CHAPTER 4 MINERAL DEPOSITS IN RECONNAISSANCE SURVEY AREA

4-1 Outline of Mineral Deposits

For the mineral deposits in this survey area, there are Sasan manganese ore deposit at north, mineralized zones of Selakean, Panji and Emang at center, and pyrite dissemination and molybdenite quartz veinlets at south.

Sasan manganese ore deposit is the bedded ore deposit embeded in Serantak dacitic tuff; Selakean mineralized zone is the chalcopyrite sphalerite arsenopyrite-bearing quartz veins in Jirak Formation; and Panji mineralized zone is the chalcopyrite dissemination in Banyi tonalite. Emang mineralization is embeded in Tiang quartz diorite. All pyrite disseminations are impregnated in the dacitic volcanic rocks of Belango Formation at south of this survey area.

4-2 Mineral Deposits and Mineralizations

4-2-1 Sasan Manganese Ore Deposit

This manganese ore deposit is situated at about 600 m north of Juratak village, the northeast end of this survey area. An exploration had been conducted before the last 2nd world war, and at the post-war, a geological survey had been conducted by the Geological Survey of Indonesia under the supervision of Dr. H. Walther (1960).

According to the field survey and the existing survey data and information, Serantak dacitic tuff are extensively distributed at this mineralized zone, where the manganese ore deposit is embeded in this formation.

Referring to the survey made on the old pits by Dr. Walther, the lower bed of ore deposit is the tuff argillized into white clay (kaoline), and the ore deposit is stratified and confirmed to have 200 m long, 40 m wide and 1.25 m thick on average. A lumped ore of approximately 1,500 tons has been stocked in the old pits.

According to the microscopic examination (RA-201) of the ores, it shows an oolitic banded texture, chiefly consisting of cryptomelane. Besides, even not clear, but hematite pattern can be detected under the X-ray diffractive analysis, in addition to a minor quantity of ores, such as psilomelane, pyrolusite, braunite, etc.

The assay result of good ore piece sampled at the outcrop was Mn-42.65% and Au-0.1 g/t. Viewing from the existing banded texture and the embedding in the dacitic tuff bed, this manganese ore deposit is the ore deposit formed by Serantak dacitic volcanic activity (Fig. 3-12).

4-2-2 Selakean Mineralization

Several trenches prospected in the past for copper ores are distributed around the elevation of 270 ∿ 285 m at east hill of Gunung Selakean (430 m above sea level). The trench individually extending by 5 ∿ 20 m is found at several spots in a area of 30 m × 40 m, but all is collapsed, so that their mining conditions are unknown.

Judging from a lump ore (approx. 1 ton), the ore is in the Pyrite-arsenopyrite-bearing quartz vein of 5 ∿ 10 cm wide embeded in andesitic tuff of Jirak Formation, chiefly consisting of assenopyrite and pyrite and accompanying chalcopyrite, sphalerite and galena (see Fig. 3-13).

In S. Nanggah running at south hill of Gunung Selakean, the boulders of chalcopyrite bearing pyrite quartz vein filling brecciated andesitic tuff were found. Viewing from the existence of mineralized boulders in this river, the strike of Selakean mineralization seems to show an extension of NEN-SWS.

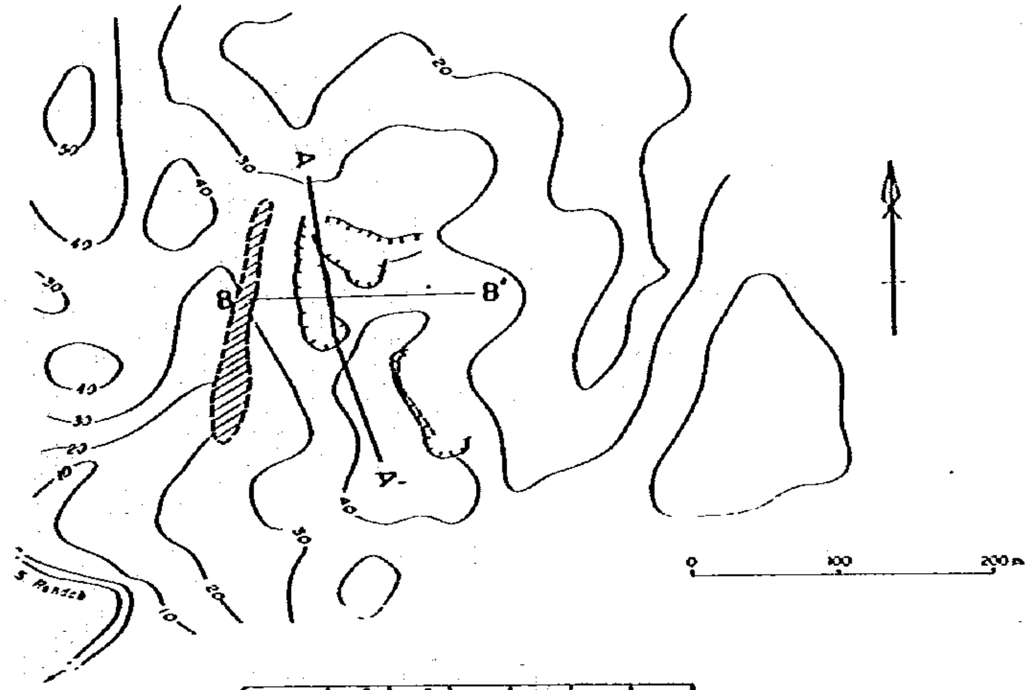
The assay result of lump ore in Selakean mineralization was 7 cm in width, Au-2.2 g/t, Ag-66 g/t, Cu-0.26%, Pb-0.04% and Zn-0.17%.

4-2-3 S. Sebumbung Mineralization

Along S. Sebumbung at north of Kalumpe village, many cracks of two systems, i.e. N30°E90° and N60°W90°, are found in the granodiorite exposure, over about 20 m of which the pyrite ores are found in the crack, but no mineralization is noticeable, beacuase of very weak grade.

4-2-4 Tikalong Alteration Zone

Along a river (called S. Salaas by the local inhabitants) running from Gunung Tiang to Kp. Tikalong, the dacitic pyroclastic rocks belonging to Belango Formation has been silicified in an extensive range with the pyrite dissemination.



	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mn %
RA201	0.1	< 2	<0.01	<0.01	<0.01	42.65

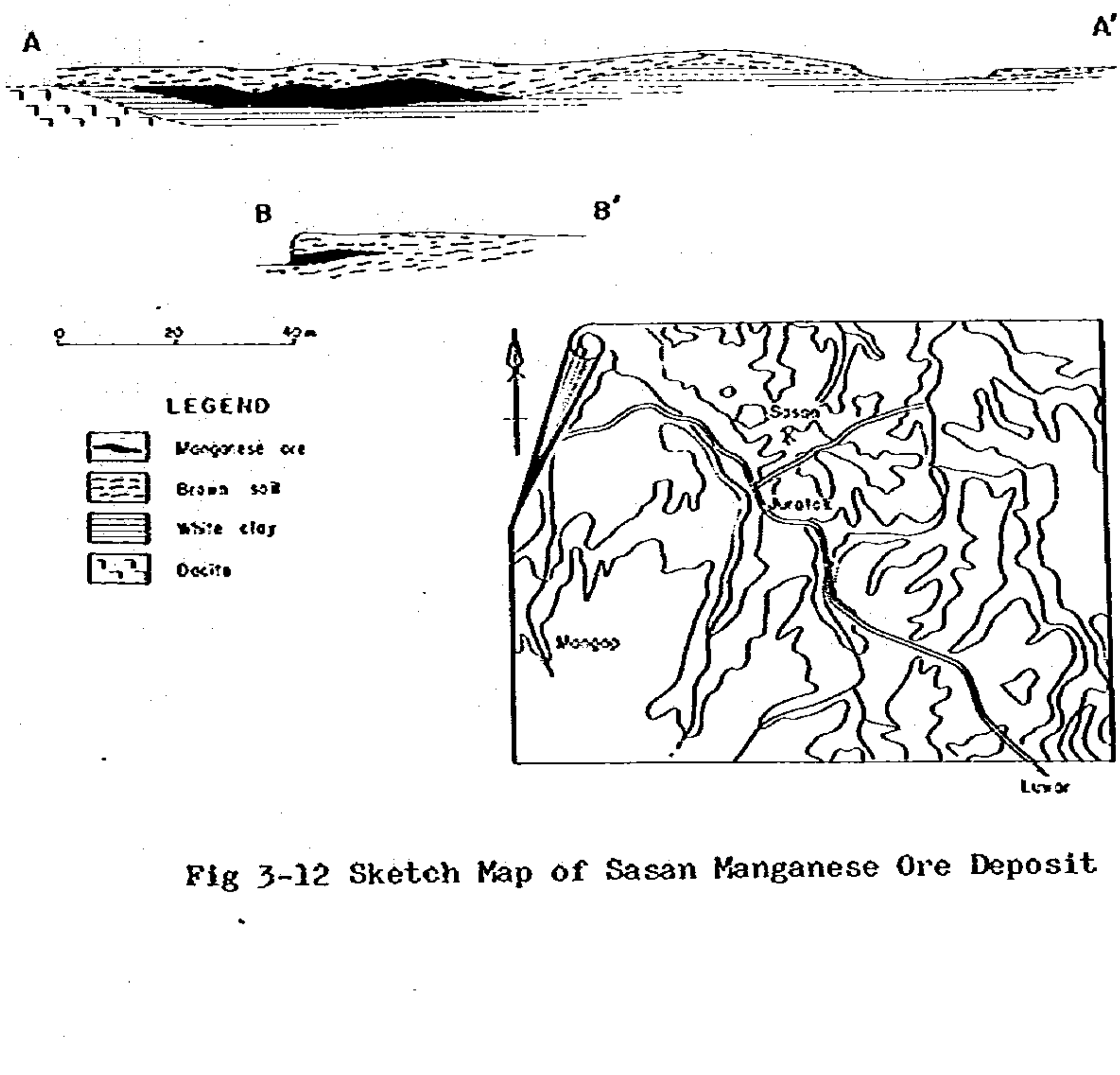
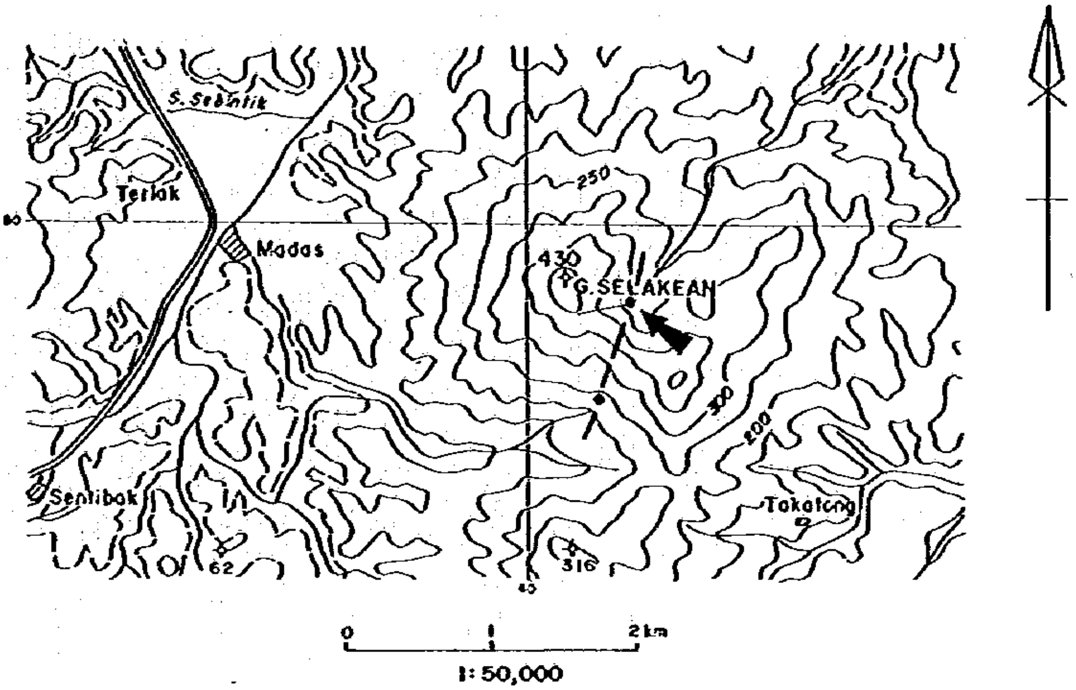
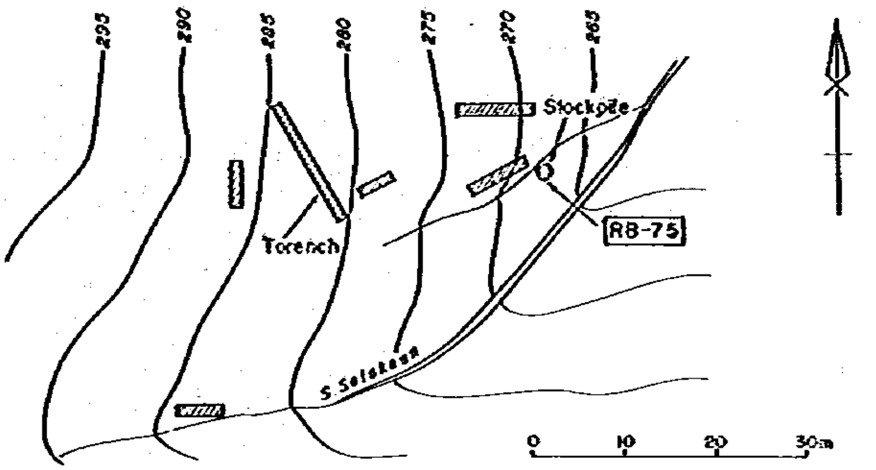
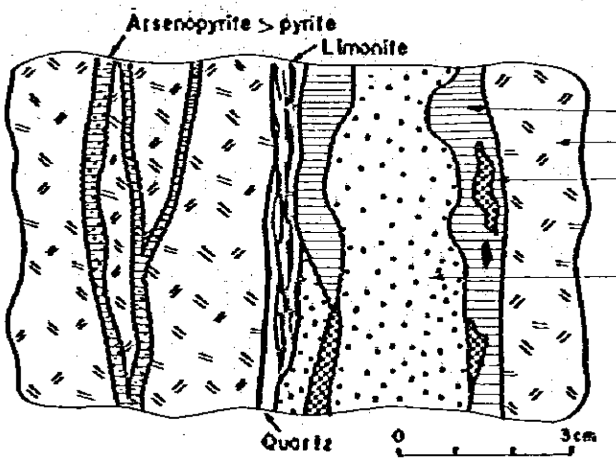


Fig 3-12 Sketch Map of Sasan Manganese Ore Deposit

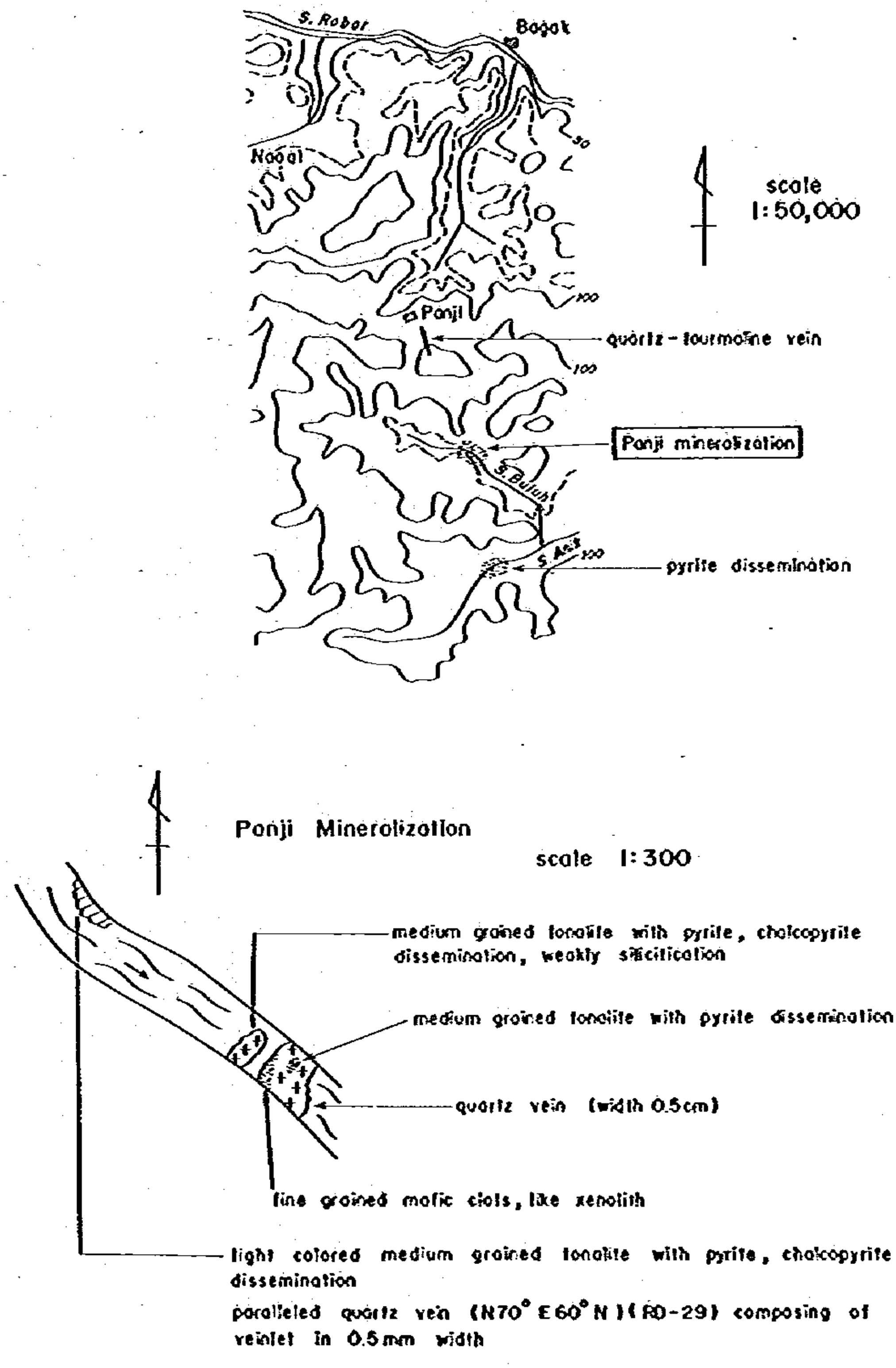






	Wd cm	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %
RB-75	7.0	2.2	66	0.26	0.04	0.19	<0.01

Fig 3-13 Sketch Map of Selakean Ore Deposit



	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %
RD-29	0.2	< 2	0.08	<0.01	<0.01	<0.01

chip samples in 2.5 m length

Fig 3-14 Sketch Map of Panji Mineralization

Table 3-4 List of Mineralized Zone and Chemical Analysis of Ore (Reconnaissance Survey Area)

Group of Mineralization	Name of Mineralization Zone	Location		Mode of Occurrence	Kind of Ore	Sample No.	Sampling Width	Assay						
		Grid of Map	River or Village					Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %	Mn %
Serantak Dacite	Sasan	25-105	S. Bendah	Bedded	Mn	RA-201	1.25 m	0.1	<2	<0.01	<0.01	<0.01	-	42.65
Banan F.	Serantak	20-100	S. Banan	Vein	Py	RA-8	1.0 cm	0.1	<2	0.12	-	-	-	-
Jirak F. Andesite	Selakean	40-80	S. Selakean	Vein	Cp, Zn, Py	RB-75 RC-72	7.0 cm chip	2.2 3.0	66 5	0.26 0.05	0.04 0.02	0.19 <0.01	<0.01 <0.01	- -
G. Raya Granodiorite	Sengga	40-65	S. Menyuke	Massire	Au ?	-	-	-	-	-	-	-	-	-
G. Serantar Gronodiorite	Sebumbung	15-80	S. Sebumbung	Vein	Py	-	-	-	-	-	-	-	-	-
Belango F. G. Raya Granodiorite	Tikalong	20-70	Tikalong	Vein diss.	Py	RA-64 RA-68	chip chip	0.1 0.1	<2 <2	<0.01 0.01	- -	- -	- -	- -
Banyi Tonalite	Panji	50-55	S. Anik	diss. net.	Cp, Py	RD-29	chips	0.2	<2	0.08	<0.01	<0.01	<0.01	-
Tiang Quartz diorite	Emang	30-55	Emang	diss.	Py, Cp	-	-	-	-	-	-	-	-	-
Belango F. Andesite	Sanurian	35-45	S. Mentako	diss.	Py	RF-53	chips	0.1	<2	0.02	<0.01	<0.01	-	-
Belango F. Dacite	Gombang	45-45	S. Tehajion	diss.	Py	RG-18	chips	0.1	<2	0.01	<0.01	<0.01	-	-
Belango F. Dacite	Sk. Durian	40-45	Sk. Durian	diss.	Py	RG-7	chips	0.1	<2	<0.01	<0.01	<0.01	-	-
Belango F. Andesite	Seliat	35-55	Seliat	diss.	Py	-	-	-	-	-	-	-	-	-
Belango F. Andesite	Sebambang	35-55	Sebambang	diss.	Py	-	-	-	-	-	-	-	-	-
Sebiawak Granodiorite	G. Kader	50-55	G. Kader	diss.	Py	-	-	-	-	-	-	-	-	-
Belango F. Andesite	S. Rovar	50-60	S. Rovar	diss.	Py	-	-	-	-	-	-	-	-	-
Belango F. Dacite	Kartop	45-40	Kartop	diss.	Py	-	-	-	-	-	-	-	-	-
Belango F. Dacite	Ganteng	45-40	Ganteng	diss.	Py	-	-	-	-	-	-	-	-	-
Belango F. Decite	Padang	50-30	Padang	diss.	Py	-	-	-	-	-	-	-	-	-
Sebiawak Granodiorite	Kunylt	40-50	S. Sengai	Vein	Mo, Mg, Mn	RG-16	5 cm	0.1	<2	<0.01	<0.01	<0.01	<0.01	-

The alterated products, such as andalusite, alunite and quartz, in the dacitic tuff (RA-200) of Belango Formation in contact with Tiang quartz diorites were identified by the X-ray diffractive analysis, and the dacitic tuff was subjected to the contact metamorphism with Tiang quartz diorites. No mineralization with copper ores or others can be observed. Shear zone (strike N60°E and dip 90°) found in S. Salaas is pyrite bearing vein of 30 cm width.

4-2-5 Sengga Silicification Zone

Along S. Menyuke from Tembawang Bale to Sengga, Sengga silicification zone is distributed at a contact between Belango Formation and the granodiorite batholith. This silicification zone in the host rocks of Beloang andesitic tuff breccia is distributed at the strike of WNW-ESE, 3.5 km long and 1.0 km wide, forming a small hill as high as 50 m.

In the placer gold prospecting carried out along S. Sekandis and S. Lengkodok, the branch rivers of S. Menyuke at the end of this silicification zone, 56 and 170 pieces of gold grains were taken sample, respectively, from which there is a possible accompanying of gold mineralization in this silicification zone, where is to be noted for the present.

4-2-6 Panji Mineralization

In the tonalite stocks intruded into the area along S. Anik and its branch river, S. Buluh, the chalcopyrite and pyrite disseminations were found. A part of tonalitis has been silicified, showing the strike of N70°E and the dip of 60°N in the outcrops at the upperstream, with small quartz veinlets (less than 1 mm in width) in paralle at an interval of 2 ∿ 4 mm, accompanying the chalcopyrite and pyrite dissemination.

The chemical assay results in Au-0.2 g/t, Ag<2 g/t, Cu-0.08%, Pb 0.01%, Zn<0.01% and Mo<0.01% of 2.5 m in width.

Further, the quartz-tourmaline vein (0.6 m in width) was also found in G. Sebiawk granodiorite in the vicinity of Panji village, as Fig. 3-14 shows.

4-2-7 Emang Mineralization

Most exposure of Tiang quartz diorite distributed near Emang village are generally accompanied by the pyrite mineralization. In the small quartz diorite exposure distributed at north of Emang village, a minor quantity of chalcopyrite ore dissemination is observed. In the quartz diorite in the vicinity of Kalumi village, thin network epidote veins are exposed.

4-2-8 Sanurian Pyrite Dissemination

This mineralization in the andesitic lava of Belango Formation is distributed in the vicinity of Sanurian village, whose direction is to NW-SE trend, having a silicification around Gunung Batu dacities. It is divided into two mineralized zones with a tonalite in between. Only pyrite but no other ore were found through the field observation.

The distribution scale is 1 km × 500 m. The chemical analysis of chip samples collected from where strongly mineralized results in Au-0.1 g/t, Ag<2 g/t, Cu-0.02%, Pb<0.01% and Zn<0.01%. This ore dissemination zone contains 3% of S grade, based on the visual judgement.

4-2-9 Gombang Pyrite Dissemination

This is a pyrite dissemination croping out of dacite of Belango Formation, accompanying an argillization and distributing along the rivers near Gombang village.

The distribution range is assumed to cover an area of 5×2 km^2, having an extension toward E-W trend. Not strong entirely, the visual judgement results in a grade of 1 or 2% of S grade, partly accompanying a silicified zone.

The chemical analysis of chip samples collected especially from where strongly mineralized results in Au-0.1 g/t, Ag<2 g/t, Cu-0.01%, Pb 0.01% and Zn 0.01%.

4-2-10 Sk. Durian Mineralization

This is a pyrite dissemination situated at about 1 km south of Sk. Durian village, accompanying an argillization in the dacite of Belongo Formation. The pyrite disseminations are mainly formed along the joints in the argillized dacites, with the estimates of megascopic observation 2 or 3% in S grade. The chemical analysis results in Au-0.1 g/t, Ag<2 g/t, Cu<0.01%, Pb<0.01% and Zn<0.01%.

4-2-11 Other Pyrite Ore Disseminations

At the center of survey area, a pyrite disseminations are exposed in the villages of Seliat and Sebangang, on the mountain of Gunung Kader and along S. Robar.

At the south of survey area, a pyrite disseminations are observed around the villages of Kartap, Gantung and Padang.

The pyrite disseminations at Seliat, Sebambang and S. Robar are embedded in the andesites, while the mineralization at Gunung Kader has the host rocks of G. Sebiawak granodiorite. Also, Gantung and Padang mineralization is generated in Belango dacitic rocks, similar to at Kantap mineralization, but any one of them is a weak pyrite dissemination.

4-2-12 Molybdenite Quartz Vein

This vein is situated at about 2 km northwest of Kunyit village at the center of survey area, exposing on the river bed of a tributary of S. Sengan. This area is in the coarce grained G. Sebiawak granodiorite area, where the molybdenite quartz veins of approximately 5 cm width were found. The outcrop ranges in about 3 m long on the river bed, accompanying magnetite ores in addition to molybdenite ores. The vein strikes N65°W and dips 85°S. The analysis resulted in Au-0.1 g/t, Ag 2<g/t, Cu<0.01%, Pb<0.01%, Zn<0.01% and Mo<0.01%.

CHAPTER 5 GEOCHEMICAL SURVEY

5-1 Outline of Geochemical Survey

Similarly in the first phase survey, the geochemical survey was performed jointly with the geological survey in this second phase as well.

For the geochemical survey samples, the stream sediments were collected and chemically analysed for Cu, Mo, Pb and Zn as the indicator elements. Each sample was divided into two packs, one for Cu and Mo analyses in Japan and the other for Zn and Pb analyses by the Directorate of Mineral Resources, the Republic of Indonesia.

The data processing for compiling the analytical results was basically standardized by the logarithmic conversion of data. The range of background was studied through preparation of histogram, cumulative frequency distribution and correlation to extract the anomalous areas.

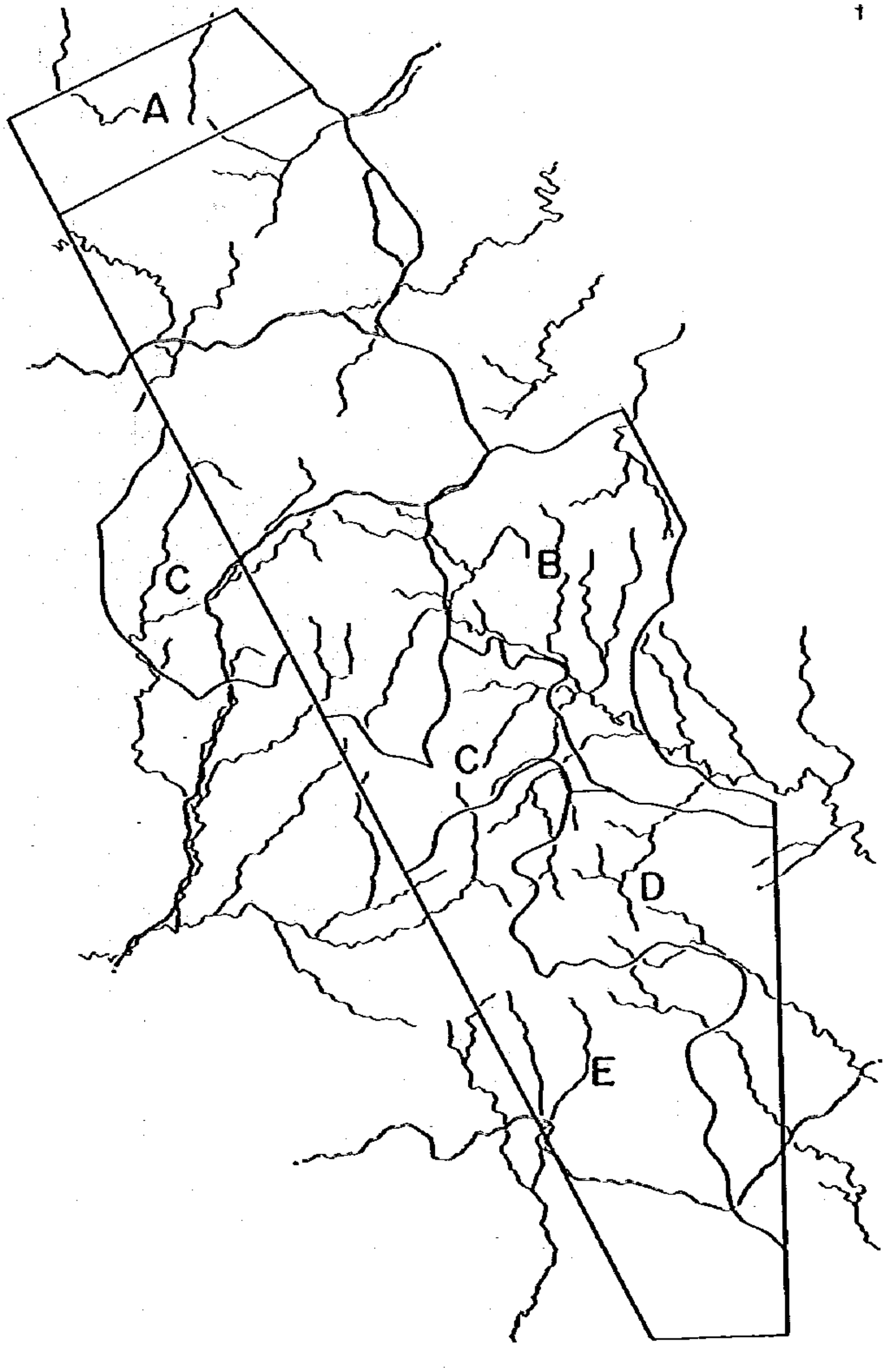
5-2 Sampling and Chemical Analyses

Sampling work was carried out jointly with the geological survey on the same route. Samples were collected from the whole survey area, confirming the sampling locations on a topographic map of 1/20,000 in scale, after they were checked to be evenly distributed in the survey area. However, to have a perfect evenness in the sampling density faced with a difficulty sometimes, depending upon the topographic conditions of rivers, mountains and others. Especially, the sampling was reduced at the plain swamps where are impossible to sample, placing the subject to the mountain regions and rivers around them.

897 samples were collected in total, but eliminating those collected from where having a high sampling density in order to make it even, 837 samples were ultimately selected for the chemical analyses.

5-2-1 Method of Sampling

Sampling was made at the upperstream of branching points from the main rivers along the geological survey route. Sample sediments were collected by direct screening by 80 mesh shieve under water.



A	Serantak Sedimentary rocks Block
B	Dorit Volcanics Block
C	Raya Granodiorite Block
D	Sebiawak Granodiorite Block
E	Senakin Volcanics Block

Fig 3-15 Geological Block for Geochemical Interpretation

After drying them in the sun at site camps or base camp, each sample was divided into two packs, one for chemical analyses in Japan and the other for the same in Indonesia.

5-2-2 Sample Treatment and Chemical Analyses

After drying in an isothermal dryer for about 24 hours, the samples collected were ground to -200 mesh size by a vibration mill, and 2 grams were weighed for dissolution to first add strong hydrochloric acid and perchloric acid, heat up and dry and then to disolve in weak hydrochloric acid. Assays were worked out for Cu content under atomic absorption method, while for Mo under colorimetric method. The lower limits of chemical analysis for each element were 1 ppm for both Cu and Mo. In addition, for Pb and Zn, the analyses were made by the Directorate of Mineral Resources, the Republic of Indonesia.

5-3 Data Processing and Interpretation

5-3-1 Classification of Blocks by Geological Unit

Before statistically processing the analyzed values, the surveyed area was grouped into five blocks as follows, in order to clarify the backgrounds and the deviations of anomalous values to be caused due to the difference in the geology and to obtain the respective optimum value. The assays analyzed were summarized along this group.

Block A: Northern sedimentary rock distribution region
To have sedimentary rocks of Bengkayang Group and Serantak dacitic pyroclastic rock distributions.
No. of samples: 59

Block B: Jirak and Belongo Formation distribution region
To have sedimentary rocks of Bengkayang Group, Jirak (andesitic volcanic rocks) and Belango (andesitic and dacitic pyroclasic rocks) Formations distributions.
No. of samples: 217

Block C: G. Raya and G. Slantar granodioriste rocks distribution region
Chiefly to have G. Raya granite distribution and partly to have Belango dacitic and andesitic rock distributions.
No. of samples: 174

Block D: G. Sebiawak granodiorite distribution region
Chiefly to have G. Sebiawak granodiorite distribution, but to include Tiang quartz diorite and Banyi tonalite distributions as well.
No. of samples: 158

Block F: Southern Belango Formation distribution region
Chiefly to have Belango dacitic and andesitic rock distributions, but to include G. Sebiawak granodiorite and Banyi nyi tonalite distributions as well.
No. of samples: 229

5-3-2 Statistical Data Processing

For the statistical processing of analyzed data, the analyzed values were standardized by the logarithmic conversion. First, the histograms and the cumulative frequency distribution charts were prepared per element per block. Then, the mean values, standard deviations and coefficients of correlations were calculated per element, based on which the anomaly areas were interpreted.

5-3-3 Correlation Among Geochemical Components

Claculating the coefficient of correlation between elements per block, the results are tabulated in Table 5-1. A correlation is more or less seen in every block between Pb and Zn, but rare among other elements.

5-3-4 Population Study

Block A: Owing to the small number of samples collected, the perfect histogram could not be drown. A logarithmic normal distribution pattern is shown for Cu and Mo. (Fig. 3-16)

Block B: A logarithmic normal distribution is shown for Cu, Pb and Zn, but a missing section is found for Mo, however, still with a normal distribution pattern. (Fig. 3-17)

Block C: The same pattern with the B-block is shown. (Fig. 3-18)

Block D: Except for Mo, a logarithmic normal distribution is patterned. For Mo, a missing section is found, which causes unknown (Fig. 3-19).

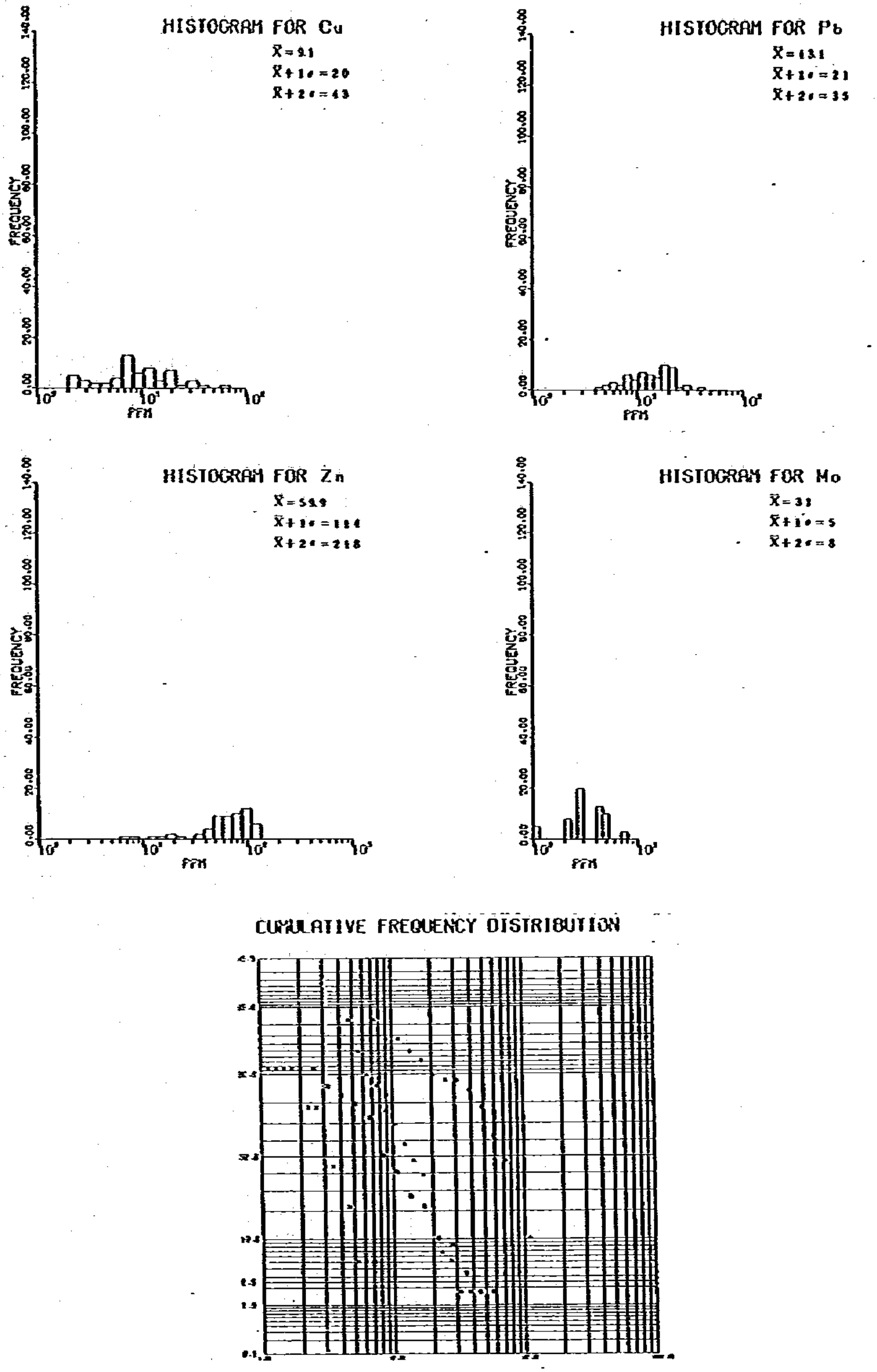


Fig 3-16 Histgram and Cumulative Frequency of Geochemical Analysis in Block-A

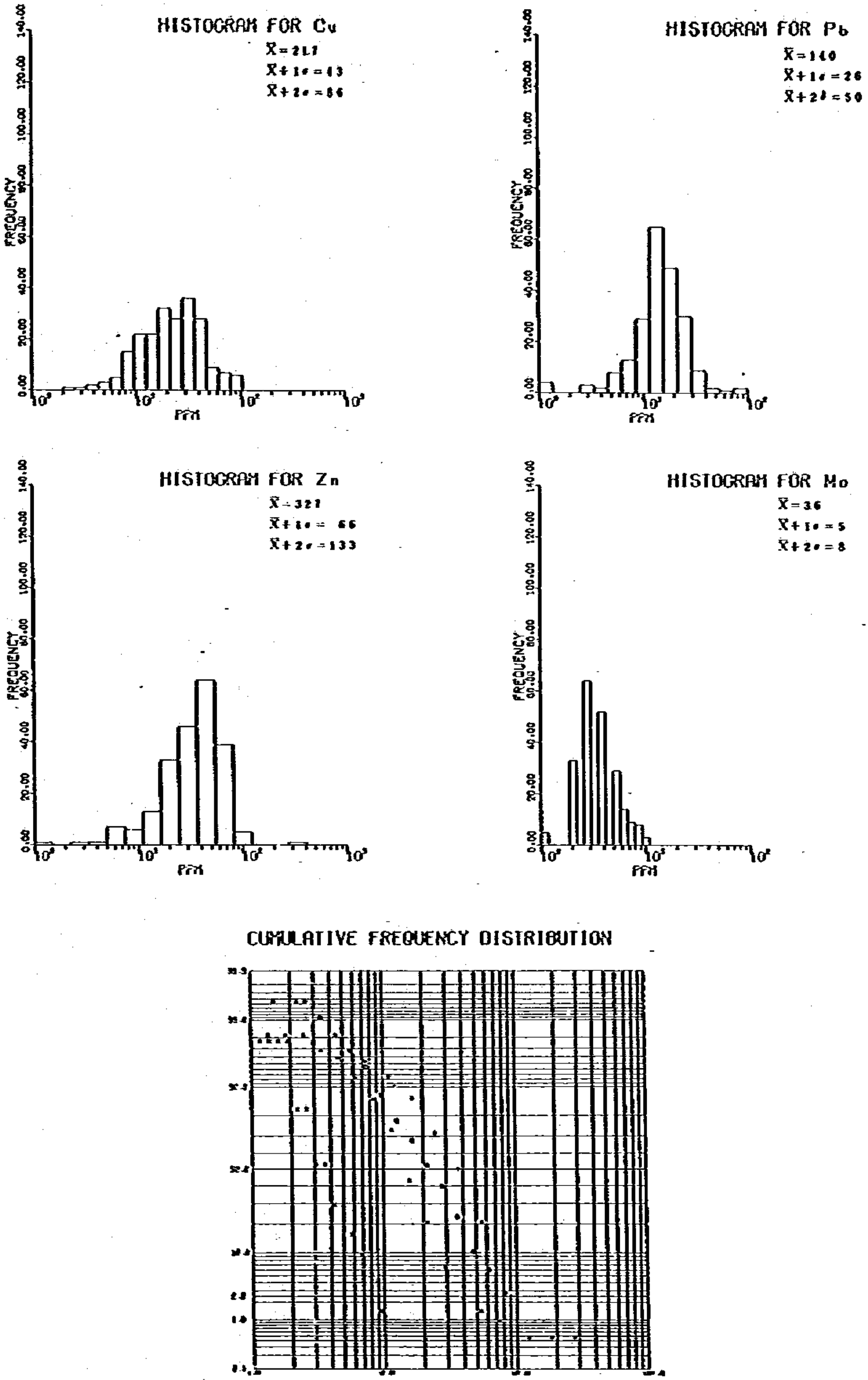


Fig 3-17 Histgram and Cumulative Frequency of Geochemical Analysis in Block-B

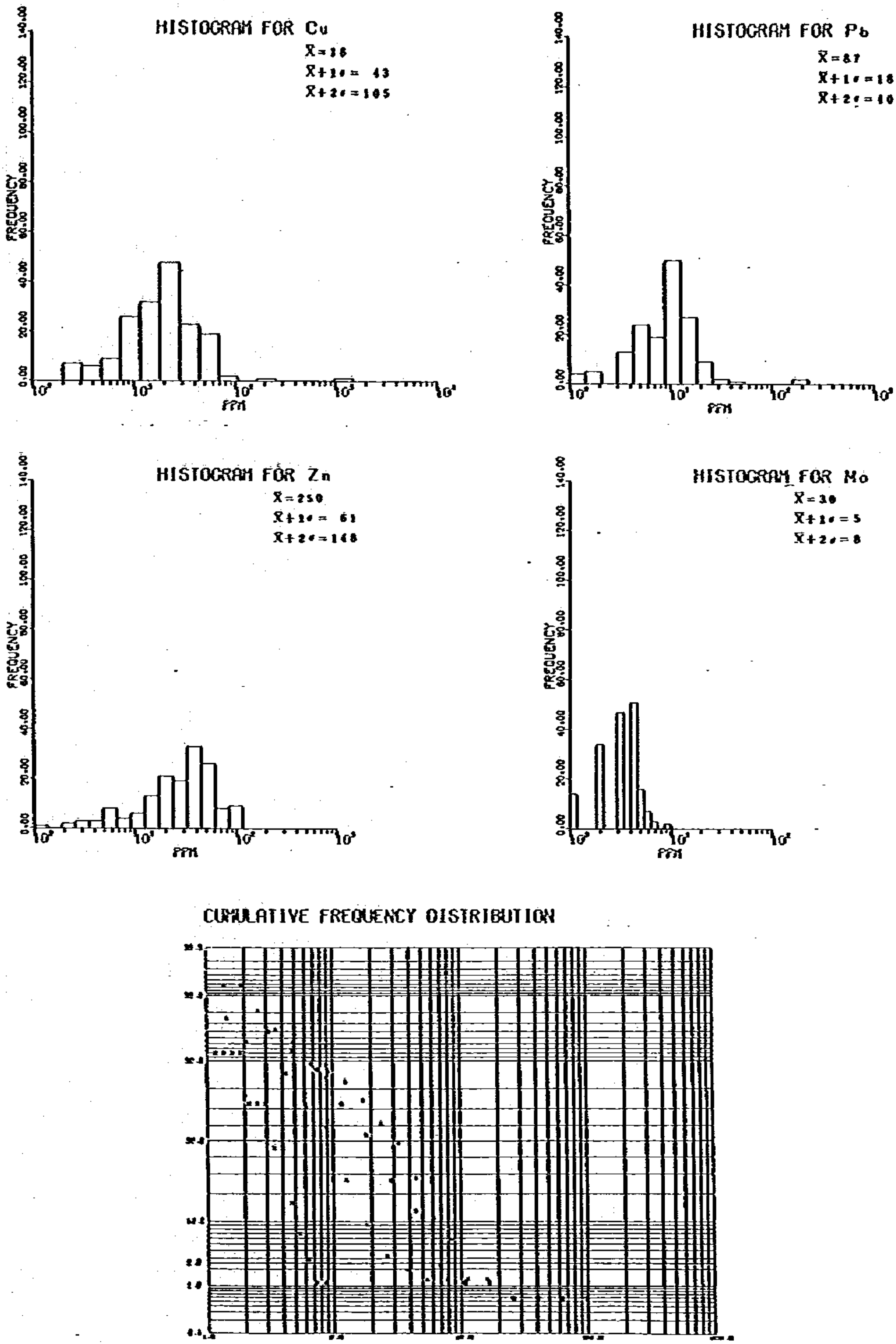


Fig 3-18 Histgram and Cumulative Frequency of Geochemical Analysis in Block-C

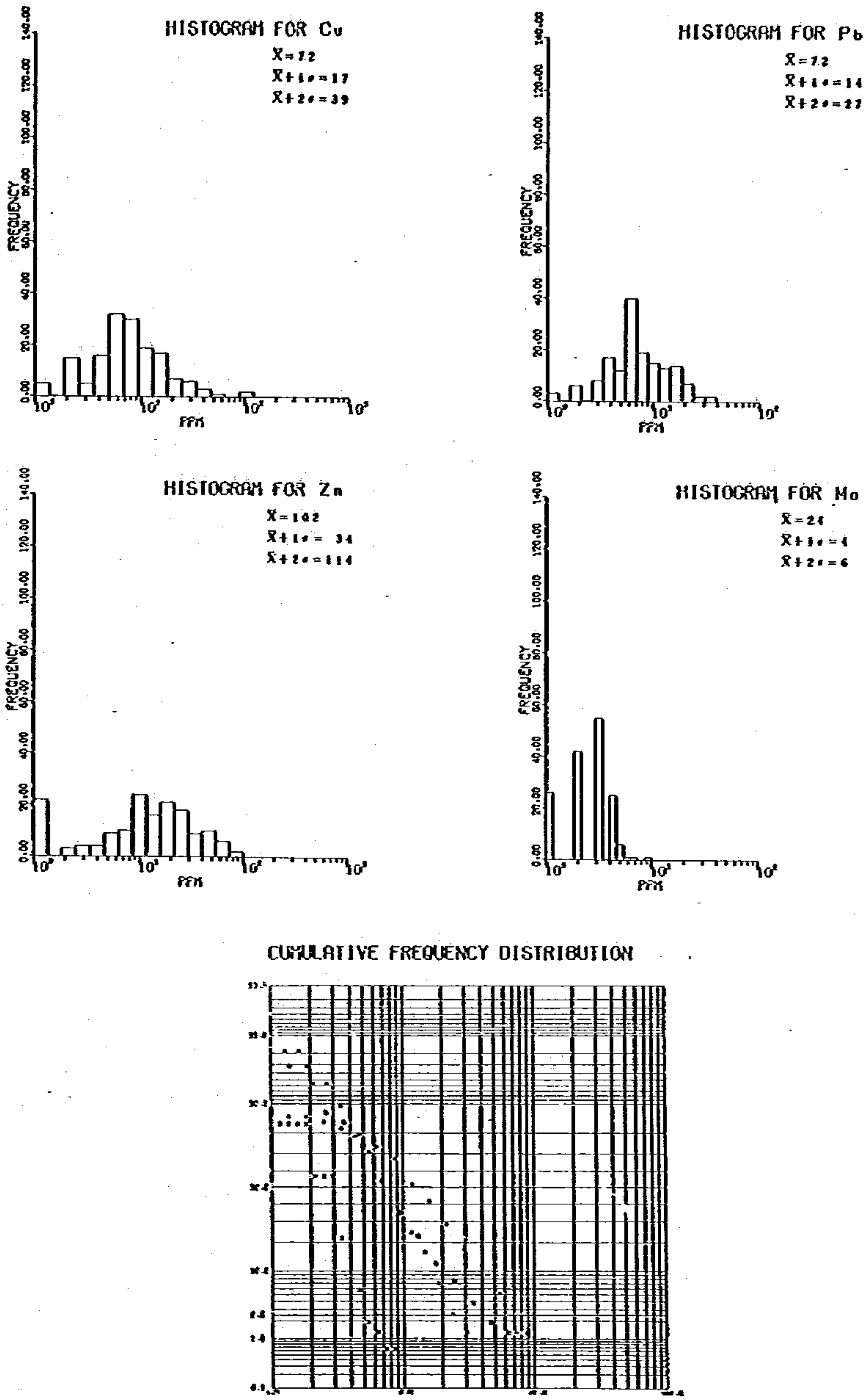


Fig 3-19 Histgram and Cumulative Frequency of Geochemical Analysis in Block-D

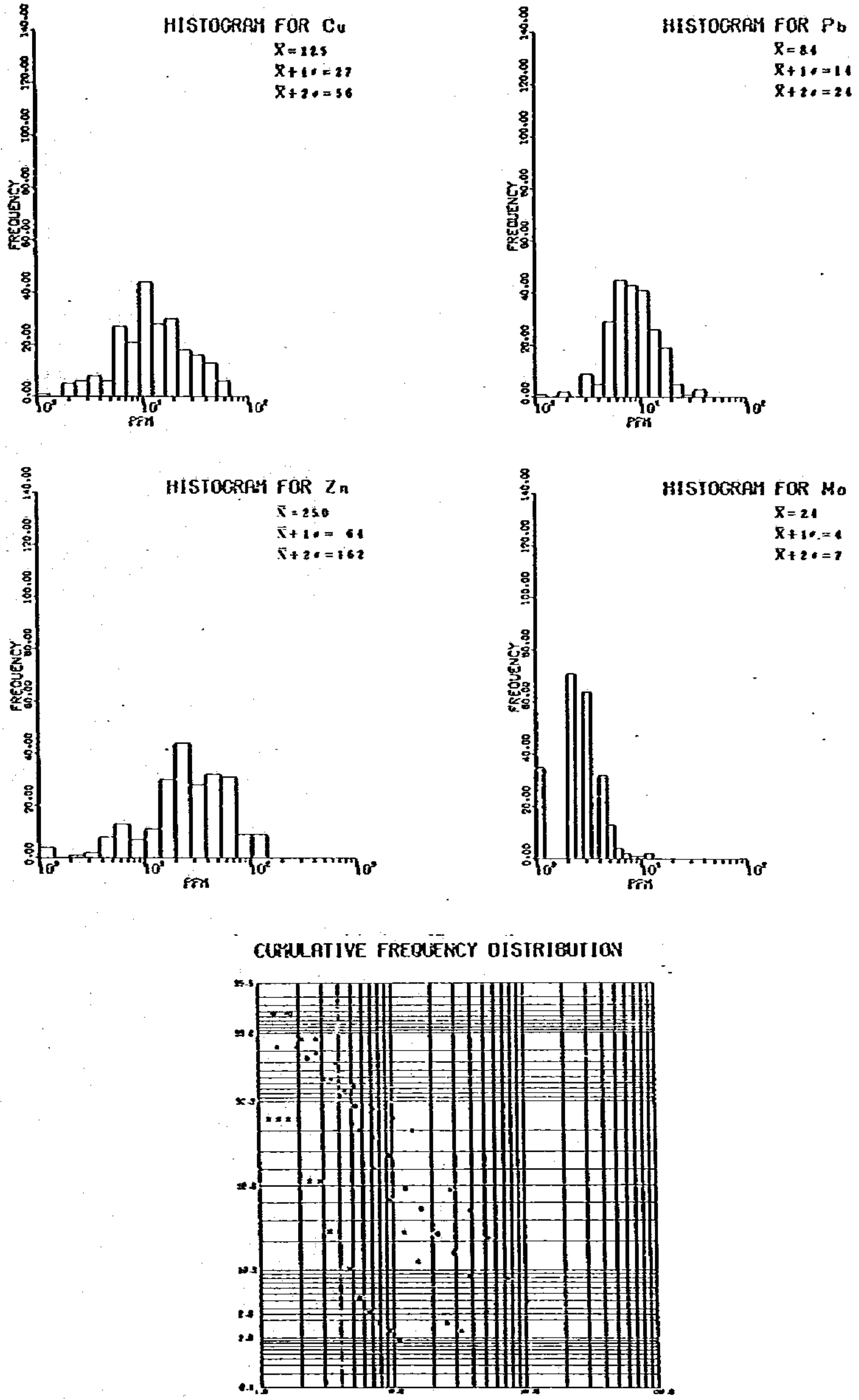


Fig 3-20 Histgram and Cumulative Frequency of Geochemical Analysis in Block-E

Table 3-5 The List of Coefficients of Correlation between each Component on Geochemical Prospecting

Area	Cu - Pb	Cu - Zn	Cu - Mo	Pb - Zn	Pb - Mo	Zn - Mo
A	0.1512	0.0711	0.0645	0.6037	-0.0375	0.0277
B	0.3747	0.3568	0.0425	0.5956	0.0856	-0.0084
C	0.0727	0.4975	0.0906	0.1739	-0.0066	0.2688
D	0.3621	0.2799	0.0873	0.6837	0.0479	-0.0238
E	0.5281	0.5997	0.3101	0.7662	0.1417	0.2156

Block E: Except for Mo, a logarithmic normal distribution is patterned. A missing section is found for Mo, but it is still almost patterned in a logarithmic normal distribution (Fig. 3-20).

From the above, the upper limit of background is determined at the mean value plus one sigma (Mean + σ), and all more than it is determined as an anormalous value. Further, a value above the mean value plus two sigma (Mean + 2σ) is ranked at the 1st-class anomalous value, while a value above the upper limit but below this is the 2nd-class anomalous value. Plotting all anomalous values on a topographic map of 1/50,000 in scale, where having two or more anomalous values are regarded as an anomalous area.

5-4 Anomalous Areas

5-4-1 Nouthern Sedimentary Rock Area

(1) Gunung Buwah Obah anomalous area

The 2nd-class copper anomalous points are concentrated over 15 km^2, centering at Gunung Buwah Obah, in which the 2nd-class molybdenum and lead anomalous areas are included. Especially, the 1st-class copper and lead anomalous areas are included at the north slope of Gunung Bawang, which should be noticeable.

Although no mineralization is confirmed around this area, as a result of geological survey, it is thought noticeable, together with the anomalous areas at Gunung Buru and Gunung Serantak.

(2) Gunung Buru anomalous area

This is chiefly the 2nd-class molybdenum anolamous area, assumed to extend as large as 5 km^2.

(3) Gunung Serantak anomalous area

This is a faily strong one of the 1st-class molybdenum anomalous areas.

The anomalous areas at Gunung Buru and Gunung Serantak are chiefly with molybdenum, and they are all assumed as the anomalous area attributable to the small molybdenite veins (known in Takap-Sirih as the existing veins and the same at S. Banan found in this detailed survey) found in Sirih tonalites, including the molybdenum anomalous area at Gunung Buwah Obah.

It is expected to have a mineralization of molybdenite quartz vein not confirmed yet at north of Sirih tonalite to where no detailed survey is conducted yet.

5-4-2 Jirak and Belongo Formations Area

(1) Gunung Selakean anomalous area

The distribution range of anomalous area covers 3 × 3 km at south of Gunung Selakean, where the 1st- and 2nd-class copper, molybdenum and lead anomalous areas are located. The geology in this anomalous area consists of Jirak andesites and G. Raya granodiorites intruding into the former. The granoriorites, at surrounding looked like tonalite.

In This anomalous area, both the chalcopyrite bearing sphalerite and aresenopyrite quartz veins exist at Selakean, while the chalcopyrite quartz veins and indications at S. Nanggan.

This anomalous area is thought to express these mineralized zones.

(2) Takam anomalous area

The distribution of this anomalous area ranges 3 × 2 km, centering at about 2 km south at Takam village, where the 1st- and 2nd-class copper anomalous areas are located.

The geology consists of Belango Formation and the granodiorite intruding into the former. In the neighbor, no mineralized zone is confirmed, but it indicates that a weak mineralization has been brought down along the structural line of NNW-SSE direction.

(3) Gunung Yangan anomalous area

This is chiefly a molybdenum anomalous area formed at north of Gunung Yangan and extended over 1 × 1 km. In this area, the 2nd-class lead and zinc anomalous points are included, in addition to the 1st- and 2nd-class molybdenum anomalous points, but the number of anomalous points is very low likely to be 3, and no mineralized zone is also confirmed yet.

The geology consists of G. Raya granodiorite, where is thought to indicate a possible existence of weak molybdenum mineralization.

(4) Panji anomalous area

This situates around Panji village, ranging 3 × 2.5 km for copper and 4 × 3 km for molybdenum. This has a 1st- and 2nd-class anomalous value for copper, and 2nd-class anomalous value for molybdenum.

The geology consists of Banyi tonalite distribution intruding into G. Sebiawak granodiorite, where Panji mineralization is located. This anomalous area is thought to express this Panji mineralization.

5-4-3 G. Selantar and G. Raya Granoriorite

(1) Gunung Semalo anomalous area

There are two locations of anomalous area distributed at south of Gunung Semalo, one ranceing 2 × 1 km to include the 1st-class copper and molybdenum anomalous area, while the other ranges 4 × 2 km, consisting of the copper anomalous area to include one 1st-class anomalous spot.

No outcrop indication is yet confirmed in the former, while in the latter, a pyrite dissemination (Sebumbung pyrite dissemination zone) is confirmed around the 1st-class copper anomalous area.

This anomalous area is thought to express this pyrite dissemination zone.

(2) Bebale anomalous area

This ranges 1 × 1 km at about 2 km west of Tunang village, and is the 2nd-class copper and molybdenum anomalous area. This is in G. Raya granodiorite, but no mineralization is yet confirmed on the ground surface.

(3) S. Kalamiara anomalous area

This is a molybdenum anomalous area, ranging about 3 × 2 km at about 5 km south-east of Tunang village, where a 1st-class anomalous area is included to range about 1 × 1 km, which is much noticeable.

There is Belango dacitic tuff breccia in this area, where a pyrite dissemination occurs. This mineralization is extensively distributed northward from this location, where no anomaly is found. Therefore, it is assumed that this anomalous area indicates a molybdenite mineralization under the pyrite dissemination zone found in the above dacitic rocks, i.e. in G. Raya granodiorites.

A further study is required on this anomalous area in the future.

5-4-4 G. Sebiawak Granodiorite Area

(1) Tajur anomalous area

This is a collective zone of 2nd-class copper, lead and zinc anomalous areas distributed northward from Gunung Satunok, ranging 1 × 3 km.

The geology consists of G. Sebiawak granodiorite distribution, but no mineralization is yet confirmed on the ground surface.

5-4-5 Southern Belango Formation Area

(1) Bongkek anomalous area

This is a lead, zinc and molybdenum anomalous area extending at south of Bongkek village, where Belango andesitic rocks are distributed. A pyrite dissemination (Selfat mineralization) is distributed from this Balango Formation to G. Raya granodiorites at west of the former.

This anomalous area is though to express the above mineralization.

(2) Pekatan anomalous area

This is the largest scale of anomalous area in the survey area, ranging about 10 × 5 km, where there are the anomalous areas of copper, molybdenum, lead and zinc, most of them being at 2nd-class but to include 1st-class anomalous points.

The geology consists of Belango andesite, dacitic volcanic rocks and Banyi tonalites intruding into the formers.

There is a poor exposure in the majority of this anomalous zone, and almost none of mineralization is found yet. Sanurian pyrite dissemination zone is found at south of this anomalous zone; Sebambang pyrite dissemination at north; and a thin vein of molybdenite in G. Sebiawak granodiorite.

These anomalies are thought to express the pyrite dissemination similarly as weak as them (not available to be found on the ground surface due to being covered by the surface soils).

(3) Lonkong anomalous area

This consists of Lonkong lead and molybdenum anomalous areas, i.e. 2nd-class for lead and 1st-class for molybdenum. The former is thought to express a pyrite dissemination (Sk. Durian mineralized zone) in Belongo dacites.

The latter has a possibility to indicate a molybdenite mineralization around the instrusive rocks distributed in the stock form where G. Raya granodiorite intruded into G. Sebiawak Granodiorites.

This point is thought necessary to be confirmed.

5-4-6 Others

Besides the above, in this survey, a pyrite dissemination zone is found at S. Kadar, S. Robar, Gantung, Padarg, Gonbang, etc., but in all these areas, no specially noticeable anomalous areas is found through this geochemical survey.

CHAPTER 6 PLACER GOLD PROSPECTING

6-1 Purpose and Method of Prospecting

In the second phase survey area, except for Serantak north area, there was no place known where gold has been mined in the past, but the placer gold prospecting with stream sediments has provded in the first phase survey very useful for the exploration of mineralized zones.

In the second phase survey, the placer gold prospecting with stream sediments was carried out at the same points in parallel with the sampling in the geochemical survey.

Two pails, each at 20 ℓ, of river bed sediments were sampled, and the sediments were panned to count the gold contents at panning place, as same as in the first phase panning.

The results were classified into five classes of gold content range, i.e. nill grain, 1 ∿ 4 grains, 5 ∿ 16 grains, 17 ∿ 69 grains and 70 or more grains, as same as in the first phase panning, which were plotted on a topographic map of 1/50,000 in scale.

The number of sampled locations counted 862 which was slightly less than that for geological survey. The results are as shown in Appendix 7.

Additionally, although a megascopic comparison is ideal to be made by considering the placer gold grain sizes collected, the analysis was made on the lump sum gold grain basis, an most placer gold collected falls in fine or medium size.

6-2 Prospecting Results

(1) Serantak north area

With 4 locations where 17 ∿ 69 grains were collected, and 5 locations where 5 ∿ 16 grains collected, this area is well known historically as a gold mining zone, but no record is left to have mined epsecially more than in the other areas.

(2) Darit north area

Gold is collected relatively at many locations in this survey, i.e. 16 locations for 5 ∿ 16 grains and 1 locations for 17 grains.

The latter is situated at the neighbour of Sengga village, a branch river of S. Menyuke.

The geology in this area consists of Belango Formation and G. Raya granodiorite intruding into the former. At the contact between these two, a silicificated zone is formed along the tectonic line of WNW-ESE trend, extending 3.5 × 1.0 km. Gold grains collected around Sengga village is assumed attributable to this silicificated zone. No feature can be seen in the distribution at other locations. However, judging the fact that Jirak Formation continues from Banyi area, they might be regarded as the east end of placer gold mining zone in Banyi area.

(3) Petni area

108 gold grains were collected from a branch river of S. Sambi running around Petni village at about 6 km south-southwest of Pahuman village. Since gold, even very few, is being mined at the swamps centered at Gunung Semawung and Gunung Sebilang at south of Pahuman, gold is assumed to be in the gold mineralization, centering at Gunung Semawung and Gunung Sebilang.

PART Ⅳ

DETAILED SURVEY

CHAPTER 1 SERANTAK AREA

1-1 Geology of Serantak Area

1-1-1 Outline of Geology

The geology at the survey area consists of Banan Fromation (tuffaceous sandstone, and sandstone) which is the lowest Formation of Upper Triassic Bengkayang Group, Paleocene - Eocene Serantak dacite and dacitic pyroclastics unconformably coverlieing the former; and Sirih tonalite intruded during the period from Paleocene age to Early Miocene age and andsetic dykes intruding all the above.

The geological structure in this area is most distinguished with and prevailed by the fissures, bedding planes and foliations trending at NW-SE direction (Fig. 4-1).

1-1-2 Geology

(1) Banan Formation

Distribution: This Foramtion is distributed from Gunung Buru to Gunung Serantak at the right bank on the downstream of S. Banan, being affected by the thermal metamorphism with the intrusion of Serantak dacite and Sirih tonalite.

Rock facies and lithology: This Formation consists of medium grained sandstones showing dark or violent grey, and medium grained tuffaceous sandstones showing grey.

The medium grained sandstones are distributed from Gunung Buru to Gunung Serantak and at the right bank on the downstream of S. Banan. Around Gunung Serantak and at the right bank on the downstream of S. Banan, the Formation consists of alternated beds of fine grained tuffaceous sandstone and medium grained of sandstone of gray or violet grey.

The felsic sandstone are composed of epiodote, clastic fragments of rock, quartz and plagioclase of 1 mm or less in size, under microcopic observation.

The medium grained tuffaceous sandstone is distributed over the east slope of Gunung Serantak and at the donwstream of S. Banan, characteristically containing quartz grains of 2 mm or below in diameter. Under microscope, many contents of 0.5 mm or less clastic rock fragments are observed, being composed of quartz grains and clastic plagioclase fragments.

Some Fine and medium grained tuffaceous sandstones has been affected by the epidotization and pyrrhotite dissemination and partly by the actinolites due to a contact metamorphism.

Thickness: 1,500 m or more

Fossil: The Formation yields no fossil up to present

Correlation: Correlative with Late Triassic age, based on the first phase survey.

(2) Serantak Foramtion

Distribution: To be extensively developed around Gunung Buru and Gunung Serantak, unconformably overlieing Banan Froamtion.

Rock facies and lithology: This formation consists of dacite, dacitic tuff breccia and fine grained tuff.

The dacite is dark grey and massive rocks having a porphritic texture with quartz and plagioclase as phenocryst being affected by the weak chloritization and epidotization. Also, this has a regulated joint of NW-SE strike.

The dacite exposed at north of Gunung Buru and Gunung Serantak contains the sandstone breccia of Banan Formation as an accident.

The flow texture of NW trend, being alternated to white or dark grey parts, are also observed. The white part consists of quartz and plagioclase. The dacite associating with the network quartz veinlets and pyrite dissemination crops out at south of each Gunung Buru and Gunung Serantak.

Under microscope, 2 mm or less quartz, plagioclase, and chloritized and/or epidotized mafic minerals of 2 mm or less in size as phenocryst and quartz are observed.

Quartz, plagioclase, opaque minerals, chlorite and epidote, some biotitie and hornblende are observed in the groundmass. Also, garnet occurs as skarn mineral, in some rock samples and weakly hornfelsic rock is also recognized.

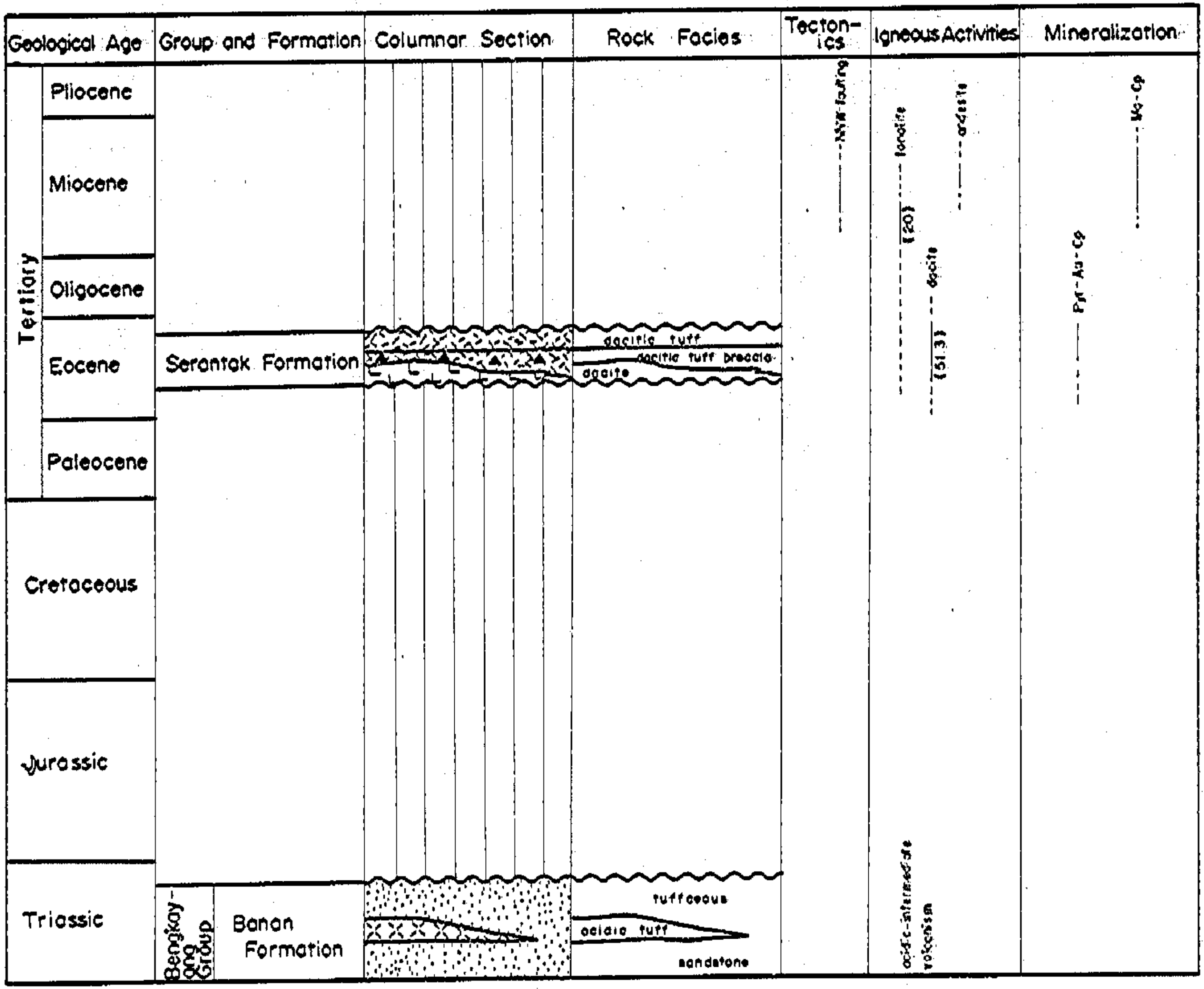


Fig 4-1 Generalized Stratigraphy of Serantak Area

The dacitic tuff breccia is exposed around the dacites extending at north and southeast of Gunung Serantak. This is a gray or green colored massive rock, having dacite and sandstone breccia of 3 ∿ 4 cm in size.

Under microscope, some samples contain many clastic fragments of dacitic rocks, quartz and plagioclase. The matrix consists of fine quartz, plagioclase, epidote, chlorite and iron ores.

Fine white tuff cropping out at the east end of survey area is soft and contains characteristically quartz grains.

Thickness: 100 m or less

Correlation: Since this formation overlies Banan Formation unconformably, the dacite (RA-31) in the reconnaissance survey was dated at 51 m.y. by the K-Ar absolute age dating, and it has been also intruded by Sirih tonalite, this Formation is correlative with the Ecocene series.

(3) Sirih tonalite

Distribution: The rock is extensively distributed from the upperstream of S. Banan to Gunung Buru. These tonalites are in a harmonious relation with Banan Formation.

Rock facies and lithology: The hornblend biotite tonalite, shows a color index of 10 ∿ 15%, having a fine or medium equi-granular texture and being affected by the alteration of weak chloritization and/or epidotization. Under microscope, this tonalite consists of plagioclase, quartz, biotite and hornblende as the main constituent minerals, and iron minerals, apatite and titanite as the accessory minerals.

The tonalite in this area is of massive uniformity, having no xenolith in general. Two trends of joints occur remarkably in the tonalites, i.e. the strike of N20° ∿ 55°W and the dip of 50° ∿ 90° and the strike of E-W and the dip of 30° ∿ 70°. Both the foliation and the linear structure are observabed through the linearment, such as arrangement of columnar hornblende crystals of lenticular mafic clots (a type of xenolith). Judging from the fact that this foliation strikes NE-SW and dips NW, and the linear structure dips NW, this tonalite is assumed to have been intruded from the dip direction of this linear structure.

The tonalite has intruded into Serantak dacites at S. Banyeng, a tributary of S. Banan between S. Banan and S. Palagi, as Fig. 4-2 shows.

Time of intrusion: The tonalite intruded into Banan Formation and Serantak dacite, and has been cut by Cu and Mo ore bearing quartz veins and andesitic dykes.

From result that the K-Ar absolute age dating in the first phase survey dated as 20 m.y. it is inferred that the tonalite has intruded at Early Miocene age.

(4) Andesitic dykes

Distribution: The rocks are distributed at south and west of this survey area, as dykes of 3 ∿ 20 m in width.

Rock facies and lithology: this is an a massive solid andesitic rock of grey color, having a porphyritic texture and extending toward N20° ∿ 40°W at the central distribution area and N60°W at west side of the distribution area. This is nearly correlated with the lineation of Sirih tonalite.

Time of intrusion: Since the andesite dyke has intruded into both Serantak dacites and Sirih tonalites, it is determined as the youngest dyke in the survey area.

1-2 Geological Structures

In the tonalite stock, the linear structure causing the arrangement of hornblende trending NW and foliation striking NE-SW are commonly recorded.

The fact that this lineation trend is rotated from NW to NNW in trend, the trend moving from the east end to north the Sirih tonalite shows that the tonalite has intruded from NW or NNW direction.

The andesite dykes intruded into the Serantak dacite and Sirih tonalite have two trends, i.e. NNW-SSE and NWW-SEE. Also, many quartz veins accompanying a mineralization have two major strikes of N10° ∿ 40°W and N60°W or E-W. The faults in the survey area have the trend of NNW-SSE at north, being inferred to have been intruded after the tonalite intrusion.

As above mentioned, most faults and andesite dykes have NW-SE direction accompanying mineralizations in the Serantak - S. Banan survey

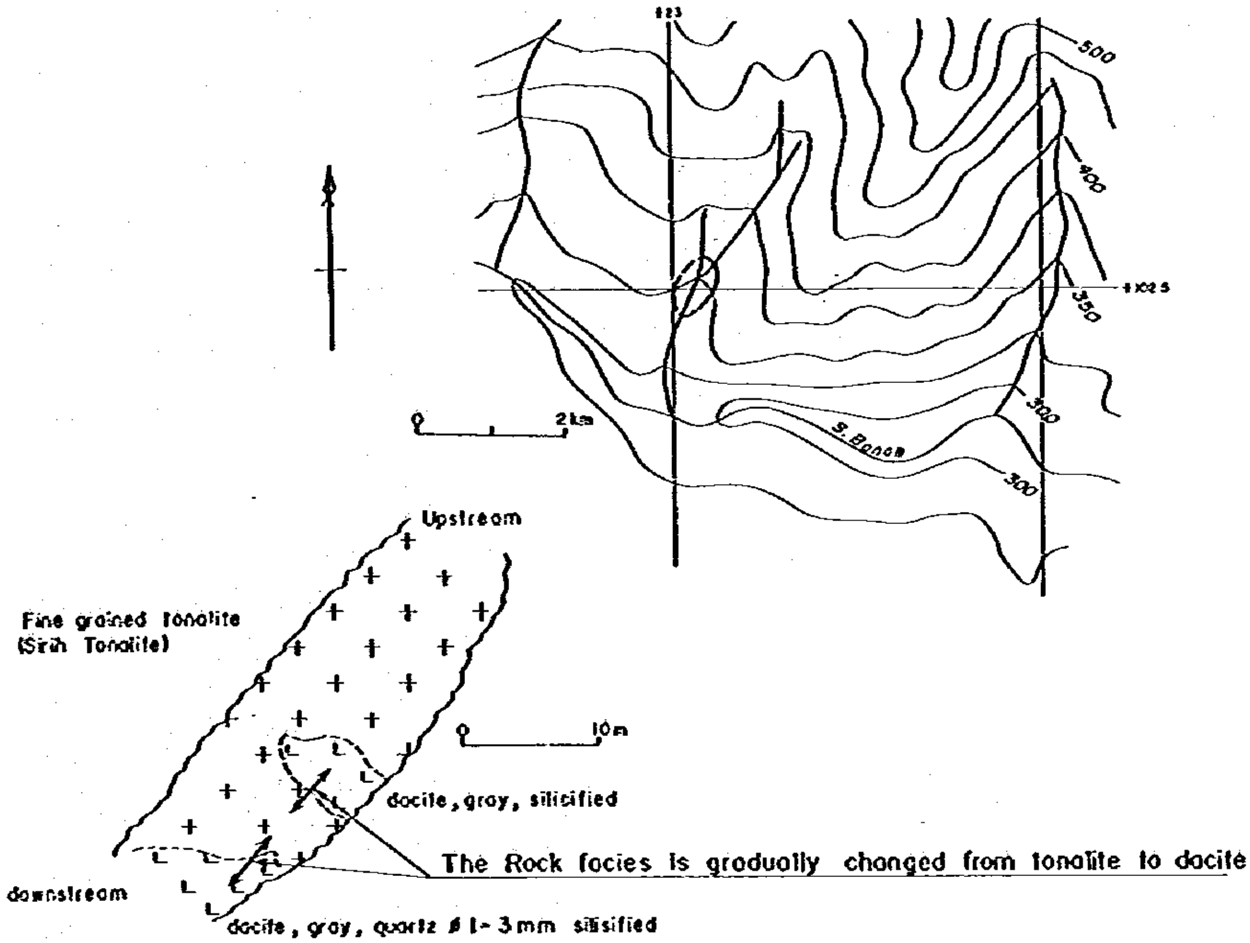


Fig 4-2 Sketch Map of the Relation between Sirih Tonalite and Serantak Dacite

Table 4-1 List of Assay Results in Banyi Alteration

Vein Name	Sample No.	Chemical Assay			Description
		Au g/t	Ag g/t	Cu %	
Strong Alteration Zone	Rg-61	<0.1	<2	<0.01	Chip sample in Pyrite dissemiration and strong alteration
	RG-101	<0.1	-	<0.01	Channel sample of 6 m length in strong alteration
	RG-102	<0.1	-	0.01	Channel sample of 0.7 m length in strong alteration
	RG-106	<0.1	-	0.01	Chip sample in alteration
	RG-107	<0.1	-	0.01	Channel sample of 1 m length in pyrite-veinlet network
	RG-108	<0.1	-	0.01	Chip sample taken from Pyrite-quartz veinlet
Vein in Strong Alteration Zone	RF-128	0.1	<2	-	Pyrite-quartz vein of 0.05 m width
	RF-129	<0.1	<2	0.01	Pyrite-quartz vein of 0.20 m width
	RF-132	<0.1	<2	-	Pyrite veinlets of 0.01 m ∿ 0.02 m width
	RF-134	<0.1	<2	<0.01	Pyrite veinlets network
Banihulu Vein	RF-136	4.8	4	-	Pyrite vein in old adit
Batu Aji	RF-137	3.3	4	0.47	Pyrite-clay vein

area. The strike NW-SE and Sirih tonalite trend also at NW-SE direction.

These facts support the idea that the tonalite, andesite dyke and mineralization have been caused by the consistent structural control.

1-3 Mienral Deposits

1-3-1 General

The mineralized zones in this survey area can be classified into three types of mineralizations, i.e. chalcopyrite-molybdenite-bearing quartz veins distributed in Sirih tonalite, gold-bearing pyrrhotite ore deposits and gold-bearing quartz veins distributed around Serantak dacite stocks. Owing to the above-mentioned fact, these mineralizations are closely related with the young igneous activities.

1-3-2 Description on Mineralizations

(1) Mineralization accompanied by Sirih tonalites

S. Banan mineralization:

Many quartz veins in Sirih tonalites intruded into the upperstream of S. Banan and its tribunary areas were found. These quartz veins and tonalite as country rock are also accompanied by a small quantity of molybdenite and chalcopyrite.

Under microscopic, the minor quantity of chalcopyrite, chalcocite, magnetite, pyrite and hematite were observed in the samples (RD-138 and RD-143) collected at the upperstream of S. Banan.

The analysis of narraw molybdenite-chalcopyrite-bearing quartz vein of 1 ∿ 2 cm in width shows Au-0.1 g/t, Cu-0.01%, Mo-0.37% in sample RD-139, as well as Au-0.5 g/t, Cu-4.32%, and Mo < 0.01% in sample RD-143.

These quartz veins strike mostly at N20° ∿ 40°W. Especially, the narrow molybdenite-chalcopyrite-bearing quartz vein strikes N20° ∿ 30°W, while the narrow molybdenite-bearing quartz vein strikes N60°W and N70°E.

This tendency is the same with the molybdenite quartz vein at the areas of S. Takap and S. Sirih in the first phase survey, and these mineralizations seem to be in the same mineralized area.

At southeast of this mineralized area, the narrow tourmaline quartz veins are exposed. Even though, many mineralizations are distributed in the tonalites where no thermal alteration has undergone.

This mineralization is regarded as the simple chalcopyrite molybdenite molybdenite bearing quartz veins, rather than the porphyry copper-molybdenite deposit.

Owing to the fact that these quartz veins cut the tonalites and the andesitic dykes in the tonalites, the mineralization is inferred to be at the latest during the young igneous activity.

In the geochemical survey with soils sampled in this survey, this mineralization tends to have the higher values of Cu and Mo than at non-mineralization area. The molybdenite quartz veins surveyed are situated at the norther part of S. Takap and S. Sirih mineralizations, from which they are all mineralized seemingly at the same period.

(2) Mineralization related with Serantak dacites

Serantak ore deposit:

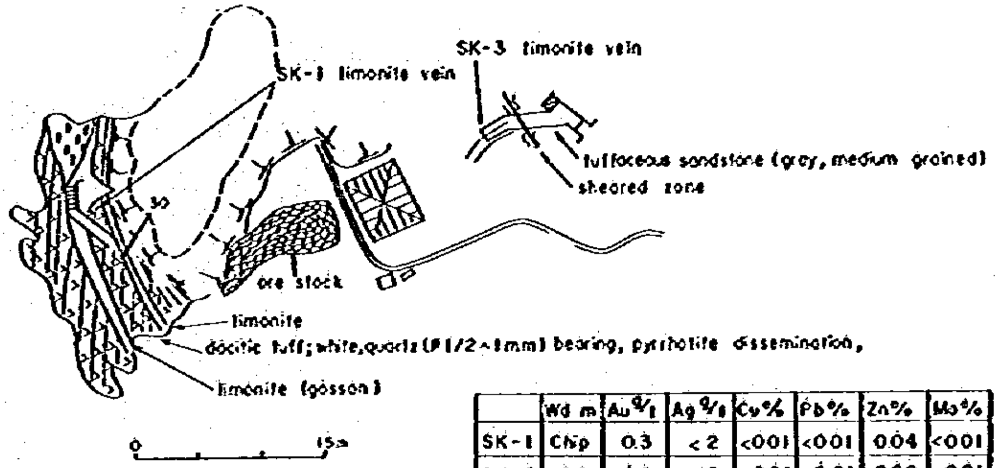
Outcrops of massive gold-bearing chalcopyrite phyrrhotite deposit are situated at east hill (386 m high) of Gunung Serantak. (Fig. 4-3, Serantak II.)

This ore deposit consists of two layers of pyrrhotite quartz vein embedded in Banan Formation, having the outcrop extension of 15 m with the average width of 57 and 70 cm, respectively, and tending to thin out southward.

The observation under microscope identified pyrrhotite accompanying small quantity of chalcopyrite.

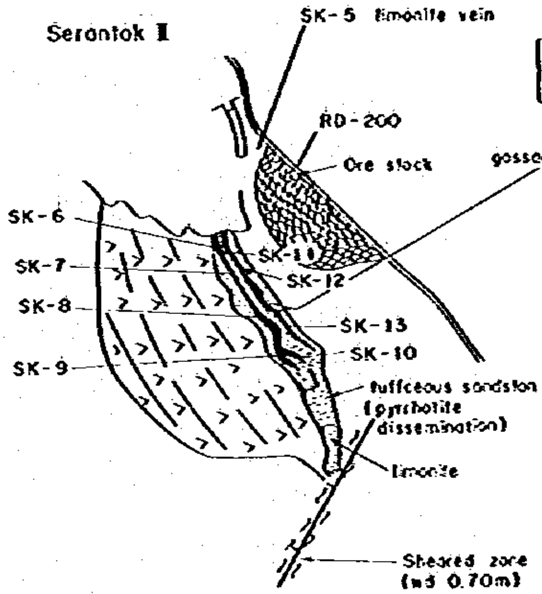
The chemical analysis shows (A): the average width of 0.57 m, Au-3.4 g/t, Ag < 2 g/t, Cu-0.19%, Pb < 0.01%, Zn < 0.01%, and Mo < 0.01%; and (B): the average width of 0.7 m, Au-3.3 g/t, Ag-7.4 g/t Cu-0.40%, Pb < 0.01%, Zn < 0.01% and Mo < 0.01%.

Gossan outcrop (0.6 m wide) formed by the oxidation of pyrrhotite exposes at about 120 m north of these outcrop.



	Wd m	Au g/t	Ag g/t	Cu%	Pb%	Zn%	Mo%
SK-1	Chip	0.3	< 2	<0.01	<0.01	0.04	<0.01
SK-3	0.6	0.2	< 2	0.01	<0.01	0.02	<0.01

Serontok II



	Wd m	Au g/t	Ag g/t	Cu%	Pb%	Zn %	Mo %
SK-5	0.45	1.2	7	0.35	0.01	0.01	<0.01

	Wd m	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %
SK-6	0.5	0.5	2	0.17	<0.01	<0.01	<0.01
SK-7	0.3	0.6	< 2	0.28	<0.01	<0.01	<0.01
SK-8	0.7	10.3	2	0.14	<0.01	<0.01	<0.01
SK-9	0.5	0.1	< 2	0.18	<0.01	<0.01	<0.01
SK-10	0.3	0.1	2	0.25	<0.01	<0.01	<0.01
Aver.	0.57	3.4	< 2	0.19	<0.01	<0.01	<0.01
SK-11	0.7	1.1	2	0.27	<0.01	<0.01	<0.01
SK-12	0.9	5.3	14	0.60	<0.01	<0.01	<0.01
SK-13	0.5	2.7	2	0.24	<0.01	<0.01	<0.01
Aver.	0.7	3.3	7.4	0.40	<0.01	<0.01	<0.01

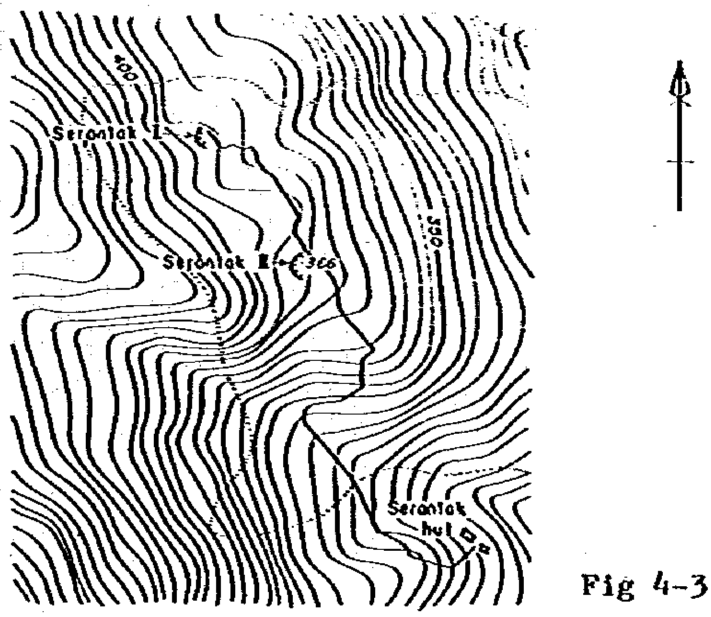


Fig 4-3 Sketch Map of Serantak Mine

Table 4-2 List of Mineralized Zone and Chemical Analysis of Ores (Detailed Survey Area) (1)

Group of Mineralization	Name of Mineralization Zone	Location		Mode of Occurrence	Kind of Ore	Sample No.	Sampling Width (m)	Assay						
		Grid of Map	River or Village					Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %	Mn %
<u>Serantak Area</u>														
Sirih Tonalite	Banan		S. Banan	Vein	Mo, Cp	RD-139	0.01-2	0.1	-	<0.01	-	-	0.37	-
								0.5	-	4.32	-	-	<0.01	-
Serantak	Serantak	103-24	G. Serantak	Vein	Cp, Pyrr, Au	5 piece Aver.	0.57	3.4	<2	0.19	<0.01	<0.01	<0.01	
						3 piece Aver.	0.70	3.3	7.4	0.40	<0.01	<0.01	<0.01	
Serantak	Sentura	102-23	S. Banan	Vein	Au (Mo, Cp)	RE-131	0.05	0.1	-	<0.01	-	-	-	-
						RE-135	1.10	<0.1	-	0.04	-	-	-	-
Banan F.	G. Buru		G. Buru	Vein	Sp, Py, Cp	RE-113	0.20	0.1	-	0.02	-	-	-	-
<u>Banyi Area</u>														
Banyi	Banyi		S. Banyi	Network	Py	RG-101	6.00	<0.1	-	<0.01	-	-	-	-
				do	do	RG-102	0.70	<0.1	-	0.01	-	-	-	-
				do	do	RG-106	Chip	<0.1	-	0.01	-	-	-	-
				do	do	RG-61	Chip	<0.1	-	0.01	-	-	-	-
				do	do	RG-107	1.00	<0.1	-	0.01	-	-	-	-
				do	do	RG-108	Chip (Vein)	<0.1	-	0.02	-	-	-	-
				Vein	do	RF-128	0.05	<0.1	<2	-	-	-	-	-
				do	do	RF-129	Chip	<0.1	<2	<0.01	-	-	-	-
				do	do	RF-137	0.10	3.3	4	0.47	-	-	-	-
				do	do	RF-132	Chip	<0.1	<2	-	-	-	-	-
	Banihulu		S. Banyi	Vein	Py	RF-136	0.20	4.8	4	-	-	-	-	-
	Sungisa North		S. Sumau	Vein	Py	RF-123	0.20	<0.1	<2	<0.01	-	-	-	-
						RF-108	0.05	39.9	12	0.09	-	-	-	-
			S. Sungisa	Vein	Py	RF-111	0.01	<0.1	-	-	-	-	-	-
			do	do	do	RF-113	0.02	0.1	-	0.02	-	-	-	-
	Sungisa South		S. Sungisa	Vein	Py	RF-117	0.10	4.3	-	-	-	-	-	-
			do	do	do	RF-118	0.05	5.3	-	-	-	-	-	-
			do	do	do	RF-104	Chip	<0.1	<2	<0.01	-	-	-	-
			do	do	do	RG-60	Chip	0.1	<2	<0.01	-	-	-	-
Mempawah	Mempah South		Mempawah	Vein	Py	RB-118	Chip	<0.01	<2	<0.01	-	-	-	-
Mempawah	Mempah North	324-82	S. Mempawah	Dissemna-tion	Py	-	-	-	-	-	-	-	-	-
	S. Rena	326-81	S. Rena	Vein	Py	RA-104	Chip	0.8	15	0.02	0.02	0.03	<0.01	-

Table 4-2 List of Mineralized Zone and Chemical Analysis of Ores (Detailed Survey Area) (2)

Group of Mineralization	Name of Mineralization Zone	Location		Mode of Occurrence	Kind of Ore	Sample No.	Sampling Width	Assay						
		Grid of Map	River or Village					Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %	Mn %
Bakilok	Bakilok	328-83	S. Lao	Vein	Taumaline	-	-	-	-	-	-	-	-	-
Jelayan	Jelayan	329-82	S. Jelayan	Vein	Py, Cu	RC-118	Chip	0.2	24	2.38(*)	-	-	-	-
Maha	Maha	329-83	S. Maha	Vein	Py	-	-	-	-	-	-	-	-	-
Bulikecil	Bulikecil	330-83	S. Bulikecil	Vein	Py	RB-143	Chip	0.1	17	1.01	<0.01	0.08	<0.01	-

(*): Containing malachite stain

Gold is enriched owing to the oxidation of pyrrhotite, but the chemical analysis results in Au-0.3 g/t, Ag 0.2 g/t, Cu < 0.01%, Pb < 0.01%, Zn-0.04% and Mo < 0.01% (SK-1).

Although the first phase survey has gained Au-7 g/t, this ore deposit seems to have an uneven gold content the through it. At present, this ore deposit is being operated under a small scale mining.

Senturu mineralized zone:

Many quartz veins of network pattern are observed in the dacites intruded into Banan Formation situating at the midstream and the branch streams of S. Banan. This zone has a wider vein as compared to that of quartz veins embedding in Sirih tonalites.

The analysis of this qurtz vein shows the vein width of 0.05 m, Au < 0.1 g/t and Cu < 0.01% (RE-131), and the vein width of 1.1 m. Au < 0.1 g/t and Cu-0.04% (RE-135).

Besides, many old adits prospecting gold ore in the past are situated at the right bank of S. Banan midstream, being in contact with Serantak dacites. However, they are almost all collapsed, and the details are unknown.

At the right bank of S. Banan midstream, many tourmaline-quartz veins with 1 cm or less in width are scattered in Serantak dacite stocks most trending at N40° ∿ 60°W.

Also, a minor quantity of molybdenite or chalcopyrite is filled in the fissures in tuffaceous sandstone of Banan Formation at west of this mineralization.

(3) Other mineralizations

Quartz veins (20 cm wide) of strike N60°W outcrop in the fine sandstone in Banan Formation near the summit of Gunung Buru at west of this survey area. This quartz vein is accompanied by sphalerite pyrite and chalcopyrite.

The ore sample (RD-144) contains sphalerite, pyrite, galena and chalcopyrite, under microscope.

At east of Senturu mineralization at southeast of this survey area, where is at the south tributary of S. Banan, an argillized alteration zone exposed along the faults striking at N22°E with the dip at 52°W in Banan Formation.

The chemical analysis shows the grade of Au-0.1 g/t and Cu-0.02% (RE-113).

1-4 Geochemical Survey

The geochemical survey with soil sampling was carried out in parallel with the geological survey. 47 samples, were collected, and the indicator elemetns are copper (Cu) and molybdenum (Mo). For the statistical data processing of analyzed values, the same procedure was used with those applied in the reconnaissance survey. As the sub-grid sampling method is applied in this survey, it was very convenient to compile iso-grade contour map to reveal geochemcial anomalous areas, for comparing the results of statistical data processing (Fig. 4-4).

1-4-1 Sampling

In parallel with the geological survey, soil samples were collected from B-horizon at ridge in order to prevent them from being contaminated by the rivers, dales, swamps and so forth.

The sampling locations are well planned so as to have an even density over the whole survey area, and the samples were collected at a rate of 3 points per km^2, totaling into 47 samples for the indicator elements of Cu and Mo.

The samples collected were dried in the sun at flying camp site and then sieved through 80 mesh to prepare the samples for analysis.

1-4-2 Anomalous Areas

(1) Banan anomalous area

This anomalous area ranges 1.5 km^2 toward N-S and 2.2 km^2 toward E-W, centering at the upperstream and tribunary bank of S. Banan. Also, a copper anomalous area is distributed toward WNW-ES direction.

The geology of this anomalous area consists of Sirih tonalites correlative with Miocene age, being accompanied by the narrow chalcopyrite molybdenite quartz veins. However, this anomalous area overlaps with Banan mineralization, clearly showing a mineralization

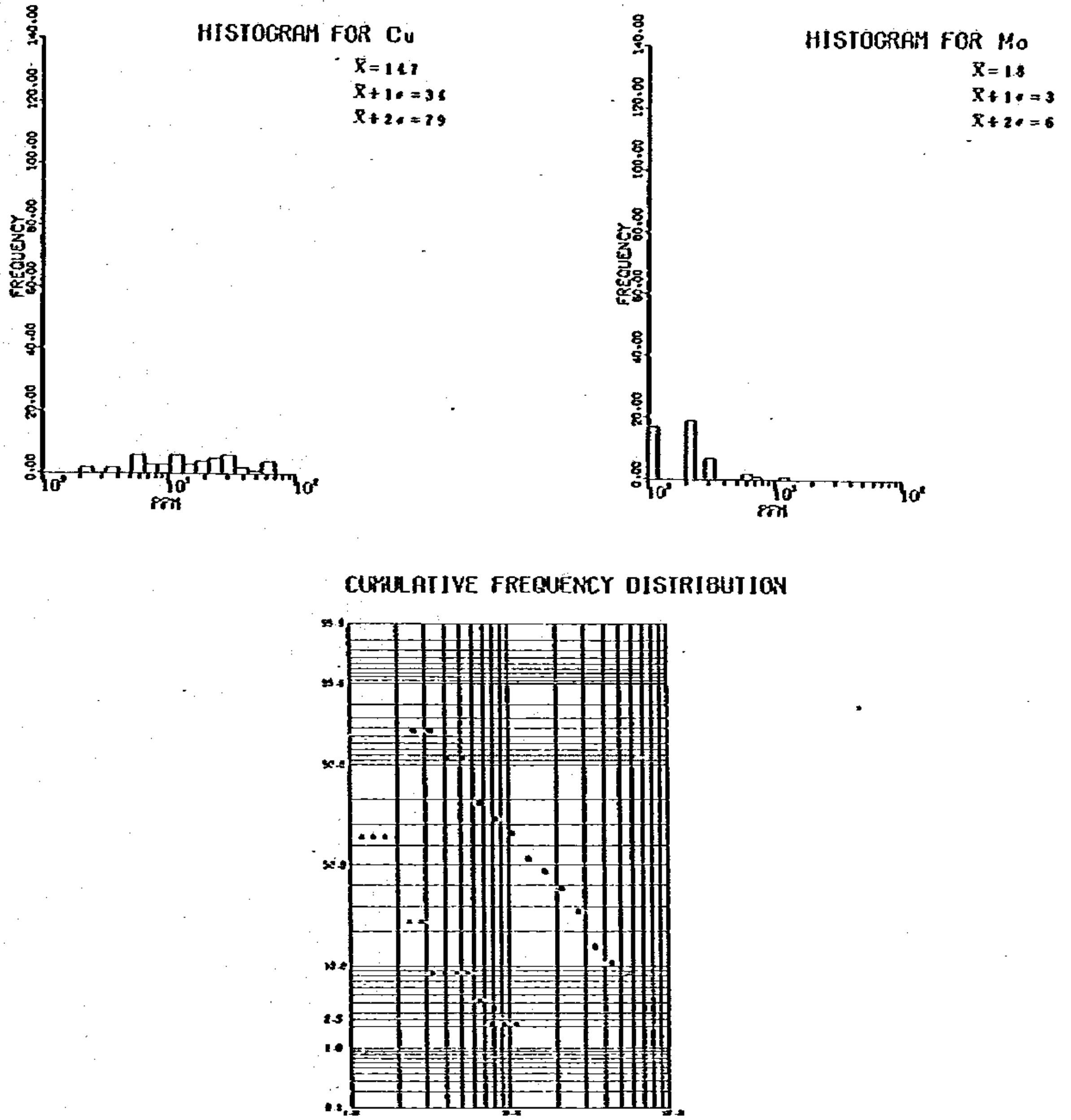


Fig 4-4 Histgram and Cumulative Frequency of Geochemical Analysis in Serantak Area

accompanying Sirih tonalite. This is most remarkable in respects of the area and strength of anomaly, among Serantak survey area.

(2) Serantak anomalous area

This is a copper anomalous area ranging in 0.3 × 0.4 km at east mid-hill of Gunung Serantak.

The geology of this anomalous area consists of Late Traissic Banan Formation and Serantak dacite instruding into the former. This anomalous area is included in Serantak mineralization, and assumed to reflect a massive gold-chalcopyrite bearing pyrrhotite mineralization around Serantak dacite.

(3) Senturu anomalous area

This is a copper anomalous area ranging in WNW-ESE direction 0.5 × 0.9 km in scale at the left bank of S. Banan downstream.

This anomalous area is also assumed to reflect mineralizations around Serantak dacite.

(4) Buru anomalous area

This is a copper anomalous area ranging in the scale of 0.6 × 0.4 km around the summit of Gunung Buru.

The geology of this anomalous area consists of Banan Formation and Serantak dacites. As the quartz vein accompanying sphalerite, chalcopyrite and pyrite embeded in Banan Formation crops out at the vicinity of soil sample collecting locations, it is assumed that copper anomaly values came from the mineralizations. From the fact that Mo is less than 1.0 ppm, which is weak compared with Cu anomaly, and that the anomalous is nearly distributed at south of Serantak dacite stock, it is assumed to reflect mineralization brought by Serantak dacite.

CHAPTER 2 BANYI AREA

2-1 Geology of Banyi Area

2-1-1 Outline of Geology

Banyi area is situated at about 5 km southeast of Bengkayang. In this detailed survey area, old suren mine and several old pits were explorated for the gold-bearing quartz vein in the past, and the extensive argillaceous alteration area accompanying pyrite dissemination at S. Banyi have been confirmed through the first phase survey.

Andesites of Jurassic Jirak Formation are distributed at west of this surrounding area, and G. Raya granodiorite intruding into Jirak Formation is exposed extensively from west to south of this survey area.

Banyi tonalites intruding into them as above are distributed along S. Banyi, around Jaku and along S. Sebintik. Besides, the dykes are distributed, such as granodiorite (gd3), intrusive stock of Tiang quartz diorite, andesite, diorite, quartz porphyry, etc. Intrusion of these igneous rocks are at Cretaceous and Tertiary age. The Cretaceous intrusive rocks consists of G. Raya granodiorite, quartz diorite and granite, but the Banyi tonalite intrusion is at Tertiary age.

In the first phase survey, Tertiary intrusive rocks, such as Banyi tonalite, Tiang quartz diorite and granodiorite (gd3), are aligned at the survey area and its surrounding in the direction of NE-SW. on the contrary Cretaceous quartz diorite has the intrusive direction of NW or N - S. In this context, a fair degree of difference may be seen between Cretaceous and Tertiary, in respect of the structural directions which have been brought by the igneous activity after instruction of G. Raya granites.

Further, Quaternary detrital system is distributed at the low land of S. Telnam and others.

2-1-2 Geology

(1) Jirak Fromation

This Formation consists chiefly of andesitic lava and dacitic pyroclasitic rocks, being intruded by G. Raya granodiorites, Tiang quartz diorites and granodiorites (Gr-4).

This Formation is distributed from S. Bayur to Gunung Pandan Kecil and Gunung Pandan Besar, at west of survey area.

Andesitic lava:

This rock has a main constitution of the Jirak Formation, being colored at dark grey or green and having a dense massive mirocrystallinic proxene andesite.

This rock is generally characterized by the strong magnetism comparing against Tertiary andesite dykes having rarely a magnetism. The silisified andesite, bearing pyrite dissemination, is extensively distributed surrounding granodiorite (Gr-4) at the upperstream of S. Mempawah and in Banyi pyrite mineralized area at north of Gunung Sekeh, and the distributions of tourmaline quartz veins are also observabed in the andesite.

Further, this rock varies from andestic facies to quartz dioritic facies in texture at the contact area, due to a contamination by the intrusion of G. Raya granodiorite.

Observation results under microscope are as follows.

This rocks were changed to hornfels with secondary hornblende and biolite and undergone chloritization. The phenocryst consists of plagioclase of 1.5 mm or less in length. The goundmass in composed of plagioclase, biotite and opaque minerals. Many chlorites partly exist. Quartz veinlets accompanying pyrite, chlorite and epidote commonly occur, especially chlorites was formed at the side of quartz vein. Many chlorites occur around the above veins. Titanite and epidote accompany as accessory minerals.

Andesitic pyroclastic rocks:

This rock is distributed at the area from the downstream of S. Bayur to S. Sengisa, extending outside the survey area. Two andestic pyroclastic beds interbedded in andestic lava consists of dark green andestic breccia tuff, pale or dark green andesitic tuff and dark green tuffaceous mudstone, bed in it. The bed generally strikes NW-SE and dips S.

Tuff breccia consists of andesitic breccia of 1 ∿ 5 mm in size and is interbedded with soft muddy tuff.

Observation under a microscope are as follows.

This rock consists of fragments of fresh plagioclase as large as 0.08 mm with quartz and in the matrix constituing fine plagioclase, clay and opaque minerals. This rock contains characteristically many fine lath crystals of plagioclase.

(2) Older granite rocks

a) G. Raya granodiorite

This rock is distributed in about 80% of this survey area, showing a color index of 10 ∿ 20% and mostly having a medium grained equi-granualr texture. In spite of that, this rock consists locally of a porphyritic texture around Jirak Formation. The granodiorite is holocrystilline texture, and consists of hornblende, biotite, plagioclase, potash feldspar and quartz.

Generally, the granodiorite exposing at the midstream of S. Semade has coarse long prismatic plagioclase and hornblende of 2 mm in size and shows an medium magnetic susceptibility checking by pen magnet. Characteristically, many andesitic xenolithes of 20 ∿ 30 cm in size occur in G. Raya granodiorite, near the contact part with the andesitic lava of Jirak Formation.

The results of Petrographic observations under a microscope are as follows.

This rock has medium - coarse - grained equi-granular texture, having plagioclase, quartz, potasic quartz, biotite and hornblende, as main components, and iron ore, titanite and apatite as accessory minerals. Plagioclase is a short prismatic (2.5 mm) hypautomorphic and slightly altered to sericite. Quartz is xenomorphic with a grain size below 1 mm. Potash foldspar is xenomorphic perthite among other minerals. Biotite is hypautomorphic with a grain size below 0.7 mm, mostly chloritized and partly epidotized. Hornblende is short prismatic (1 m or less in length) and hypautomorphic. Sample (RB-156) has commonly myrmekite and micro pegmatite texture. This granodiorite was dated as Middle Cretaceous age by the K-Ar absolute age dating in the first phase survey.

b) Tiang quartz diorite

This rock has two types of stocks, i.e. one distributed at around the summit and southern slope of Gunung Pandan Besar and the other distributed from S. Benteng at southeast corner of this survey area to extend outward.

The stock around Gunung Pandan Besar has 1 × 2 km in distribution scale. The rock facies shows a color index of 30%, having a strong magnetic susceptibility tested by pin magnet, and being a medium or coarce grained quartz diorite with the phenocryst of hornblende, biotite and quartz.

Observation under microscope is as follows.

The main constituent minerals are plagioclase, biotite, and hornblende. Augite, quartz, iron mineral and minor amount of ilmenite are also present. Plagioclose is short prismatic of 1.7 mm in length and hypautomorphic showing zoning. Hornblende is hypautomorphic with a grain size of 1.5 mm or less, being altered partly to carbonate. Biotite is hypautomorphic or xenomorphic with a grain size of 0.5 mm or less. Iron ore is of hexagonal or iregular form.

This rock has intruded into Jirak Formation and G. Raya granodiorites as the stock, whose it intrusion age was dated at Middle Cretaceous age.

c) Granite (gr 1)

This is a dyke intruding into G. Raya granodiorite and having the intrusive direction of N20°W ∿ N40°W, being distributed at a small scale along S. Maha, S. Sempuan and S. Jelayan.

The dykes distributed along S. Maha and S. Sempuan consist of biotitic granites having a leucocratic fine or medium grained texture with a color index of 5 ∿ 10%, providing strong silicification and pyrite dissemination to G. Raya granodiorites around it.

The granite rock distributed at Jilayan has a color index of 3% in pink color with a fine equi-granular texture. Both the chrysocolla and the pyrite disseminations and situated along the fissures of approx. 10 cm in width of E-W and N-S trend.

Observed under a microscope are as follows.

With a fine or medium grain size, minerals are plagioclase, quartz, potash feldspar, biotite and iron ore, in the order of larger content. Plagioclase is hypautomorphic or xenomorphic with a grain size of 3.0 mm, heavily argillized, altering to sericite or others. Quartz is xenomorphic with a grain size of 2.0 mm. Potashic feldspar is of perthite and xenomorphic filling among other minerals. Biotite is hypautomophic or xenomorphic with a grain size of 1 mm, chloritized and epidotized. A few shows a micrographic pegmatite texture.

(3) Younger igneous rocks

The younger intrusive rocks ocnsist of Banyi tonalites intruding into G. Raya granodiorites, granodiorites (gd 4) intruding into both Banyi tonalite and Jirak Formation, and the dykes of quartzdiorite and andesite.

a) Banyi tonalite

This is extensively exposed along S. Banyi, intruding into G. Raya granodiorite. The exposing scale ranges in 4 km toward E-W direction and 3 km toward N-S direction, including the outside of this survey area.

Having a color index of 30 ∿ 40% with a fine equi-granular texture, the major component minerals are hornblende and plagioclase. A mineralized zone exposes along S. Banyi. The first phase survey determined that this rock is of Oligocene. Even not in a large scale, it is assumed to be the laccolith intrusion.

Observed under a microscope are as follows.

The rock has coarse-grained texture, and its major constituent minerals are glagioclase (approx. 3.5 mm) and quartz (approx. 1.2 mm). Accessory minerals are biotite and hornblende. Plagioclase is partly altered into carbonate and sericite. Besides the above, opaque mineral, titanite, zircon, apatite, etc. are included.

b) Granodiorite (gd 4)

Within the survey area, this rock is distributed at two zones, i.e. at the upperstream of S. Banitamanas and at the upperstream of S. Mempawah.

At the former area, it is a circular stock from of about 500 m in diameter intruding into Banyi tonalites, while at the latter area, a nearly oval stock form of 500 × 1,000 m intruding into Jirak andesite.

The rock facies is characterized by a leucocratic fine equigranuler texture with a color index of about 10% and a weak magnetism. The main constituent minerals are hornblende and biotite in addition of quartz and feldspar.

For the rock at the upperstream of S. Banitamahas, in addition to a diorite dyke at a direction concordant with the external shape at the vicinity, a molybdenite dissemination zone is observed in the vicinity of S. Banitamahas upperstream.

For the rock at the upeprstream of S. Mempawah, a strongly silicificated zone is observable around the contact part with Jirak andesite, with tourmaline - quartz veins and an ore dissemination in the joints at both north and south.

Observation under microscope is as follows.

It has medium graind equi-granular texture, and main constitutent minerals are sericitized hypautomorphic plagioclase (2.0 mm in size), xenomorphic quartz (1.0 mm in size), partly chloritized hypautomorphic biotite (1.5 mm), titanite, minor quantity of zircon and apatite.

c) Quartz porphyry (qp)

This is a small scale of dykes distributed at the midstream of S. Mempawah, along S. Maha and S. Bentung, having a surface width of 0.5 ∿ 1.0 m at NW-SE or N-S direction.

The rock facies is characterized by a grey or greyish green with a color index of 10%. The phenocrysts of plagioclase and quartz is distinguishably observed.

Providing a strong silicification to the surrounding granodiorites, pyrite dissemination, pyrite-bearing quartz veins exist in it.

Observation under microscope is as follows.

This consists of plagioclase with a grain size of 3.5 mm or larger and quartz with a grain size of about 3.5 mm in a corrosion, both of whose phenocrysts are stained by epidotization and/or sericitization. The groundmass contains a lot of quartz (0.1 mm or less in grain size), followed by plagioclase, hornblende, epidote, chlorite, iron minerals, titanite and apatite. Some are seen to integrate all of above in a mosaic pattern.

These dyke have intruded into G. Raya granodiorite, and partly into Jirak Formation. Because the diorite dykes similar to this dyke has intruded into Banyi tonalite, it could be regarded as Tertiary intrusive rock.

d) Diorite dykes (dio)

This dykes are distributed around S. Banitamahas, S. Tapang and at the upperstream of central S. Menyuke, having width of 1 ∿ 10 m at the strikes of NW-SE and E-W in Raya granodiorites, Jirak andesites and Banyi tonalite.

Further, at the upperstream of S. Banitamahas, this distribution is made at a direction to conform with the circular intrusive stock of granodiorites (gd4).

Along S. Tapang and at the upperstream of S. Menyuke, this is chloritized, accompanying a pyrite dissemination.

The rock facies is characterized by a fine or medium granular texture of dark grey or green color with a strong magnetism and a color index of 50%.

The main constituent minerals are feldspar, quartz, amphibole, biotite, etc.

Observation under microscope is as follows.

Hornblende showing green phenocryst, plagioclase in a minor and quartz are observable. The groundmass consists of plagioclase, hornblende, iron minerals and titanite, the last two in a minor quantity.

Because this rock has intruded into Banyi tonalites along S. Banyi, it is thought to be a Tertiary intrusive rock concordant around the granodiorites (gd4).

e) Andesitic dykes (and3)

This is distributed in everywhere over the whole survey area, but concentrated around the ridge at 10 km^2 south-east of Gunung Sermaya and along the upperstream of S. semande.

Many dykes intruded into Raya granodiorites and Banyi tonalite are distributed at NW-SE, N-S and E-W directions.

The rock facies is characterized by a light green or green fine grained texture of andesite with almost weak magnetic susceptibility tested by pen magnet. Many of dykes have 0.5 ∿ 4.0 m in width.

Observation under microscope is as follows.

This consists of hypauthomorphic or xenomorphic plagioclase with a grain size of 1.7 mm or less, idiomorphic or hypauthomorphic hornblende with a grain size of 2.0 mm or less, showing green due to epidotization and/or chloritization, as phenocysts. Plogioclase has been affected to argillization, such as seriatization and epidotization.

The groundmass consists of plagioclase, hornblende, eqidote and quartz, being integrated in a mosaic pattern.

Viewing from the intrusion into Banyi tonalite stock, it is a Tertiary intrusive rock. This is also assumed to be intruded after granodiorite (gd4), because of its concordance with the granodiorite (gd4), but nothing is known about the relationship with any other dyke.

2-2 Geological Structure

The geological structure in this survey area is characterized with the intrusion of G. Raya granodiorite and another instrusions, such as many stocks and dykes of Tiang quartz diorites and granodiorites (gd4), directions of mineralized zones, ore veins, small faults and fissures, etc.

(1) Structure of Jirak Formation

Jirak Fromation consists mostly of andesite lava, where has pyroclastic rock layers comprised of tuff breccia, tuff and muddy tuff.

This pyroclastic rock bed varies in the strike, but in general, a monoclinal structure showing NW-SE with 20° N dip. Therefore, it is assumed that Jirak Froamtion within this survey area and its neighbors presents the monoclinal structure.

Owing to a majority of andeste lava in Jirak Formation, the disturbance in Jirak Formation incidental to the intrusions of G. Raya granodiorites is rarely observable, except a fair extent of contamination at the head of granodiorite intrusion at Bayur.

(2) Direction of igneous activity after intrusion of G. Raya granodiorite

There is a direction of near NE-SW at the boundary between Jirak Formation and G. Raya granodiorites.

For the movement of G. Raya granodiorites at the time of intrusion into Jirak Formation, it has a direction of NE-SW in and around the survey area, which is well reflected upon the conditions of exposing G. Raya granodiorites. This direction is also in a good coincidence with the intrusive form of Banyi tonalite stock.

While, Tiang quartz diorite stock has intruded with the directional extension of NW-SE, which is acrossing at a right angle with the direction at the time of intrusion of above G. Raya granodiorites.

Also, the granodiorites (gd4) have a circular intrusive form at S. Banitamahas along S. Banyi, while an elliptical form extending nearly toward E-W at the upperstream of S. Mampawah. The direction tying these two stocks is almost identical to that of trending the stock at the upperstream of S. Mampawah and these in trusives are fairly differing direction at the time of activities of these intrusive.

(3) Directions of dykes, faults, fissures and ore veins

Interpretation was attemped to know the tendency of direction of dykes, small faults and fissures of ore veins to that of above major igneous rocks by projection of their strike and dip on schmidt's net

And the results are as follows.

a) Granite dykes (gr1)

This rock is situated at south area in G. Raya granodiorites, having a few in number, but its direction is at NW-SE nearly acrossing at perpendicular to the direction of G. Raya granodiorites.

b) Diorite dyke

This dyke is distributed in both G. Raya granodiorite bathelith and Banyi tonalite stock and there are two directions of NW-SE and E-W.

c) Quartz porphyry dyke

This dyke is distributed in G. Raya granodiorite and there are three directions of NW-SE, N-S and NE-SW.

d) Andesite dyke

This dyke is distributed in both G. Raya granodiorites and Banyi tonalite and there are the largest number of this type, among all other types of dykes.

e) Fissures in small faults

There are various directions to be shown, but concentrated into NNW-SSE and NEE-SWW directions.

f) Fissures in ore veins

Banyi mineralization shows generally a distribution of NE-SW direction as a whole, but the individual ore vein in it and those distributed within this survey area are many showing the directions of E-W or NW-SEE and NE-SW.

2-3 Mineral Deposits

2-3-1 General

As for the mineralizations occurred in an extensive area accompanying with pyrite dissemination in this survey area, there are Banyi mineralized zone, S. Mempawah north mineralized zone, and Mempawah south mineralized zone. Further, although already mined out, there is old Suren mine. Besides, pyrite quartz veins and tourmaline quartz veins are distributed in Raya granodiorites at south of this survey area.

Banyi mineralized zone is exposed almost toward NE-SW direction, centering along S. Banyi, on the central sections undergoes the alterations, such as pyrite dissemination, network pyrite quartz veins and strong argillization, outside of which a pyrite dissemination widely occurs.

In it, there are many prospected pyrite quartz veins, and some are those where the underground prospecting has been conducted in the past.

The S. mempawah north and south mineralizations are situated at the south-west extension of Banyi mineralized zone, and are a mineralized zone to include tourmaline quartz veins, accompanying with the pyrite dissemination occurred at both north and south side of granodiorite stocks (gd4) at the upperstream of S. Mempawah.

Old Suren mine has been surveyed in the first phase. The ore deposits are fissures filling type embedded in Banyi tonalite stocks, being of gold-bearing pyrite chalcopyrite quartz veins ranging in 0.5 ∿ 1.0 m wide with the strike of N85°W and dip of 60°S.

The prospected and mined area is assumed to be approximately 300 m in the striking extension with the average depth as deep as 20 m.

The vein width of metalliferous veins ranges in 0.60 ∿ 1.18 m, having Au-1.4 g/t, Ag 8.0∿13.8 g/t, Cu 0.58∿0.81%, Pb 0.01∿0.02%, and Zn 0.01%, in the average metal contents.

Further, for the tourmaline quartz veins and the pyrite quartz veins (partly accompanied by pyrite and molybdenite) distributed at south of this survey area, they are distributed in the zoning arrangement to center at Banyi tonalite stocks and Banyi mineralized zone.

A summary distribution seems probably zoning of tourmoline-pyrite-molybdenum zone, pyrite-chalcopyrite mineralized zone, from center to outer.

2-3-2 Descriptions on Mineralizations

(1) Banyi mineralization

This is a mineralized zone exposed northward from the area along S. Banyi, and its strongly altered area is extended along S. Banyi.

This strongly altered area has a distributing scale of approximately 4,500 × 500 m, further, around which a weak alteration occurs, distributing in a scale of approximately 4.5 × 2.0 km to include the area of strongly altered area. Many pyrite quartz veins are distributed in it. Bayur vein, Sengisa north vein, Sengisa south vein, Banihulun vein and Batu Aji quartz vein had been explorated and prospected by underground or pitting in the past.

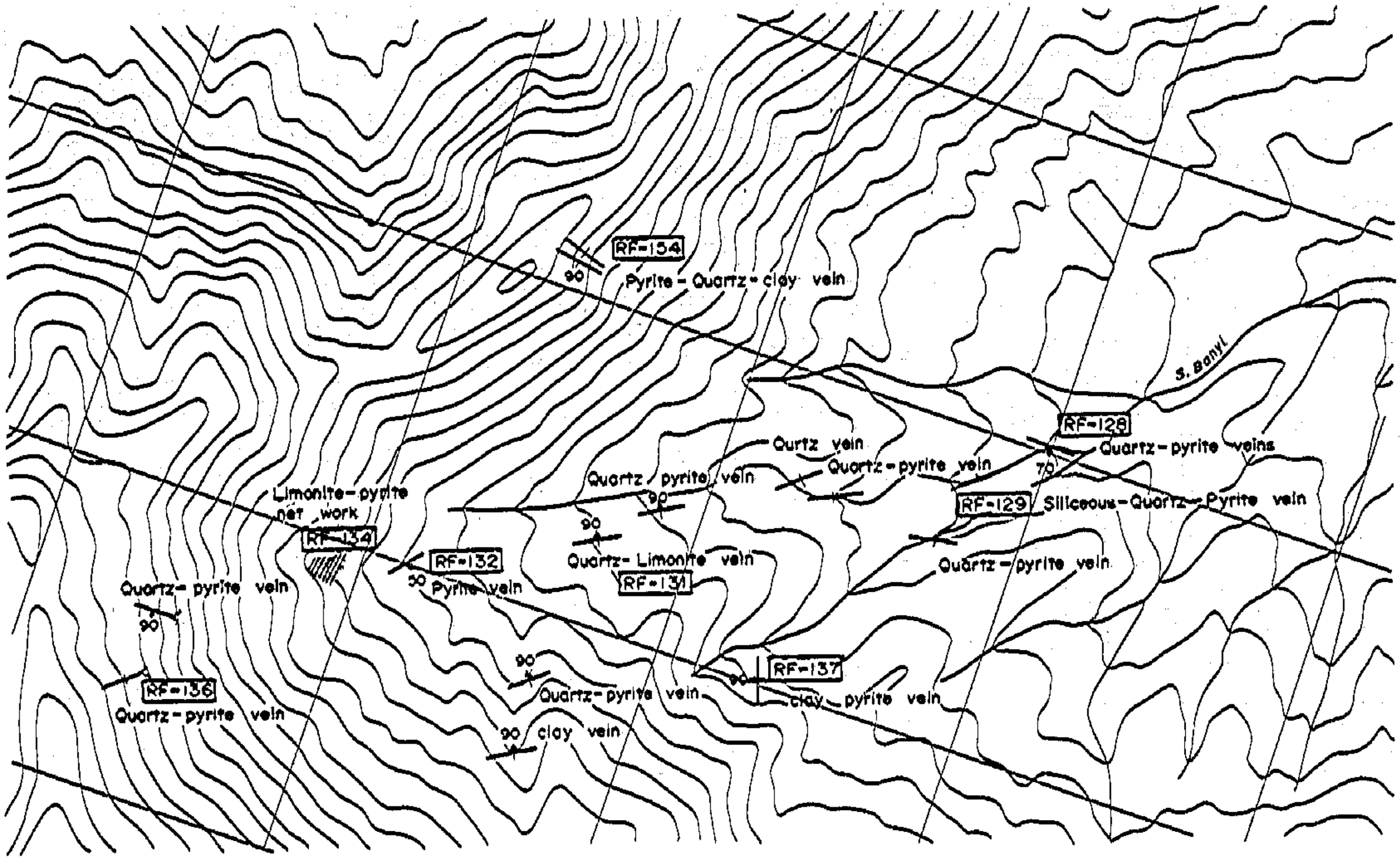
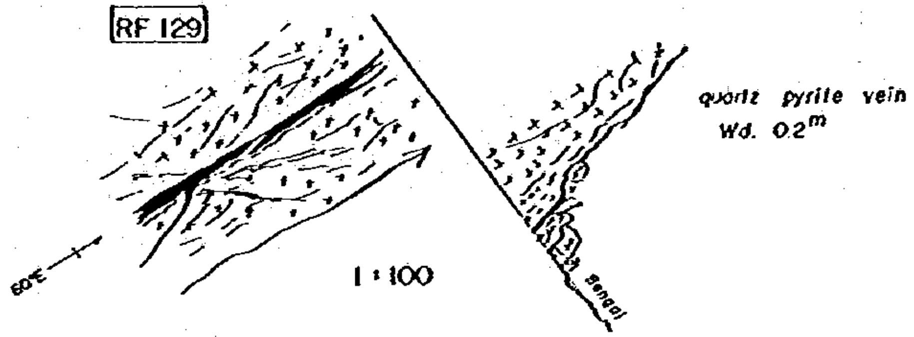
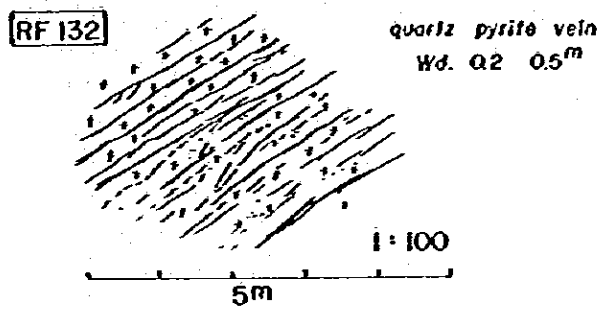
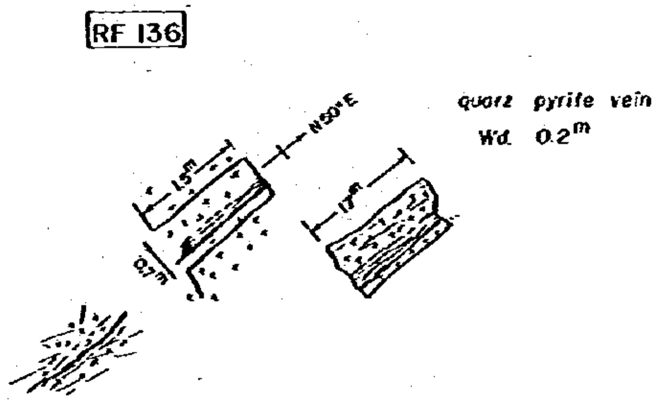


Fig 4-5 Location Map of Mineralization in Sungai Banyi





Sample No	Wd. m	Au g/t	Ag g/t	Cu %
RE128	0.05	0.1	< 2	—
RF129	0.20	<0.1	< 2	<0.01
RF131	0.10	—	—	—
RF132	0.30	<0.1	< 2	—
RF134	0.20	<0.1	< 2	<0.01
RF136	0.20	4.8	4	—
RF137	0.10	3.3	4	0.47
RF154	0.50	<0.1	—	—



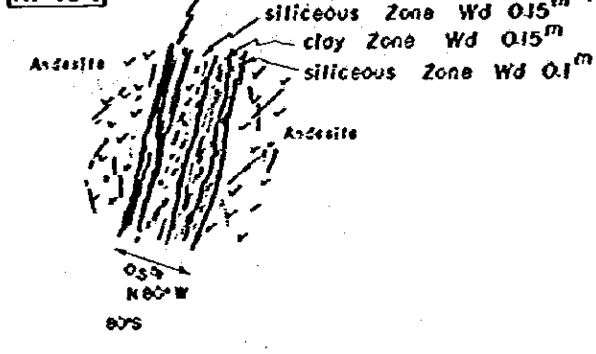


Fig 4-6 Sketch Map of Banyi Mineralization

a) Strongly altered area along S. Banyi and metalliferous veins in it

The strongly altered area are mostly distributed along S. Banyi in Banyi tonalite, and continues up to G. Raya granodiorites and Jirak andesitic lava at north of Gunung Sermaya.

This alteration was strongly argillized, in where many pyrite quartz veins and their network pattern veins occurred.

The X-ray diffractive analyses made on the assays sampled from these veins result in the detection of altered clays, such as sericite, quartz, albite, chlorite, etc. with the assay (RF-134) sampled at around Banihulu vein and the assay (RF-149) at a tributary of S. Banyi midstream.

Also, with the assay (RG-109) sampled at the downstream of joint between S. Genting Payang and S. Banyi, quartz, kaoline and sericite were detected.

The sericite found with RF-134 and RF-149 is judged Polytype of $2M_1$ and 1M sericites, as it has many peaks between Cu 2θ 19°~ 32°.

This sericite has a good crystallinity, and is judged to have been formed through a hydrothermal alteration.

Kaoline and Sericite were detected from Sample RG-109 by X-ray diffractive analysis. Sericite peak was not predominant, as compared with kaoline peak. Kaoline has a poor crystallinity, and from this, may possibly be halloysite as well. This is seemingly attributable to the fact that the location where RG-109 has been sampled has received the same hydrothermal alteration as above, but it is also assumed that the sericite, chlorite, plagioclose, etc. have been decomposed through weathering, while the kaoline or halloysite has been formed.

The chemical assay results with samples collected at this strong alteration area are as shown in Table 4-1 and Fig.s 4-5 and 4-6.

Noticeable as above are those with assays from Banihulu vein and Batu Aji quartz vein, both at southeast side of this strong alteration.

b) One veins distributed inside and outside of weak alteration and mineralizations

The weak mineralization is extended approximately 500 m at south and approximately 1 km at north of the strong alteration, surrounding the latter area.

Differing from the strong alteration, this is argillized not so strongly, keeping visually fresh country rocks in the mineralization, i.e. S. Banyi tonalites, G. Raya granodiorite and Jirak andesitic lava to be hand, but the colored minerals and plagioclase are altered to a fair extent. The colored minerals (chiefly hornblende) were chloritized, while the plagioclase to sericites.

A silicified zone is ranged in about 1 km in diameter from the upperstream of S. Sengisa to Gunung Sermaya. This silicified zone is fairly strong, and almost none of host rock texture can visually be observed in it.

The dissemination in the weak alteration is such that the pyrites are deposited into the joints of country rocks in a film from or replaced with the colored minerals around these joints.

There is only pyrite as the ore minerals, but nothing else can be observed. Its sulfur content is 3 ∿ 4% by visual observation. However, among the outcrops limonitized, some are enriched with gold.

Sengisa north vein (see Fig. 4-7)

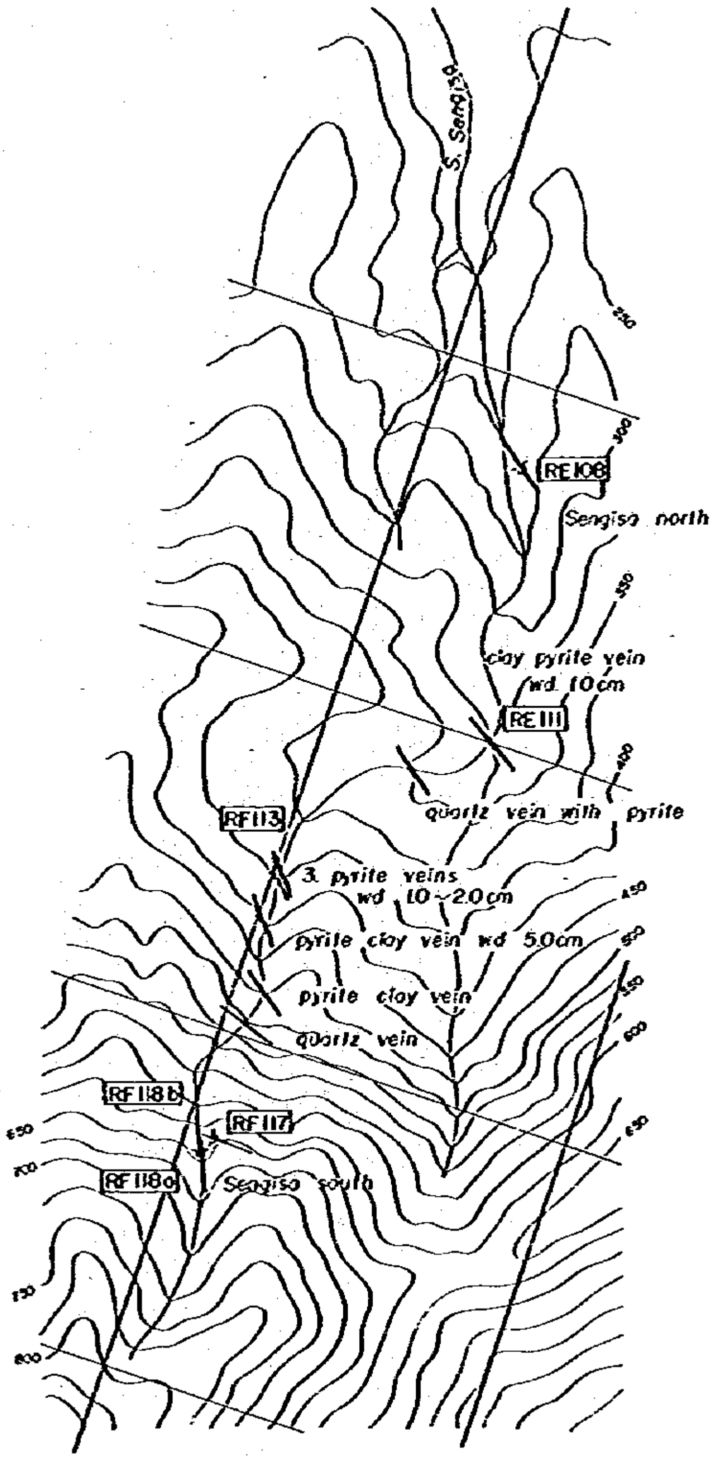
This is situated at about 1 km upperstream from the joint between S. Sengisa and S. Sebalan, being a pyrite quartz vein where G. Raya granodiorite is the country rock.

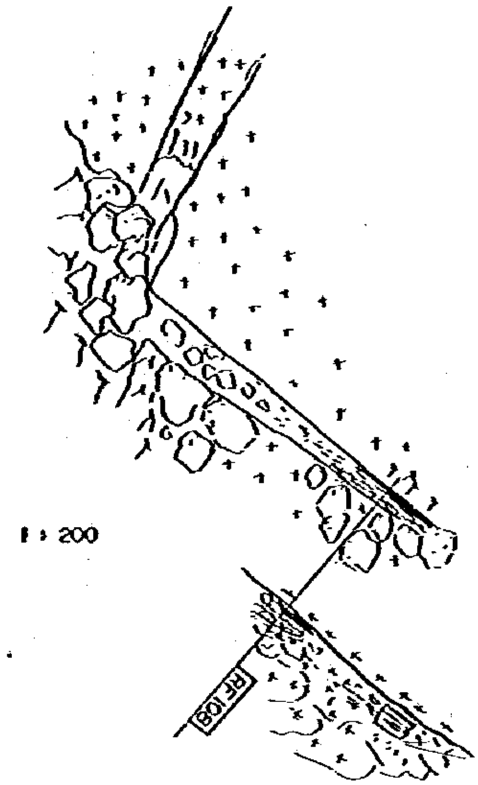
This ore vein has the strike of N50°W with the vertical dip and width of 0.05 m, and the assay results in Au 34.9 g/t, Ag 12 g/t and Cu 0.09%.

This ore vein had been trenched in the past over about 10 m along the ore vein, but the prospecting is now suspended, as collapsed.

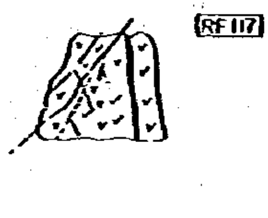
Sengisa south veins (see Fig. 4-7)

This ore vein is situated at the upperstream of a Sengisa,





Sample No.	Wd. m	Au g/t	Ag g/t	Cu %
RF108	0.05	34.9	12	0.09
RF111	0.10	<0.1	—	—
RF113	0.01 0.02	<0.1	<2	<0.01



Sample No.	Wd. m	Au g/t	Ag g/t	Cu %
RF117	0.10	4.3	—	—
RF118a	0.05	5.3	—	—
RF118b	0.05	0.1	2	<0.01

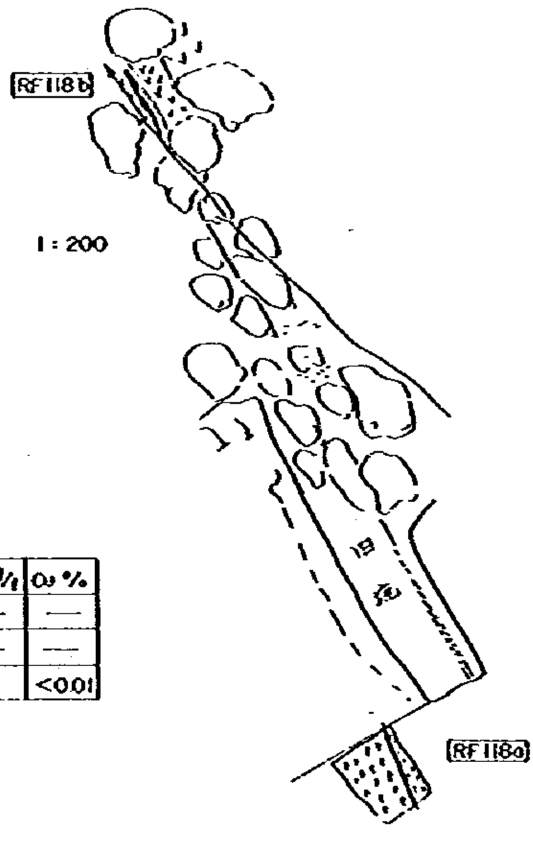


Fig 4-7 Sketch Map of Sengisa North and South Mineralizations

and is a pyrite quartz vein where Jirak andesitic lava is the country rock, having two veins.

The strike and dip of each vein are E-W with vertical and N30°W - S30°E with 80°NE. The ore vein of E-W direction has 0.10 m wide. The assay results in Au 4.3 g/t. The ore vein of N30°W direction with 30°S dip has 0.05 m wide. The assay results in Au 5.3 g/t and Au 0.1 g/t, Ag 2 g/t, and Cu < 0.01%.

The underground prospecting had been conducted near the ground surface for these two veins in the past. The underground prospecting of about 3 m had been conducted for the ore vein of E-W direction, where is now suspended, as collapsed. After carrying out the underground prospection of about 10 m for the ore vein of N30°W - S30°E direction, it is now suspended.

Several thin pyrite quartz and clay veins can be observed between this and S. Sengisa north vein, each showing the strike of NW-SE direction.

Among the above, for the ore veins at about 400 m upperstream of S. Sengisa north vein, the vein width is 0.10 m with the analysis result of Au < 0.1 g/t.

<u>Bayur vein</u>

This ore vein had been surveyed in the first phase. This is situated at the upeprstream of S. Bayur (550 m above sea level).

This is a pyrite-quartz vein, where Jirak andesitic lava is the country rock. Its strike is E-W with the dip of 85°S, around which a pyrite dissemination can be observed along the joints.

<u>Batu Aji quartz vein</u>

This ore vein is situated at the elevation of about 500 m along a tributary of S. Mapara.

This is a limonite quartz vein of irregular network pattern embedded around the boundary G. Raya granodiorites and Banyi tonalites.

The first phase survey reported the results of chemical analysis as, Au-1.0 g/t, Ag-3 g/t, Cu-0.13%, and Mo-0.02%.

The boulders accompanying the green copper stain can be observed around the old pit at Batu Aji.

Suren mine

This is an old mine situated at 5 km SSW of Bengkayang town and at the upperstream of S. Suren, a tribunary of S. Banyi.

This has been surveyed in the first phase. The ore deposit is a gold-bearing pyrite chalcopyrite quartz vein embedded in Banyi tonalites.

The vein width ranges in 0.5 ∿ 1.0 m with the strike of N80°W and dip of 69°S. The strike extension prospected and mined up to now is approximately 300 m with the average depth as deep as 20 m. The mined ores are estimated to have approximately 15,000 tons or so.

Banitamaha molybdenite mineralized zone

This is a molybdenite disseminated and mienralized zone of thin fractured network fissures in Banyi tonalites at around granodiorite (gd4) stocks exposed at the upeprstream of S. Bantitamahas, a triburary of S. Baniyi.

(2) S. Mempawah upperstream north mineralized zone

This has a distribution scale of 800 × 200 m extended toward NE-SW direction along the source stream of S. Mempawah, at east slope of Pandankecir, and at northwest area of Jirak Formation where the granodiorite (gd4) intruded into.

This is a pyrite ore dissemination zone exposed around the contact between the granodiorite (gd4) and Jirak andesites, consisting partly of the quartz veins accompanying thin and network patter veins and tourmalines.

In addition to the pyrites weakly disseminating in the silicified Jirak Formation, the minerals are yieled in the thin veins as wide as 1 cm and/or in the fine network pattern veinlets as wide as 0.2 ∿ 0.3 mm. Tourmoline quartz veins of N-S and NW-SE directions are also distributed in this mineralization.

(3) S. Mempawah upperstream south mineralized zone

This shows an extension of NE-SW direction along S. Mempawah at south of Pandanbesar, ranges in 400 m at the upperstream and 200 m at the downstream, and has 1.1

The week pyrite ore dissemination and the tourmaline quartz veins can be seen around the contact among Jirak Formation, G. Raya granodiorites and Tiang quartz diorites.

These tourmaline-quartz veins are yielded in the breccia fracture zone (1 m wide) of strike N25°W, filling the gaps between granodiorites and breccias (grain size of 5 cm at maximum).

The analytic result of this quartz-tourmaline is Au < 0.1 g/t, Ag < 2 g/t and Cu < 0.01%.

(4) Bakilok mineralization

This mineralization is distriubted at ten and some locations on the south slope of Gunung Bakilok at the cneter of this survey area.

Having G. Raya granodiorite as the country rocks, many black tourmolines of 0.5 ∿ 5.0 cm in width can be seen along the fissures of N-W, E-W and N-S directions.

The first phase survey has found the mineral indications of Sekah, Maha and Lao accompanying a minor quantity of molybdenites around this mineralization.

(5) Pyrite-copper mineralization (Jerayan mineralization)

The thin pyrite veins can be observed, filling the fissures of N-S and E-W directions in the granite No. 1 intruded into the granodiorites, along the upperstream of S. Jerayan.

This fissures of N-S direction extend 10 m with the maximum width of 10 cm, being accompanied by the green copper minerals (chrysocolla).

The analysis (RC-118) resulted in the vein width of 10 cm, Au-0.2 g/t, Ag-24 g/t, and Cu-2.38%.

An identical mineralization, i.e. the thin pyrite ore veins of N-S direction can be observed at the downstream of S. Maha, filling the granite No. 1 intruded into the granodiorites.

(6) S. Samasangan mineralization

At the upperstream of S. Samasangan, a minor quantity of chalcopyrites is observable in the joints of N80°W and N10°E at G. Raya granodiorite.

Both the chloritization and the epidotization can be observed at a weak extent along these mineralized joints, but the mineralization is very weak.

(7) Rena meneralization

At the upperstream of S. Rena, the thin pyrite ore veins are embadded in G. Raya granodiorite along fault (1.0 m wide) of N20°W with the dip of 80°NS.

The analysis results in the vein width of 1.0 cm and Au-0.8 g/t. (see Fig. 4-8).

(8) Tourmaline-quartz vein

Barren tourmaline-quartz veins are distributed at the upperstreams of both S. Mempawah and S. Semade in the detailed Banyi survey area.

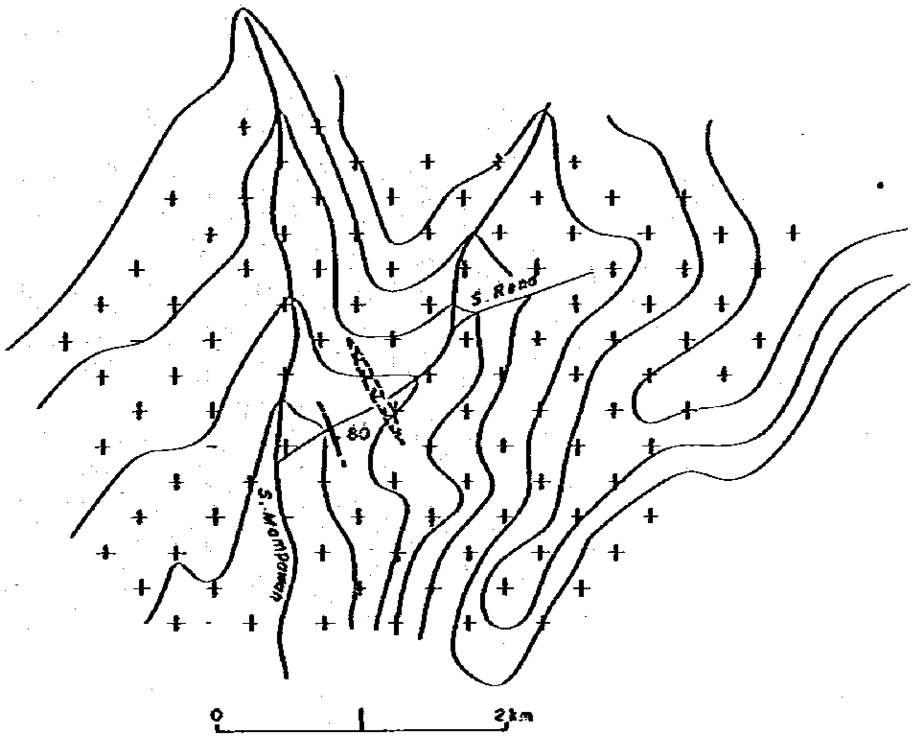
2-3-3 Characteristics of Mineralization at Banyi Area

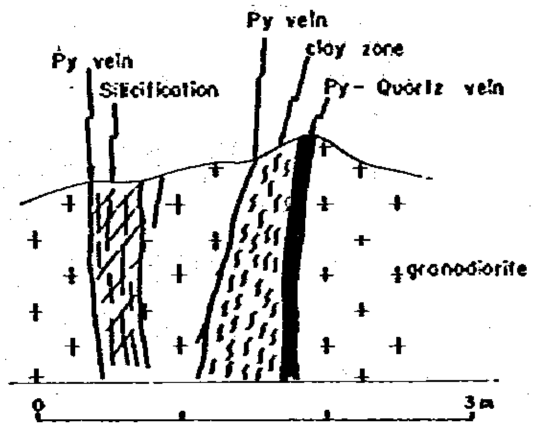
The mineralizations distributed at Banyi area were shown in Fig. 4-9.

The mineralizations at Banyi area are weak in general. According to this ore deposit distribution map, the zonal arrangements can be summarized on the ore mineral arrangements, such as barren tourmaline mineralized zone, molybdenite chalcopyrite mineralized zone, pyrite mineralized zone and gold-quartz mineralized zone, from Gunung Bakilok to the upperstream of S. Mempawah and also from center to outer.

As a result of the geochemical survey with soils, the copper and molybdenum anomalous areas are each well correlative with the copper molybdenite zones. Almost none of alteration is observed in these zones.

The mineralized zones along S. Banyi were accompanied by the altered zones, such as sericite, chlorite and quartz, together with the pyrite ore mineralized zones.





Sketch of Ore outcrop, Sungai Reno.
(South face)

	Wd cm	Au g/t	Ag g/t	Cu %	Pb %	Zn %	Mo %
RA-104	10	0.8	15	0.02	0.02	0.03	<0.01

Fig 4-8 Sketch Map of Rena Mineralization (Banyi Area)

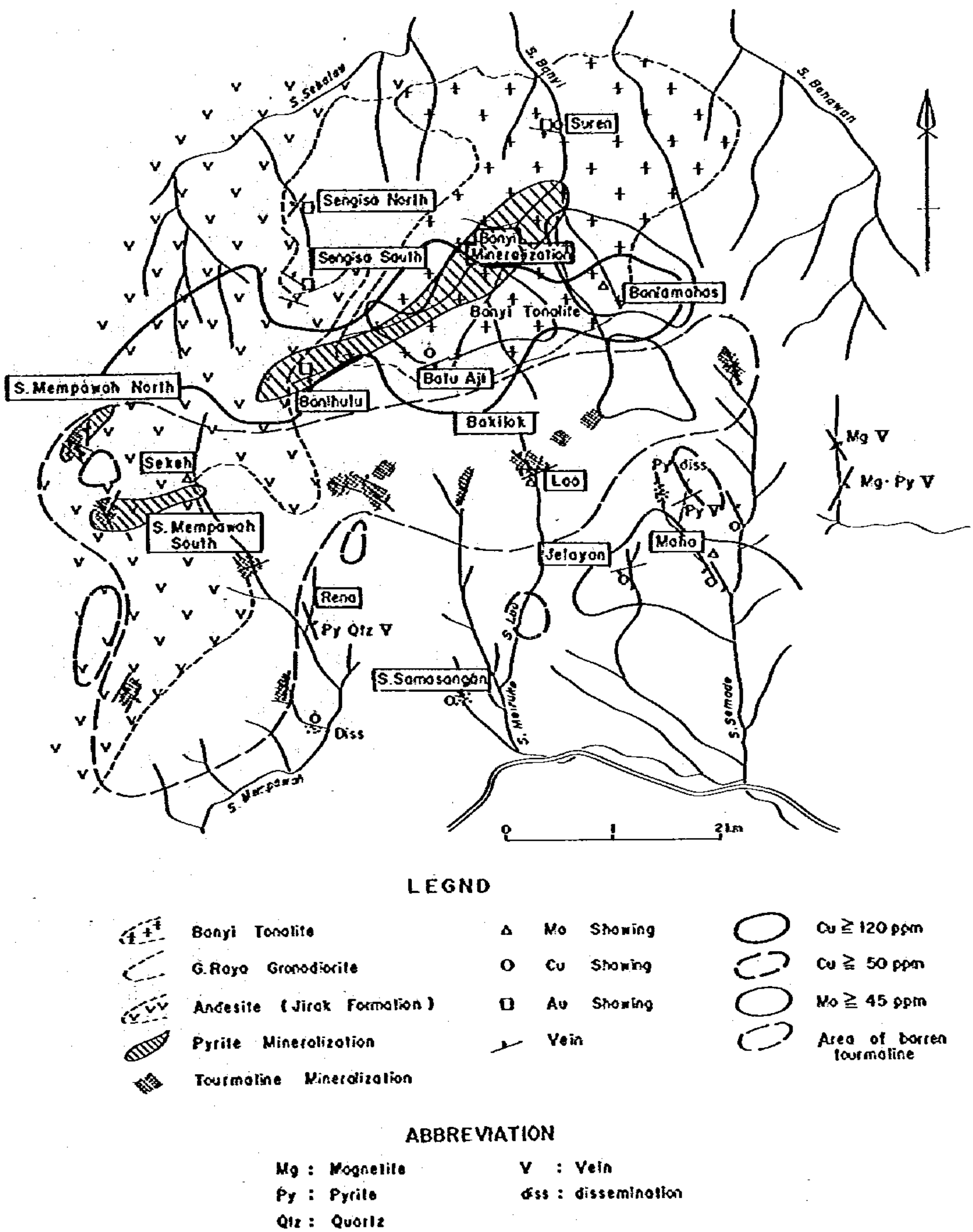


Fig 4-9 Distribution Map of Mineralization in Banyi Area

However, the mineralization is weak in gold, copper, molybdenum, etc., (results of chemical analyses: Au < 0.1 g/t, Cu < 0.1% and Mo< 0.1%), but being accompanied only by the pyrite mineralization, which is supposed as the one chiefly with the pryrites occurred in the strong shear lines along S. Banyi.

There are the phyllic or argillic alteration zones (pyrite halo) consisting of sericite, chlorite and quartz accompanying the pyrite mineralization, as well as the tourmaline mineralization at the center.

In the middle area, the potashic alteration can rarely be observed (partly to have a weak biotitization, but uncertain yet). Where the copper-molybdenite mineralization can be observed are identical to the zoning of mineralization and alteration of porphyry copper ore deposits (Lowell and Guilbert, 1970 and Hollister, 1980).

The scale of zoning (this zoning: more than 2 × 4 km) is larger than those for general porphyry copper ore deposit.

If the mineralization be at north of porphyry copper deposit, the pyrite bearing argillization area is regarded as pyrite halo, and the chalcopyrite molibdenite mineralization area is Cu-Mo mineralized zone, even though it is a weak mineralization.

Further, a small scale of copper (molybdenite) mineralized indications can only be observed a spreading at several places at south of the tourmaline zones.

2-4 Geochemical Survey

The geochemical survey with soil sampling from B-horizon has been carried out in parallel with the geological survey in the project area.

Samples were collected from 113 locations at a ratio of 3.1 samples per 1 km^2, and the indicator elements were Cu and Mo.

Although the statistical processing of analyzed data has been the same as in the previous Serantak area, a contour map has been prepared to determine the anomalous areas based on the results of statistical processing in this case, because of near to the grid sampling.
(See Fig. 4-10)

2-4-1 Sampling

An effort is made so as to sample at an equal interval in the entire survey area, but the actual sampling is made at a field in the vicinity of planned location where is impossible to access to likely at a steep cliff or others.

113 samples were collected and analyzed, resulting in 3.1 samples per km^2 on across-the-board. Sampling at field is made from B-horizon at about 30 cm depth, where presents a brown or yellowish brown color, after removing all plant roots, humic soils, etc.

After drying them in the sun at field camps or base camp, each sample was divided into two packs, one for analysis in Japan and the other for analysis in the Republic of Indonesia.

2-4-2 Anomalous area

(1) Banyi anomalous area

The distribution range of copper anomalous area (more than 120 ppm of Cu) extends 5.0 × 1.0 km, centering at the upperstream of S. Hapara at the near center of this survey area, and is trend toward E-W diagonally acrossing the intrusive direction of Banyi tonalites.

The molybdenum anomalous area (mroe than 4.5 ppm of Mo) consists of three blocks, i.e. east and central blocks, at both of where overlapping with the copper anomalours area, and southeast end external anomalous area.

Most of them covers Banyi tonalite stocks, and partly Jirak andesite Formation and G. Raya granodiorite.

These anomalous areas include the mineralized zones (many pyrite-quartz veins weakly argillized) at Batu Aji, Banihulu and Bayur, and Banitamahas mineralized zone (fissures accompanying a molybdenite ore dissemination).

At outside of these anomalous areas, existed are the mineralized zones at Sengia, S. Hempawah north and south, and old undergrounds at Seren.

The average of copper in the entire anomalous area shows 209 ppm (excluding the maximum value of 1,150 ppm), which means not in a transi-

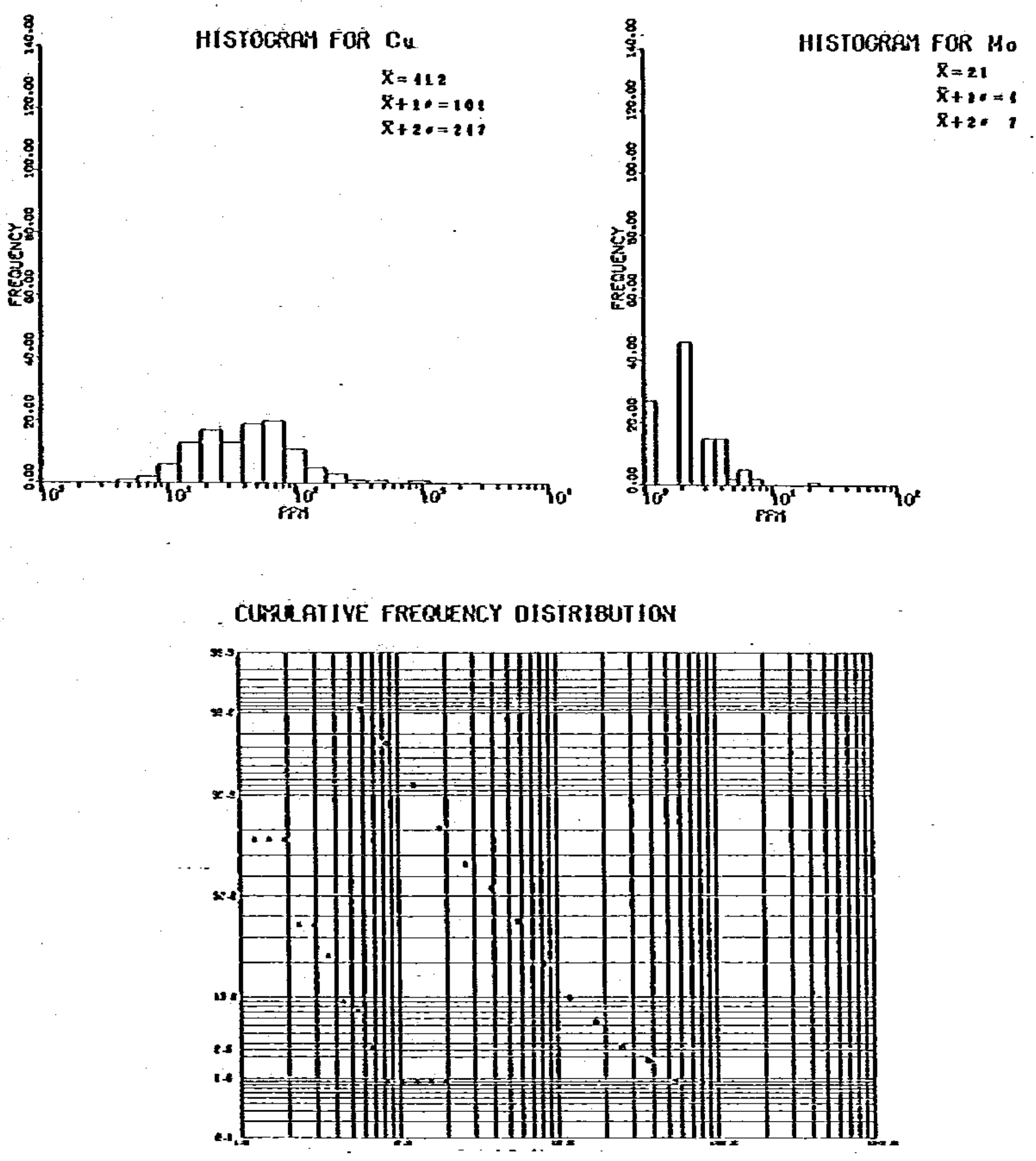


Fig 4-10 Histgram and Cumulative Frequency of Geochemical Analysis in Banyi Area

tion relation with Cu-value at outside the area, but sharply increasing, and most of them covers Banyi tonalite. From this, the mineralizations can be considered in correlation with Banyi tonalite.

(2) Maha anomalous area

This is an anomalous area ranging in 1.4 × 0.7 km along S. Semade and its tributaries, S. Maha and S. Jelayan, having 4-locations of anomalous values (5.8 ppm in Mo average value).

The geology consists of G. Raya granodiorite and granite (gr 1) intruding into the former.

Jelayan mineralized zone accompanying pyrite-chrysocolla dissemination and Maha mineralized zone of pyrite-molybdenite quartz veins are distributed around this anomalous area.

Since there are several intrusions of granite (gr 1) dykes in the vicinity, it is also supposed to reflect the mineralization related with this granite.

SUPPLEMENTARY REMARKS

SUPPLEMENTARY REMARKS

1. Contents of Tin and Tangsten in Granitic Rocks

The results of analysis made for tin and tangsten contained in granitic rocks in this survey area are as shown in Table 5-1.

Sn of 12 - 15 ppm is contained in granitic rocks in this area. Since there is no report of analytic results on granite accompanying tin by the Republic of Indonesia, no comparison can be made with this. However, in the study in Thailand Peninsula (Ishihara, 1980), there are granite accompanying tin at 38.6 - 7.8 ppm, while grante not accompanying tin at 17.0 - 3.0 ppm.

It is recommended as a future program that a comparison should be made through the analysis of tin-bearing granitic rocks of Indonesia. Thus, the results of these analyses are to be reported just reference purpose in this report, as no way can be compared.

Table 5-1 Chemical Analysis of Tin, Tungsten Elements in Granitoid Rocks

Saunle No.	Dock name	Sn ppm	W ppm	Remarks
RC-64	Granodiorite	14	44	114 m.y. ± 6
RC-67	"	13	32	
RD-45	"	15	52	111 m.y. ± 6
RD-65	"	15	52	
RE-32	"	15	65	
RE-52	"	14	40	
RF-52	"	13	39	107 m.y. ± 5
RE-21	"	12	17	
RD-67	Quartz Diorite	15	68	95 m.y. ± 4.8
RE-5		14	46	
RA-24	Sirih tonalite	15	51	(20 m.y. ± 1.0)

2. Another Trial of Data Processing on Geochemical Survey in the Survey Area

For the statistical processing of data obtained from the geochemical survey, in addition to the method of examination and analysis through the standardization by means of logarithmic conversion of analyzed data, as prevlsouly explained in the main statements, a study under another method was made on the different concept.

Briefly presented herein are the results of the above.

This is a method applied for data processing under the alpha truck method, one of the procedures for radon gas applied by Terradex Inc., of U.S.A.

If a comparison is made between the results as obtained under this method and as obtained under the method in the main statements, the former has less anomalies than the latter had, depending upon how to set the upper limit of background. However, there is no big difference in the both results, i.e. almost the same.

Since the latter method via logarithmic conversion takes a time, the former method for data analysis is much easire in case of no computer being used.

(1) Method of data processing

How to determine the background is as follows.

(a) Arrangement of assay values in the order from low to high value.

(b) Determination of a mean value in the above alignment (M1)

(c) Multiplication of the mean value thus obtained by three.

(d) Re-arrangement of values up to 3 × (M1) from low to high.

(e) Determination of a mean value in the above rearrangement (M2)

(f) Multiplication of M2 by three, 3 × M2, and then, arranging the data from low to high, and determine the mean value in it.

(g) Repeat this process up to Mn = Mn-1.

(h) When Mn equals to Mn-1 multiply Mn by 3, which is to be determined as the upper limit of background.

(i) For the background determined as above, calculate the average value and the standard deviation value under the general statistical process.

However, since the upper limit of background thus determined is no more than an approximation, it is also required to determine it from a histogram of its neighbors.

Calculate the elementary statistical values about the thus determined background. Based on this, obtain the Z-value as follows, and values falling in the range of $Z<3$ are the background, while those falling in the range of $Z\geq 3$ are the anomaly values.

$Z = (X - B.\,G.\,M.)/\sigma B$ (X: assay value)

σg: Standard deviation of background

B.G.M.: Mean value of background

As seen from this formula, Z-value represents a degree of dispersion from the measurements of B.G.M. Supposing that the population distribution of background is normal, as previously mentioned, and the upper limit (G.G.M + $3\sigma B$) of range in where about 99% of population inferred from the measurement distribution is contained is the upper limit of bakcground, the measured values up to Z = 3 belong to the background.

Also, if the upper limit (B.G.M. + $2\sigma B$) of range in where about 95% of population is contained is taken, then, the measured values up to Z = 2 belong to the background.

Now, taking account of the theory that the Mean + 2σ is determined as the upper limit of background, which is generally applied in the analysis of geochemical survey data, the measured values falling in the range of $2<Z\leq 3$ can be said the background having the probability of anomaly values.

Once plotting the anomaly values thus obtained on a chart, it shows as in Fig. 5-1, resulting in not so much difference from PL6-1∿3.

In addition, if B. G. M and σB are shown, respectively, just for the reference purpose, they are as shown in the following Table 5-2

Table 5-2 Statistical Values on Background
(another geochemical data processing)

Area (Samples No.) \ Statistical Values		Mean Value of Background	σ of Background	Range of Background	Number of Anormaly
A (59)	Cu	9.76	5.74	3.18 ∿ 10.84	5
	Pb	14.24	6.06	4.91	1
	Zn	-	-	-	-
	Mo	-	-	-	-
B (217)	Cu	24.33	13.57	3.00 ∿ 5.87	11
	Pb	15.75	7.65	3.56 ∿ 10.88	5
	Zn	38.39	19.62	3.19 ∿ 18.79	3
	Mo	-	-	-	-
C (174)	Cu	20.22	12.68	3.29 ∿ 117.48	11
	Pb	9.93	5.47	3.12 ∿ 40.41	5
	Zn	31.65	20.09	3.00 ∿ 4.15	5
	Mo	3.35	1.38	4.09 ∿ 4.81	2
C (158)	Cu	7.72	4.12	3.34 ∿ 27.84	16
	Pb	8.16	4.60	3.01 ∿ 6.70	5
	Zn	11.48	8.21	3.11 ∿ 10.78	20
	Mo	2.67	1.15	3.77 ∿ 6.39	2
E (229)	Cu	12.66	7.00	3.05 ∿ 7.76	27
	Pb	9.21	4.32	3.19 ∿ 7.60	6
	Zn	29.72	19.22	3.09 ∿ 5.97	12
	Mo	2.71	1.30	3.29 ∿ 7.89	6

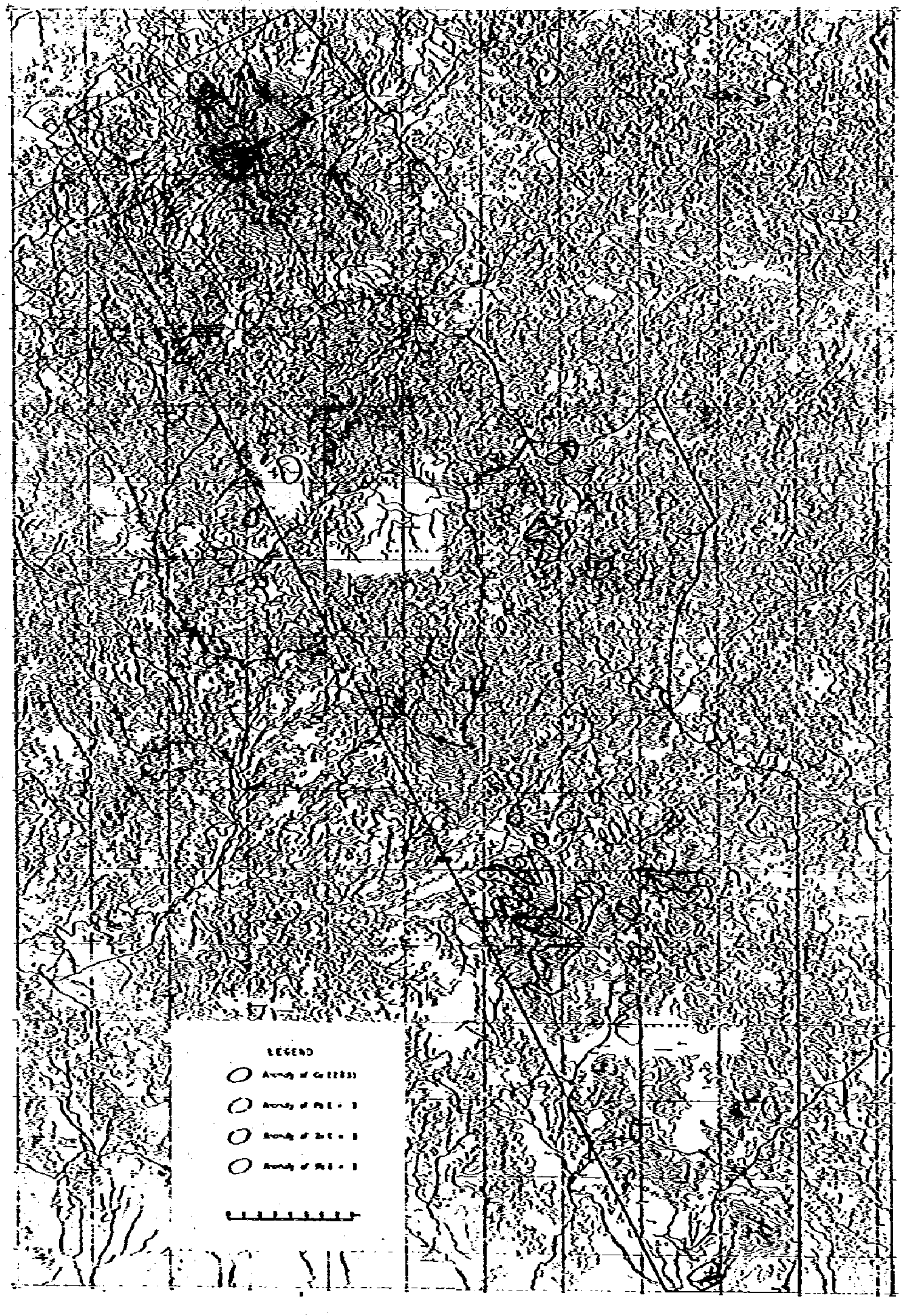


Fig 5-1 Geochemical Anomaly Map (another data processing)

APPENDICES

Appendix 1 List of Rock and Ore Samples Tested

Reconnaissance Survey Area

Sample No.	Rock Name	Thin Section	Polished Section	X-Ray Analysis	K-Ar Dating	Chemical Analysis		Chemical Analysis
						Whole Composition	Tin, W	
RA - 5	tfbr	o						
RA - 8	Q-ss		o					o
RA - 10	dactf	o						
RA - 18	f. sil rock	o						
RA - 24	f. ton						o	
RA - 28	dactf			o				
RA - 31	pl-Q-por				o			
RA - 38	pl-Q-por	o						
RA - 40	dactf	o						
RA - 46	f. Bt-Hb-ton	o						
RA - 49	clay			o				
RA - 54	grdio por	o						
RA - 56	pl-Q-por	o						
RA - 59	and	o						
RA - 61	Bi-Hb-grdio	o						
RA - 64	sil rock (Py)							o
RA - 65	f. gb	o						
RA - 68	sil rock (Py)							o
RA - 77	ss. ms	o						
RA -200	dactf	o		o				
RA -201	sasan mine		o	o				o
RB - 39	vldtf	o						
RB - 60	ss	o						
RB - 64	and tf	o						
RB - 70	dio	o						
RB - 75	and tf (Cu)		o					o
RB - 81	dio por	o						
RB - 89	and	o						
RB - 90	and (Py)		o					
RB - 92	cgl	o						
RB - 93	tfslt	o						
RC - 27	and	o						
RC - 30	Pl por	o						

Sample No.	Rock Name	Thin Section	Polished Section	X-Ray Analysis	K-Ar Dating	Chemical Analysis Whole Composition	Chemical Analysis Tin, W	Chemical Analysis
RC - 37	and tf	o						
RC - 47	tfss	o						
RC - 53	and tf	o						
RC - 64	ton	o	o		o	o	o	
RC - 67	grdio	o	o			o	o	
RC - 70	laptf	o						
RC - 72	Py-Q-V							o
RD - 8	grdio	o						
RD - 29	ton							o
RD - 30	ton	o	o					
RD - 45	grdio	o	o		o	o	o	
RD - 65	ton		o			o	o	
RD - 67	q dio	o	o		o	o	o	
RD - 74	grdio	o						
RD - 79	dactf	o						
RE - 5	q dio		o			o	o	
RE - 13	qp	o						
RE - 15	tfbr	o						
RE - 16	tf	o						
RE - 21	grdio	o	o			o	o	
RE - 32	grdio		o			o	o	
RE - 47	P. grdio	o						
RE - 51	grdio		o			o	o	
RE - 60	and	o						
RE - 73	grdio	o						
RF - 6	and	o						
RF - 22	grdio	o						
RF - 38	and	o						
RF - 40	dac tfbr	o						
RF - 41	dactf	o						
RF - 52	grdio	o	o		o	o	o	
RF - 53	alt sil rock			o				o
RF - 54	sil rock	o						

Sample No.	Rock Name	Thin Section	Polished Section	X-Ray Analysis	K-Ar Dating	Chemical Analysis Whole Composition	Tin, W	Chemical Analysis
RG - 4	por-dio	o						
RG - 7	alt dac							o
RG - 16	Q-V		o					o
RG - 18	alt dac							o
RG - 19	dactf	o						
RG - 21	dac tfbr	o						
RG - 24	dac	o						
RG - 25	por and	o						
RG - 31	c. grdio	o						
RG -200	acd tf					o		
Rh - 22	f. dio	o						
RA - 27	grdio	o						
RE - 68	da tuff	o		o				
Total		58	16	6	5	11	11	11

Detailed Surveyed Area

Sample No.	Rock Name	Thin Section	Polished Section	X-Ray Analysis	K-Ar Dating	Chemical Analysis Whole Composition	Chemical Analysis Tin, W	Chemical Analysis
(Serantak Area)								
RD - 101	tfbr	o						
RD - 116	tfbr	o						
RD - 120	qp	o						
RD - 122	ss	o						
RD - 128	ss	o						
RD - 130	Qz-V							o
RD - 131	qp	o						
RD - 138	CP, Py diss		o					
RD - 139	Mo-Qz-V							o
RD - 140	Ton	o						
RD - 143	CP-Py-Qz-V		o					o
RD - 144	CP-Qz-V		o					
RD - 200	Py-Pry ore		o					o
RE - 103	qp	o						
RE - 113	Clay							o
RE - 120	qp	o						
RE - 131	Qz-V							o
RE - 135	Qz-V							o
RE - 147	qp	o						
RE - 152	Ton	o						
RE - 154	And	o						
SK - 1	gossan							o
SK - 3	gossan							o
SK - 5	gossan							o
SK - 6	Py-pry-Qz-V							o
SK - 7	Py-pry-Qz-V							o
SK - 8	Py-pry-Qz-V							o
SK - 9	Py-pry-Qz-V							o
SK - 10	Py-pry-Qz-V							o
SK - 11	Py-pry-Qz-V							o
SK - 12	Py-pry-Qz-V							o
SK - 13	Py-pry-Qz-V							o

Sample No.	Rock Name	Thin Section	Polished Section	X-Ray Analysis	K-Ar Dating	Chemical Analysis Whole Composition	Chemical Analysis Tin, W	Chemical Analysis
(Serantak Area) - cont'd -								
RD - 109	ton	o						
RE - 119	QP	o						
(Banyi Area)								
RA - 104	Py-Q-V							o
RA - 129	grl	o						
RB - 112	and	o						
RB - 118	tl-V							o
RB - 130	grdio	o						
RB - 139	grl	o						
RB - 143	Py-specul-V							o
RB - 146	grdio	o						
RC - 104	and	o						
RC - 106	q dio	o						
RC - 110	grdio	o						
RC - 113	and	o						
RC - 118	Py ore							o
RC - 122	qp	o						
RC - 123	Q-V			o				
RF - 101	and	o						
RF - 104	Py-Q-V							o
RF - 106	sil tf	o						
RF - 108	Q-Py-V							o
RF - 111	clay-Py-V							o
RF - 113	Py-V							o
RF - 117	Py-clay-V							o
RF -118A	Py-clay-V							o
RF -118B	Py-clay-V		o					o
RF - 121	ton	o						
RF - 123	Q-V							o
RF - 128	Q-Py-V							o
RF - 129	Q-Py-V							o
RF - 132	Q-Py-V		o					o

Sample No.	Rock Name	Thin Section	Polished Section	X-Ray Analysis	K-Ar Dating	Chemical Analysis Whole Composition	Tin, W	Chemical Analysis
(Banyi Area) - cont'd -								
RF - 134	Lim-Py-V		o	o				o
RF - 136	Q-Py-V							o
RF - 137	Q-Py-V							o
RF - 140	grdio	o						
RF - 145	grdio	o						
RF - 149	clay			o				
RF - 154	Py-clay-V							o
RF - 156	grdio	o						
Rf - 27	grdio	o						
RG - 56	tf sh	o						
RG - 60	Q-Py-V		o					o
RG - 61	sil rock							o
RG - 65	grdio							o
RG - 67	ton	o						
RG - 101	Py imp							o
RG - 102	Py imp							o
RG - 106	Py imp							o
RG - 107	Lim-Py-netw							o
RG - 108	Lim-Py-netw							o
RG - 109	alt ton			o				
RB - 132	grdio	o						
RB - 156	grdio	o						
RC - 115	gr.l.	o						
RF - 125	f.tuff	o						
RF - 139	sil.(Py)	o						
RF - 147	ton	o						
RF - 151	ton	o						
RG - 55	and	o						
RG - 63	ton	o						
RG - 111	ton	o						
Total		43	8	4	-	-	-	45

Appendix 2 Microscopic Observation of Thin Sections

Abbreviation

Rock

and	:	andesite
tf	:	tuff
wl tf	:	welded tuff
tf crys	:	crystal tuff
tf br	:	tuff breccia
tf ss	:	sandy tuff
dac	:	dacite
xeno	:	xenolith
ss	:	sandstone
fss	:	fine sandstone
cgl	:	conglomerate
silt	:	siltstone
gradio	:	granodiorite
qtz dio	:	quartz diorite
ton	:	tonalite
dio por	:	diorite porphyry
gab	:	gabbro

Texture

pyro	:	pyroclastic
flow	:	flow texture
hol cry	:	holocrystalline
inters	:	intersertal
ss	:	sandstone
porph	:	porphyry
intergr	:	intergranular

Remarks

Hf	:	hornfels
Mat	:	matrix
Lith	:	lithic
and	:	andesite
dac	:	dacite
cher	:	chert
ms	:	mudstone
oxfe	:	oxide iron
sil	:	silicious rock
pum	:	pumice

◎: abundant
○: common
•: rare

Mineral

Q	:	quartz
k-f	:	kali feldspar
Pl	:	plagioclase
Bt	:	biotite
Hb	:	hornblende
Au	:	augite
Hy	:	hypersthene
Ol	:	olivine
Op	:	opaque mineral
Lith	:	lithic fragment
Si	:	silica
Cpx	:	climopyroxene
Opx	:	orthopyroxene
Cc	:	calcite
Ser	:	sericite
Chl	:	chlorite
Kao	:	kaoline
Act	:	actinolite
Epi	:	epidote
Tou	:	toulmarine
Ander	:	anderlusite
Alu	:	alunite
Lim	:	limonite
Sph	:	sphane
Apa	:	apatite
Zir	:	zircon

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op			
Sedimentary Rock																																					
Benkayahg Group Banan Formation																																					
RA-10	SS	SS	◎		o							and,dac ms, cht	o									●				●						o					lith: mat ≒ 5:1
RA-18	fSS	SS	◎		o							dac and	◎	o								●	sph zifi									o					lith: mat ≒ 2:1
Kalung Formation																																					
RA-27	fSS	S.S	o		o								o	o								o				o										Hb	Hf.
Sungaibutung Formation																																					
RB-60	SS	S.S	●		◎									o								o					o		o								
RC-47	tf	pyro	●								●			o								o											●				
Jirak Formation																																					
RB-92	cgl	cgl	o								o	cht and	o	o								o						◎									lith: mat ≒ 5:1
RB-93	Silt	Silt										o											ox f-e				o		o								
Hypabyssal Volcanic and Pyroclastic Rock																																					
Jirak Formation																																					
RB-89	and	pyro			◎		●				●			o		o						o														Hb	Hf
RC-53	and tf	pyro			o											o						o				o		◎				◎					Sheared Structure
RC-70	tf	pyro			o								●									o					◎		◎								altered rock (clay)
RA-59	and				◎								o			o						●					●					●					Xero in Gradio
Belango Formation																																					
RA-77	dac tf	pyro	●		o							dac and										o		o			●	●		o							lith: mat ≒ 1:7,Hf
RA-200	dac tf	pyro	●									silici-fied rock	o									o		◎			●									Ander Alu	Contact metamorphish silicified rock
RB-39	dac wl tf	pyro	●		o						●	dac and	o	o		●						●						●				●					flow str

Hypabyssal volcanic and pyroclastic rock

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op			
RB-64	and tf	pyro			○			○				and				○						○						○				○					
RC-37	and tf	pyro			◎		○				○		○	○								○					●	◎				◎					
RD-79	and tf	pyro	●		○						○	and,dac ms				●						●		◎						◎		○					lith: mat ≒ 1:3,Hf
RE-13	dac tf crys	pyro	◎		○							sil	◎			●	○					○		○													weak Hf
RE-15	and tf br	pyro			◎							and		○		○						○						○				○					lithic
RE-16	and tfss.	pyro	●		○							and										◎					◎		○							lim	altered rock
RE-60	and tf	pyro	●		○							and sil	○			○	○					○		○						○							lith: mat ≒ 1:5,Hf
RE-68	Sericitized tf	pyro											●									●		○			◎										2M type Sericite
RF-6	and	pyro			◎		○?									○						○					○				◎	○				Hb	Hf
RF-38	and	intersertal			○						○			○		○						○						○				○				carbo-rite	(lava)
RF-40	dac tf br	pyro	○		○							and dac	◎			◎						○						◎				◎					
RF-41	and tf	pyro										and	○	◎		●												●				◎					lith: mat ≒ 1:7 epidote
RF-54	and tf	flow	●		◎						●	and	○				○					○		◎	○					◎		●					Hf
RG-19	dac tf	pyro	●		●						●	and dac	○	○								●		○	○		○					○					lith: mat ≒ 1:1
RG-21	dac tf br	pyro	○		◎						○	and alterd dac pumice	○	○		●						●					○	○									dacite pumice
R-24	dac	hol-cry			◎		◎	○			●																					●					dioritic
R-25	and				◎											◎						●								●						Hb	Hf
Serantak Formation																																					
RA-5	tfbr	pyro	●									cht dac ms sil	○	○								○					○	●				●					
RA-38	dac tf crys	pyro	◎		○								◎			○						○	sph zir				○					○					lith: mat ≒ 2:1

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op			
RA-40	dac	porp			◎											◎						o						o				o					Clastic texture
RA-56	dac	porp	o		◎								o			o		●				●					●	●				●					
Intrusion Rock Hypabyssal Rock																																					
G. Sebiawak Granodiorite																																					
RD-8	Hb, Bt, Gradio	hol cry	◎	●	◎	o	o					sph,zir apa																●									
RE-21	Bt, Gradio	hol cry	◎	o	◎	o					●	zir apa															●	●				●					
RE-22	Hb, Bt Gradio	hol cry	o	o	◎	o	o				●	sph apa															●	●				●					
RG-31	Bt, Gradio	hol cry	o	o	◎	o					●																●	●				●					
G. Raya Granodiorite																																					
RA-61	Bt, Hb, Gradio	hol cry	o	●	◎	o	o				●	apa sph															●	●									
RB-70	Hb, Gradio	hol cry	o	●	◎		o				●	apa															●	●				●					micrgraphic tex.
RC-64	Bt, Hb, Qtz-dio	hol cry	o	●	◎	●	●	●	o		●																										tonalitic
RC-67	Hb, Bt, Gradio	hol cry	o	●	o	o	o		●		●	zir																									tonalitic
RD-45	Hb, Bt, Gradio	hol cry	o	●	◎	o	o				●	apa zir															●					●					
RD-74	Hb, Bt, Gradio	hol cry	o		◎	o	o				●	apa,gph zir															●	●				●					tonalitic
RE-73	Bt, Gradio~ Grdiopor	hol cry	o	●	◎	o					●	apa sph zir															●	●				●					porphyritic
RF-52	Bt, Hb Gradio	hol cry	o	●	◎	o	o				●	zir apa sph																									
G. Selantar Grandiorite																																					
RA-54	bt, hb, Gradio	porph	o		◎	o	o						o			o	●					●						●				●					

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op			
Tiang quartz diorite																																					
RD-67	hb, qtz, dio	hol cry	○		◎		○				●	sph																○				◎					
Granite (grl)																																					
RE-47	bt gra	hol cry	○	○	◎	●					●	sph															●					●					
Banyi tonalite																																					
RD-30	bt, ho, ton	porph	○		○								○			○	○	○				●	apa					●									
RG-4	ton	porph			○								○			◎						●						○				◎					
Sirih tonalite																																					
RA-46	bt, ton	hol-crys	○		◎	○					●	apa, sph																●				●					
Hypabyssal rock																																					
RA-65	gab	hol-crys	●		◎	○		○			○	apa																●									dyke rock
RB-81	dio, por	integr			●			●					●			◎			○			○				○						○					doleritic texture
RC-27	dio, por	hol-crys~ porph			◎		○	○								○		○	○			○	apa									○					
RC-30	qtz por	porph			◎		○				○		○			○		○				○	apa				○					●					Flow structure
RC-22	dio por	porph			○								●			◎		◎				○						●				●					

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op	Py		
Serantak Area																																					
Banan Formation																																					
RD-122	ss	S.S	◎		o								◎	o		o							sph				o					o					
RD-131	ss	S.S	o		o								o	o									sph	o	o						o						Hf
Serantak Formation																																					
RD-101	dac, tf, br	pyro	o		o							dac,ss ms	◎	◎		•						•					o										myrmekite
RD-109	dac, por	porph			◎		o						o			◎		o					sph														
RD-116	dac, tf, br	pyro	o		o							dac	o									o					o					◎					epidote vein
RD-120	dac, tf, br	pyro	o		o							dac	◎			o						o		o		o						o				gar	
RD-128	dac	porph	◎		o						o		o									o	sph	o								o				gar	skarn contact metomorphism
RE-103	dac, tf	pyro	o		o							dac	◎	o		o						o				o	o					o					Sandy
RE-119	dac, tf, br	pyro	◎		◎							rhy dac	o	o								•						o				o					
RE-120	dac	porph	o		o							diori-tic rock	◎			◎	o	o				o						o				o				hb	mafic→chl, epi Hf
RE-147	dac	porph	◎		•								◎					•				•		o				o				o					Silicified rock
Sirih tonalite																																					
RD-140	hb, bt, ton	hol-crys	o		◎	o	o				•	apa															•					•					
RE-152	hb, bt, ton	hol-crys	o		◎	o	o					apa zir sph															•					•					
Hypabyssal rock																																					
RE-154	and	hol-crys			◎								o			◎	o					•	sph					o		o		o				hb	Hf ?

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op	Py		
<u>Banyi Area</u>																																					
Jirak Formation																																					
RB-112	and				●											○	○	○						○				◎		○		●			○	Hb	Hf
RC-104	dac, tf	pyro	●		●								◎									○		○		○		○				◎	●				
RF-101	and, tf	flow tex	○		◎								○	○		○						○					○										lith: mat = 1:1 wltf
RF-106	dac, tf	pyro	○										○									●					○		○								Silicified and argillized rock
RG-55	and	pyro			◎								○	○			○					○					○	○		○					○	hem	Silicified
RG-56	dac, tf	pyro	○		○								○	○		○						○															flow sth
G. Raya granodiorite																																					
RB-130	hb, bt, gradio	hol-crys	○	●	◎	●	●				●																	●				●					
RB-146	bt, gradio	hol-crys	○	●	◎	○					●																○	○				○					intermediatoly alterad
RB-156	bt, gradio	hol-crys	○	●	◎	○					●																●	●				●					myrmekite, micro graphic tex
RF-145	hb, bt gradio	hol-crys	○	●	◎	○	○				●																●	●									
RF-156	bt, gradio	hol-crys	○	●	◎	○					●																●	○				●					
RF-27	(hb) bt, gradio	hol-crys	○	●	○	○					○																●	●				●	○				myrmekite str
Tiang quartz diorite																																					
RC-106	dio	hol-crys	●		○	○	○		●		○																										
General	(grl)																																				partly, micro graphic tex
RA-129	bt, gra	hol-crys	○	○	◎	●					●																	●				●					partly, micro graphic tex
RB-139	hb, bt, gra	hol-crys	○	●	◎	●	●				●																●	●				●					myrmekite, micro graphic tex weak albitization
RC-115	tb, gra	hol-crys	○	●	◎	●					●																●										

Sample No.	Rock Name	Texture	Fragment/Grain										Groundmass/Matrix											Secondary Mineral													Remarks
			Q	k-f	Pl	Bt	Hb	Au	Hy	Ol	Op	Lith	Q	Si	k-f	Pl	Bt	Hb	Cpx	Opx	Ol	Op		Q	Si	Cc	Ser	Chl	Kao	Bt	Act	Epi	Tau	Op	Py		
Banyi tonalite																																					
RC-110	bt, ton	hol-crys	o		o	o																						●									
RF-121	hb, bt, ton	hol-crys	o		◎	●	●				●																●	o		●		o					
RF-125	bt, ton	hol-crys	o		◎	o					●																	o				o					myrmekite str
RF-139	bt, ton	hol-crys	o		o	o					●																o	o		●			●				silicified rock
RF-140	bt, ton	hol-crys	o		◎	o					●																●	◎				◎	●				myrmekite str
RF-147	hb, bt, ton	hol-crys	o		◎	o	o				●																●	o		o		o					myrmekite str
RF-151	bt, ton	hol-crys	o		o	o					●																●	o				o					myrmekite str
RG-63	bt, ton	hol-crys	o		o	o					●																●	o				o					
RG-67	bt, ton	hol-crys	o		o	o					●																●	◎		o							chloritization biotitization carbonitization
RG-111	hb, bt, ton	hol-crys	o		o	o	●				●																●	o				o					myrmekite str
Hypabyssal rock																																					
RB-132	diopor	porp	●		●		◎						●			o		o				●	apa														
RC-113	and				o		o						●			o		o						o			o	o				◎					
RC-122	qtz-dio por	porp	o		o		●						◎			o		o				●	apa sph	o			o	o				o					

Appendix 3 Minoscopic Observation of Polished Sections

Reconnaissance Survey

Area	Sample No.	Location	Occurence	Cp	Cc	Cov	Py	Arpy	Gal	Sph	Mag	He	Pyrh	Mn	Remark
G.Serantak	RA-8	G.Serantak	Quartz Vein				○								
Sasan	RA-201	Jeratak	Straciform									?		◎	Cryptomelene
Selakean	RB-75	S.Selakean	Veinlet	○			○	◎	○	○					
"	RB-90	S.Nanggak	"				○								
Panji	RD-30	S.Anik	Dissemination	○			●				○				
G.Raya Granediorite	RD-65	S.Mentaba	"	●											
Quartz Diorite	RE-5	S.Pangangsa	"				●								
G.Raya Granodiorite	RE-32	S.Biani	"	●											
Kunyit	RG-16	S.Tehadjian	Veinlet			●					●				

Detailed Survey

Area	Sample No.	Location	Occurence	Cp	Cc	Cov	Py	Arpy	Gal	Sph	Mag	He	Pyrh	Mn	Remark
	RD-138	S.Banan	Dissemination	●	○										
Serantak	RD-143	"	Veinlet	●				○			○	●			
	RD-144	"	Veinlet	●			○		●	○					
	RD-200	G.Serantak	Massive	○									◎		
	RF-132	S.Barinnin	Veinlet	●	●	●	◎								
	RF-134	"	Veinlet				○								
Banyi	RF-118B	S.Sengisa	Veinlet				◎								
	RG-60	S.Ampah	Veinlet				◎								

Cp : Chalcopyrite　Cc : Chalcocite　Cov : Coverine　Py : Pyrite
Arpy : Arsenopyrite　Cal : Galena　Sph : Sphalerite　Mag : Magnetite
He : Hematite　Pyrh : Pyrrhotite　Mn : Manganese oro

◎ : Abundant
○ : Common
● : Rare