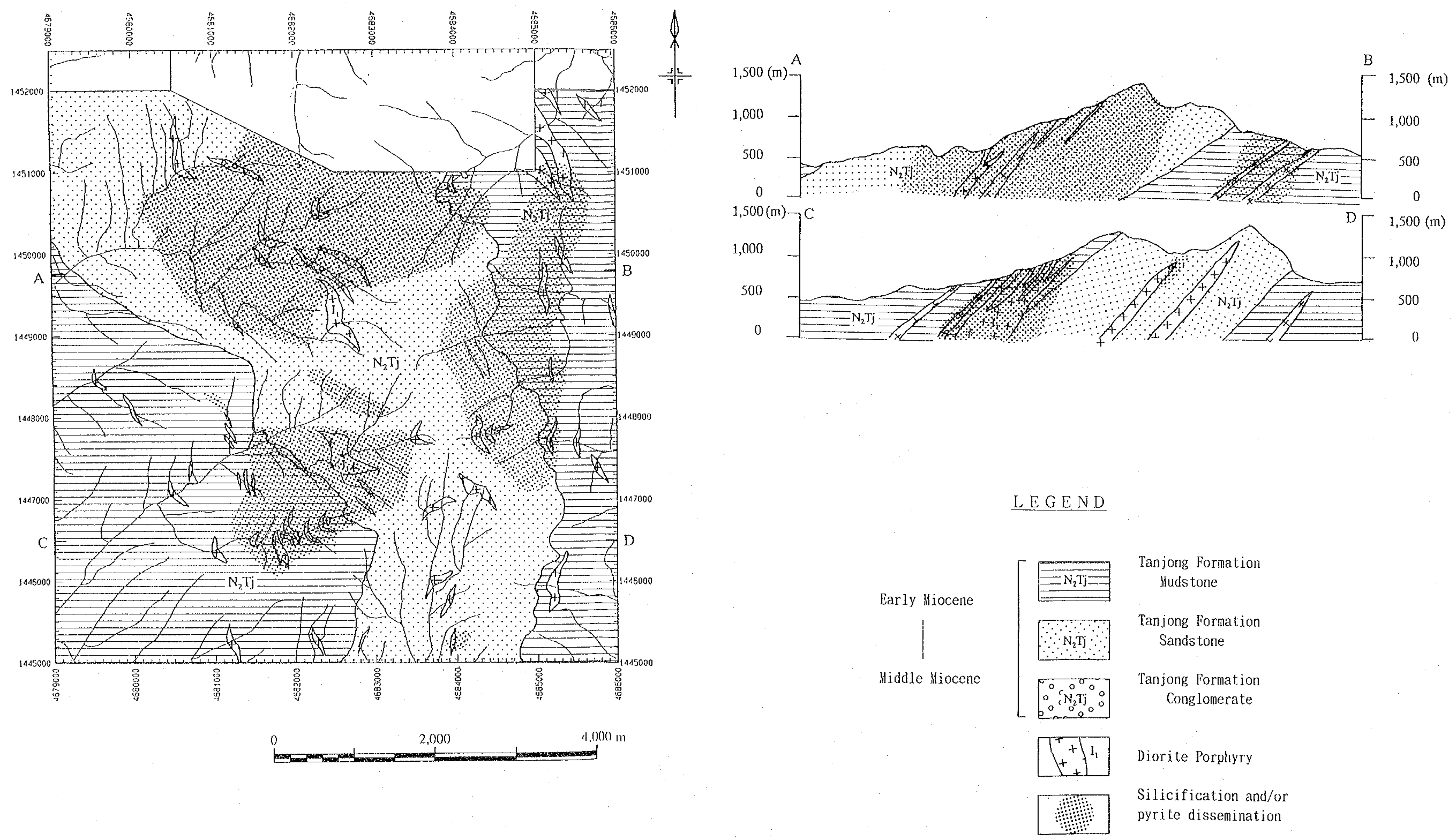


Fig. II-4-3 Geological map and cross section of S. Imbak Sub-area South

nodules of few cm across, rarely, occur in the mudstone.

The sandstone formation occupies the area along the ridge in the center of the area and it form steep topography. It predominantly consists of gray to dark gray, fine to medium grained, massive sandstone. The sandstone found at the higher elevation near the ridge is bleached and shows pale gray color, while, the one near the intrusion of the diorite porphyry is silicified and hard rock with pyrite dissemination. The silicified sandstone is typically observed on the western slop of the ridge in northwest and center parts of the area. In central north part of the area, lenses of conglomerate with thickness of few tens m are intercalated in the sandstone. The conglomerate consists of granule to pebble size sandstone and mudstone. The sandstone occasionally intercalate thin mudstone beds.

The sandstone formation is overlain by the upper mudstone formation in southwest part of the area. The upper mudstone formation, predominantly, consists of mudstone with rare intercalation of sandstone beds and shows the same lithology as that of the lower mudstone formation. .

The strike and dip of the Tanjong Formation in the S. Imbak Sub-area South is consistent over the entire area. It shows a monoclinic stricture, striking N-S to WNW-ESE(45 to 70° W) and dipping at 20° to 40° SW. The strikes tend to gradually change following the trend of the ridge. In the south and east part of the area, the sedimentary rocks strike in N-S to NNW-SSE (0 to 30° W), then, they gradually change toward west direction and NW-SW (40 to 60° W) is predominant strike in northwest part of the area. The sedimentary rocks dip consistently 20° to 40° to southwest.

The diorite porphyry is a gray porphyritic rock with plagioclase and hornblende phenocrysts of a few mm across. Numerous small intrusions with widths ranging from few m to 100 m occur along the slopes of both sides of the ridge and they are concordant to sub-concordant to the sedimentary rocks. The diorite porphyry of small body is dark fine grained rock with fine hornblende phenocrysts and it is similar in appearance to andesite. Because of the different degree of alteration observed in the diorite porphyry, it varies from gray color rock with clear porphyritic texture to a totally argillized, white color rock consisting of quartz and sericite. There is no clear indication of thermal metamorphism to the sedimentary rocks at the vicinity of the intrusion. The diorite porphyry of the central south of the area is disseminated by pyrite and chalcopyrite. The K-Ar dating, done in Phase I, suggests that intrusion of the diorite porphyry took place in late Miocene to early Pliocene (7.27 ± 0.18 Ma to 10.5 ± 0.27 Ma).

4-3-3 Mineralization

The main mineralization and alteration of the S. Imbak Sub-area South occur within the area of silicification/pyrite dissemination zones located in the central north of the area(SA), on the west slope of the ridge in the center of the area(SB) and on the east slope of the ridge in the east of the area (SC). The association of many small intrusions of the diorite porphyry in these areas suggests that the mineralization in the area is closely related to intrusion of the diorite porphyry. In these zones, silicification, rarely argillization, and pyrite dissemination with thin pyrite veinlets along fracture occur to the sandstone and mudstone of the Tanjong Formation. Furthermore, quartz–sulfides veins and lenses occur cutting the sedimentary structure.

The mineralization zone SA is considered to be a southern extension of silicification/pyrite dissemination zone of the S. Imbak Sub–area North (NA) and it is characterized by silicification/pyrite dissemination with quartz–sulfide veins of Cu and Ag, similar to the Type② vein of the S. Imbak Sub–area North. Although slightly low Cu grade was obtained, the mineralization zone SB, characterized by pyrite and chalcopyrite disseminated diorite porphyry, shows a similar occurrence of mineralization to porphyry copper type. The intensive mineralization and high grade ore were not found in the mineralization zone SC.

Three main zones of silicification/pyrite dissemination and mineral showings within them are summarized below and Table II –4–1. Locations and sketches of the main mineralization are given in Fig. II –4–4 and Fig. II –4–5.

1. Mineralization zone of northwest part of the area (SA)

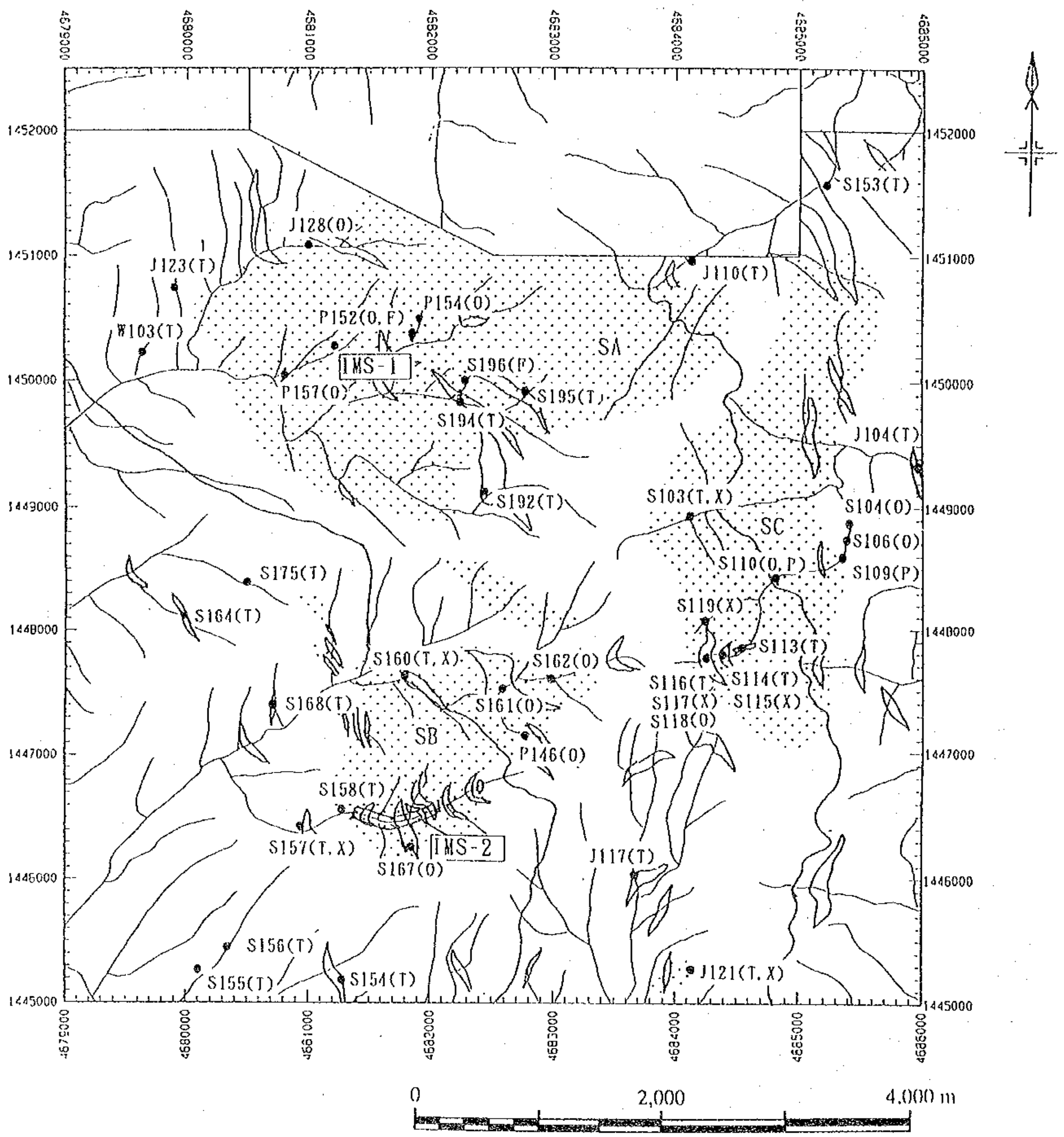
The silicification/pyrite dissemination zone of SA has an extent of approximately NS 1.5 km × EW 2.0 km and it is the southern extension of the silicification/pyrite dissemination zone of the S. Imbak Sub–area North (NA). Pyrite dissemination, associated by quartz sulfide veins of few cm wide, occurs both in the sedimentary rocks and the diorite porphyry. The quartz–sulfide veins occur both in parallel to and oblique to the sedimentary structure and they do not show a consistent trend. The vein of the largest size (maximum width: 35 cm) occurs at the mineral showings of IMS–1.

IMS–1 (Sketch 1A, 1B, 1C): On the bed of a steep stream, a scattered distribution of quartz–pyrite–chalcopyrite–arsenopyrite veins is observed in silicified and pyrite disseminated sandstone for an extent of 150 m. The width of the veins is generally few cm, however, the largest one reaches maximum width of 35 cm and it continues for 30 m until it is covered by debris. The assay results of these veins show similar grade with high Cu (2.21 % to 9.37 %) and Ag (61.9 g/t to 509.7 g/t). Au (0.1 g/t to 1.1 g/t), and Zn and Pb are low.

Other quartz–sulfides (pyrite) veins of few cm wide in the mineralization zone (SA) give Ag grades ranging from 5.1 g/t to 37.8 g/t with Cu±0.1 % and Au, Pb and Zn are low. From the assay results, these veins are similar to Type② vein of the S. Imbak Sub–area North. The assay result of Ag 14.8 g/t obtained from the pyrite disseminated sandstone suggests some Ag mineralization in the host rock.

Table II-4-1 Mineral showings of S. Imbak Sub-area South

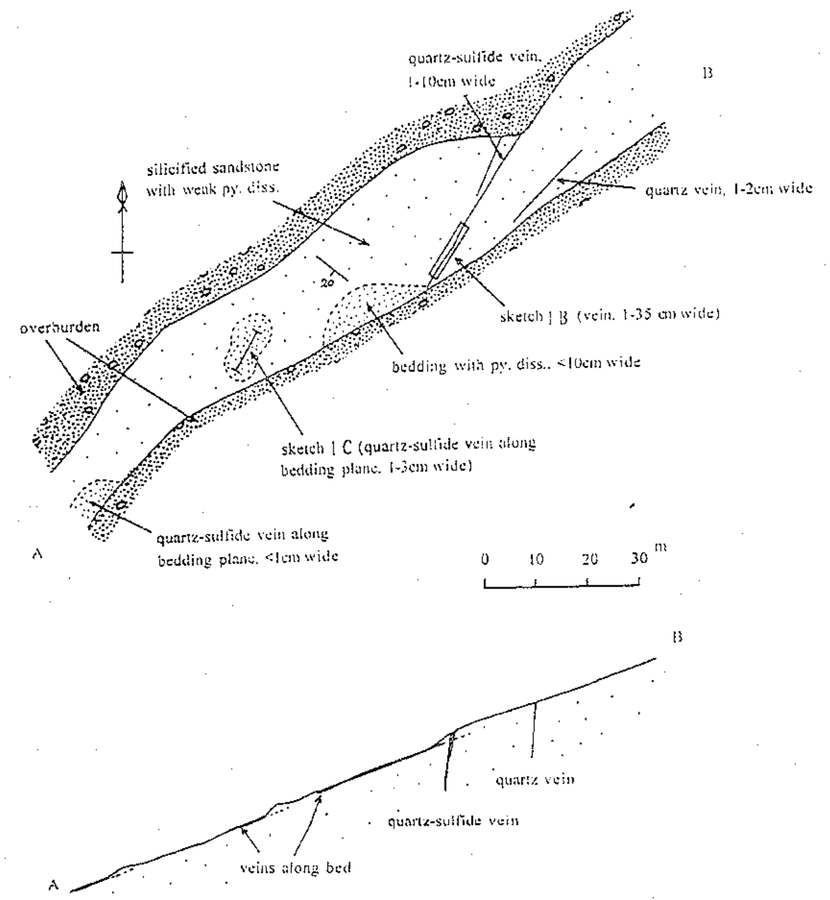
Mineral Showing No.	Descriptions of Mineralization	Host Rock	Alteration	Assay Results						
				Sample No.	Sampling width (m)	Au (g/t)	Ag (g/t)	Cu (ppm)	Pb (ppm)	Zn (ppm)
IMS-1	Quartz - sulfides (pyrite, chalcopyrite) veins, 1cm to 35cm wide cutting or concordant to bedding of sandstone. The largest one trends N35° E, dips 85° E and extends more than 35m across the outcrop. (Sketch 1A, 1B, 1C)	sandstone	silicification	P164	0.35	0.4	61.9	22,154	48	282
				S198	1.00	0.1	122.9	58,888	39	594
				S200	0.30	0.3	155.0	37,097	71	621
				S201	1.00	0.1	129.6	39,868	82	776
				S202	1.00	0.9	158.0	46,864	51	855
				S203	1.00	1.1	506.7	77,192	2,001	5,751
				S204	1.00	0.4	295.0	93,736	78	2,198
IMS-2	Dissemination of pyrite and chalcopyrite and some thin veins in diorite porphyry and mudstone. The main part of the mineralization occurs in the area 500m × few hundred meters. (Sketch 2)	mudstone and diorite porphyry	silicification	P136	1.00	<0.1	0.4	1,085	54	45
				P137	1.00	<0.1	<0.1	338	29	38
				P138	1.00	<0.1	<0.1	370	34	38
				P139	1.00	<0.1	0.3	253	124	107
				P140	1.00	<0.1	0.6	936	40	85
				P141	1.00	<0.1	0.2	1,249	54	55
				P142	1.00	<0.1	2.7	211	62	371
				P143	1.00	<0.1	0.7	1,950	34	42
				P144	1.00	<0.1	1.7	759	82	56
				P145	1.00	<0.1	1.3	1,136	63	104
				S171	grab	<0.1	1.8	1,558	62	73



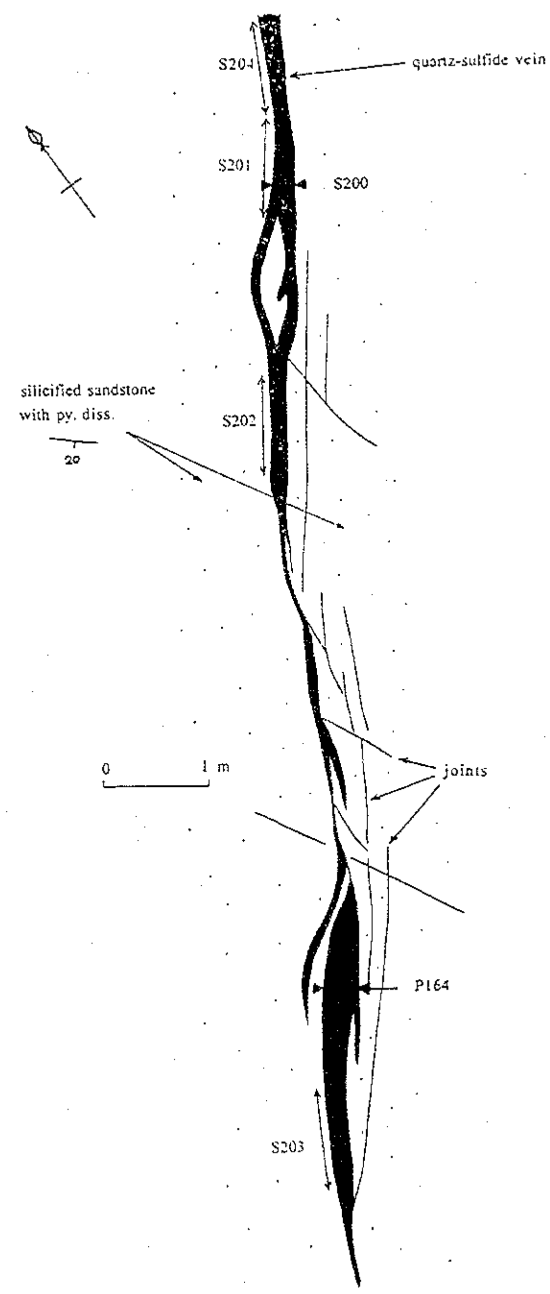
IMS-1	IMS-2
P164(O)	P136(O)
S198(O,P)	P137(O)
S199(F)	P138(O)
S200(O)	P139(O)
S201(O)	P140(O)
S202(O,P)	P141(O)
S203(O)	P142(O)
S204(O,P,F)	P143(O)
	P144(O)
	P145(O)
	S159(T)
	S169(P,T)
	S171(O,P,F)
	S172(T)
	S173(F)
	S174(P)

(O):	Ore assaying
(P):	Polished section
(T):	Thin section
(X):	X-ray diffraction
(F):	Fluid inclusion filling temperature
IMS-1	Mineral showing

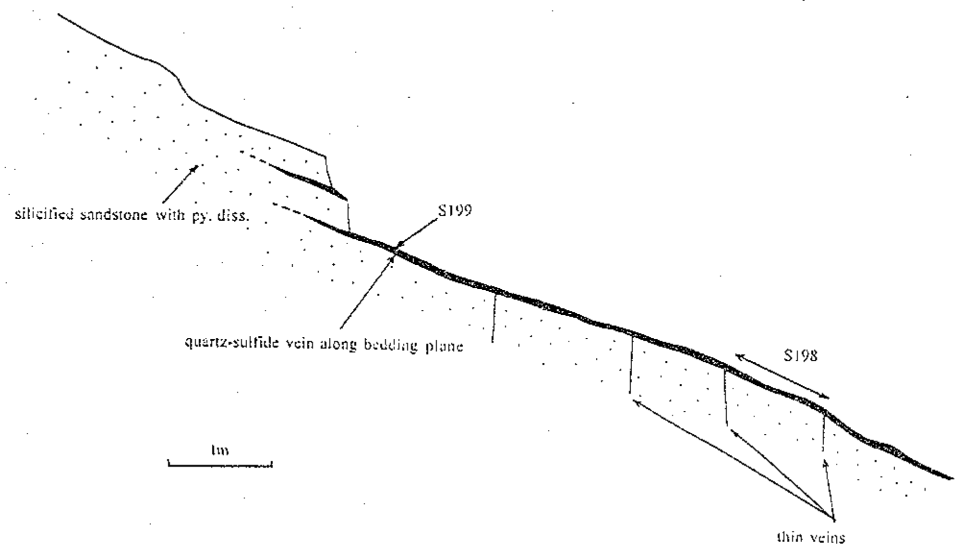
Fig. II-4-4 Location of mineral showings in S. Imbak Sub-area South



IMS-1 sketch 1A



IMS-1 sketch 1B



IMS-1 sketch 1C

Fig. II -4-5 Sketch of mineral showings in S. Imbak sub-area South (1)

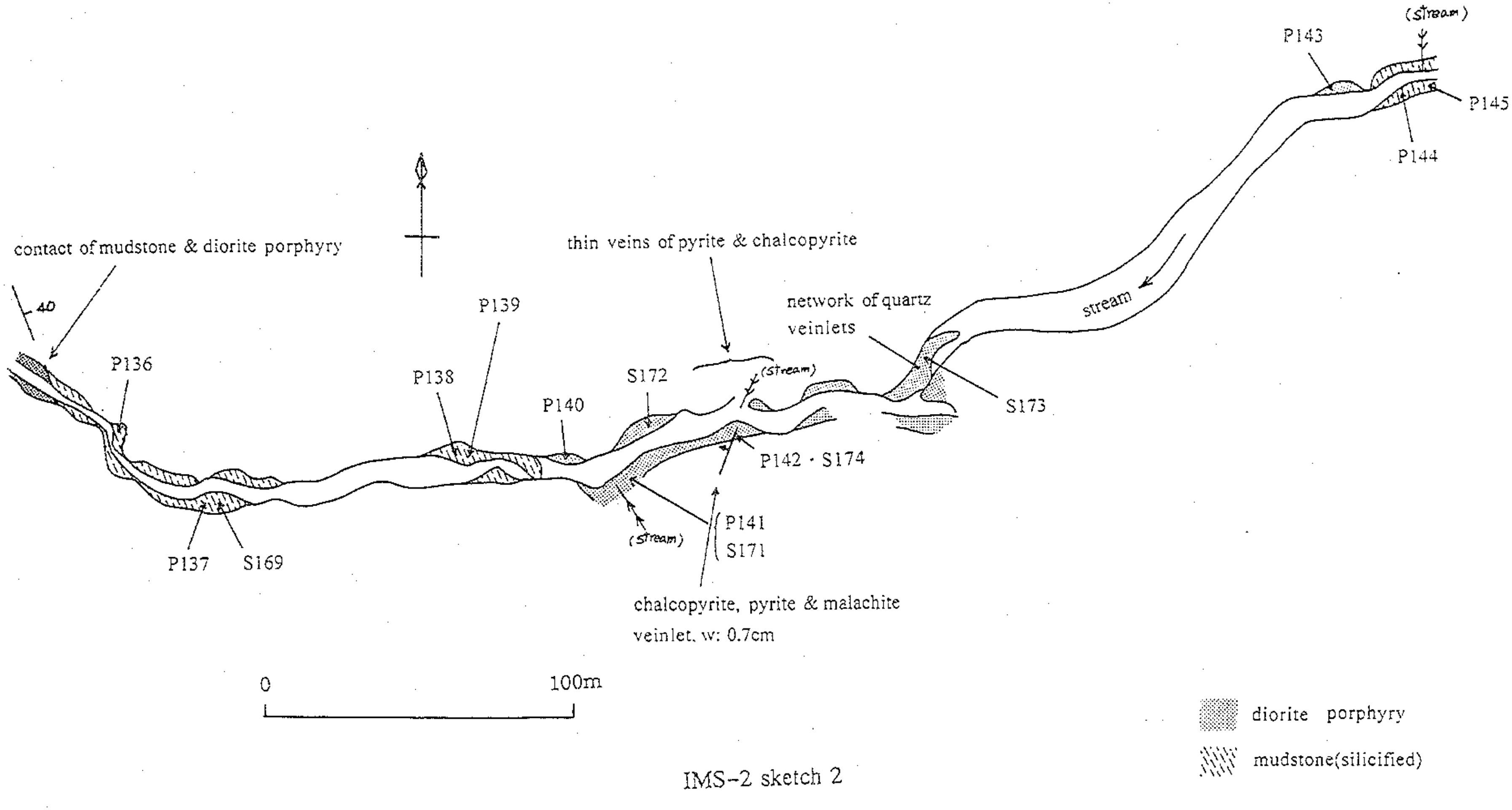


Fig. II -4-5 Sketch of mineral showings in S. Imbak sub-area South (2)

2. Mineralization zone of center part of the area (SB)

The silicification and pyrite dissemination zone of SB occur in the area of approximately NS 1 km × EW 1.5 km. The dissemination, mainly pyrite and occasionally chalcopyrite and Cu oxides, occur both in the sedimentary rocks and diorite porphyry. The dissemination appears to be more intense in the diorite porphyry than in the sedimentary rocks. Thin quartz–pyrite veins rarely occur in the mineralization zone. The center of the mineralization is the mineral showing IMS–2, located in southwest part of the mineralization zone (SB). Few grains of native gold in the chalcopyrite grain were found through microscope in the Phase I from the sample collected from this mineral showing.

IMS–2 (Sketch 2): Pyrite and chalcopyrite disseminated mudstone and diorite porphyry occur along a stream for a distance of approximately 500 m. Strongly silicified, white mudstone is intruded by the diorite porphyry and dissemination of pyrite and chalcopyrite associated by fracture filling films of the same minerals occur in the mudstone. The pyrite and chalcopyrite disseminated diorite porphyry is slightly felsic type with biotite phenocryst in addition to plagioclase and hornblende and it is strongly silicified with abundant secondary quartz and sericite. Dissemination is slightly stronger in the diorite porphyry than in sedimentary rocks. The assay results of the samples collected at 1 m span show Cu ranging from 0.10 % to 0.20 % and Ag ranging from 0.2 g/t to 2.7 g/t in the diorite porphyry. While, 1 m span samples of mudstone show Cu grade of ± 0.10 %, slightly lower than that of the diorite porphyry. Au, Pb, Zn grades are low in the both of samples.

3. Mineralization zone of east part of the area (SC)

The mineralization zone SC occur on the east slop of the ridge. Silicification and pyrite dissemination associated by fracture filling pyrite film in the sandstone and mudstone occur in the zone. The silicification and pyrite dissemination tend to be more intensive at the vicinity of diorite porphyry intrusion. In addition to this, quartz–sulfides (pyrite, arsenopyrite, sphalerite, galena) veins sporadically occur in the sedimentary rocks. One of the quartz–sulfide vein show assay results of Ag 8.8 g/t, Pb 0.37 % and Zn 0.43 % and it appears to belong to the Type③ vein of the S. Imbak Sub–area North.

4. Fluid inclusion filling temperature

Filling temperature measurement was conducted for six samples of quartz–sulfides veins collected form the mineralization zone (SA) and (SB).

Among four samples collected from the mineralization zone (SA), two samples were collected from quartz–pyrite–chalcopyrite veins of mineral showings IMS–1 and other two samples were collected from the quartz–sulfides veins similar to Type② vein (Ag>Au type) of the S. Imbak Sub–area North. The former shows higher average temperature of 351.5° C and 364.3° C with narrower temperature range compared with the later with average temperatures of 333.3° C and 336.4° C. The two samples collected from the quartz veins occurring in the pyrite–chalcopyrite disseminated diorite porphyry of the mineral showing IMS–2 show average temperatures of 319.5° C and 355.2° C.

4-3-4 Rock geochemical survey and alteration

(1) Rock geochemical survey

To obtain a whole view of geochemical halos related to the mineralization in the entire area of the S. Imbak Sub–area, the 201 samples collected in the S. Imbak Sub–area North in PhaseI and the 300 samples collected in the S. Imbak Sub–area South in PhaseII were combined together and data analysis were conducted for a total of 501 samples.

The correlation coefficient shows groups of elements such as Au–As, Ag–As, Cu–S–Zn and Pb–Zn show a good correlation, probably reflecting the chemical nature of mineralization in the area. As shown in Fig. II –4–6, anomalies and high value zones of Ag, As, Au, Cu occur closely associated each other, covering the areas from silicification/pyrite dissemination zone of S, Imbak Sub–area North (NA) to the western part of the mineralization zone (SA) in the S. Imbak Sub–area South. While, the area of mineral showing IMS–2 in the mineralization zone (SB) is covered by high value zones of Au and Cu and high value samples of As, Au and Cu are scattered in mineralization zone SC.

The mineralization of the area from (NA) to (SA) is characterized by Au, As, Cu, Pb and S. While, the mineralization of the area including the mineral showing IMS–2 is characterized by Cu, Au and S. Zn does not seem to form clear chemical halos related to the mineralization. The low concentration of Ca, Mg, Na and Sr for the samples collected in the mineralization zones suggest a removal of these elements through the mineralization/alteration. Further, the mineralization zone (NA) in the S. Imbak Sub–area North is slightly enriched in K and Rb, possibly, through the mineralization/alteration episode.

The result of factor analysis shows that the following factors are related to the mineralization of the area.

Factor 1 : –As, (–Au), Ca, Mg, Na, Sr, Zn
Factor 2 :(Ag),(As), Au, Cu, Pb, S, (Zn)
Factor 4 : –K, –Rb

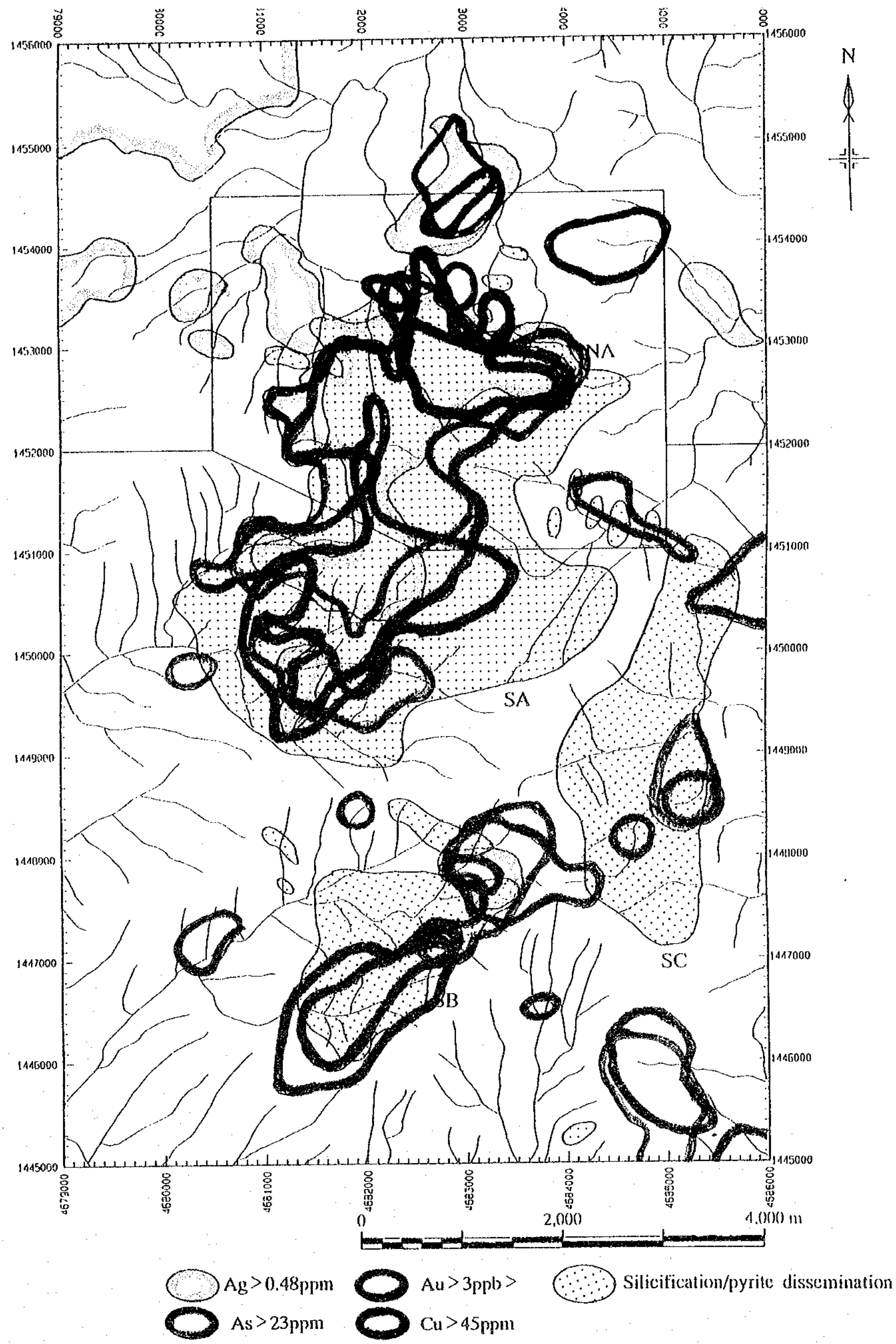


Fig. II -4-6 Distribution of geochemical anomalous zone in S. Imbak Sub-area

The distributions of high factor scores of the three factor are shown by three colors, Factor 1 (blue), Factor 2:(red) and Factor 4(yellow) in FigII -4-7. The high factor score zones of Factor 1 are distributed covering the area of the mineralization zone (NA) of the North to the mineralization zone SA of the South and they further continues toward south along the ridge. The high factor score zones of Factor 2 occur in the mineralization zone (NA) to (SA), overlapping Factor 1 high scores. The mineral showing IFS-2 and east part of the mineralization zone (SA) are covered by high Factor 2 scores. The mineralization zone (NA) and (SB) are covered by high factor scores of Factor 4.

The Factor 1 represents the elements reflecting the mineralization of the area (As-Au) on the negative side and the elements reflecting the alteration of the area (Ca, Mg, Na, Sr) on the positive side. Factor 2 consists of the elements reflecting Ag-Au mineralization in addition to base metal (Cu, Pb) mineralization. The Factor 1 and Factor 2 are considered to be reflecting the mineralization of the area. Although it is not clear, however, Factor 3 seems to reflect a possible addition of K during the episode of mineralization/alteration, especially, in the mineralization zone (NA) of the North.

(2) Alteration

For understanding the alteration halos of the entire area of the S. Imbak Sub-area, the investigation was done combining 55 samples of S. Imbak Sub-area North and 51 samples of S. Imbak Sub-area South. The assemblages of alteration minerals together with filling temperature of fluid inclusions are shown in Fig.II -4-8.

The common mineral assemblage of geochemical samples is quartz-sericite-kaolinite and, with occasional appearances of chlorite and Se/Mo(mixed layers of sericite and montmorillonite). The amount of sericite changes from trace to abundant regardless of lithological facies and it has a negative relation with plagioclase, suggesting decomposition of plagioclase to produce sericite by alteration. Chlorite appears more and Se/Mo and kaolinite appear less in the S. Imbak Sub-area South compared to the North. Using three key minerals characterizing the alteration of the area, Se/Mo, chlorite and appearance of sericite more than trace amount, the alteration of the area is considered.

As shown in Fig. II 4-8, which shows occurrences of abundant quartz and biotite in addition to three key minerals, three zones of alteration minerals are identified in a concentric distribution surrounding the mineralization zone (NA) at the center. Se/Mo occurs in the outer margin, mainly northwest part of the area and chlorite occurs in the middle, near the out margin of the mineralization zone (NA). The samples with sericite more than trace amount occur only inside the mineralization zone (NA). The three zones are considered to be indicators of the intensity of alteration. The alteration increases toward the mineralization zone (NA).

The S. Imbak Sub-area South dose not show a clear zoning of alteration minerals. Only few samples show So/Mo and many samples include both chlorite and greater than trace amount of

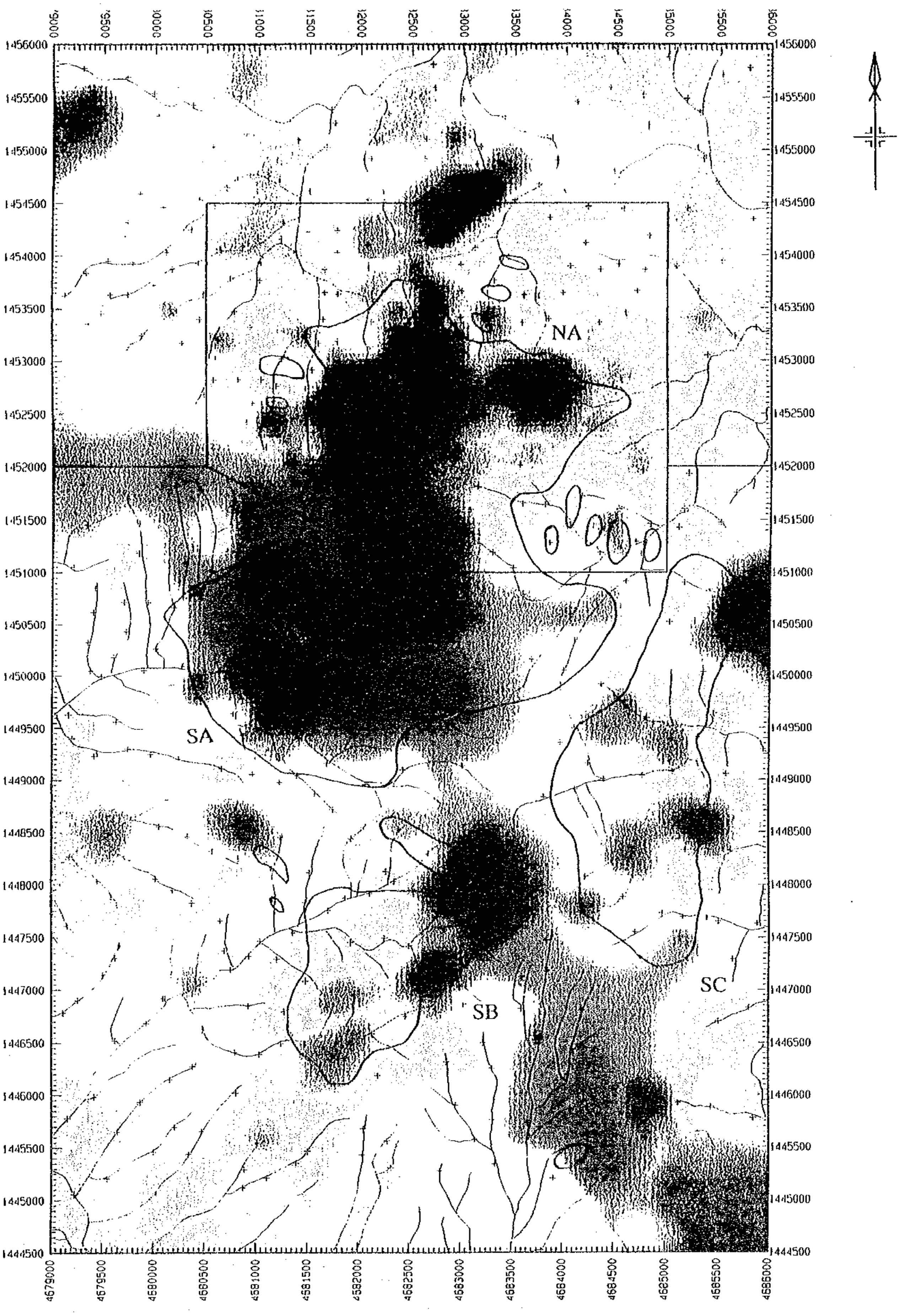


Fig. II-4-7 Distribution of high factor scores in S. Imbak Sub-area

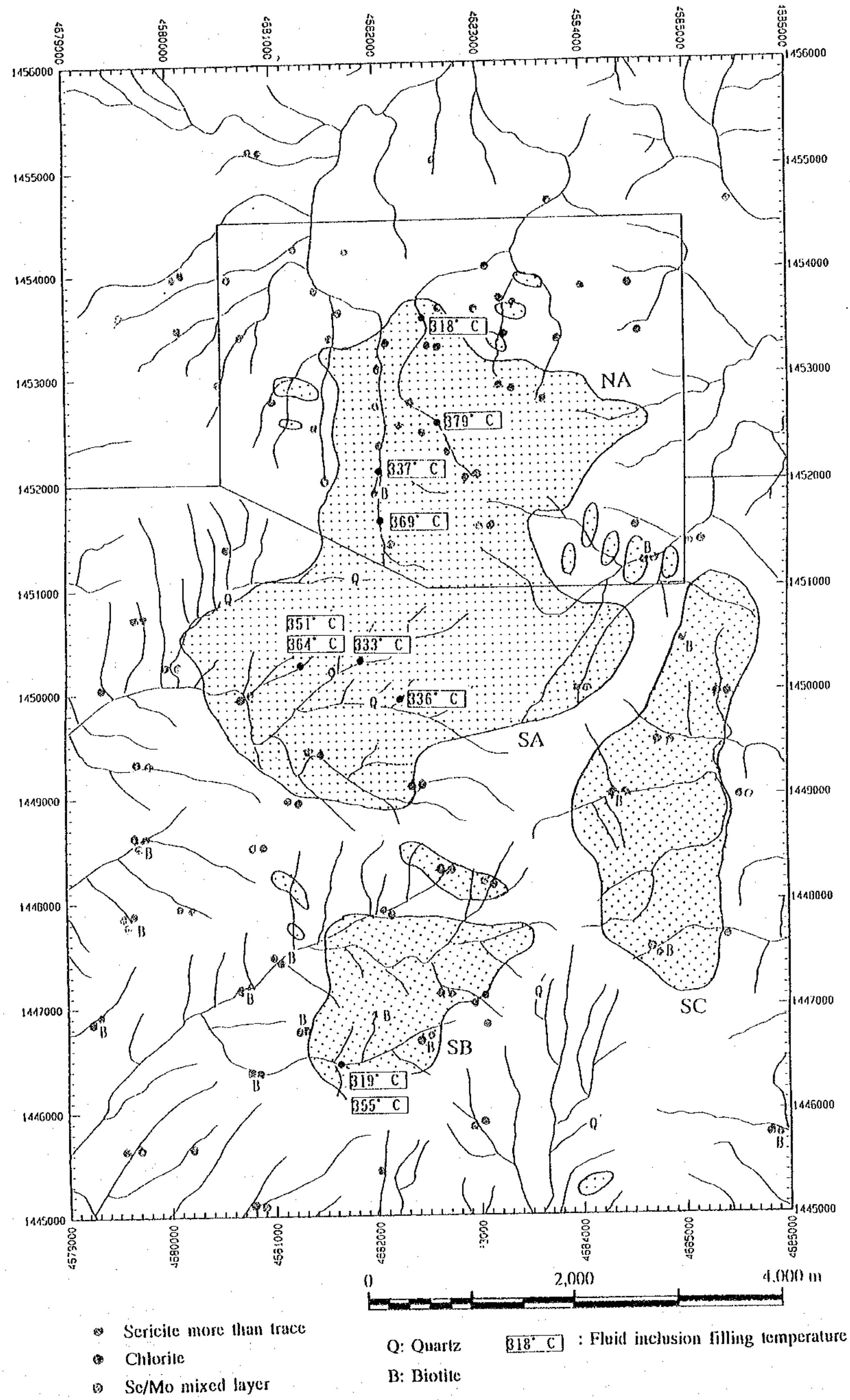


Fig. II-4-8 Distribution of alteration mineral assemblages

sericite. In the mineralization zone (SA), unlike the mineralization zone (NA) of the North, the samples with abundant sericite was not found. Instead of it, the samples in the zone show abundant quartz with trace amount of sericite. The occurrences of biotite in and around the mineralization zones (SB) and (SC) probably suggest the appearance of biotite through thermal metamorphism by the intrusion of diorite porphyry.

Comparing the alteration of the S. Imbak Sub-area to that of a typical porphyry copper mineralization, the west part of the mineralization zone (NA) belong to phyllic zone characterized by abundant sericite with disappearance of chlorite. The phyllic zone is surrounded by propylitic zone characterized by chlorite and argillic zone characterized by Se/Mo occurs further outer margin. In the S. Imbak Sub-area South, widespread occurrence of abundant sericite with chlorite samples suggest that the area belongs to the transitional zone between propylitic zone and phyllic zone. The occurrences of samples with abundant quartz in the center of mineralization zone (SA) and samples with abundant sericite in the mineralization zone (SB) suggests that alteration of the these zones are slightly higher than surrounding area and close to phyllic zone. As shown in Fig.II-4-7, filling temperature of fluid inclusion is the highest in the mineralization zone (NA) and slightly lower in the mineralization zone (SA) and (SB). The temperature of the phyllic zone of the typical porphyry copper type mineralization is known to be 300° C to 400° C. The filling temperatures of mineralization zone (NA), (SA) and (NB) fall in this temperature range.

4-4 Discussion

The main mineralization and alteration in the S. Imbak Sub-area South occur in the silicification/pyrite dissemination zone of central north part (SA), central part (SB) and eastern part (SC). The occurrences of many intrusive bodies of the diorite porphyry in the mineralization zones suggest the mineralization and alteration in the S. Imbak Sub-area South are closely related to the diorite porphyry. Geological information and geochemical survey suggest the mineralization zone (SA) is the southern extension of the mineralization zone (NA) of the S. Imbak Sub-area North. It is characterized by the quartz-sulfide veins in the silicification/pyrite dissemination zone. The most prominent veins were observed in the mineral showing IMS-1 where Ag and Cu rich veins with maximum width of 35 cm occur. Other than this, Type② vein with Ag occur in the mineralization zone (SA). The mineral showing IMS-2 of the mineralization zone (SB) shows the mineralization similar to that of porphyry copper type with dissemination of pyrite and chalcopyrite both in the diorite porphyry and the sedimentary rocks. In the mineralization zone (SC), distinguished mineralization was not found.

The rock geochemical survey of S. Imbak Sub-area, including North and South, shows that the most prominent geochemical anomalies occurs in the area covering from the mineralization zone (NA) of the North to the western part of the mineralization zone (SA) of the South characterized by Au, As and Cu associated by Pb and Zn. The area covering the mineral showing IMS-2 in the mineralization zone (SB) is characterized by Cu, Au and S. While, clear chemical anomaly is not found in the mineralization zone (SC). The elements such as Ca, Mg, Na and Sr are considered to be indicator of the alteration. All these elements are depleted in the mineralization zones. While, an enrichment of K through the mineralization and alteration is presumed only in the mineralization zone (NA) of the S. Imbak Sub-area North.

In the S. Imbak Sub-area North, a clear alteration zoning similar to typical porphyry copper mineralization was obtained. The center of the alteration, corresponding to the phyllic zone, is located in the west part of the mineralization zone NA and it is surrounded by propylitic zone and argillic zone. Although, clear zoning of the alteration was not found in the S. Imbak Sub-area South, alteration in the mineralization zones (SA) and (SB) are slightly higher than surrounding areas because of the occurrences of quartz and sericite rich samples.

The filling temperature of fluid inclusion collected in the mineralization zones (NA), (SA) and (SB) show that average temperature of all the samples fall in a range of from 300 C to 400° C, correspond to the temperature of phyllic zone of the typical porphyry copper type.

From the above, the mineralization zones (SA) and (SB) are the centers of the mineralization and alteration in the S. Imbak Sub-area South and more intense alteration and mineralization are expected underneath the surface. Therefore, these two zones are considered to be the most promising area in the S. Imbak Sub-area South.

Part Ⅲ Conclusions and recommendations

Chapter 1 Conclusions

(1) Telupid West Sub-area

The laterite soil of the Telupid West Sub-area shows similar vertical profile and chemical character to laterite soil of the typical Ni laterite deposit elsewhere in world. The succession of the soil in Telupid West Sub-area consists of, from top to bottom, laterite soil, laterite soil with weathered peridotite fragments and saprolite.

A wide range of Ni grade, ranging from less than 100 ppm to more than 2 %, was obtained from the laterite soil and saprolite in the Sub-area. Although vertical chemical variation exists at each site, it is considerably small compared with a large lateral variation. This, in addition to shallow development of laterite soil especially around the central hill, may suggest the laterite soil of the Telupid West Sub-area to be premature.

Although relatively high grade soil samples (more than Ni 0.8 %) were obtained along and around the crest of the central hill, their thicknesses are restricted from 2 m to 3 m. While, thickness of the laterite soil reaches more than 5 m in flat area, the Ni grade is poor. The limited lateral and vertical distribution of high Ni, which occurs only along and around the crest of the central hill implies that the ore reserve is not enough for further exploration and exploitation of Ni laterite in the Telupid West Sub-area.

(2) Pinanduan Sub-area

Intensive alteration and mineralization were not found during the geological survey in the area. The mineralization of the area occurs only in restricted area around bodies of gabbro where relatively strong serpentinization occurs accompanied by weak pyrite dissemination. No clear evidence of the mineralization and alteration that reflect Cu, Ag and Ni anomalies detected during the Supra-regional survey was found.

The IP anomalies obtained during the survey, on the other hand, correlate very well with the distribution of Cu anomalies detected during the Supra-regional survey. However, no clear indication of IP effect was detected on the alteration and weak pyrite dissemination zones found by the geological survey.

Relatively intense IP anomaly obtained in the southwestern part of the area correspond to the occurrences of Cu bearing sulfide mineralization found by the previous survey. This may implies an occurrence of considerable amount of sulfide underneath the surface. The most intensive anomalies were obtained over the area from southwestern to northeastern part (northern part of Line B north, Line D middle, Line E north, Line F south and Line G middle). No clear alteration and mineralization were found by the geological survey over this area, however, these clear anomalies suggests an existence of possible sulfide veins or dissemination underneath the surface of the area.

The intense anomalies covering the distribution of geochemical anomalies suggest that further detailed survey is recommended in the area to further determine the source of IP anomaly.

(3) S. Imbak Sub-area North

The S. Imbak Sub-area North is underlain by the early to middle Miocene Tanjong Formation and diorite porphyry intruding to the Tanjong Formation. The mineralization of the area, closely associated with the intrusion of the diorite porphyry, occurs in the silicification/pyrite dissemination zone in the center to southern part of the area. It occurs as and it shows: (i) quartz sulfides veins in the sedimentary rocks and (ii) network veins of sphalerite and dissemination of sulfides in the diorite porphyry.

The quartz-sulfides (pyrite, arsenopyrite, sphalerite, galena, chalcopyrite) veins of few cm to 25 cm wide sporadically occur in the sedimentary rocks within the silicification/pyrite dissemination zone. These quartz-sulfides veins are classified into three types: Type① Au and Ag vein, Au≧Ag, Type② Au and Ag vein, Ag>Au, Type③ Pb and Zn vein. Type① and Type② occur in the zone of higher alteration corresponding to phyllic zone in the west of the silicification/pyrite dissemination zone, while Type③ tend to occur in the eastern part of the silicification/pyrite dissemination zone.

Among the seven holes(MJSI-1 to MJSI-7) drilled during the project, the most prominent mineralization was found at MJSI-4 where sphalerite-(chalcopyrite) network veins and patches with Zn grade ranging from 0.40 % to 1.00 % occur in the diorite porphyry for 15 m . This Zn mineralization zone includes 3 m long Ag rich (Ag 37.2 g/t to 90.5 g/t) zone. Some minor mineralization was, also, observed in the other holes, such as MJSI-5 and MJSI-7. In both of these holes, diorite porphyry is generally, disseminated by pyrite and pyrrhotite with rare occurrences of chalcopyrite associated with pyrrhotite. The Au bearing quartz-sulfides veins occur in the sedimentary rocks close to the intrusion of the diorite porphyry. The drilling survey , also, suggests that the distribution of diorite porphyry in the underground is larger than expected from the geological survey.

The geological information, mineral assemblage of ore minerals, filling temperature of fluid inclusion (300° C to 400° C) suggest that the most possible geological environment of mineralization in the S. Imbak Sub-area is that of similar to the outer margin of the porphyry copper environment.

The results of geophysical survey in the Phase I and Phase II revealed that the strong IP anomalous zones coincided with the silicification/pyrite dissemination zone (Fig.III-1-1). The Au, Ag and Cu anomalies of the rock geochemical survey in the center to the southern part of the area correspond to medium to high chargeability anomalies of more than 20 m V/V. The distribution of these strong anomalies form the shape of letter "C" which open ended to the east. This shape of IP anomaly distribution is similar to typical porphyry copper type mineralization else where in the world and the main copper mineralization is known to occur in the area with relatively weak IP anomaly at the center of circular strong anomalies.

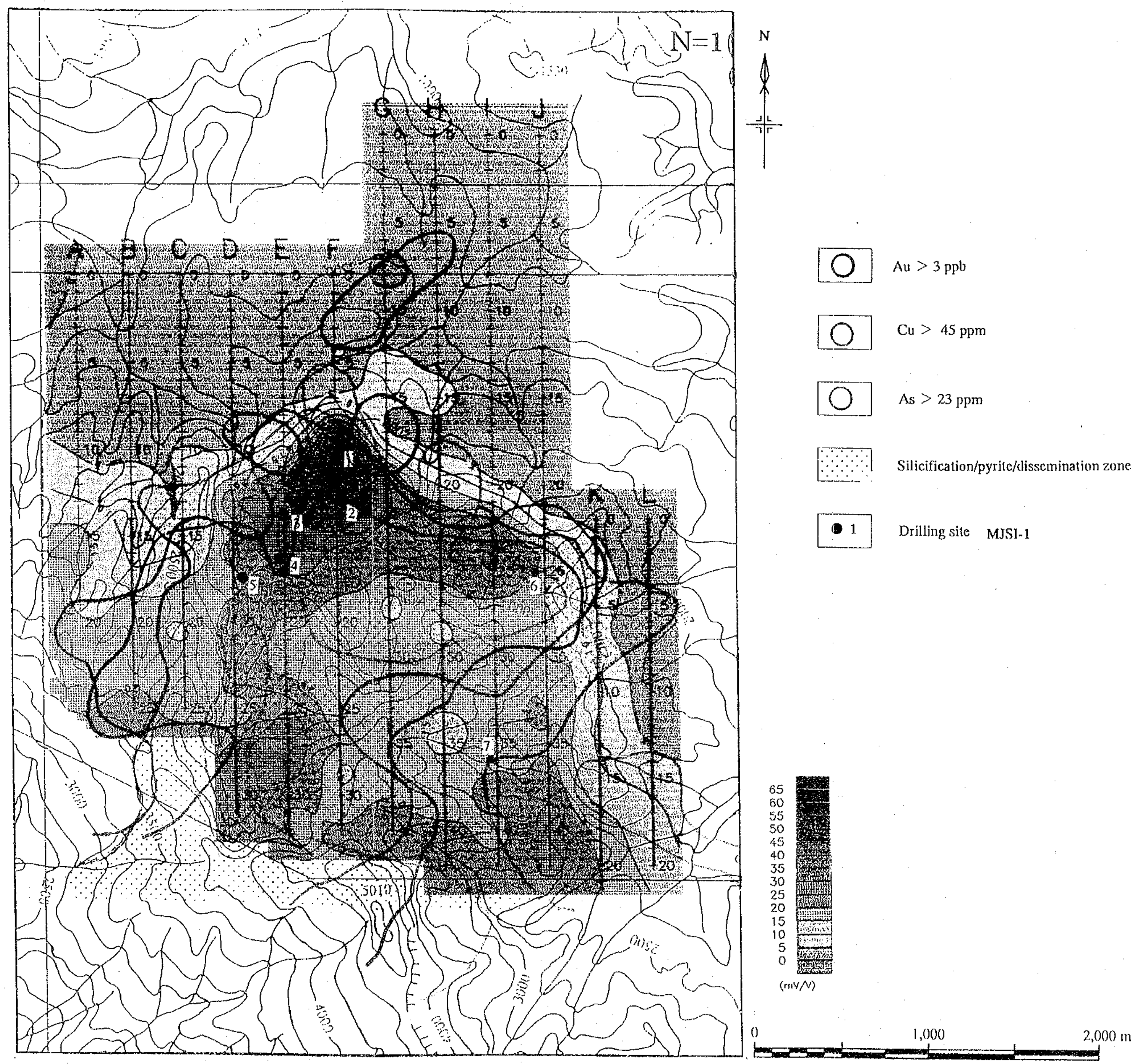


Fig.Ⅲ-1-1 Compilation of survey results in S. Imbak Sub-area North

The drilling survey conducted in the Phase II at the site of very strong IP anomalies and in the Phase III in the east part of the area with Type 2 and Type 3 IP anomalies resulted in intersecting only minor mineralization. The area at the center of "C" shape anomalies is recommended as target for further exploration work in the S. Imbak Sub-area North.

(4) S. Imbak Sub-area South

The geology of S. Imbak Sub-area South, which is similar to the S. Imbak Sub-area North, consists of the early to middle Miocene Tanjong Formation and the diorite porphyry intruding to the Tanjong Formation. The mineralization of the area is closely associated with the intrusion of the diorite porphyry and occurs within the silicification/pyrite dissemination zone in the center of the north part (SA), center part (SB) and east part (SC).

The mineralization zone (SA) is believed to be the southern extension of the silicification/pyrite dissemination zone of S. Imbak Sub-area North (NA) and characterized by Ag and Cu enrichment in quartz-sulfides veins and Type② vein of the S. Imbak Sub-area North. The western part of the zone is covered by high value Au, As and Cu zones of the rock geochemical survey and alteration is slightly intensive than the surrounding area. The mineralization zone (SB) (mineral showing IMS-2) is characterized by dissemination of pyrite and chalcopyrite in the diorite porphyry and the sedimentary rocks, and it is covered by anomalies of Au, Cu and S. The Cu grade is slightly low, however, it shows similar mineralization to that of porphyry copper type. Distinguished mineralization and clear geochemical anomaly were not found in the mineralization zone (SC). The alteration zoning and fluid inclusion temperature suggest a similar environment to the phyllic zone of porphyry copper type mineralization for mineralization zones (SA) and (SB).

The survey results suggest that the most potential areas for mineralization in the S. Imbak Sub-area south are the western part of the mineralization zone (SA) and (SB), and further detail survey should be conducted in future.

Chapter 2 Recommendations

(1) Telupid West Sub-area

Although relatively high Ni grade in soil occurs along and around crest of the central hill, the thicknesses are restricted from 2 m to 3 m. While, thickness of the laterite soil reaches more than 5 m in flat area, the Ni grade in very poor. The limited lateral and vertical distribution of relatively high Ni, which occurs only along and around the crest of the central hill implies that ore reserve is not enough for further exploration and exploitation of the Ni laterite in the Telupid West Sub-area. However, the neighboring area with a similar geological environment to Telupid West Sub-area should be examined.

(2) Pinanduan Sub-area

The drilling survey are recommended to determine the source of the IP anomalies at the upper stream of S. Pinanduan. Prior to any drilling operation, a detail geological survey (3km × 3km) including rock geochemical survey and IP geophysical survey to outline in detail the distribution of the anomaly are recommended to decide the drilling target.

(3) S. Imbak Sub-area North

If the mineralization similar to porphyry copper type exists in the S. Imbak Sub–area North, the locations of drilling site conducted in PhaseII and Phase III is in the peripheral area of the main mineralization. The center of mineralization probably exists in the area at the center of a letter "C" shape geophysical anomaly. The drilling survey with more than 300 m deep holes is recommended in the area at the center of "C" shape geophysical anomaly for further evaluation of the S. Imbak Sub–area North (Fig. III–2–1).

(4) S. Imbak Sub-area South

The mineralized zone (SA) and (SB) show a similar type of mineralization to that of (NA) in the S. Imbak Sub–arc North. As shown in Fig.III–2–2, detail geological survey and IP survey are recommended prior to any drilling survey.

Mineralization zone (SA)

Area: 3.15 km² (1.5 km × 2.1 km)

IP survey lines: 12 km (1.5 km × 8 lines)

Mineralization zone (SB)

Area: 4.20 km² (2.0 km × 2.1 km)

IP survey lines: 16 km (2.0 km × 8 lines)

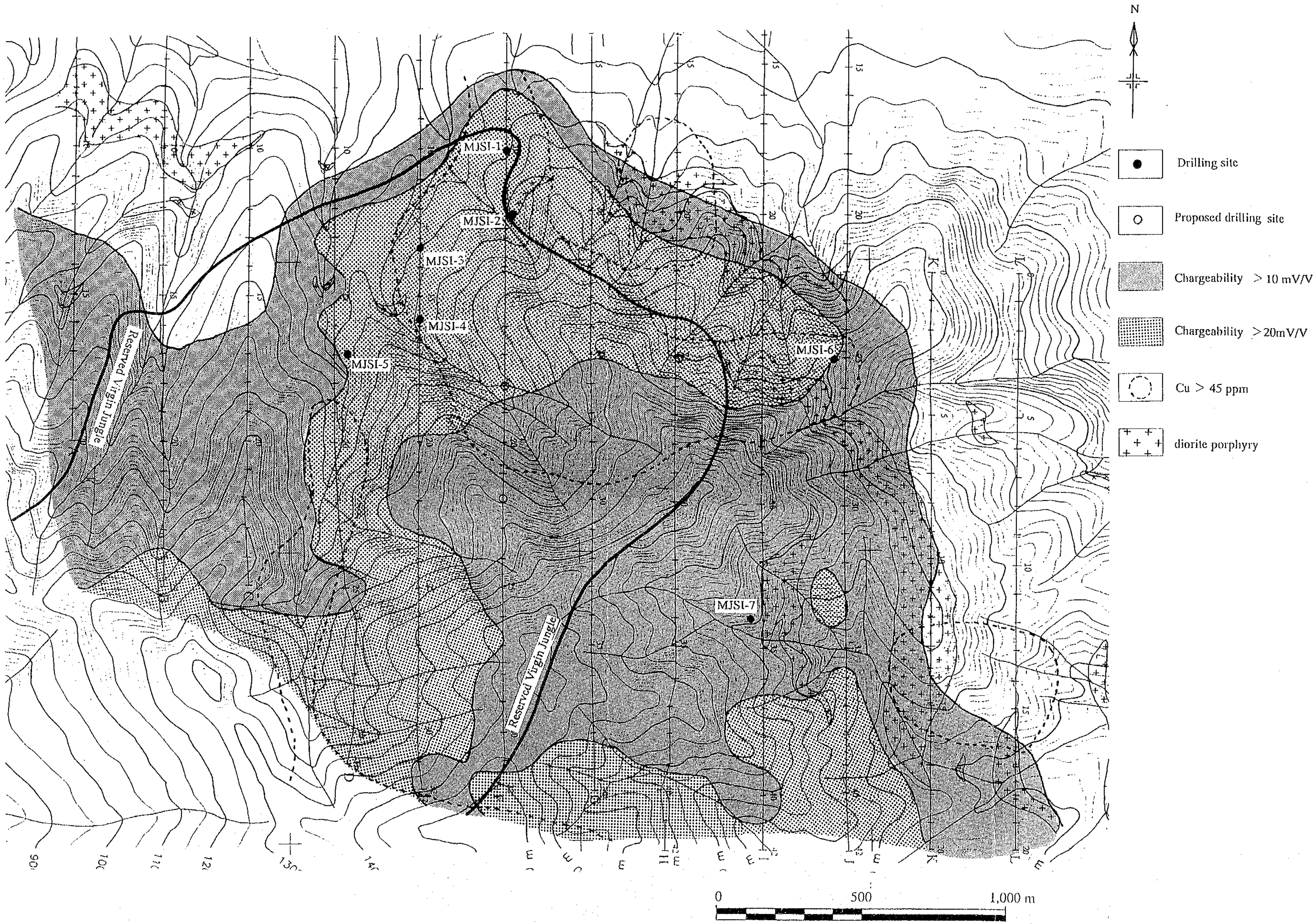


Fig.III-2-1 Recommendation for future work in S. Imbak Sub-area North

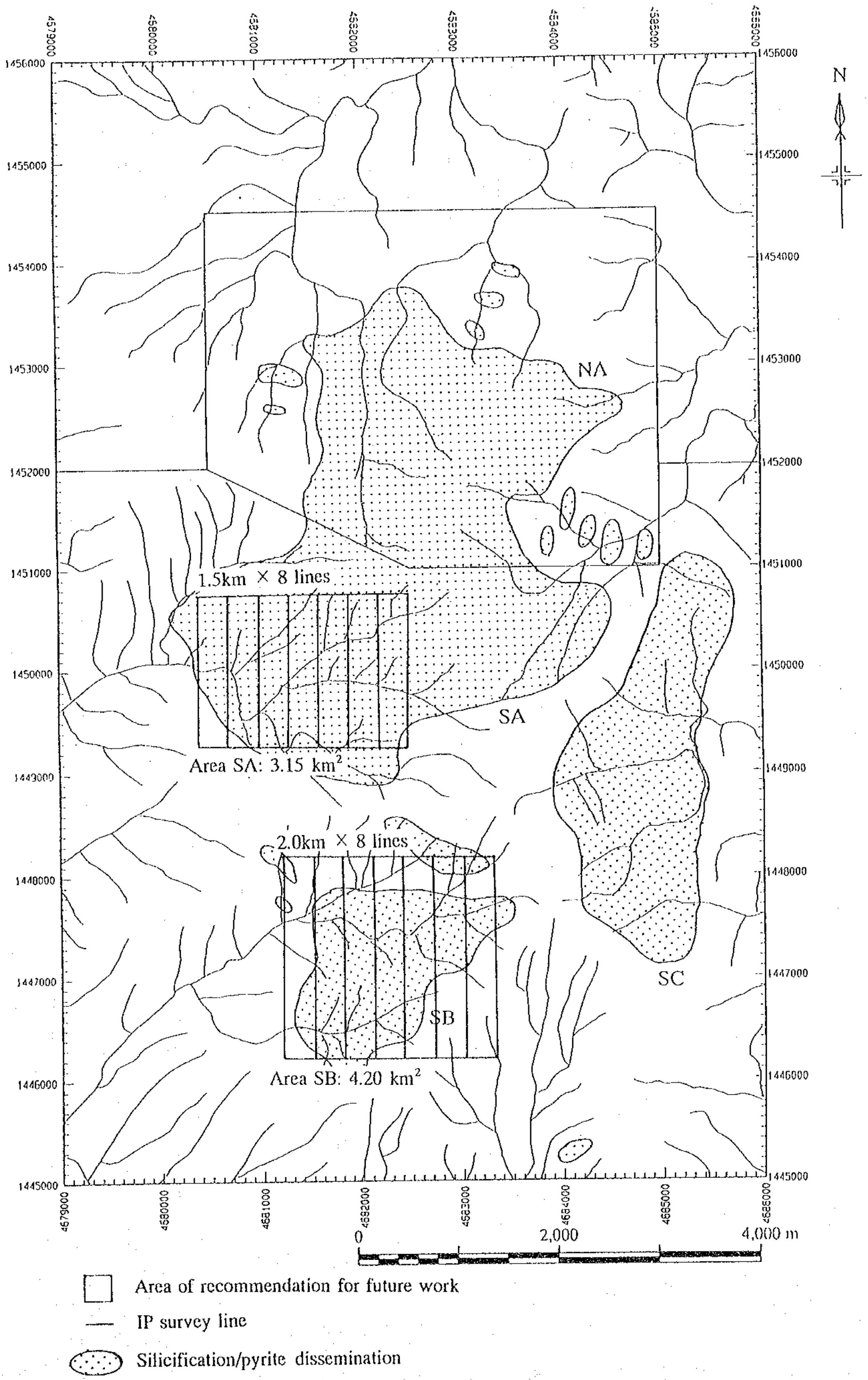


Fig.III-2-2 Recommendation for future work in S. Imbak Sub-area South

A similar type of mineralization occurs along the G. Kuli range in S. Imbak Sub-area North and South. In addition to these, a similar mineral showing was recently found in the area further south of these areas, south of S. Kuli. This suggests that the area along the G. Kuli range is cover by a similar type of mineralization with high potentiality for Au and Cu mineralization. A detail survey covering from the S. Imbak Sub-area to the south of S. Kuli is awaited.

References

Akiyama Y. (1984): A case history – exploration, evaluation and development of the Mamut porphyry copper deposit, Geol. Soc. Malaysia, Bull. 17, pp.217–225

Benard F., Muller C., Letouzey J., Rangin C., Tahir S. (1991): Evidence of multiphase deformation in the Rajang–Crocker Range (northern Borneo) from Landsat imagery interpretation: Geodynamic implications, Tectonophysics, 183, pp.321–339

Chung S. K. (1984): Annual Report 1982, Geological Survey of Malaysia, Ministry of Primary Industry.

Collenette P. (1965): Prospecting in Sabah by Borneo Mining Limited 1959 – 1963. Borneo Reg., Geological Survey of Malaysia Annual Report for 1964, pp.57–61

Heng E. H. (1985): Geological Map of Sabah, Third Edition, Geological Survey of Malaysia

JICA and MMAJ (1994) : Report on the mineral exploration: Supra–regional survey in Central Sabah , Malaysia (PHASE Ⅳ)

JICA and MMAJ(1995): Report on the mineral exploration in Central Sabah Area, Malaysia, (PHASE Ⅰ)

JICA and MMAJ(1996): Report on the mineral exploration in Central Sabah Area, Malaysia, (PHASE Ⅱ)

JICA and MMAJ(1997): Report on the mineral exploration in Central Sabah Area, Malaysia, (PHASE Ⅲ)

Kurzl H. (1988): Exploratory data analysis: recent advances for the interpretation of geochemical data. Journal of Geochemical Exploration, vol. 30 pp. 309–322.

Hail N. S. (1968): The northwest Borneo geocyncline in its geotectonic setting. Geolo. Soc. Malaysia Bull. 1, p.59

Leong K. M. (1976): Mineral distribution map of Sabah, 1st edition. Geological Survey of Malaysia.

Newton-Smith J. (1967): Bidu Bidu Hill area, Sabah, East Malaysia, Exploration of Sheet 5-117-2 and part 5-117-1. Geological Survey of Malaysia.

Pelton W. H. and Smith P. K. (1976): Mapping porphyry copper deposits in the Philippines with IP. Geophysics, Vol. 41, pp.106-122

Ragin C., Bellon H., Bernard F., Letouzey J., Muller C., Sanudin T. (1990): Neogene arc-continent collision in Sabah Borneo (Malaysia), Tectonophysics, 183, pp. 305-319

Willson R. A. M. (1964): Annual Report of the Geological Survey, Borneo, Malaysia, Geological Survey of Malaysia.

List of Figures

List of Tables

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