, which were detected by drainage survey in Phase I.

For these, the whole tributary of S. Jopal was mapped on a scale of 1/10,000 and covered by geochemical rock sampling. Rock samples were collected at about 250m intervals along the creek in such way that a uniform sample density was obtained.

After prepration of collected rock samples, they were sent to GSM chemical loboratory for Au, Ag, Pb, Zn, Cu, As, W, Sn analyses and Chemex Laboratory for REE analyses.

1-3 Contents of the Survey

Contents of the Phase II Survey are shown in Table IV-1-1

TableIV－1－1 Amount of Survey in Area c

Item	Amount	
Geological & Geochemical Surveys		
a) Area C	Survey Area	$18km^2$
	Survey Route Length	57.7km
	No. of Rock Samples	123pcs
	No. of Ore Samples	8pcs

1-4 Data Processing

Geochemical survey in Phase II collected 123pcs of rocks, which were analyzed for 20 elements such as Au. Ag, Cu, Pb, Zn, Sn, W, As and Nb, Ta, U, Th, La, Ce, Sm, Eu, Tb, Yb, Lu, Nd.

All the analytical data were statistically processed by computer. Regarding analytical values lower than detection limit, they were assumed as 1/2 of detection limit value for computation purposes.

Interpretation was carried out through both single component analysis and multivariate statistical analysis, applying the same methodology that was used for the Area a-1.

2-1 Geology

The Area c is composed of the Main Range granite. The boundary between the Main Range granitė and mica schist phillite of Paleozoic is located 4km to the northeast of the area. The geological map and geological columnar section of the area are shown in Fig. IV-2-1 and Fig. I-2-2.

The granite which is porphytic, contains characteristically megacrysts (chiefly K-feldspar) with a 2-5cm length. Main constituent minerals under microscope are generally quartz K-feldspar plagioclase biotite muscorite in volume. Magnetite, zircon and apatite are included as accessory minerals.

Monazite is rarely found.

Fifty (50) pcs of the Main Range granite in Phase I and 123 pcs of the same granite in Phase II are studied for REE. Fig. IV-2-2 shows their REE pattern.

In this figure, REE from La to Lu are arranged on the X-axis in atomic numerical number and values of REE (which are standarized by chondrite) on the Y-axis.

In order to simplify the data analysis, mean values of REE for each phase and for each area were used instead of using individual observations.

This pattern is of A-type granite which is known as REE bearing granite. It is clear that the granites in the Area A and in the Area C in Phase I show almost the same REE patterns, but the granite in the Area c in Phase II has 2-4 times as much REE content as phase I granite.

It may be considered that the patterns of the phase I granites show a background pattern of the Main Range granite and the pattern of phase II shows anomalous REE values.

According to air photo interpretation, there are two type of granites, i.e. high resistance granite in the upper reaches of a river and low resistance granite in the lower reaches of a river.

Hoewever, there are no difference between them in constituent minerals except for amounts of K-feldspar and plagioclase (high resistivity granite is slightly rich in plagioclase and slightly poor in K-feldspar).

A fault of a NE-SW system runs along S. Jopal in the central part of the area, and another NW-SE system, along a branch in the northern part. Other lineaments shown in Fig. IV-2-1 are recognizable on the air photograph.

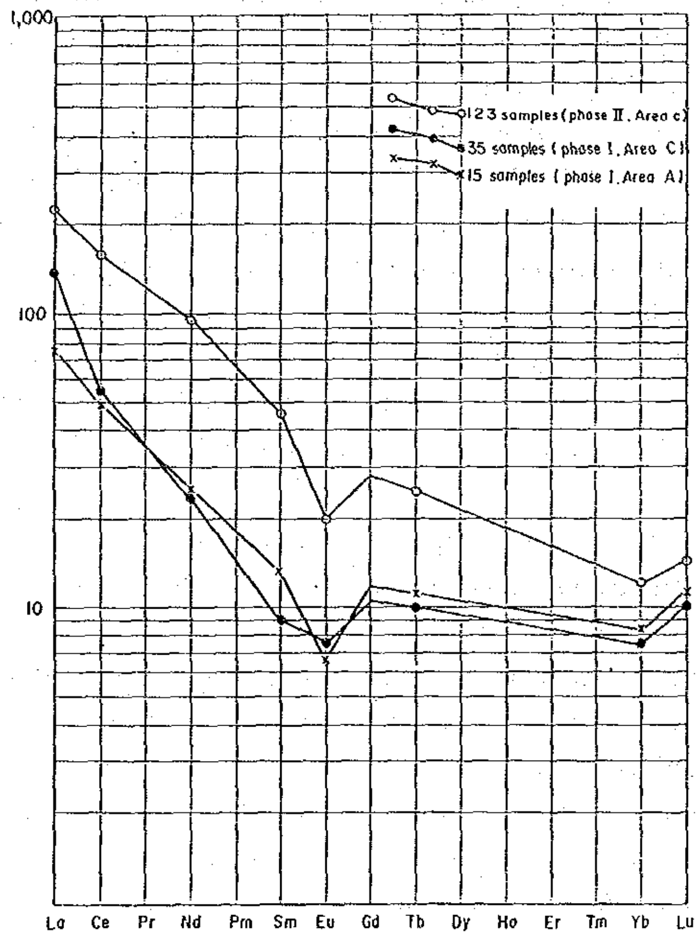


Fig. IV-2-2 REE pattern of the Main Range Granite

2-2 Mineralization and Alteration

Ten odd veins of aplite, pegmatite and tourmalline-quartz were found, but all of them were barren.

Some traces of old pits for placer Au are located in the upper reaches of S. Jopal. A panning test was done at the old pits but no gold flakes were found. A small-scaled silicification and kaolinization were enfirmed in S. Jopal.

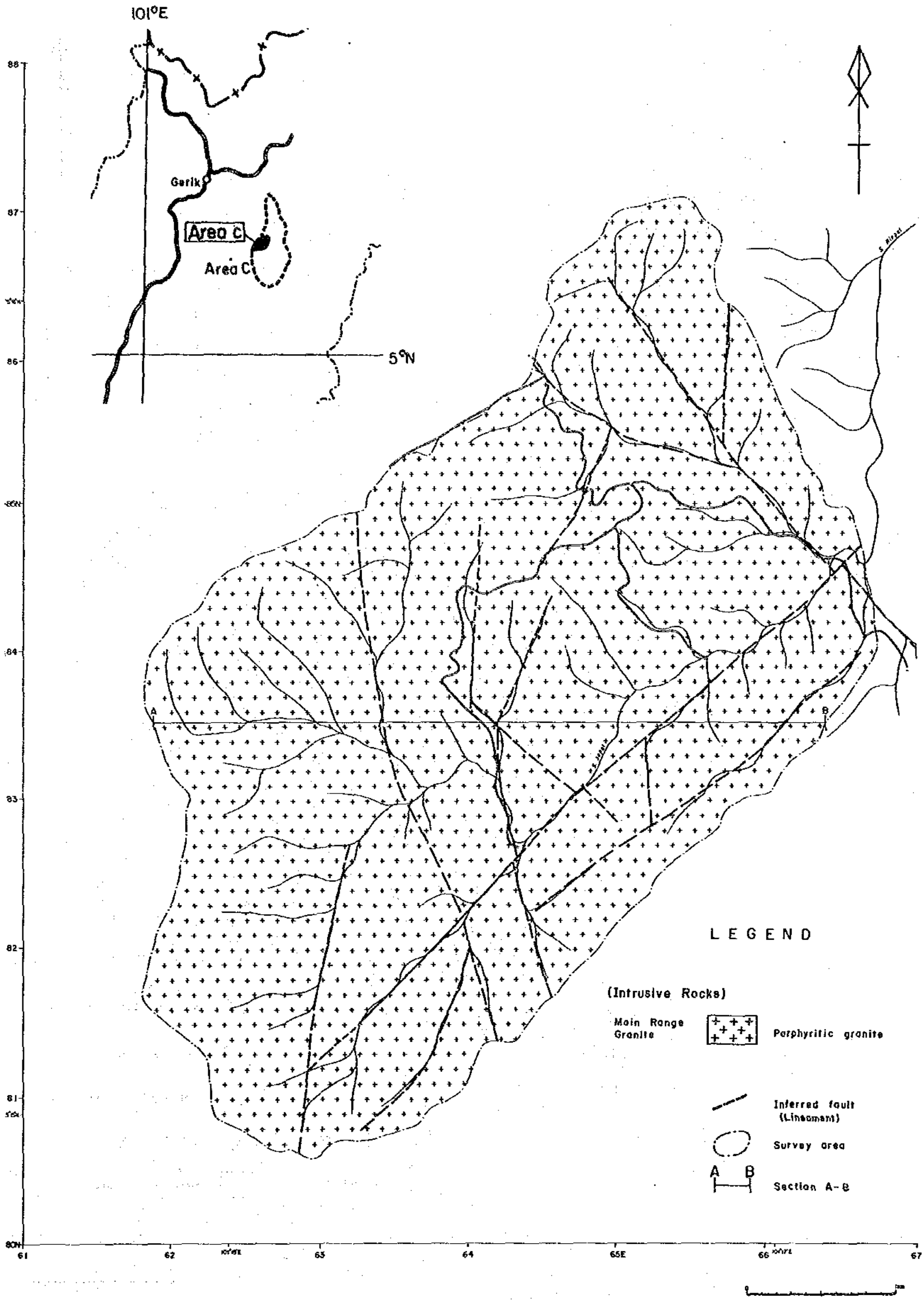


Fig. IV - 2 - 1 Geological map of the Area c

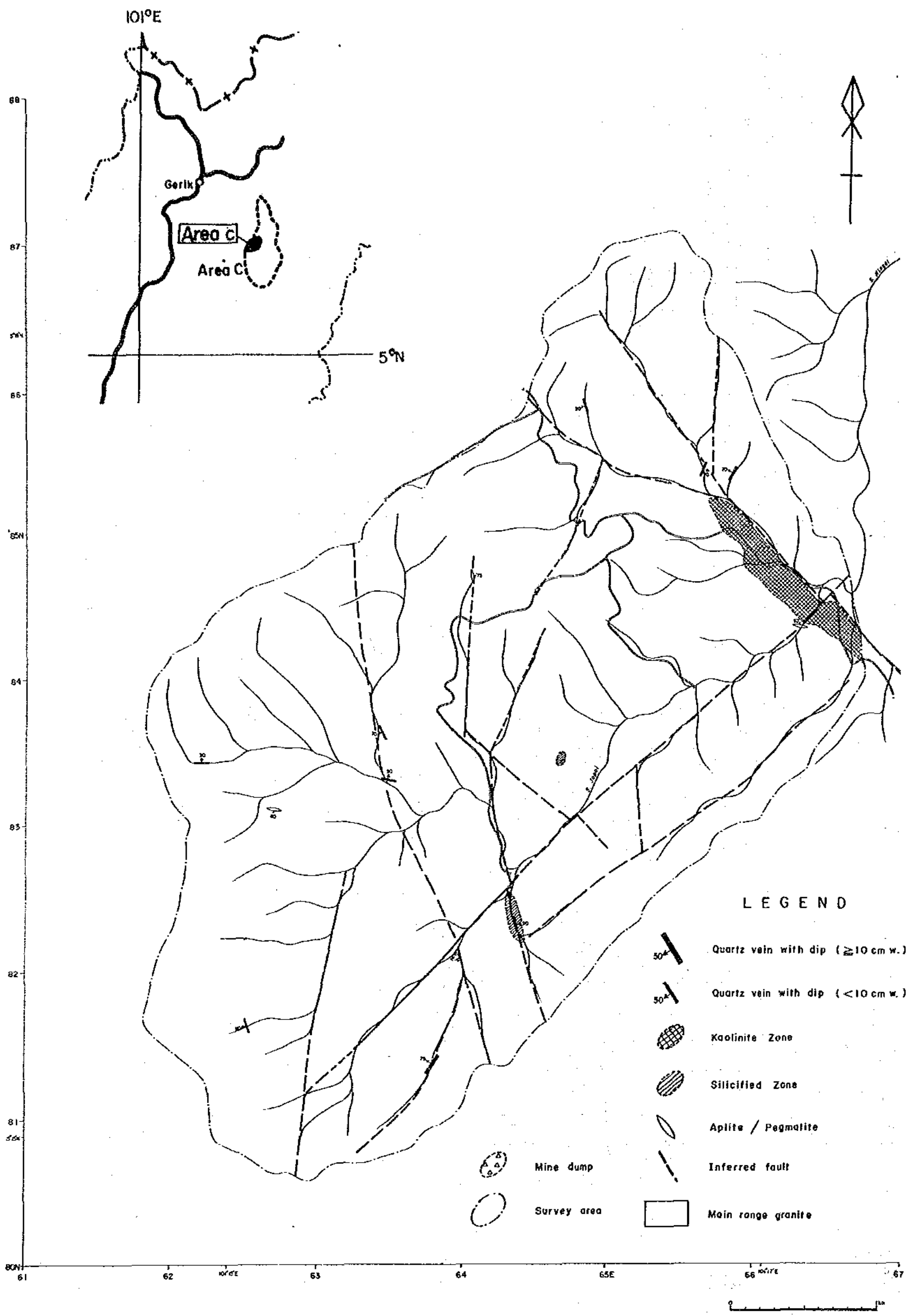


Fig. IV - 2 - 3 Distribution map of quartz veins and alteration zones in the Area c

3-1 Interpretation Results

Rock samples (123pcs) were analyzed for Au, Ag, Pb, Zn, Cu, As, W, Sn and REE. As all Ag values were 0.05ppm, a statistical processing on Ag data was not necessary.

[1] Mean, Minimum, Maximum Values and Correlation Ratios

The mean, minimum, maximum, values, correlation ratios and EDA values are shown in Table IV-3-1.

The analytical values of Au, Pb, Zn, Ca and W are on the same range of average values of the common rocks. Sn content is also similar to a mean value of the Main Range granite.

The correlation ratios among REE are as high as La-Sm = 0.844, La-Ce = 0.824 and La-Nd = 0.823. In contrast with these, correlation ratios among Au, Ag, Pb, Zn, Cu, As, W, Sn group and REE group are as low as 0.380 (maximum).

[2] EDA Interpretation Results

Through EDA, histogram for each element and the boxplot were constructed to get values of lower fence, lower whisker, lower hinge, median, upper hinge, upper whisker and upper fence (Table IV-3-1).

The analytical data were classified by these values to draw the Distribution Map of Elements (Fig. IV-3-1), from which geochemical anomalous zones were extracted (Fig. I-3-5).

The values above the upper fence were regarded as anomalous values for each element, but 0.003ppm was taken as anomalous value for Au, because the values from upper fence to lower fence show same value as 0.001 ppm.

Au

Minimum value: 0.001ppm maximum value: 0.009ppm, about 83% of the analytical values are less than 0.002ppm. As the boxplot is truncated towards lower content side, statistic values as upper fence etc., cannot be estimated. The velue of 0.003ppm represents the value at 18% of the histogram.

(1) Maximum, minimum and mean values (ppm)

	All samples (123)			
element	Maximum	Minimum	Mean	S.D.
Au	0.009	<0.003	0.001	0.245
Ag	0.05	0.05	0.050	0.000
Pb	80	2	10.6	0.238
Zn	76	2	28.4	0.226
Cu	36	1	5.2	0.232
As	80	3	6.4	0.297
W	80	4	6.9	0.224
Sn	70	5	9.0	0.243
La	176	11	67.7	0.177
Ce	270	19	126.6	0.157
Nd	147	7	57.3	0.189
Sm	22.6	1.6	8.80	0.156
Eu	3.4	0.4	1.39	0.134
Tb	3.1	0.3	1.18	0.211
Yb	7.8	0.5	2.44	0.208
Lu	1.10	<0.1	0.458	0.040
Nb	33	9	20.7	0.077
Ta	20	<2	1.5	0.233
U	33	2	12.8	0.164
Th	118	7	54.5	0.140

(3) Result of EDA (ppm)

	Au	Ag	Pb	Zn	Cu	As	W	Sn
MAXIMUM	0.009	0.05	80	76	36	80	80	70
U.FENCE	0.001		23	56.5	11.5	17.5	14	17.5
U.WHISKER	0.001		16	39	7	10	8	10
U.HINGE	0.001		14	37	7	10	8	10
MEDIAN	0.001		10	33	6	5	8	10
L.HINGE	0.001		8	24	4	5	4	5
L.WHISKER	0.001		7	18	3	3	4	5
L.FENCE	0.001		-1	4.5	-0.5	-2.5	-2	-2.5
MINIMUM	<0.003	0.05	2	2	1	3	4	5

(ppm)

	La	Ce	Nd	Sm	Eu	Tb
MAXIMUM	176	270	147	22.6	3.4	3.1
U.FENCE	123.5	218	115	15.0	2.2	2.65
U.WHISKER	88	164	80	11.2	1.7	1.7
U.HINGE	83	152	73	10.5	1.6	1.6
MEDIAN	71	129	57	9.1	1.4	1.3
L.HINGE	56	108	45	7.5	1.2	0.9
L.WHISKER	47	92	39	6.2	1.1	0.7
L.FENCE	15.5	42	3	3.0	0.6	-0.15
MINIMUM	11	19	7	1.6	0.4	0.3

(ppm)

	Yb	Lu	Nb	Ta	U	Th
MAXIMUM	7.8	1.1	33	20	33	118
U.FENCE	5.3	0.9	29	3.5	25	89.5
U.WHISKER	3.5	0.6	23	2	16	67
U.HINGE	3.2	0.6	23	2	16	64
MEDIAN	2.7	0.5	21	1	13	55
L.HINGE	1.8	0.4	19	1	10	47
L.WHISKER	1.4	0.3	18	1	9	44
L.FENCE	-0.3	0.1	13	-0.5	1	21.5
MINIMUM	0.5	<0.1	9	<2	2	7

(2) Correlation matrix

	Au	Pb	Zn	Cu	As	W	Sn	La	Ce	Nd
Au	1.000									
Pb	.009	1.000								
Zn	-.024	.353	1.000							
Cu	.044	.224	.308	1.000						
As	.011	.206	.085	.200	1.000					
W	.121	.066	-.274	.008	.141	1.000				
Sn	-.097	.005	.224	.260	.186	.062	1.000			
La	-.128	-.083	.232	.279	.037	.071	.097	1.000		
Ce	-.168	-.102	.211	.239	.010	-.007	-.017	.824	1.000	
Nd	.031	-.031	.118	.259	.114	.121	.028	.823	.782	1.000
Sm	-.045	-.071	.203	.244	.096	.065	.061	.844	.781	.813
Eu	.083	.069	-.043	.151	.069	.098	.032	.434	.313	.539
Tb	.030	-.034	.305	.230	.070	-.160	.127	.449	.398	.487
Yb	.182	.109	.072	.040	.109	.038	-.048	.090	.049	.215
Lu	.127	.001	.140	.143	.092	.120	.053	.223	.216	.293
Nb	.017	-.080	.284	.296	.087	.067	.324	.438	.272	.392
Ta	-.007	.031	-.052	.139	.039	.162	.378	-.003	-.006	.113
U	.013	.084	.120	.158	.225	.010	.116	.162	.139	.243
Th	-.082	-.031	.238	.239	.121	.031	.010	.660	.702	.679

	Sm	Eu	Tb	Yb	Lu	Nb	Ta	U	Th
Sm	1.000								
Eu	.462	1.000							
Tb	.618	.201	1.000						
Yb	.225	.075	.374	1.000					
Lu	.346	.173	.391	.602	1.000				
Nb	.480	.015	.492	.222	.246	1.000			
Ta	.053	.026	.122	.048	.180	.411	1.000		
U	.286	.011	.436	.462	.330	.422	.346	1.000	
Th	.702	.206	.506	.356	.368	.491	.154	.466	1.000

(4) Result of factor analysis

Factor loading and communality

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Communality
Au	-0.097	-0.224	0.082	0.206	-0.071	0.1141
Pb	-0.103	-0.059	0.063	-0.002	-0.597	0.3748
Zn	0.178	-0.069	-0.096	-0.453	-0.469	0.4712
Cu	0.247	-0.019	-0.251	-0.054	-0.445	0.3252
As	0.033	-0.109	-0.149	0.126	-0.342	0.1682
W	0.032	-0.033	-0.139	0.506	-0.003	0.2777
Sn	0.011	0.100	-0.568	-0.005	-0.234	0.3868
La	0.923	0.008	-0.095	-0.027	-0.052	0.8643
Ce	0.893	0.013	0.006	-0.123	0.030	0.8128
Nd	0.883	-0.161	-0.071	0.184	-0.077	0.8498
Sm	0.894	-0.210	-0.108	-0.007	-0.036	0.8570
Eu	0.486	-0.018	0.122	0.407	-0.199	0.4574
Tb	0.486	-0.450	-0.214	-0.282	-0.078	0.5703
Yb	0.083	-0.794	0.022	0.030	-0.076	0.6451
Lu	0.223	-0.667	-0.083	0.107	-0.077	0.5184
Nb	0.364	-0.251	-0.591	-0.150	-0.040	0.5690
Ta	-0.009	-0.123	-0.637	0.173	-0.005	0.4503
U	0.154	-0.536	-0.380	-0.082	-0.072	0.4676
Th	0.700	-0.368	-0.199	-0.144	-0.000	0.6853

Factor contribution (%)

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
54.161	17.474	11.366	9.013	8.244

Table IV - 3 - 1 Statistical values of each element in the Area c

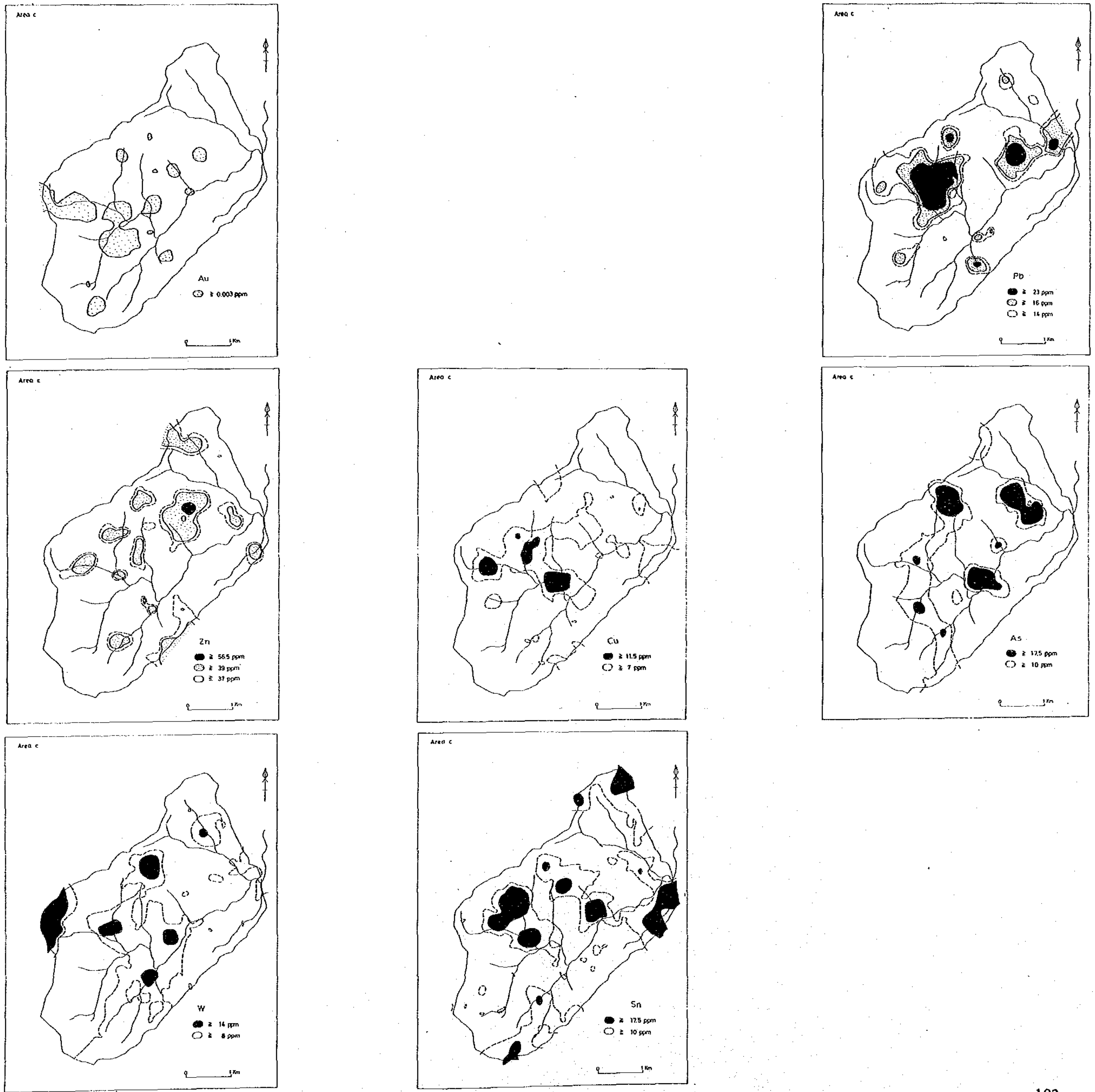


Fig. IV–3–1 Distribution map of elements in rock samples in the Area c (1)

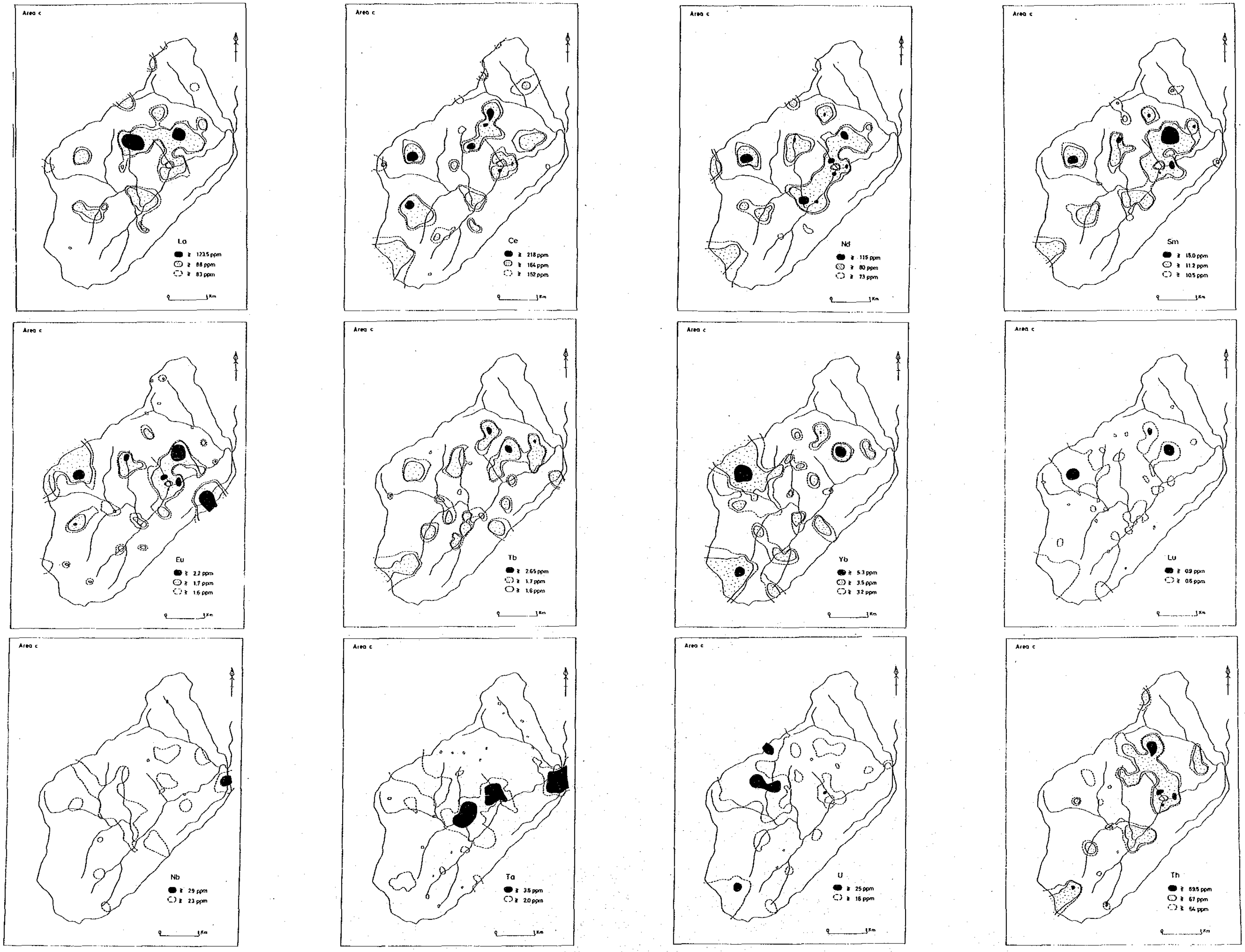


Fig. IV–3–1 Distribution map of elements in rock samples in the Area c (2)

Anomalous zones of Au are distributed like small isles in the western and central parts of the area. Correlation between geology and anomalies is not so clear due to poor exposures.

Pb

Minimum value = 2ppm, maximum value = 80 ppm. The corresponding boxplot is wide, showing 10ppm as a median value.

The distribution map is illustrated by the three divisions of upper fence (23ppm), upper whisker (16ppm) and upper hinge (14ppm). The anomalous zones tend to extend in a ENE - WSW direction from the central part of the area. The alteration zone (kaolinization) located in the lower reaches of S. Jopal is in the anomalous zone.

Zn

Minimum value = 2ppm, maximum value = 76 ppm. The boxplot is wide and shows 33ppm as a median value.

The distribution map is illustrated by the three divisions of upper fence (56.5ppm), upper whisker (39ppm) and upper hinge (37ppm). The anomalous value over the upper fence was detected at only one site in the eastern part of the area. On the whole, high Zn - content zone tend to scatter and not to concentrate.

Cu

Minimum value = 2ppm, maximum value = 36 ppm. The boxplot is wide. The median value = 6ppm.

The distribution map is illustrated by three divisions of upper fence (11.5ppm), upper hinge (7ppm) and lower hinge (4ppm). The anomalous zones over the upper fence are located in the central part, extending along NNW-SSE and NE-SW directions. Relationship between anomalies and geology is not clear due to no exposure.

As

Minimum value = 3ppm, maximum value = 80 ppm. The boxplot is truncated towards lower content side. The median value is 5ppm.

The distribution map is illustrated by three divisions of upper fence (17.5ppm), hinge (10ppm), lower hinge (5ppm). The anomalies over upper fence are scattered in the central to eastern area and in the central to southern area. The Au anomalies are not overlapped with the anomalies of any other element.

W

Minimum value = 4ppm, maximum value = 80 ppm. The boxplot with a median of 8ppm, is truncated towards lower content side. The median value is 5ppm.

The distribution map is illustrated by divisions of upper fence (14ppm) and upper hinge (8ppm). The relatively high values over upper hinge are located in the central part, extending in a N-S direction.

Sn

Minimum value = 5ppm, maximum value = 70 ppm. The boxplot with a median of 10ppm is truncated towards lower content side. The median value is 5ppm.

The distribution map is illustrated by two divisions of upper fence (17.5ppm) and upper hinge (10ppm). Anomalies over upper fence are scattered without no trend, but relatively high values over upper hinge tend to extend along a NW-SE direction.

REE with U Th

The upper fence value of each element is as follows;

La:	123.5 ppm	Yb	5.3 ppm
Ce:	218	Lu	0.9
Nd:	115	Nb	2.9
Sm:	15	Ta	3.5
Eu:	2.2	U	25
Tb:	2.65	Th	89.5

The anomalies over upper fence are apt to cover small areas or scatter. As shown in Fig. I-3-5, there are 7 places where anomalies of more than 4 elements are overlapped. However, they are sporadically distributed without a horizontal extension.

[3] Multivariate Analysis

Through factor analysis for all the rock samples (123pcs), 5 factores were extracted, as shown in Table IV-3-1. The contributions of Factor 1, Factor 2 and Factor 3 are 54.2%, 17.5% and 11.1%, making a total contributions of 83%. These three factors are discussed as follows;

Factor 1

Among REE, Factor 1 is much affected by La, Ce, Nd, Sm, Th, etc.

High scores of Factor 1 are distributd in the main stream of S. Jopal.

Factor 2

Factor 2 is affected by Yb, Lu, U etc.

High scores of Factor 2 scatter in the area. They are partially overlapped with Factor 1 high scores, but on the whole they are distributed as if they surrounded the Factor 1 high scores.

Factor 3

Factor 3 is affected by Sn, Nb, Ta etc.

High scores of Factor 3 are scattered in the central area, without overlapping with other factors.

3-2 Discussions

In Phase I, geochemical stream sediment survey disclosed anomalies of Au, Sn and REE in this area. The Phase II geochemical rock survey revealed Au anomalies in the upper reaches of the river where the phase I anomalies were detected.

The Sn anomalies obtained in this phase also correspond to the Phase I anomalies. However, no Au-bearing quartz veins and Sn-bearing quartz veins were found due to limited exposures.

The anomalies of REE are overlapped at 7 places. All of them are sporatically distributed and seems to have no relationship among them. Therefore, the anomalies are considered to be reflected by the local accessory minerals of rocks.

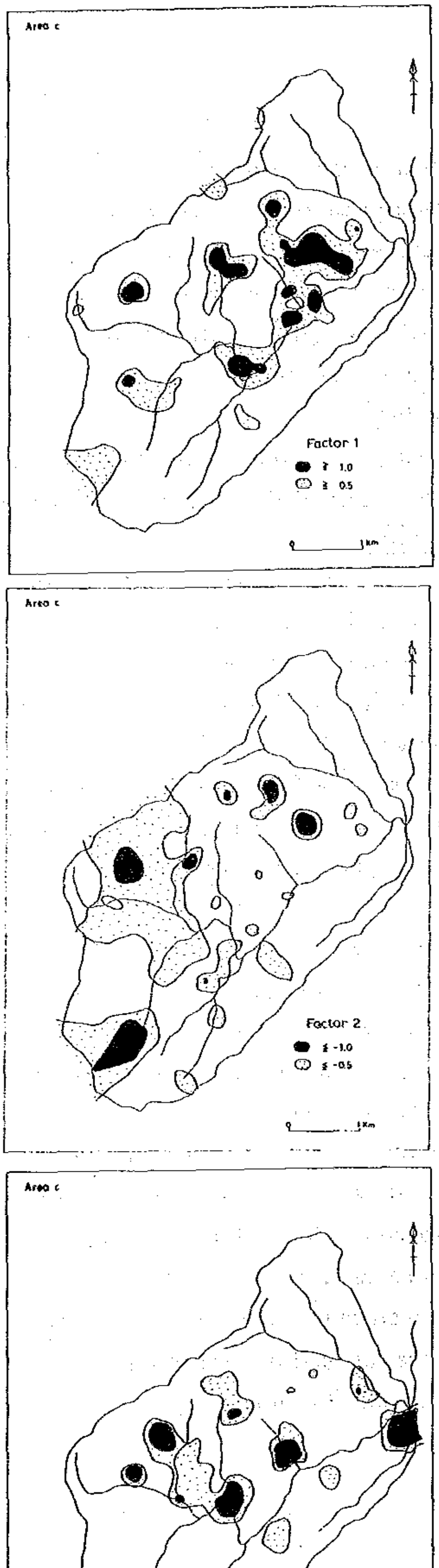


Fig. IV - 3 - 2 Factor analysis map in the Area c

Chapter 4 General Discussion on the Survey Results

The whole area is composed of the Main Range granite, which has a uniform appearance and bears characteristically megacrysts (2-5cm in size) of K-feldspar.

Main structural lines are along NE-SW and NW-SE systems.

A N-S system is also recognized. Ten odd tourmalin-quartz veins were found in the fissures of granite. However, they were almost barren. Greisen, silicification and kaolinization were locally distributed.

A geochemical anomaly map based on 123pcs of rock samples is shown in Fig. I-3-5.

All elements tend to be distributed sporadically. Only in the central part of the area, anomalies of Au, Cu, Pb, Sn, W are partially overlapped. Those anomalies are probably the same source of Au and Sn anomalies which were detected by Phase I stream sediment survey.

According to Hutchison C. S. (1977), Hosking K.F.G. (1977), Schwarts M.O. (1989) and MMAJ (JICA)-GSM (1989), the mean values of Au and Sn in the Main Range granite are Au = 0.009ppm and Sn = 10ppm.

Compared with these values, the contents of the above-mentioned anomalies are only 1-5 times bigger.

PART V CONCLUSIONS AND RECOMMENDATIONS

Chapter 1 Conclusions

Based on the results of gological, geochemical and geophysical (gravity method) surveys, and drilling carried out in Phase II in Perak, Malaysia, the following conclusions were drawn:

(1) Area A (Areas a-1, a-2 and a-3)

[1] Area a-1, a-2 and a-3 are composed of Paleozoic phyllite and the Main Range granite, which intruded into the phyllite in the Permian -Triassic age.

[2] In the Area a-1, an Au-As anomalous zone (width = 0.6km, length = 1.4km, mean = 0.410ppm Au maximum = 2.708ppm Au) is located near the boundary between the Main Range granite and phyllite. The Au contents tend to increase towards depth. As anomalies of Zn, Sn and W are overlapped here, this anomalous zone is considered to have high potential for Au deposits.

[3] In the Area a-2, geochemical Au anomalis were detected in phyllite on the east of granitic stock. However, their mean and maximum values of Au are 1/4 and 1/6 times as low as those of the Area a-1, therefore this area has low potential for Au resources.

[4] In the Area a-3, geochemical Au anomalies were obtained along S. Chebor. The mean and maximum Au values are 1/4 and 1/20 times as low as those of the Area a-1, indicating low potential for Au deposits.

(2) Area B (Area b)

[1] Gravity survey revealed the bedrock relief under the Quaternary sediments. The relief structure of the bed rock shows in the NE part an usual vertical height difference of more than 100m.

A U-shaped hollow open toward north was also estimated in the central part. Both hollows seem to be a trace of ancient rivers.

[2] Three (3) drillhole encountered placer tin beds on the crest of bedrock. The past drillholes conducted by GSM are also located over the crest of bedrock. A follow-up survey is needed for hollows.

[3] The superficial clays obtained by drilling are of not so high quality and may, therefore, be used for bricks or tiles.

(3) Area C (Area c)

[1] The whole area is composed of the Main Range granite with a porphyritic texture.

[2] Geochemical rock survey disclosed Au and Sn anomalous zones in the central part with sporadical REE anomalous zones. The anomalous values themselves are very low, therfore, potential for Au, Sn and REE seems very low.

Chapter 2 Recommendations for Phase III Survey

Based on the above-mentioned conclusions, the following activities are recommended for Phase III survey.

(1) Area a-1: To carry out drilling in order to clarify details of mineralization in the Au-Au geochemical anomalous zone which is located near the boundary between the Main Range granite and phyllite in the northeastern part of the area.

(2) Area b: To carry out gravity survey in order to clarify the bedrock relief in the surrounding area of the Phase II area and to carry out drilling in order to investigate details of tin ore deposits in the hollows.

References

Chu L.H.(1985) Heavy Mineral Concentrates and Rock Sampling in Tin Exploration SEATRAD, Technical Publication No.5 pp. 91-96

Fateh C.(1980) A Manual of Geochemical Exploration Methods GSM. Spdeial Paper 3

Fleher W.K. et al.(1984) Behaviour of Tin and Associated Elements in a Mountain Stream, Bujang Melaka, Perak, Malaysia Report Investigation No.24 April 1984 SEATRAD

Gan A.S.(1) The geology and mineral resources of the Tanjong Malim Area, Perak

Goldstein, M.A. et al (1975) Audio Frequency Magntotelluric with a Ground Dipole Source. Geophysics vol 40. pp. 669-684

Hagiwara Y.(1982) A Formula Expressing Vertical Gradient of Normal Gravity, Journal of the Geodetic Society of Japan, Vol. 28, No.3, pp. 177-178

Hall, M.L. et al.(1982) Geochronological Control for the Main Tectonic-Magmatic Events of Ecuador, Ear. Sci. Rev., 18, pp. 215-239

Hosking K.F.G.(1977) Known Relationships between the 'Hard-Rock' Tin Deposits and the Granites of Southeast Asia. Geol Soc. Malaysia, Bulletin 9, Nov. 1977: pp. 141-157

Hutchison. C.S.(1977) Granite Emplacement and Tectonic Subdivision of Peninsular Malaysia Geol, Soc. Malaysia, Bulletin 9. Nov. 1977 pp. 187-207

Ingham E.T.(1938) The Geology of the Neighbourhood of Tapah and Telok Anson, Perak, with an Account of the Mineral Deposits GSM Memoir No.2

Kurzl, H. (1988) Exploratory Data Analysis, J.Geochem. Exploration 30, pp.309-322

Loh C.H. (1987) Quaternary Geology of the Teluk Intan Area GSM report (unpublished)

Mitchell A.H.G.(1977) Tectonic settings for Emplacement of Southeast Asian Tin Granites. Geol Soc. Malaysia, Bulletin 9, Nov 1977 pp. 123-140

Schwartz M.O. et al (1989) Geologic, Geochemical and Gluid Inclusion Studies of the Tin Granites from the Bujang Melaka Pluton, Kinta Valley, Malaysia. Economic Geology Vol 84, 1989, pp.751-779

SHARIF A.B.(1986) JARINGAN GRAVITI ASAS SEMENANJUNG MALAYSIA, Jabatan Geodesi dan Astronomi Fukulti Ukur Universiti Teknologi Malaysia

Zantop, H.et al.(1979) Heavy-Mineral Panning Techniques in Exploration for Tin and Tungsten in Northwestern Spain in Geochemical Expolration 1978, Association of Expolration Geochmists, Rexdale Ont., pp. 329-336

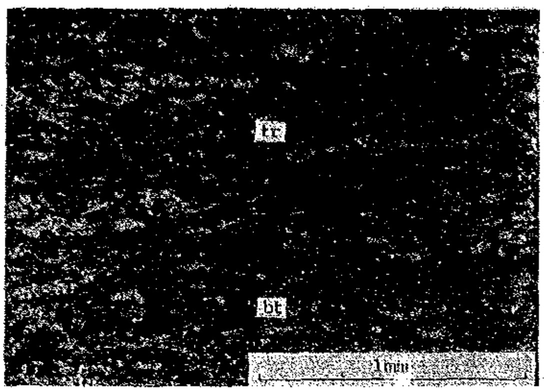
Wilson I.R. (1989) A Report on the Ball Clays from the State of Perak, Malaysia pp. 7-15 (unpublished)

APPENDIXES

Photo A - 1 Microphotograph of Thin Section

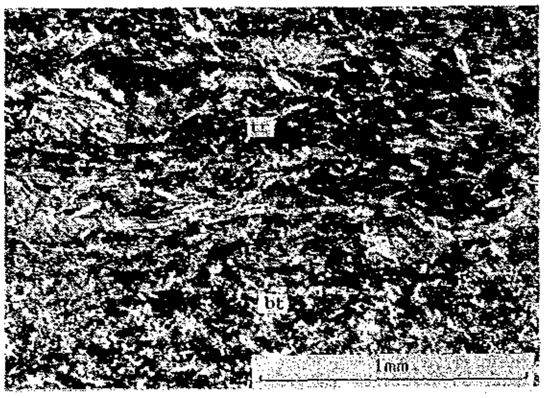
Abbreviation

q : quartz
pl : plagioclase
K–f : potash feldspar
bt : biotite
tr : toremolite
ch : chlorite
se : sericite
cb : carbonic material

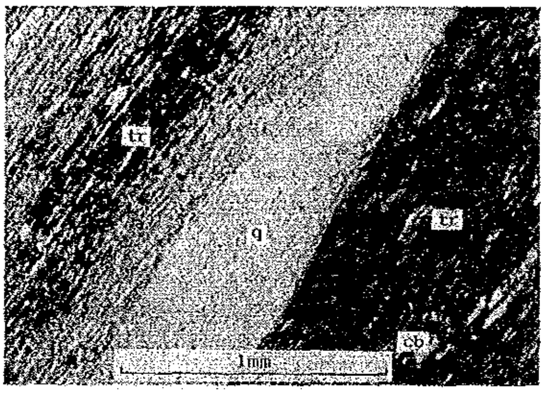


Sample No. : Y 15
Rock name : hornfels
Location : Area a–1
Texture : nematoblastic

(only lower polar)

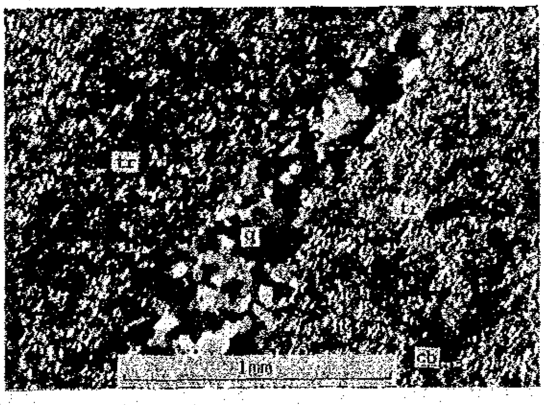


(crossed polars)

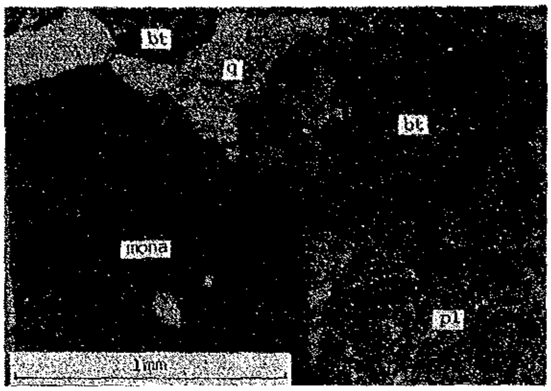


Sample No. : Y 53
Rock name : graphite phyllite
Location : Area a–1
Texture : nematoblastic

(only lower polar)

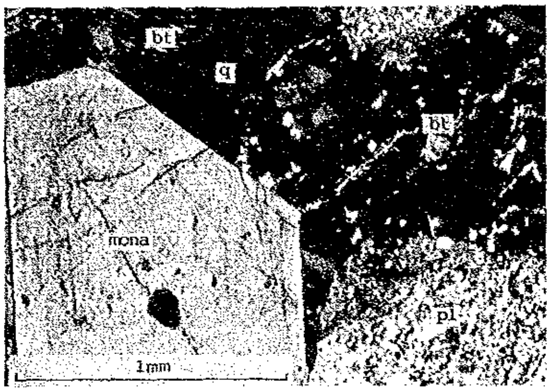


(crossed polars)

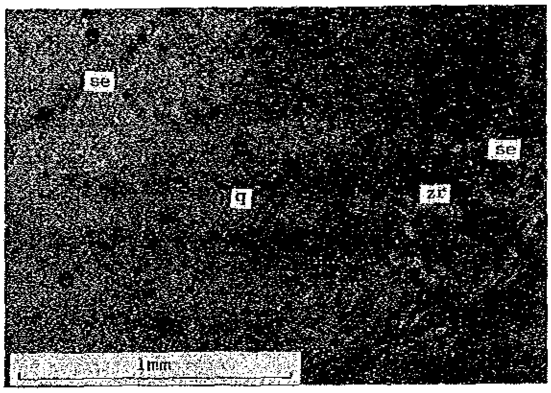


Sample No. : CY 18
Rock name : granite
Location : Area c
Texture : porphyritic

(only lower polar)

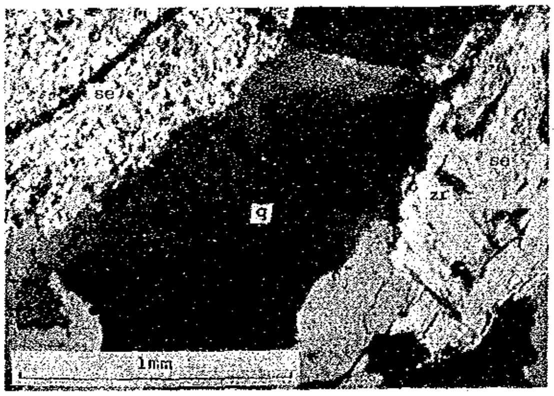


(crossed polars)

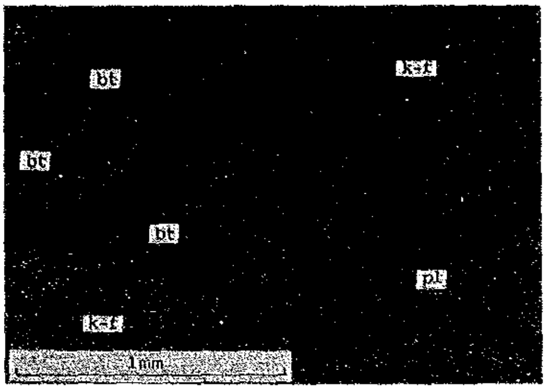


Sample No. : CY 20
Rock name : granite
Location : Area c
Texture : granoblastic

(only lower polar)

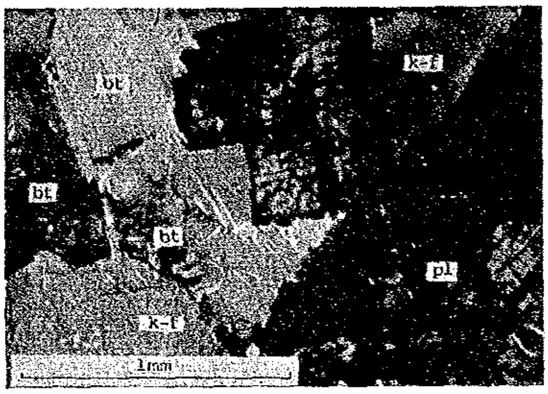


(crossed polars)

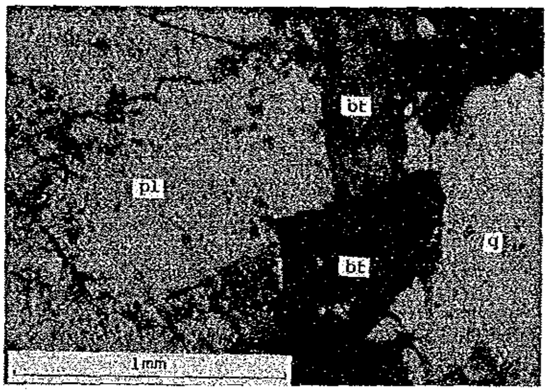


Sample No. : CF 27
Rock name : granite
Location : Area c
Texture : porphyritic

(only lower polar)



(crossed polars)



Sample No. : CF 41
Rock name : granite
Location : Area c
Texture : porphyritic

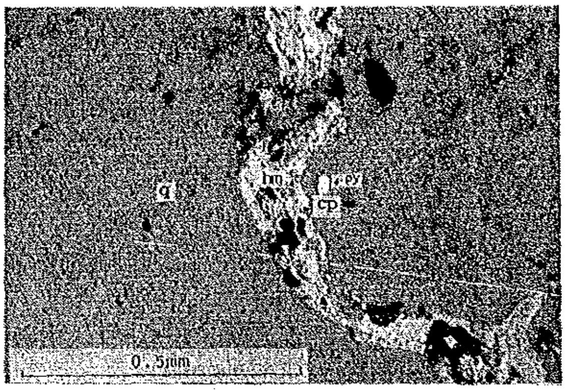
(only lower polar)

(crossed polars)

Photo A - 2　Microphotograph of Polished Section

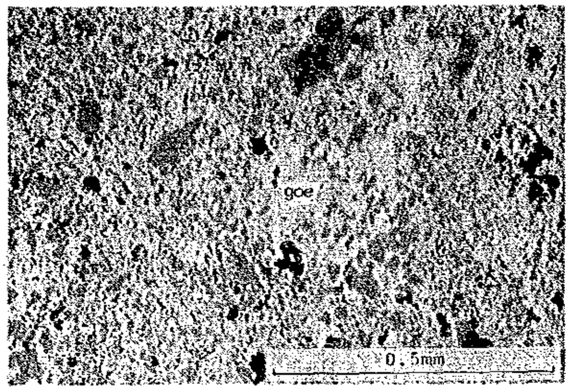
Abbreviation

py : pyrite
cp : chalcopyrite
goe : goethite
q : quartz
hm : hematite



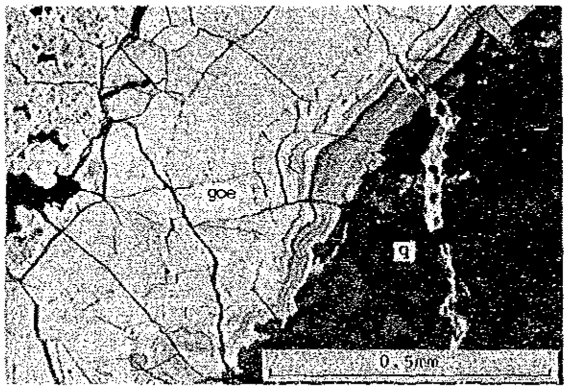
Sample No. : F 26
Ore name : quartz vein
Location : Area a–1

(only lower polar)



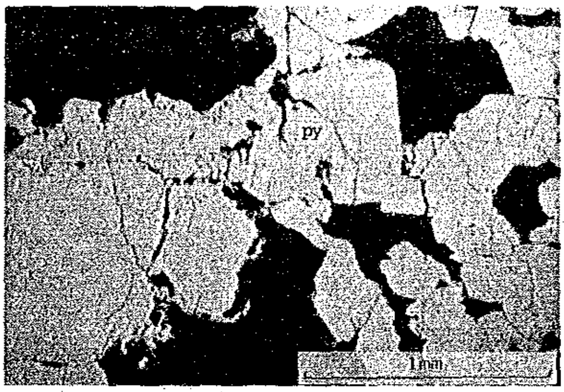
Sample No. : Y 02
Ore name : goethite-hematite ore
Location : Area a–1

(only lower polar)



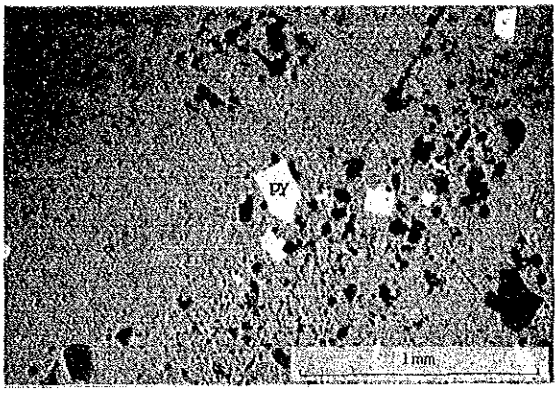
Sample No. : Y 26
Ore name : goethite-hematite ore
Location : Area a–1

(only lower polar)



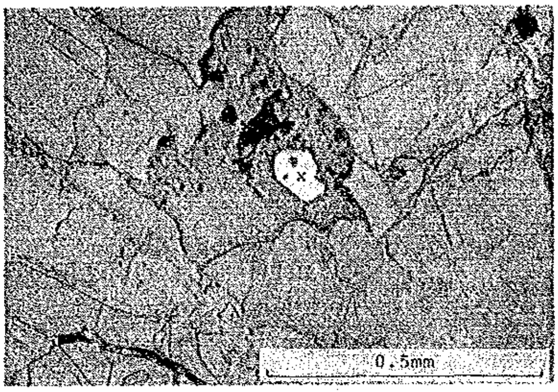
Sample No. : Y 57
Ore name : quartz vein
Location : Area a–1

(only lower polar)



Sample No. : Y 60
Ore name : quartz vein
Location : Area a–1

(only lower polar)



Sample No. : CY 52
Ore name : unknown mineral (x)
Location : Area c

(only lower polar)

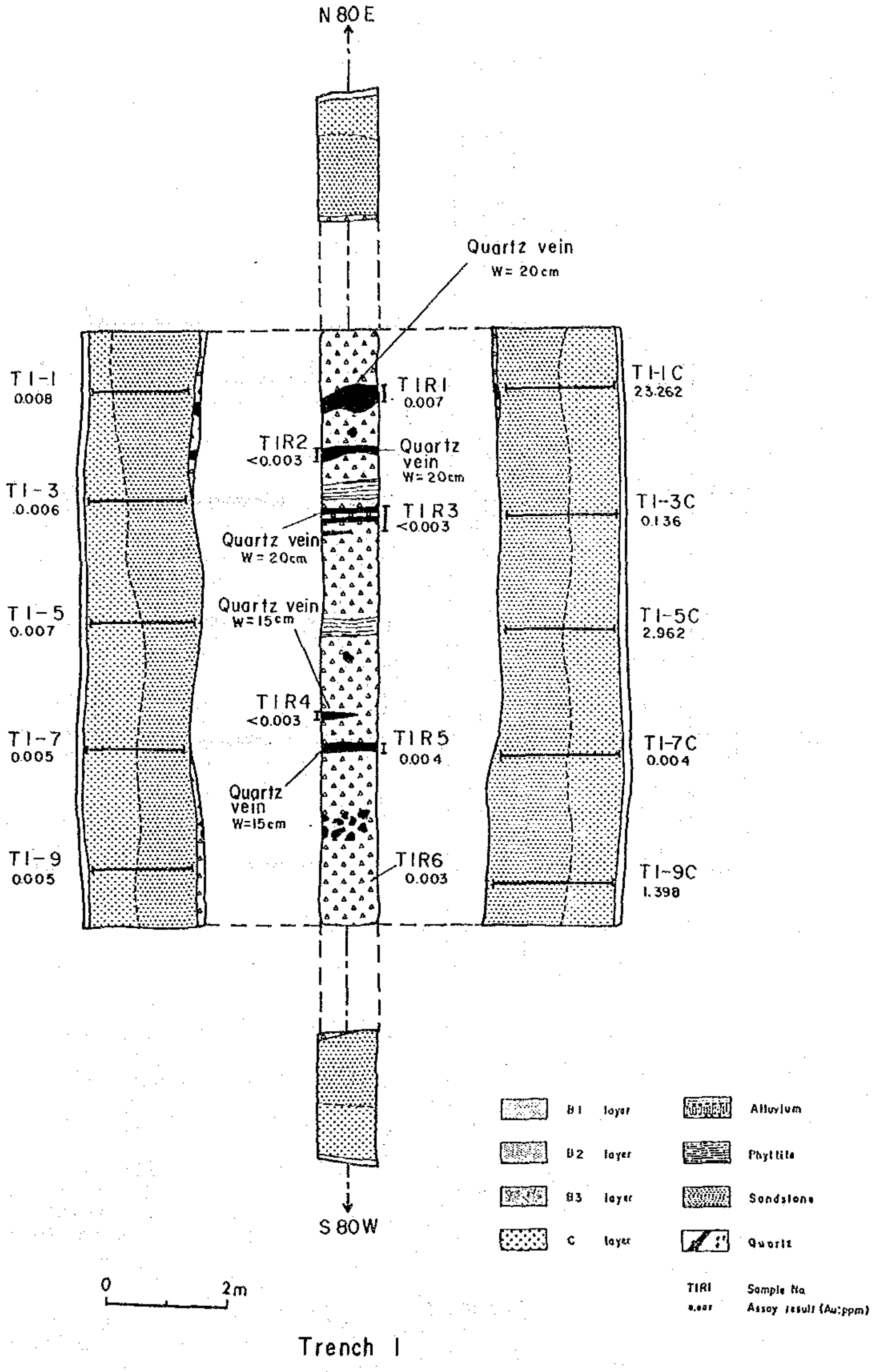
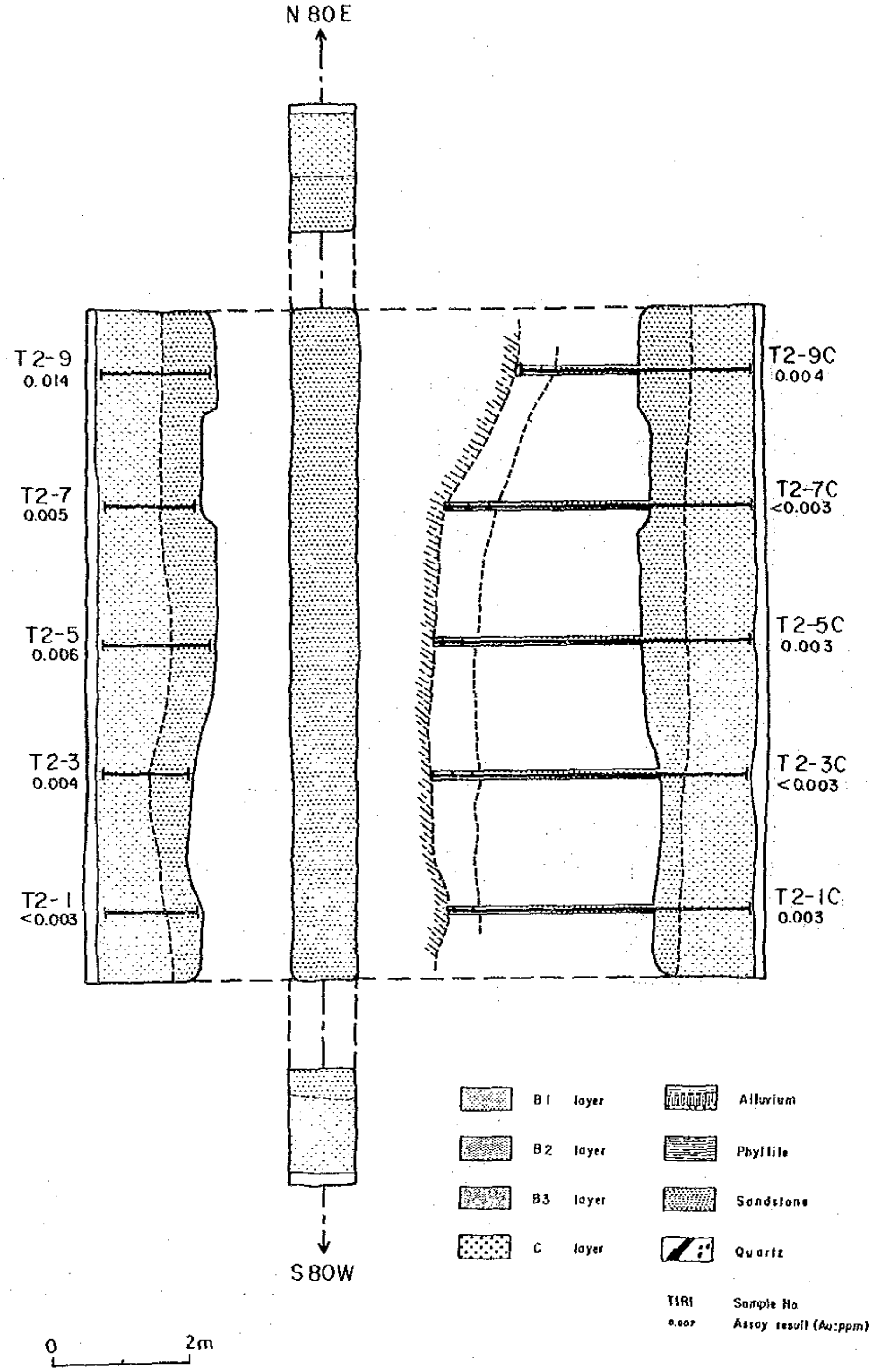
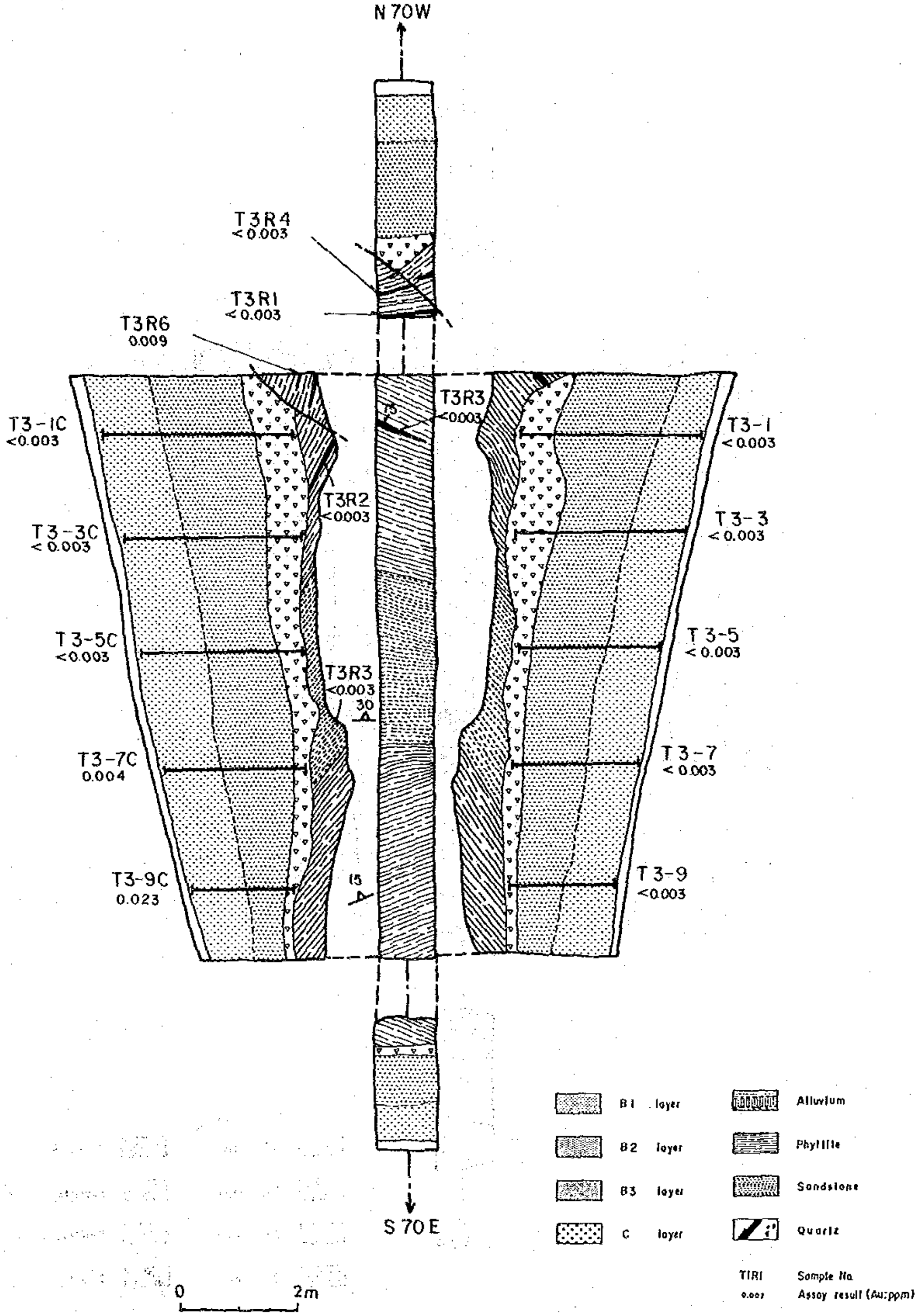


Fig. A–1 Sketch map of trenches in the Area a-1 (1)



Trench 2

Fig. A–1 Sketch map of trenches in the Area a-1 (2)



Trench 3

Fig. A–1 Sketch map of trenches in the Area a-1 (3)

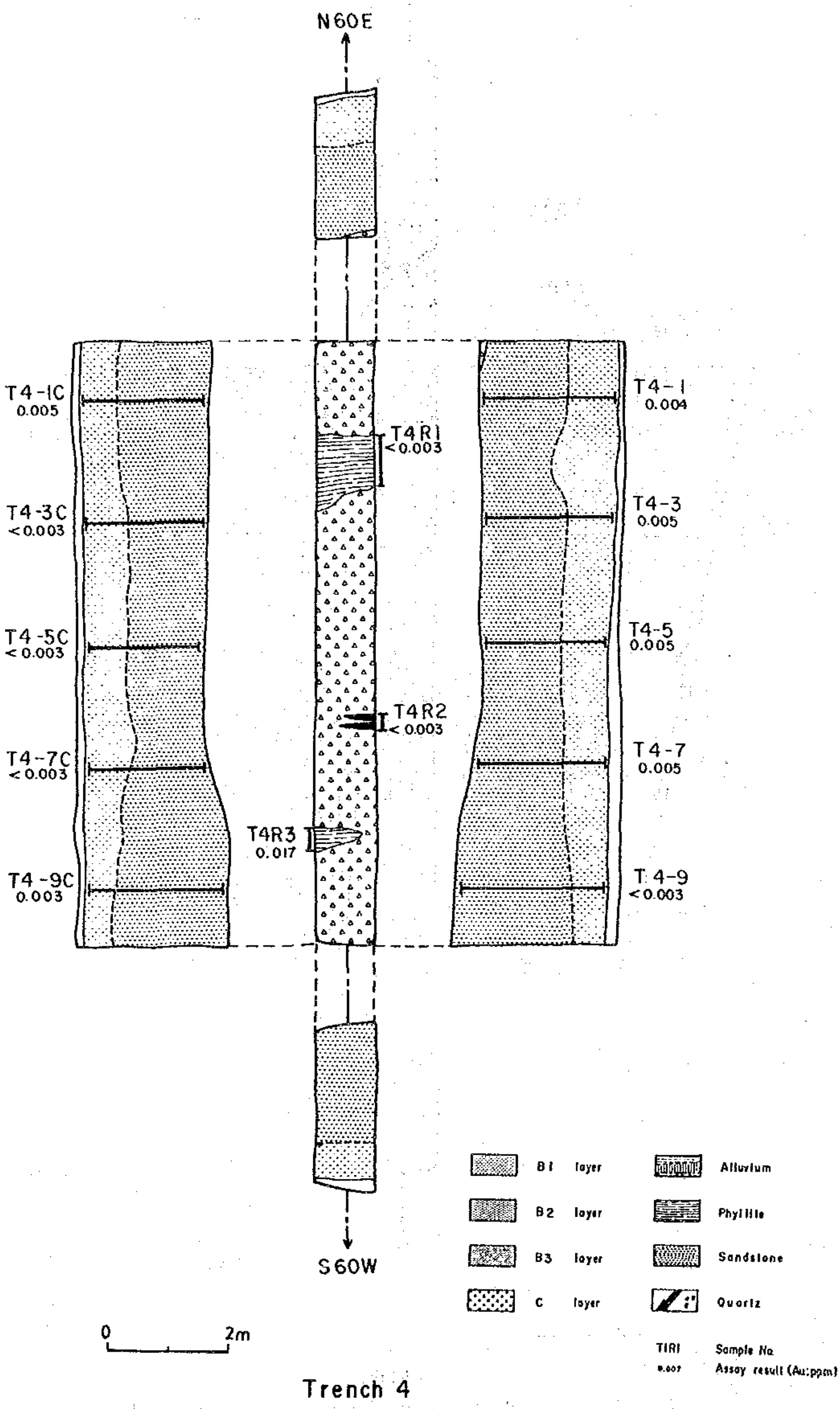
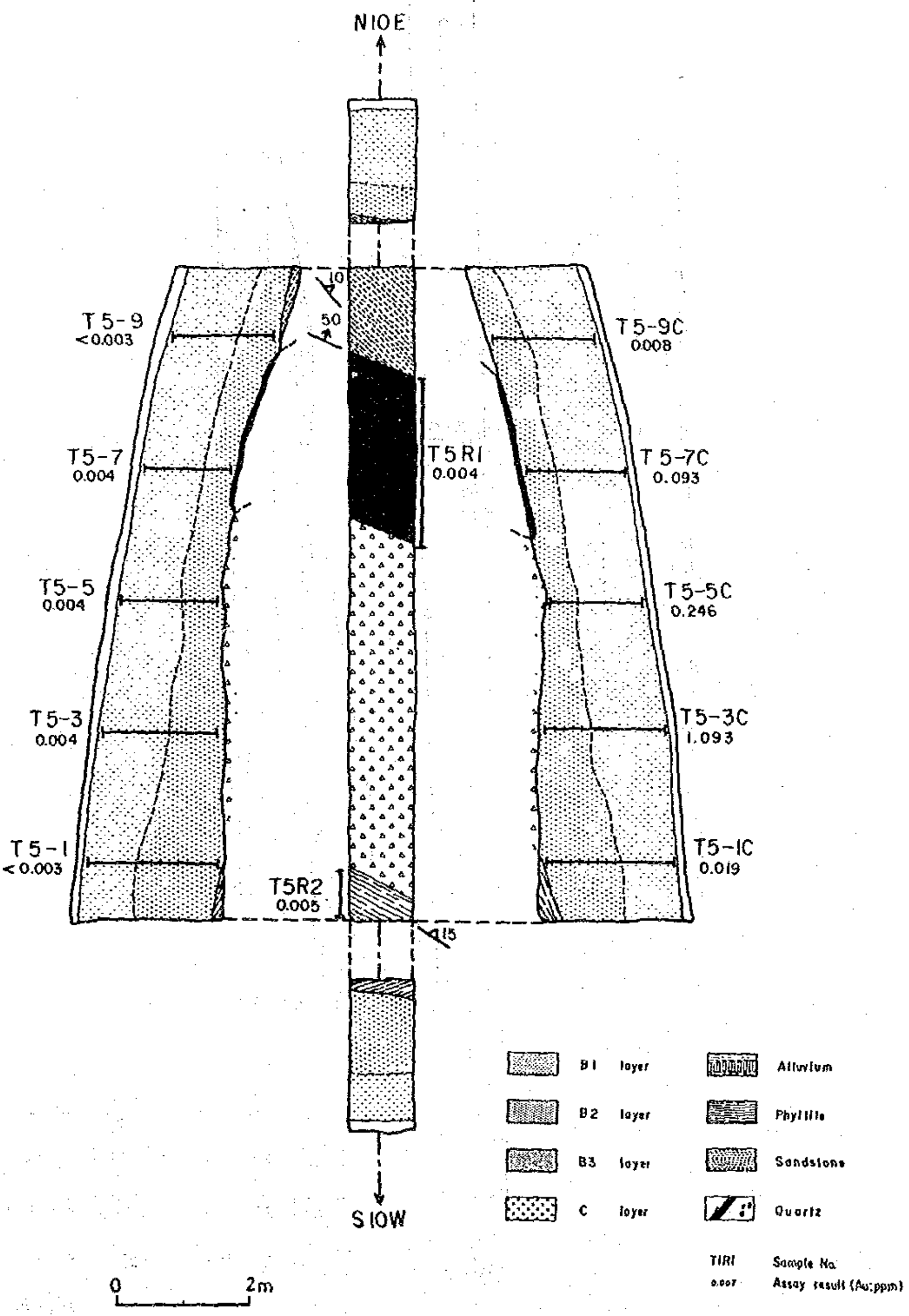
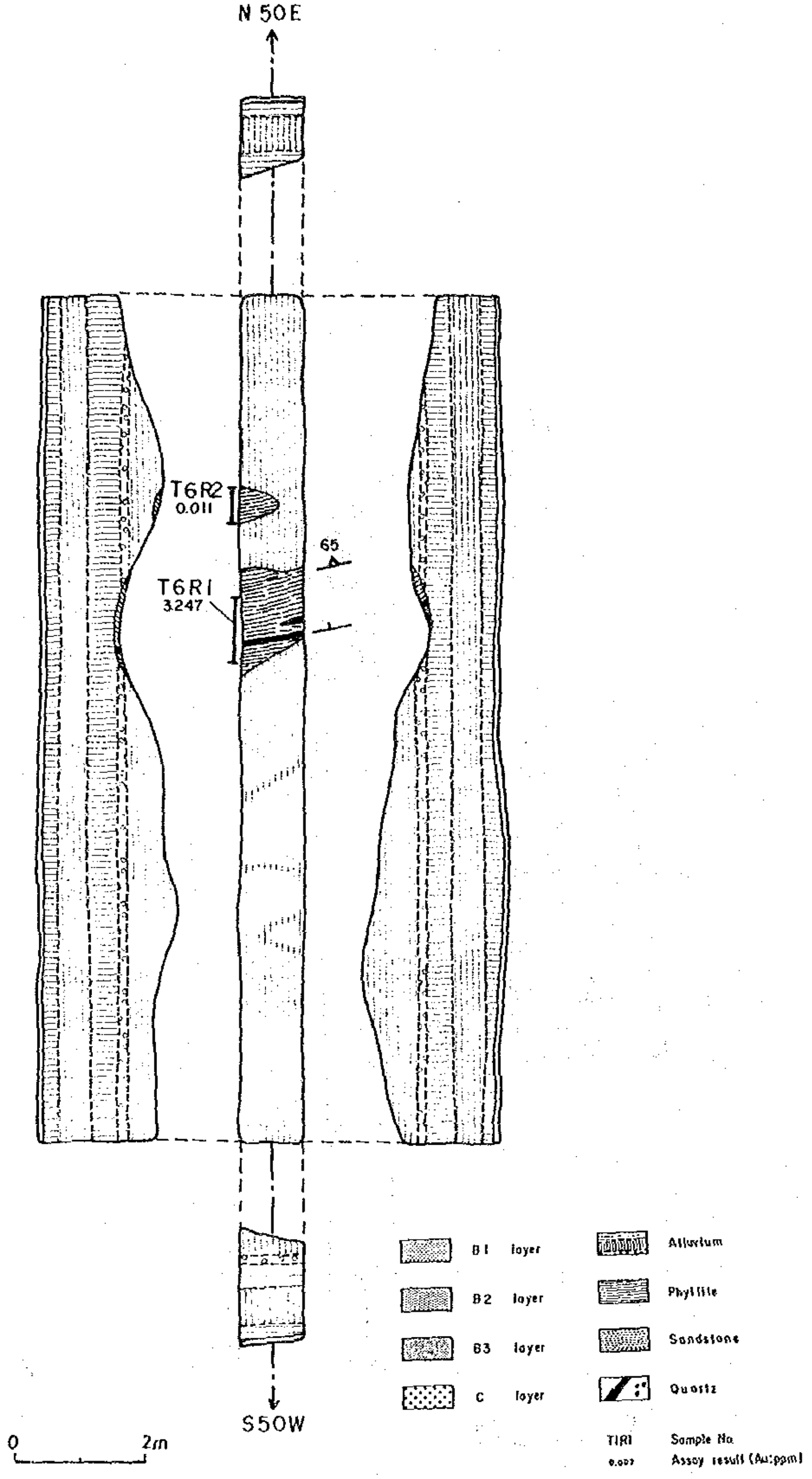


Fig. A–1 Sketch map of trenches in the Area a-1 (4)



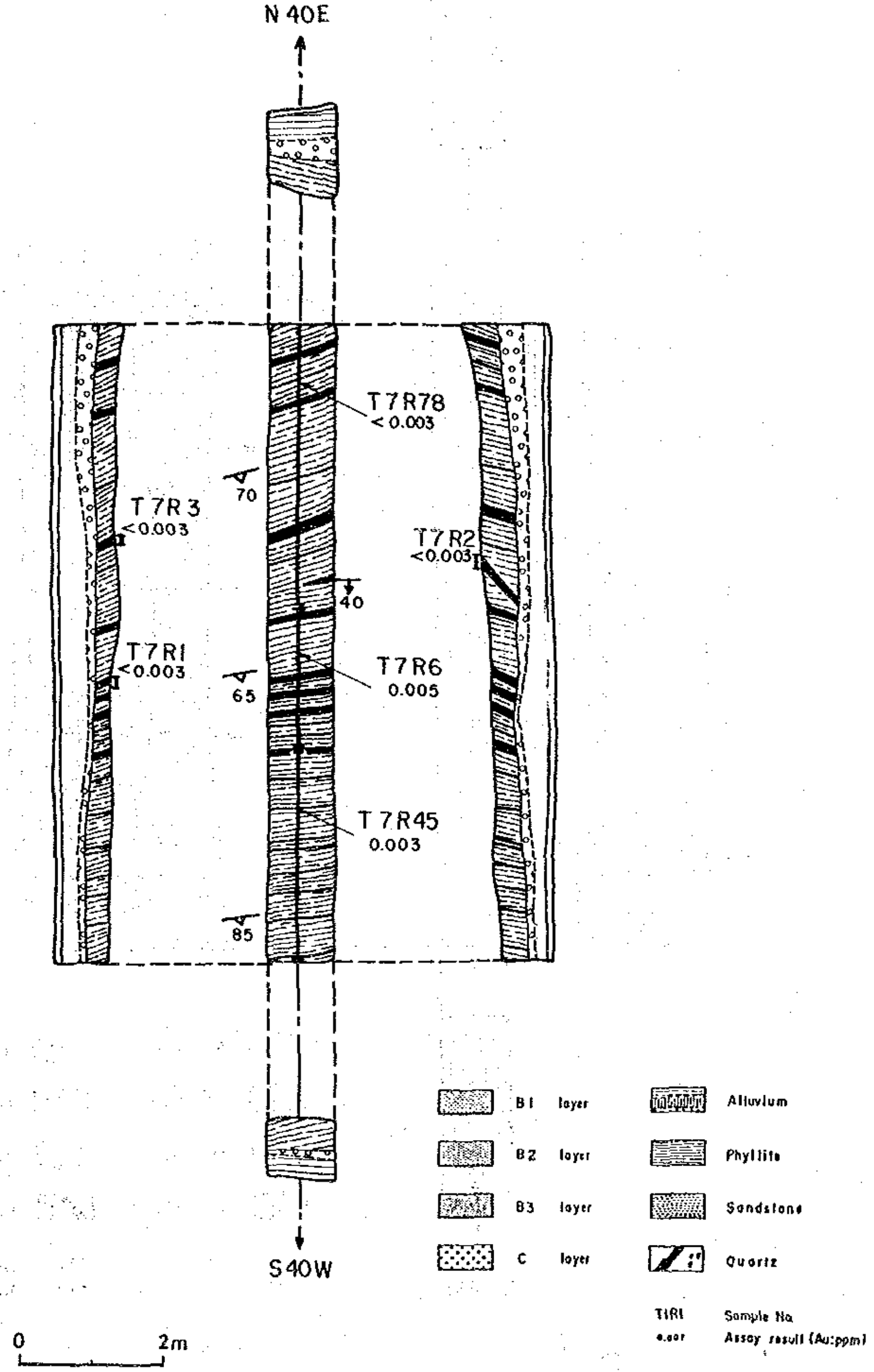
Trench 5

Fig. A-1 Sketch map of trenches in the Area a-1 (5)



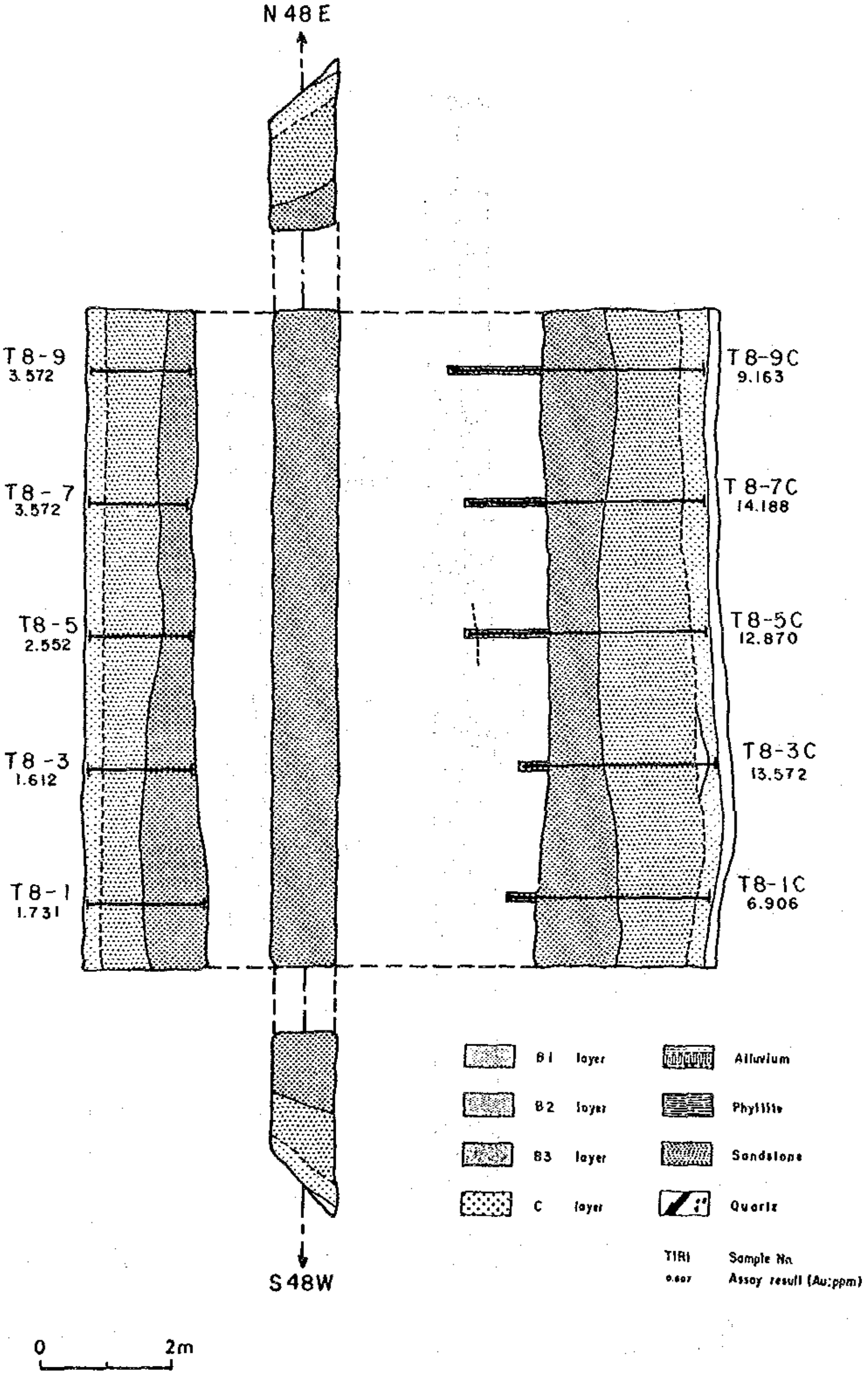
Trench 6

Fig. A−1 Sketch map of trenches in the Area a-1 (6)



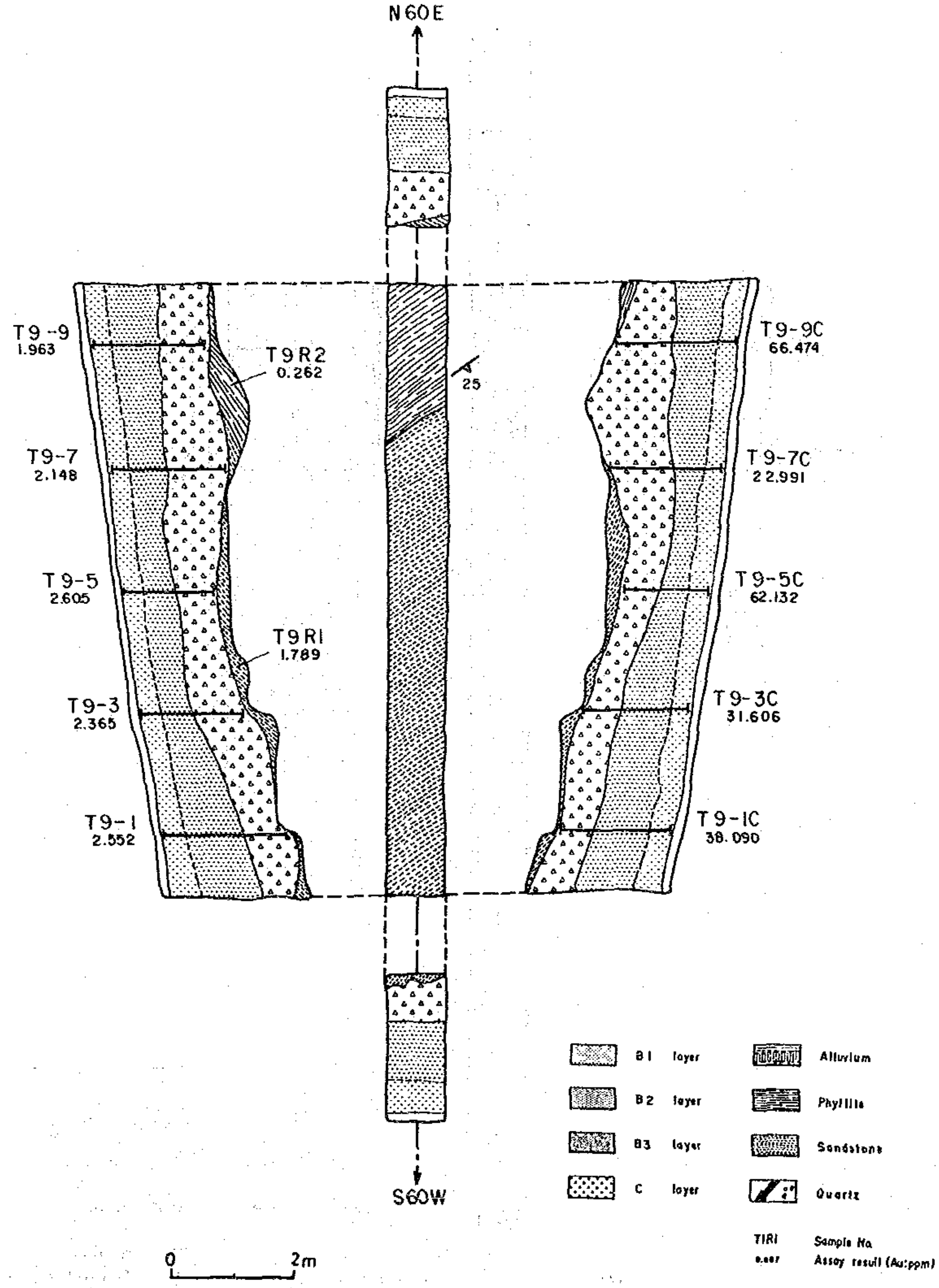
Trench 7

Fig. A-1 Sketch map of trenches in the Area a-1 (7)



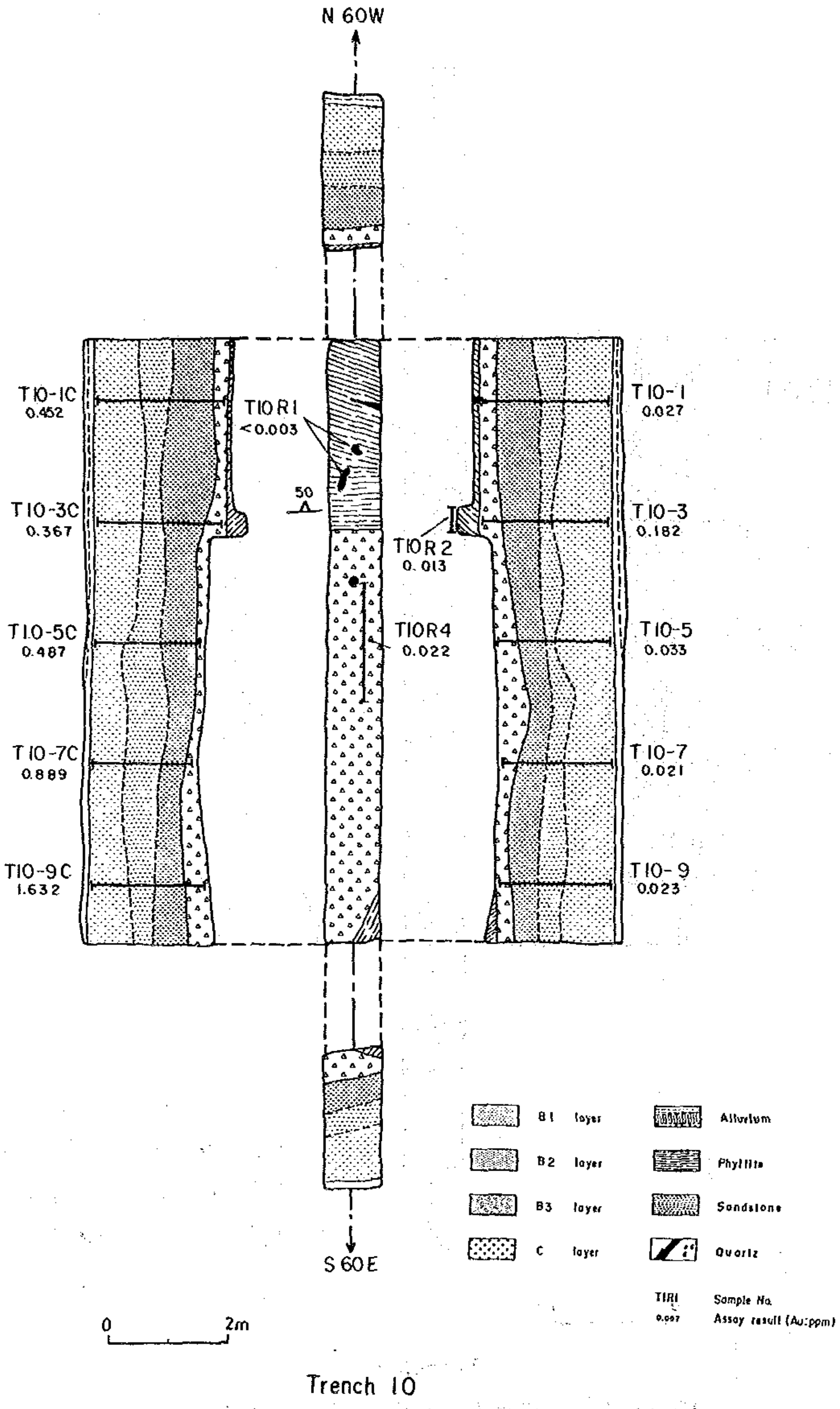
Trench 8

Fig. A–1 Sketch map of trenches in the Area a-1 (8)



Trench 9

Fig. A–1 Sketch map of trenches in the Area a-1 (9)



Trench 10

Fig. A-1 Sketch map of trenches in the Area a-1 (10)

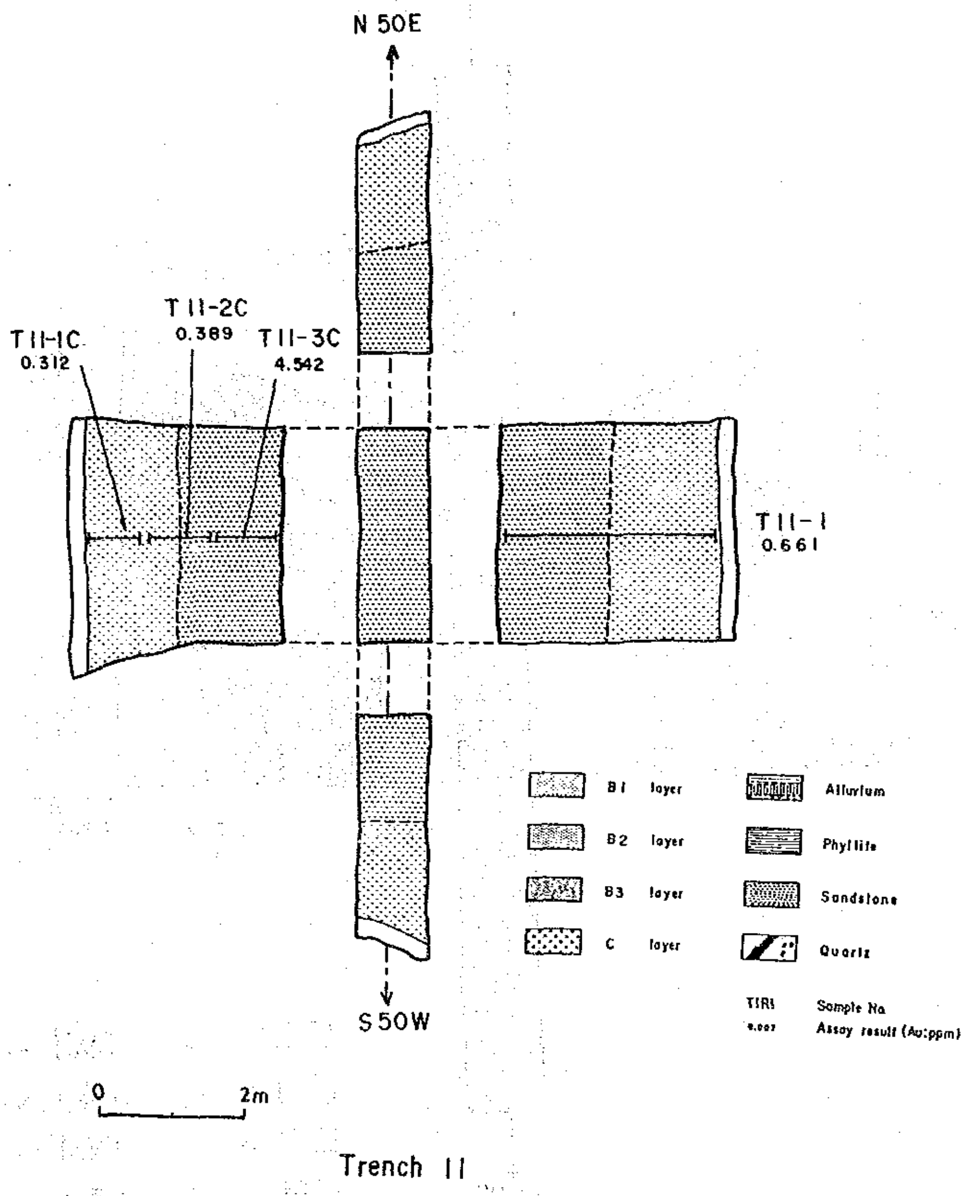
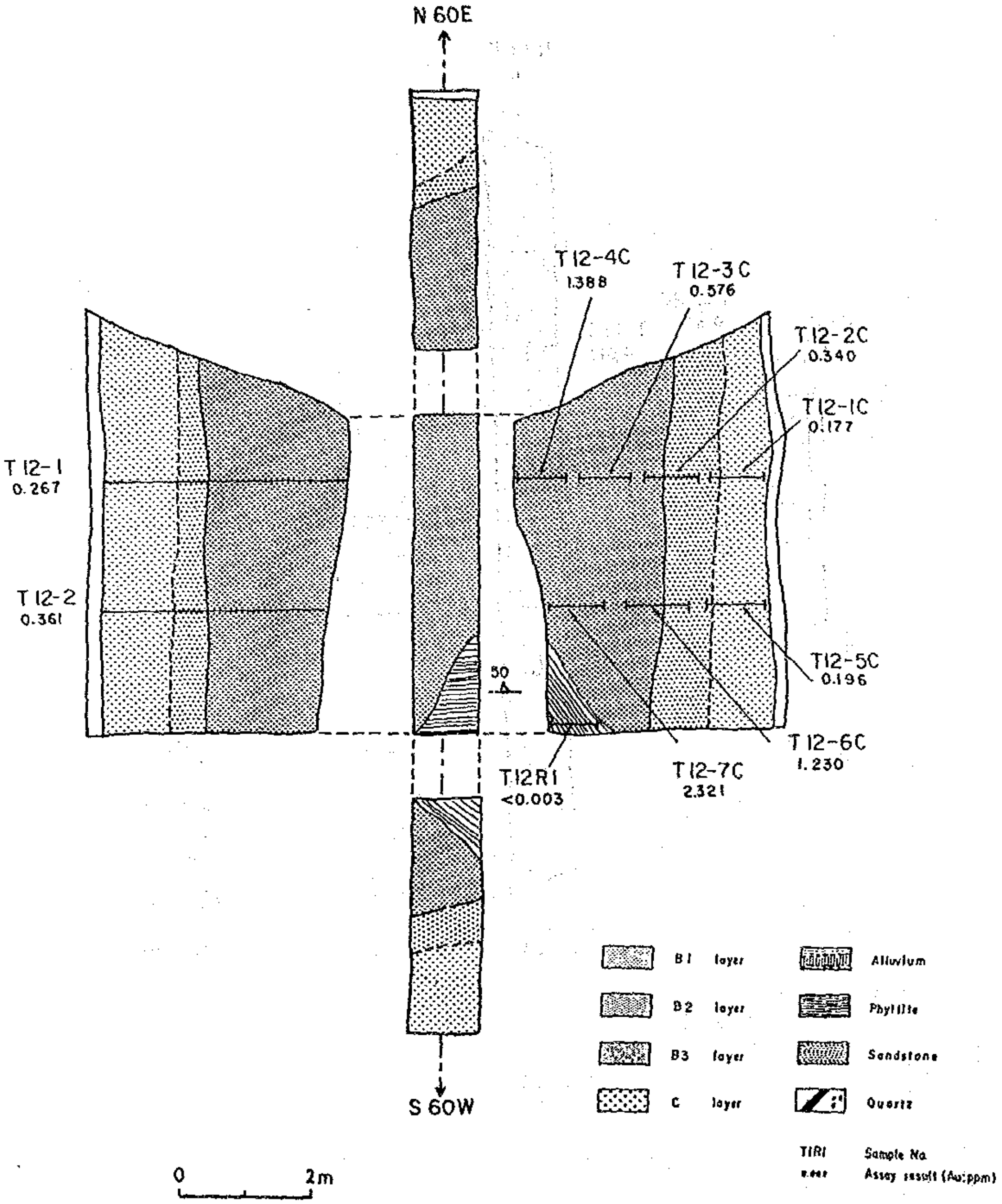


Fig. A-1 Sketch map of trenches in the Area a-1 (11)



Trench 12

Fig. A–1 Sketch map of trenches in the Area a-1 (12)

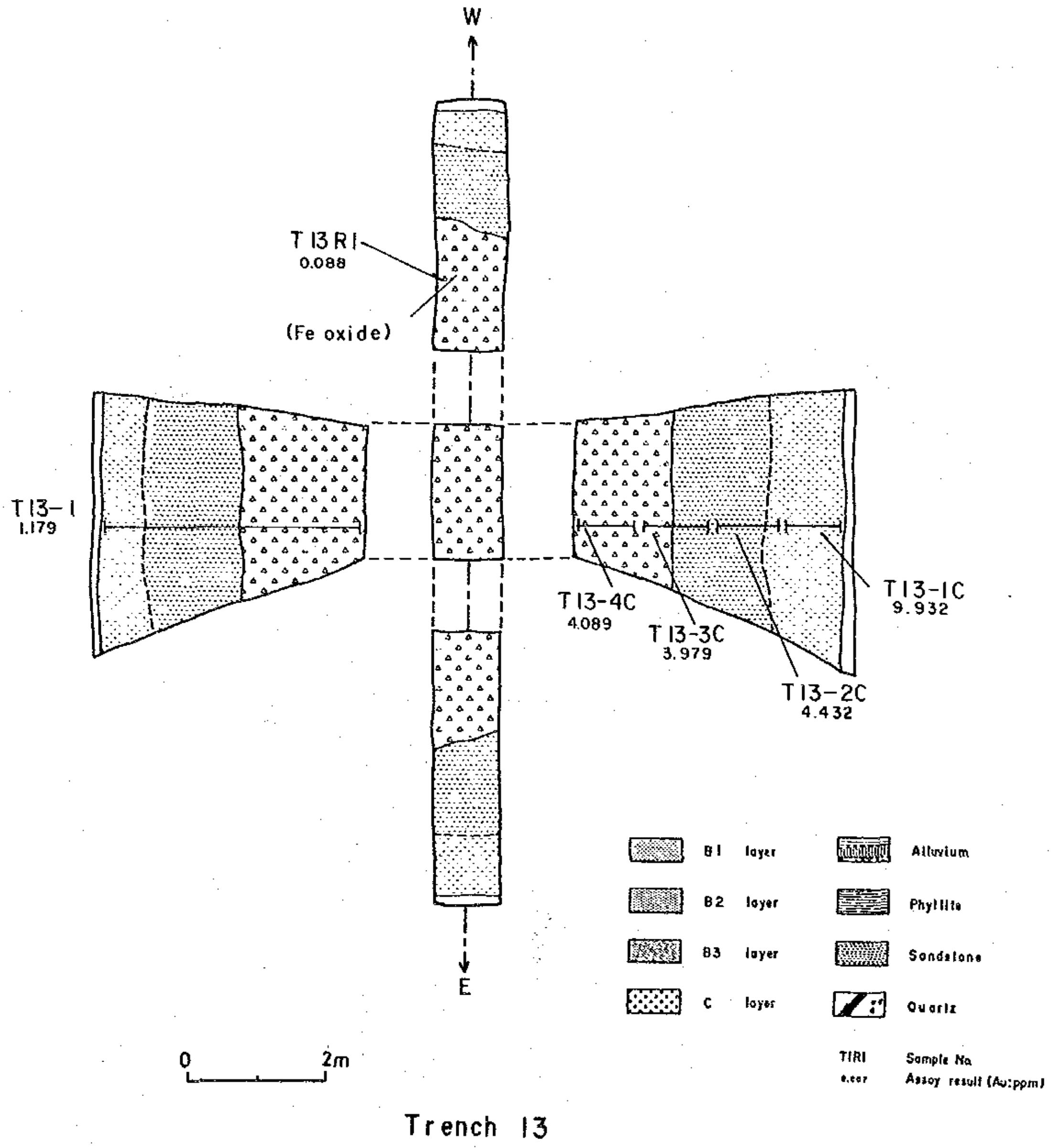
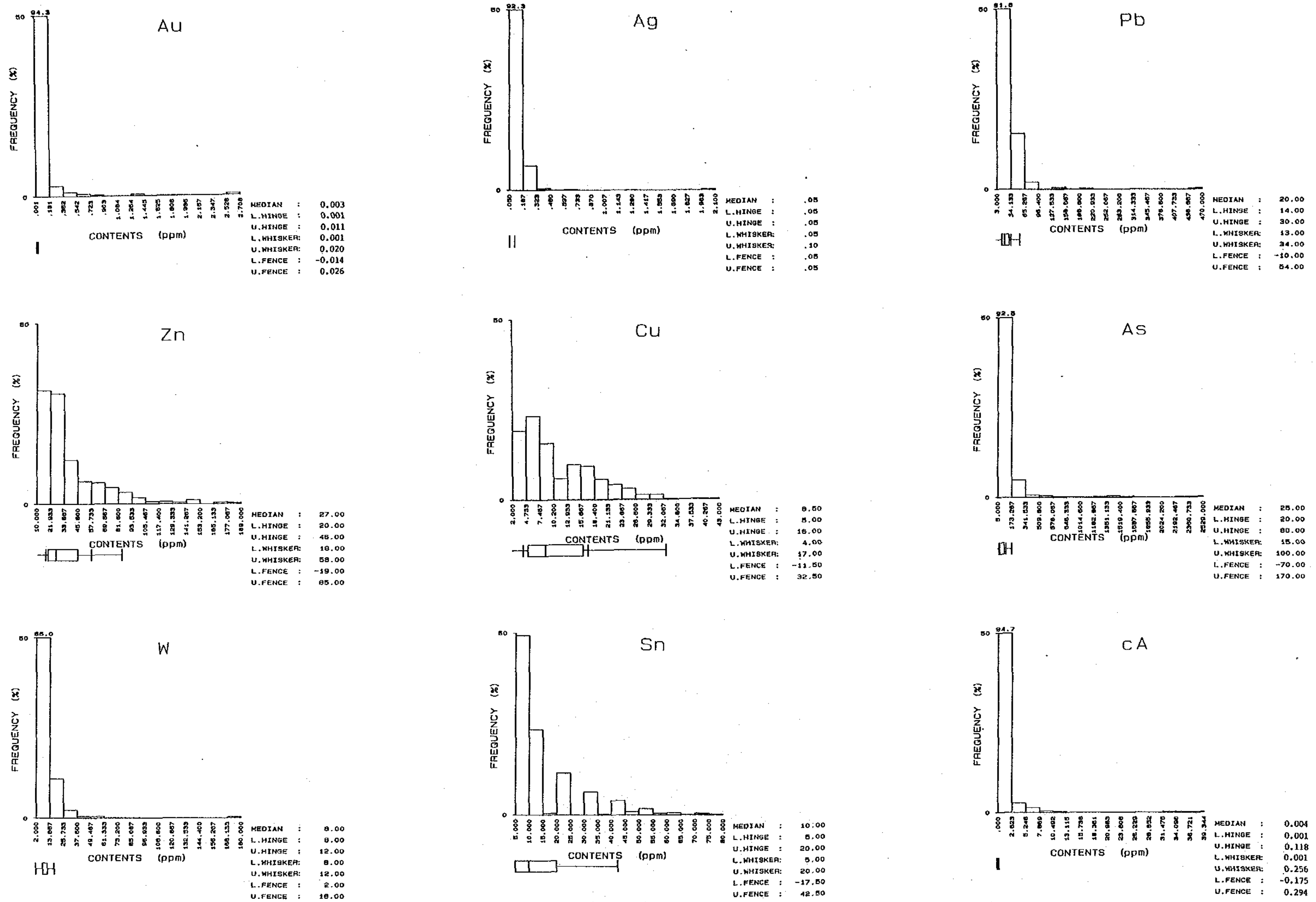
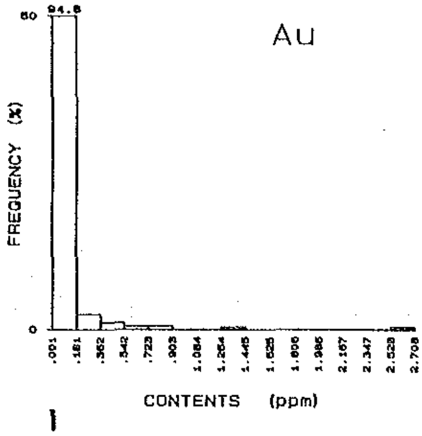


Fig. A–1 Sketch map of trenches in the Area a-1 (13)

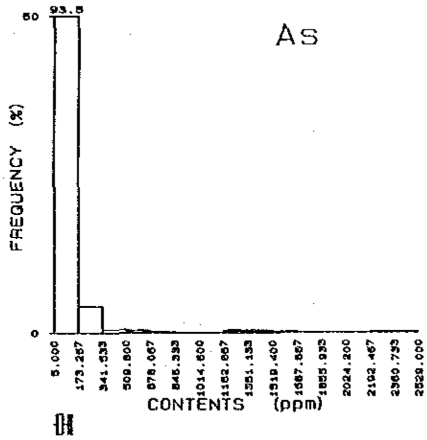


(Soil samples except for alluvium samples)

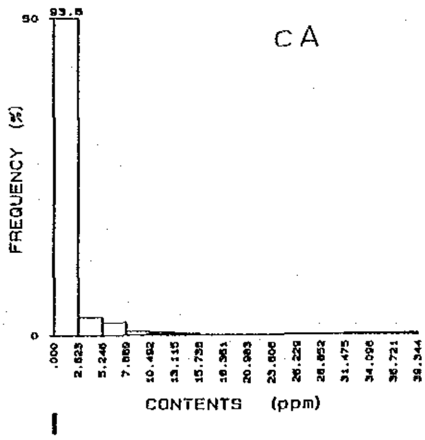
Fig. A–2 Histogram of elements of soil samples and boxplots in the Area a-1 (1)



MEDIAN	:	0.003
L.HINGE	:	0.001
U.HINGE	:	0.010
L.WHISKER	:	0.001
U.WHISKER	:	0.017
L.FENCE	:	-0.012
U.FENCE	:	0.023



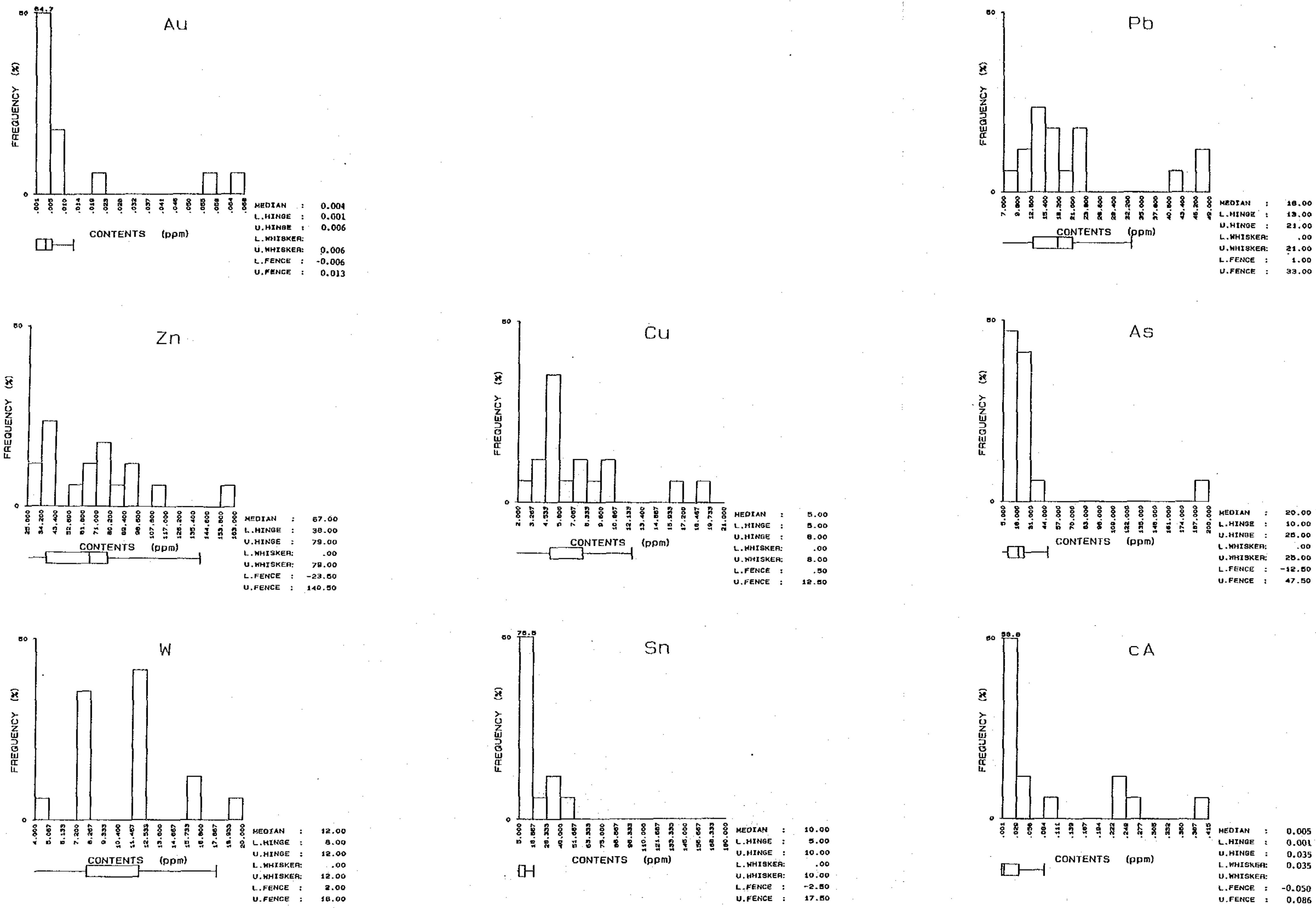
MEDIAN	:	25.00
L.HINGE	:	20.00
U.HINGE	:	60.00
L.WHISKER	:	15.00
U.WHISKER	:	100.00
L.FENCE	:	-40.00
U.FENCE	:	120.00



MEDIAN	:	0.004
L.HINGE	:	0.001
U.HINGE	:	0.138
L.WHISKER	:	0.001
U.WHISKER	:	0.282
L.FENCE	:	-0.204
U.FENCE	:	0.343

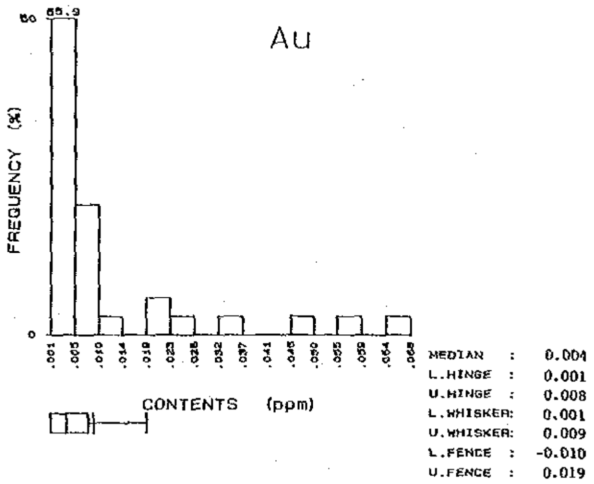
(All samples)

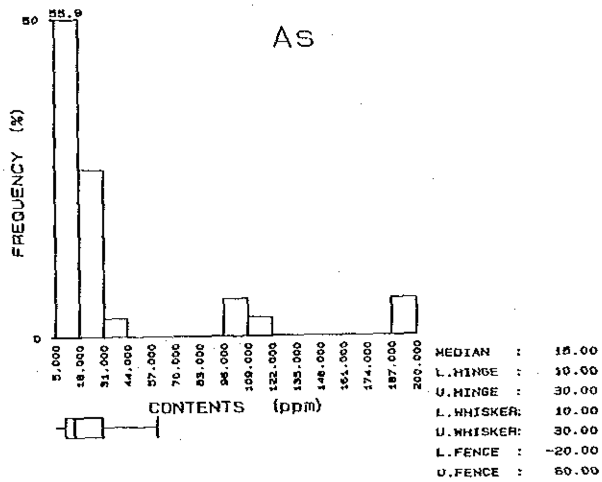
Fig. A–2 Histogram of elements of soil samples and boxplots in the Area a-1 (2)

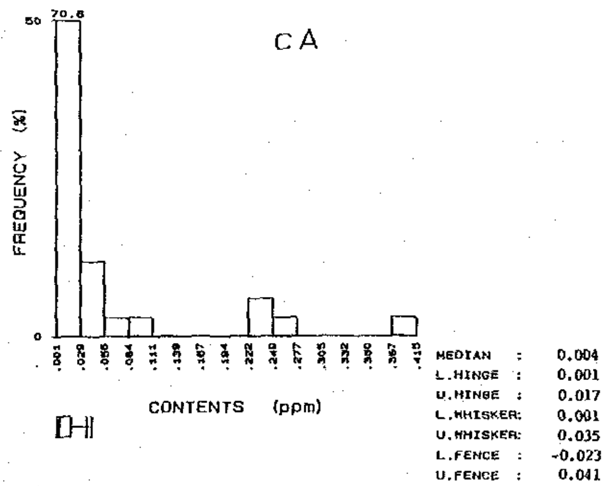


(Soil samples except for alluvium samples)

Fig. A–3 Histogram of elements of soil samples and boxplots in the Area a-2 (1)

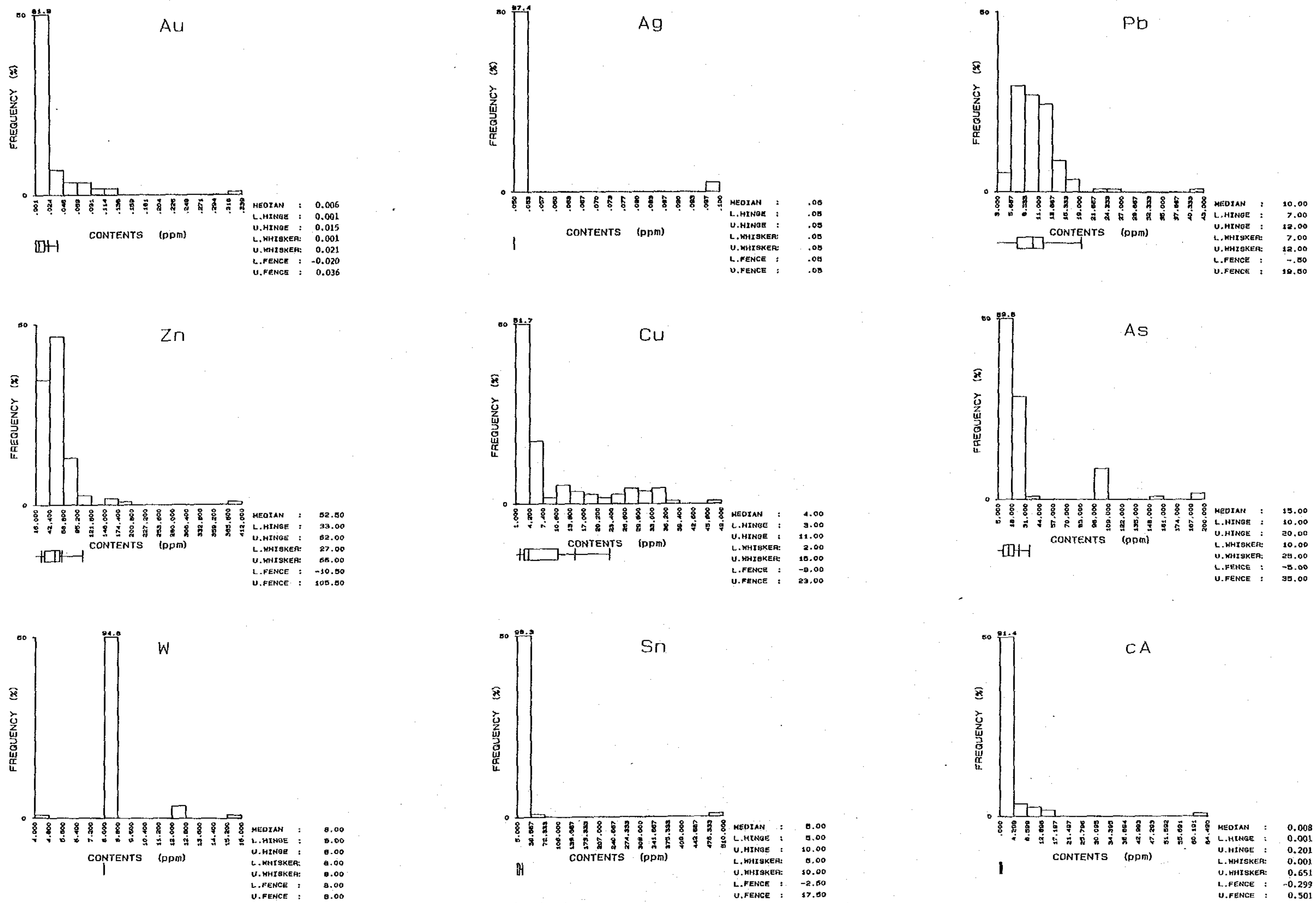






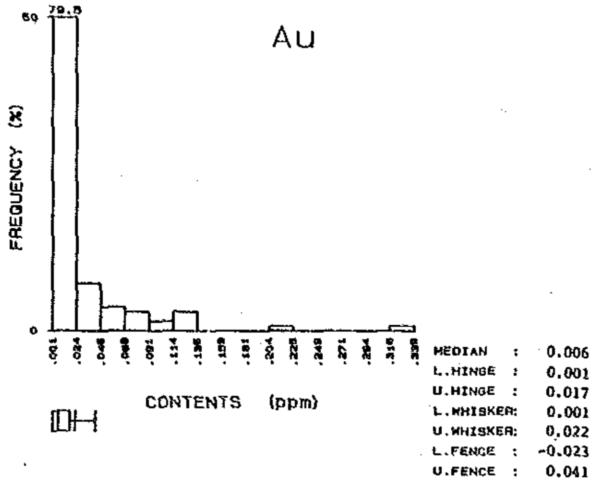
(All samples)

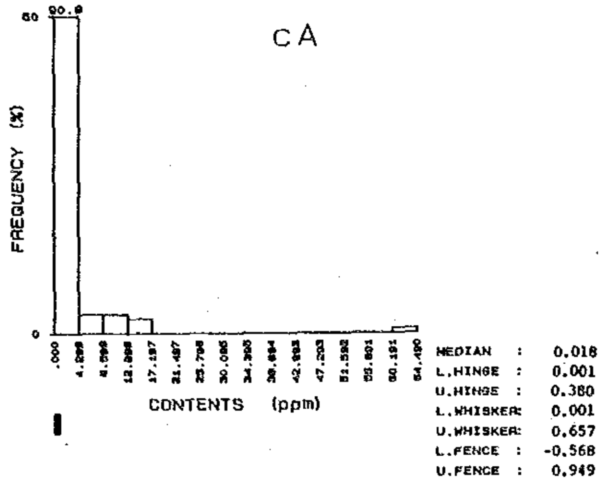
Fig. A–3 Histogram of elements of soil samples and boxplots in the Area a-2 (2)

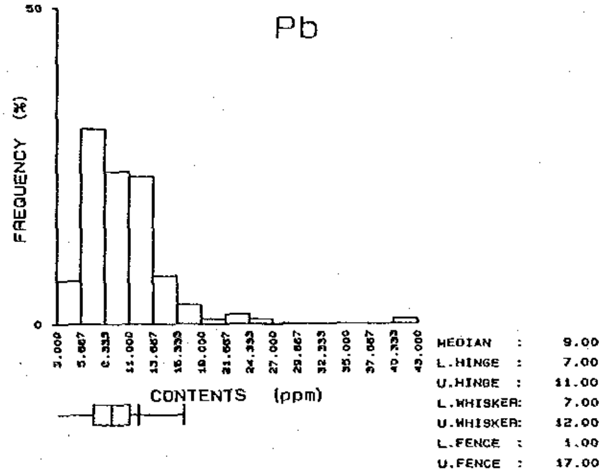


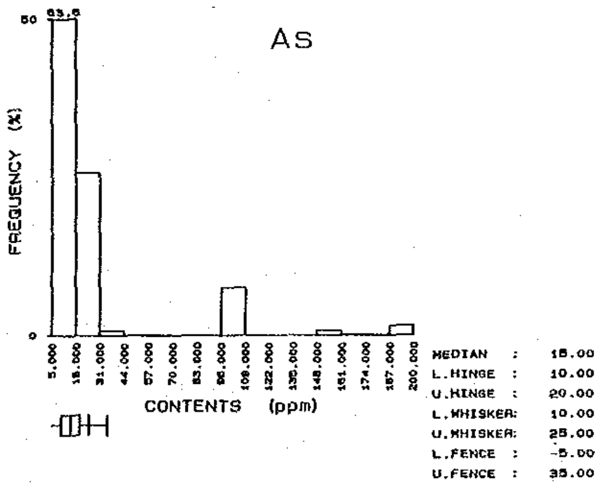
(Soil samples except for alluvium samples)

Fig. A–4 Histogram of elements of soil samples and boxplots in the Area a-3 (1)



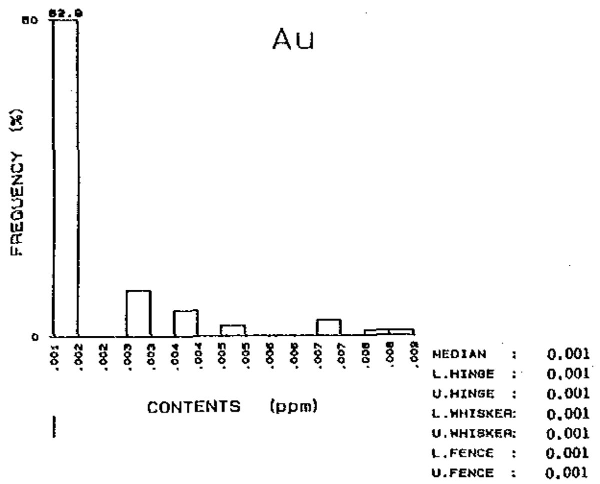


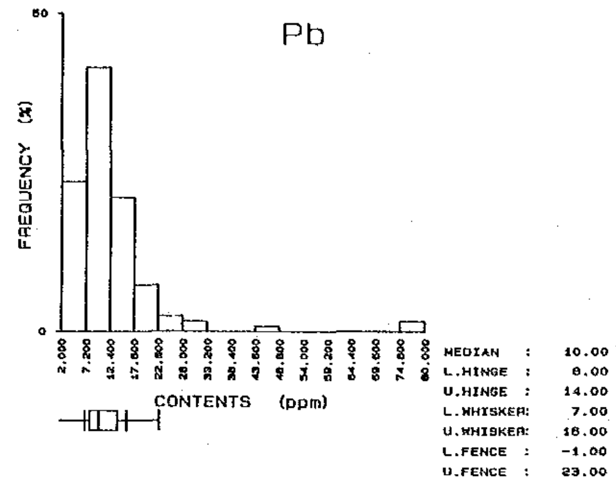


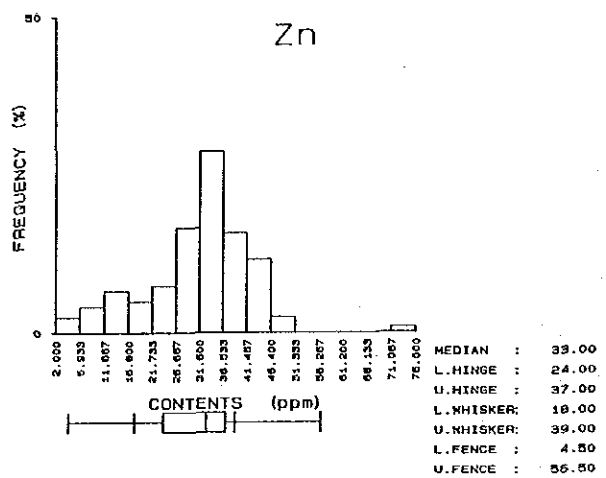


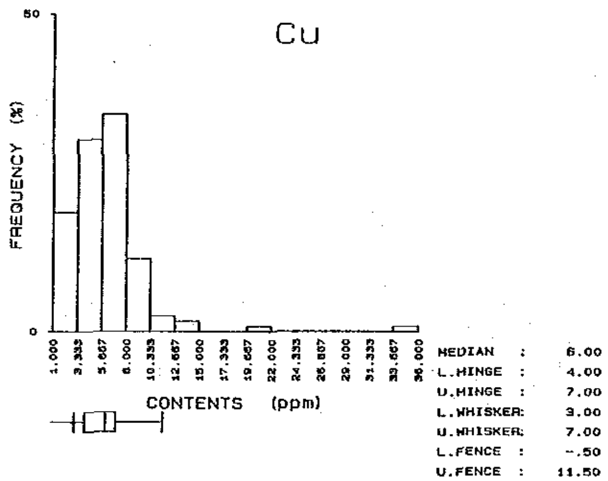
(All samples)

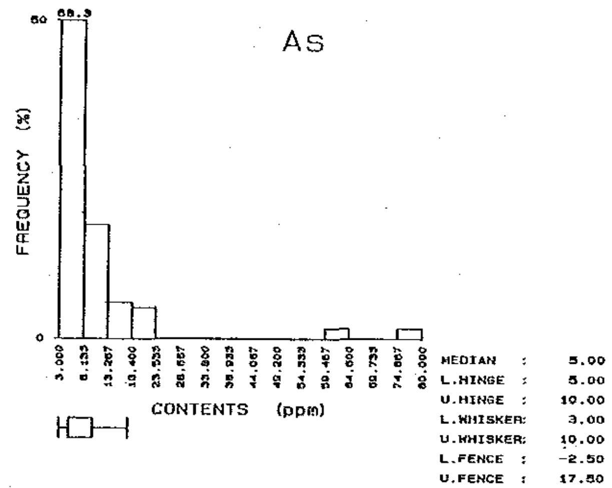
Fig. A–4 Histogram of elements of soil samples and boxplots in the Area a-3 (2)

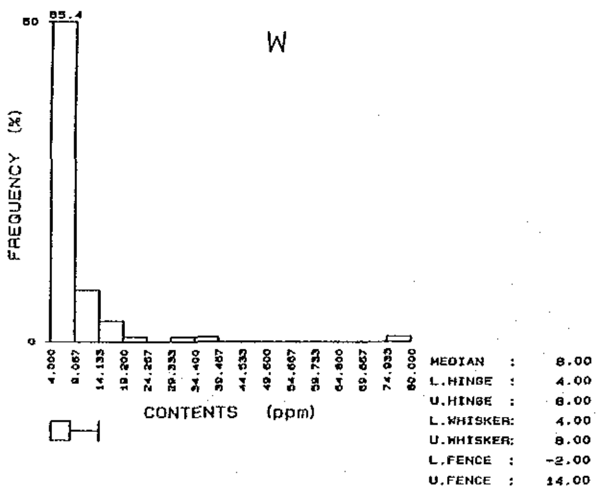












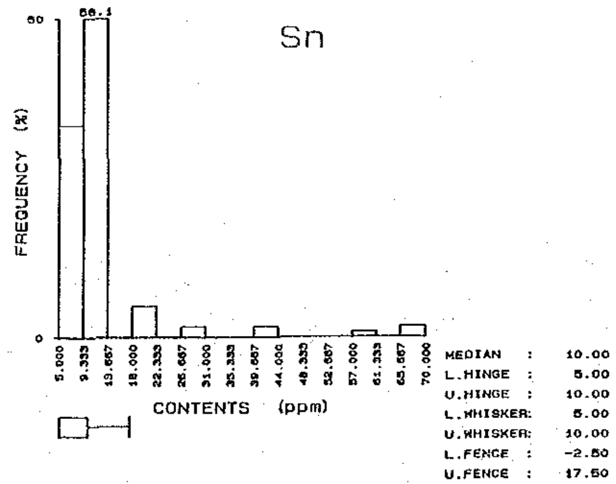


Fig. A–5 Histogram of elements of rock samples and boxplots in the Area c (1)

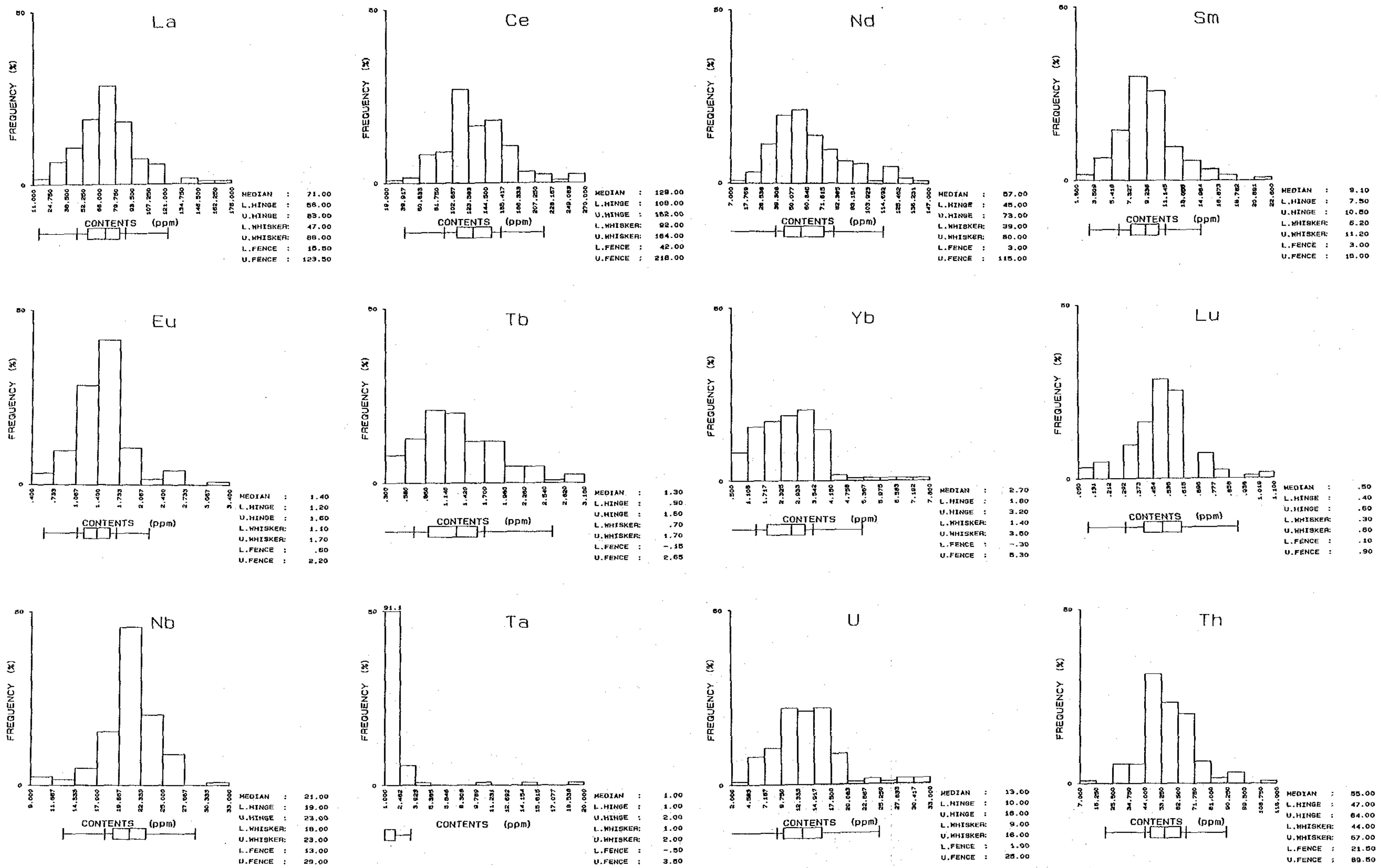


Fig. A–5 Histogram of elements of rock samples and boxplots in the Area c (2)